MINE SAFETY AND HEALTH RESEARCH
ADVISORY COMMITTEE (MSHRAC)
November 29-30, 2018

CENTERS FOR DISEASE CONTROL AND PREVENTION

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MINE SAFETY AND HEALTH RESEARCH

ADVISORY COMMITTEE

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COMMITTEE MEETING

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THURSDAY

NOVEMBER 29, 2018

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The Mine Safety and Health Research Advisory Committee (MSHRAC) met in the Room S215, ENR2 Building, 1064 East Lowell Street, Tucson, Arizona, at 8:00 a.m., Dr. Priscilla Nelson, Chairperson, presiding.

MSHRAC COMMITTEE MEMBERS PRESENT

PRISCILLA NELSON, Chairperson

RONALD BOWERSOX, United Mine Workers of America

JEFFEREY BURGESS, University of Arizona

DALE DRYSDALE, National Stone, Sand & Gravel Association

RICHARD FRAGASZY, National Science Foundation WILLIAM FRANCART, Mine Safety & Health Administration

KRAMER "KRAY" LUXBACHER, Virginia Polytechnic Institute and State University

MARIFRAN MATTSON, Purdue University

AUBREY MILLER, National Institutes of Health

BRUCE WATZMAN, National Mining Association

KYLE ZIMMER, International Union of Operating Engineers

COMMITTEE MEMBERS ABSENT

STACY KRAMER, Freeport McMoRan

MICHAEL WRIGHT, United Steelworkers of America

ATTENDEES PRESENT IN PERSON

JENNICA BELLANCA, NIOSH

PAULINE BENJAMIN, NIOSH

DONOVAN BENTON, NIOSH

CASEY CHOSEWOOD, NIOSH

AMIA DOWNES, NIOSH

ED GREEN, Crowell & Moring

MARCIA HARRIS, NIOSH

WILL HELFRICH, NIOSH

JESSICA KOGEL, NIOSH

GEORGE LUXBACHER, NIOSH

RJ MATETIC, NIOSH

ART MILLER, NIOSH

JERRY POPLIN, NIOSH

TODD RUFF, NIOSH

BRAD SEYMOUR, NIOSH

ADAM SMITH, NIOSH

JEFFREY WELSH, NIOSH, Designated Federal Officer

PETER ZHANG, NIOSH

DEBORAH GONZALEZ, Digital Court Reporter

STAFF ATTENDING VIA ZOOM CONFERENCE

MARIE CHOVANEC, NIOSH

CARA HALLDIN, NIOSH

JOHN HOWARD, NIOSH

BOB RANDOLPH, NIOSH

M-I-N-U-T-E-S

(8:02 a.m.)

Introduction, Announcements, Approval of Minutes

MR. WELSH: Good morning. My name is Jeff Welsh. I'm the Designated Federal Officer for the MSHRAC Federal Advisory Committee. I want to welcome you to our fall MSHRAC meeting. I would also like to thank Jeff Burgess and the University of Arizona for hosting this meeting.

A couple items that I'll go over before we get into our meeting agenda. First, we have a new MSHRAC member, Marifran Mattson, she comes to us from Purdue University. Welcome, and we're certainly glad to have you on our committee.

MS. MATTSON: Thank you.

MR. WELSH: Second, this is Bruce Watzman's last meeting, he is retiring from NMA. We appreciate your service over the years, and certainly, the input and recommendations to our mining program, so, Bruce, thank you.

MR. WATZMAN: Thanks.

MR. WELSH: The next item, MSHRAC members participating in this meeting must be free from conflicts of interest. Members must self-declare any conflicts of interest that may arise during the meeting and recuse yourselves 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.

CHAIRPERSON NELSON: Thank you, Jeffrey. Welcome. This is a wonderful facility. Welcome all, welcome Marifran. Look forward to getting to know you, and, Bruce, we will miss you, so we'll have to work you hard today.

I do not have any announcements to make. The first thing to do is approval of the minutes. So you've all received the minutes. We have our typical prodigious 85-page package of minutes for our last meeting, which I know you all read, and are there any questions, or comments, or additions to be suggested concerning these minutes?

Hearing none, may I have a motion that the minutes be approved?

DR. KRAMER LUXBACHER: So moved.

CHAIRPERSON NELSON: Seconded?

MR. ZIMMER: Second.

CHAIRPERSON NELSON: Okay. Without further discussion, we'll call the vote. All those in favor of approval, say, aye.

(AYES)

CHAIRPERSON NELSON: Those opposed, nay.

CHAIRPERSON NELSON: Do I have any other tasks that I have to do before we start?

MR. WELSH: We have a slight change in the agenda, Dr. Howard will be joining us by telephone tomorrow to address the committee, provide some remarks, and answer questions. He had a prior commitment in Boston.

CHAIRPERSON NELSON: Good. Okay. So we'll look forward to talking with him tomorrow morning.

MR. WELSH: Yes.

CHAIRPERSON NELSON: All right. Then we can move on to the agenda. We will make up time, and start Jessica early on her report, and that will leave us lots of time for more questions.

Report from the Associate Director for Mining

Dr. Jessica Kogel

DR. KOGEL: So good morning, everybody. First of all, I'd like to extend a warm welcome to everybody and thank you all for traveling here for this meeting. These are very important meetings for us and your feedback is really very useful to us.

DR. KOGEL: I have two agenda items. The first one is just to give a very quick overview on the presentation itself, and then I would like to spend the balance of my time talking about a reshaping initiative that NIOSH has been involved in over the past year or so. So just quickly, with the agenda, Dr. Howard will be joining us tomorrow to make his comments.

We'll start, as we always do, with my report, followed by the Director's, Todd and R.J., from Spokane and Pittsburgh, and then George will talk about the extramural research program.

After that, we'll have a break and then we'll move into a series of three presentations that will focus on miner health, we'll have a presentation from Jerry Poplin on the miner health program, Art Miller will talk about DPM monitoring, and then Dr. Casey Chosewood, who's here from Atlanta, will be talking about NIOSH research in the area of opioids.

We'll then have lunch.

From there, we'll go through a number of other presentations. Bob Glenn, who was going to give his Industrial Minerals sector report, was not able to make it because he's had a family issue that he has to attend to.

We decided to not put anything on the agenda because I think often we find that we need additional time for discussion, and we have some other topics that we can bring up during that time.

Then Kray's going to give us a report about the metal mine automation workgroup and the workshop that we had in Denver this summer, and then there will be some time for committee discussion. As you will recall, this is an MSHRAC workgroup, and so we would like to get your feedback on that report as well.

After the break, we'll have a presentation on some really neat stuff around virtual reality for mining research that we can do here in this room. We have Jennica and Will here from Pittsburgh to do that.

And then following that, we'll have a presentation from Dr. Amia Downes, she's going to talk about contribution analysis and how we use that to measure impact.

And you may remember that at the last MSHRAC meeting, I mentioned that the mining program is going through a ten-year review, and so she'll talk about how we actually measure impact, and the review that we are in the process of going through.

So that'll conclude today. We have a half day tomorrow. We'll kick it off with some remarks from Dr. Howard, and then a report from Dr. Cecille Rose. This is the National Academy's respirable coal dust study report, so she'll present that report and the recommendations from that report.

And then, the first three presentations tomorrow morning are all oriented around coal, Marcia Harris will talk about coal mine explosion and fire prevention research in Pittsburgh, and then Dr. Zhang will talk about active gas wells in longwall abutment pillars.

Then we'll have a break and move into two presentations from Spokane, Donovan and Brad will talk about various aspects of ground control in U.S. metal mines in the Western U.S. And then we'll have our wrap-up and public comments.

So the next slide is one that I've been putting in just to show you how the various presentations align with our strategic goals and our intermediate goals, for your information to give you context.

And now I'd like to move into the reshaping and as I mentioned, NIOSH has been involved in a reshaping effort for over a year now. We're in phase 1. Phase 1 has largely been focused on NIOSH divisions that

are in Cincinnati, and once the phase 1 is completed, we will then move into phase 2, and phase 2 will involve mining.

We have to ask ourselves, why do we want to reshape our workforce? You know, this is something that requires a lot of effort, it can create instability, you know, there's costs to doing this, so there has to be a clear benefit, and we have to give a lot of thought to these things.

The impetus for this revolves around two things. One is that, both the Office of Management and Budget and the White House, in 2017, sent out directives saying that they would like government agencies to take some steps towards streamlining their organizations.

Some of the things that they were specifically asking agencies to look at is ways to make a more lean, accountable, and efficient government, and also, to identify redundancies and take steps to start removing those redundancies.

And then the last one is to align the federal workforce to really focus on future needs as opposed to past, so being proactive versus reactive. And I want to talk a little bit about the future because I think the future, you know, everybody in this room is very well aware, our industry and our stakeholders, the mine workers, is going through a lot of changes.

And so the future is something that's going to be very important for our program and we have to be responsive to those changes, and that's because our stakeholder's priorities are changing as a result.

I'm going to talk about two trends, I could talk about many, many more, but I just picked two to talk about because I think these are two that are particularly relevant to NIOSH and to the mining research that we do around occupational health and safety.

You've all heard a lot of talk about the fourth industrial revolution and that is something that we're seeing, actually, starting to show up in mining in this country. This isn't something that's just started happening. We've been in this process, but it's starting to gain momentum and we're starting to see some real changes.

And with this technology revolution and the fourth industrial revolution, which involves automation, robotics, big data, data analytics, it's kind of a whole new world out there.

All of these things, once they're incorporated into the work environment, is going to change the nature of work as well as that work environment, and that's going to lead to the need for new occupational safety and health practices, so clearly, that's a place where NIOSH works. That's kind of the space we live in.

The other thing that's going to happen as a result of this is that, there's going to be a significant change in the relationship between humans and the machines that they work with in the mining environment.

This relationship is going to probably become much more complex, particularly during the transition as operations start bringing in these new technologies.

Because it's not going to be, let's flip a switch and we become 100 percent automated and pull the miner out. That's not going to happen. It's going to be a much more mixed kind of environment where we're going to have humans interacting with autonomous and semi-autonomous machines, and so that's going to just create a whole different set of challenges that we need to understand.

And that is going to lead to, more in-depth, human factors research, and we're very, very well positioned to work in this area.

The other thing that we're seeing is the emergence of new mining techniques, particularly in western metals mines, where many of these mines are looking at going deeper. There are new technologies that allow them to do this, and so that's going to require new ground control and ventilation practices. So these are just some examples.

The other trend that I want to mention, this is one that's been going on, also, for a while as well, is that, in this country in particular, we have mined out the easy-to-access ores. And so in order to access ores now, we have to go to deeper mines, we have to go to mines that are in more complex geologies, and the other trend is towards mining lower quality ores.

This is something that we're able to do because of technology development that's made these reserves mineable and has changed the economic situation.

So all of these things will also lead to changes in the health and safety risk profile for miners. And as a result, miner health is emerging as a larger -- or a priority, and so that's something else that NIOSH has been working in that space, and also, we're positioning ourselves to look at some of the emerging issues that Jerry and his team have been focusing on and has talked about at previous meetings.

So these are just two examples. I could have spent my whole presentation talking about more. I think you're all very familiar with these, but I wanted to show how these relate to what we do.

So in response to OMB and to the White House, their directives to, basically, streamline, we're streamlining our organization to accomplish a number of critical goals, and they're listed here on this slide.

First is to sharpen our research focus on current as well as emerging workplace safety and health challenges. And I've already talked about why we feel that this is necessary to do. We must be forward thinking and poised to recognize and address the new occupational health and safety challenges that are coming our way.

Particularly as the industry transitions to automation and new technologies.

We feel that by streamlining, our organization will become even more efficient and effective, and I said, even more, because I feel like we already are there, but there's always room for an improvement.

And this is in terms of generating new knowledge and also transferring that knowledge into practice, which is what our stakeholders come to us for. And so as the mining industry changes, as our stakeholder priorities change, we need to be able to react to that and do it in a very effective and efficient way.

We also believe that this will help position our organization to attract new talent as well as investment, and this is particularly important to us to be sustainable in the future.

We need to have a workplace that can compete with Silicon Valley, and startups, and the private sector. And the government isn't always one of those places that people look to, and so we have to look more like those places.

And this reorganization kind of helps create that kind of culture and that kind of work environment. Also, it will strengthen our ability to deliver high-quality, high-impact, and relevant research.

And then the last one I think is a very important one, and that is that this new organization will help us optimize our research dollars, and that's particularly important because we basically live in a world of flat funding, and also, we've talked, I think, at previous MSHRAC meetings and shown you data about how we have -- we're facing significant retirements, potentially, and this is true government-wide. It's not unique to us.

So that's just some of the constraints that we need to work in. Let me say a little bit more about flat funding and, what this looks like.

So since FY15, FTEs have dropped from about 230 to somewhere between 200 and 205. The numbers change, but the cost, if you look at this slide, the cost of these FTEs, in terms of their salaries and benefits, has risen.

So as people retire and we bring new people into the workforce, they cost more. That's just the reality of that. And that then impacts the discretionary funds that we have available for doing research.

So if you project this out and continue in this trend, you can see where we end up, and it's not where we need to be. It's not where we want to be.

CHAIRPERSON NELSON: Will you take questions now?

DR. KOGEL: Sure. Yes.

CHAIRPERSON NELSON: Could you clarify if those are authorized FTEs or filled FTEs on that chart?

DR. KOGEL: So these are filled FTEs, our authorized are higher and we have a lot of vacancies, so, yes, and this is program-wide.

So these trends towards increasing costs will continue and so -- the solution to optimize our research dollars is through strategic collaboration, and by that, I mean, strategic collaboration both internally within NIOSH, and even within the mining program, as well as extramurally or externally, so collaboration's going to become increasingly important to us so that we can get the work done that we need to get done.

So there are a couple of things that we expect to accomplish with this new structure. One is that we expect that it will create a flexible organization, and organization that can rapidly respond to changes, and particularly, changes in priorities that are coming back to us from our stakeholders.

The other is that we feel that this will promote more cross-division, cross-branch, and cross-team research resource sharing. And we will do this by removing, as much as we can, some of the organizational silos.

Also, we wish to promote multidisciplinary research, this will really lead to creativity and innovation, and we'll do this by establishing a matrix-like structure, and I'll talk a little bit more about that and what I mean by matrix-like.

The other thing that's really important is, we have a really strong program now. So this isn't about doing things to change where we're successful. We're going to build on our foundation and it's really where our traditional strengths are. That's not going to go away. That's not what I'm talking about.

We keep the traditional strengths and then we expand to bring in these new areas, but based on that foundation, so that's, I think, the really important thing to understand.

Also, it's very, very important that this new organization creates an inclusive environment. We want to make sure that we foster professional development and growth for our employees, and we want our employees to be able to meet their highest potential.

You saw on that slide that we spend a lot of money on our human capital, our human resources, and if we waste those, we're not going to be successful.

So it's really important we focus on how to take those resources and it sounds like I'm making people really impersonal, but, you know, what can we do to give people what they need to really succeed and excel. I think that's what we all want.

So reorganizing is only part of the picture. Just by reorganizing, we're not going to accomplish all the things that I just went over in those previous slides. It's really important that we also look at our culture. We have to have a cultural shift to support the organizational change and they support one another to be able to accomplish this.

And really, what we have to do is, we have to think about ways to build trust, we have to create a culture of collaboration, and basically, it's sort of a new ecosystem for doing our work. And so communication and engagement are incredibly important for this.

And in this diagram, which actually, I wish I had made a little differently, and I'll explain that in a minute, every aspect of the organization has a role. So I'll just start with leadership.

So leadership has to articulate the vision and promote that vision. And then management are the frontline champions of the vision. And then as I mentioned, the organizational structure has to align with that vision.

Now, where I wish I had changed -- or done something differently on this slide is, where I put employees, I wish I had made the employees a circle too, because they're absolutely critical in this picture here, and part of this new cultural environment.

And so this is a participatory process and that's how we've set it up. And as we've been going through this, we've tried to engage employees by creating mechanisms for them to give us feedback, we've met with them, we've talked about what we wish to do, we've talked about the vision, and we've gotten feedback, and we've used that feedback then to look at what we're proposing and make some changes.

And so we're going to continue to do that so it's very important as a participatory process.

And as we start talking about culture, we're going to need employee input to help inform what we're doing and give us feedback to make sure that we're on the right track with this.

So when we started thinking about a culture of collaboration, we started thinking about, well, how can we benchmark this and what are some good models of where other organizations have established a culture of collaboration and have done it successfully?

We've looked at government entities, so NASA is actually a really good example. I have 3M up here because we spent a day with 3M last year and we went to their innovation center, and it was really interesting. We asked them a lot of questions about, so how does it work here?

And they're very well known worldwide for their culture of collaboration. And this isn't something new for 3M. This is something that was established in the 1950s at 3M. They had a very visionary CEO and so this has been working for them for a long, long time.

And they told us that their culture of collaboration was based on three pillars, which I've shown here on this slide. The first pillar are the individuals, and what I have is two quotations there that I just took out of my notes from the time that we met with them.

And so the first one is, hire good people. So it really comes back, again, to the workforce and to your human capital. But don't just hire good people, let them do good work and grow. And I think I kind of mentioned that as part of our vision as well. This is essential.

The other one that they mentioned was that management's role is not to manage in a sense that maybe would be the traditional sense, but it is to create opportunity for those employees and to step back, stay hands off, give employees ownership.

Well, you all know that this is a company that's been very successful. They've been very successful at innovation and we were all, I think, very, very impressed with what they've been able to achieve there.

The second pillar is the 15 percent time. Everybody's probably heard of this. That's what led to Post-it notes. This is where all employees have the opportunity to take 15 percent of their time to, I'm going to say, play, to go into the laboratory, and they can work on any project they want.

They also talked about, how is it that you can give employees this opportunity? How does this work in terms of, performance, and evaluation, and all these things that we traditionally think about when we think about how we manage research organizations?

3M does not do metrics. We don't have performance metrics, is what they told us. It was, like, wow. Okay. So that's a really novel idea, I think, and for the government, I think that would be even more novel than it would be in the private sector.

They talked about how employees were rewarded for collaboration. And one of the examples that they gave us was that they have peer-nominated awards. These aren't awards where a manager is nominating somebody, these are peer-nominated awards.

And I actually was listening to NPR the other day and they were interviewing somebody who was talking about, and I can't remember what the company was, but they had a peer-nominated award where peers nominate people for who has helped them the most during the past year to achieve whatever their objectives were.

So it's that sort of thing and I think, 3M probably has something similar like that.

The third piece of this is a connected network. So they've created something that they call the tech forum. If you're interested in it, you can go to their Web site and they have, a nice write-up about how this works.

What's really interesting about the tech forum is that, 3M is a very large, I can't remember the total number of employees, company with operations worldwide. And this tech forum covers the company globally.

And it's self-organized, management doesn't run it, it's completely self-organized by the employees and it's self-directed. And so it allows for this global cross-pollination that's so important to the success of the company.

So that's the 3M model and I think there's some ideas and things that we can borrow from 3M. So that's all well and good, but we work in the Federal Government. That's a really different place.

So we need to create this culture of collaboration, but we have some very real barriers and we can't ignore those, we can't pretend that they don't exist. We have to understand them, we have to acknowledge them, and then we have to think about, given these barriers, what can we do to establish this culture of collaboration?

So the first barrier is competition for resources, and now I'm talking about within the mining program, so we have two division since 2015. We compete for the same funding. Those dollars haven't changed in the last I don't know how many years.

And so that means we compete for FTEs, we compete for travel, fortunately, we don't have a travel ceiling anymore, so that's relaxed a little bit. Equipment, so these are some of the resources that we end up having to compete for.

It sort of feels like a zero-sum game and as soon as people are put in that situation, the natural tendency is to become, kind of, territorial and protective of their resources because they're scarce. That's just how humans are wired. And so that's the situation that we've kind of found ourselves in.

So the next one is that our divisions and branches within the mining program historically have operated in isolation. And there are a number of excellent reasons for it, and this is just part of our history and the culture we have today, one is geography.

Spokane's on the West Coast, Pittsburgh's on the East Coast. It's very hard to, interact spontaneously when it's like that. But obviously, companies have overcome these barriers and there's ways to do it, and we're working on that.

We've put lots of things in place, but it's still a challenge. I mean, even the time zone differences, scheduling meetings, it's a challenge. The other is history. Pittsburgh has been coal focused, historically, Spokane has historically focused on metal/non-metal.

So they haven't had to work together. They each kind of have their own area and they can each go do their own thing. There's some real strength in that, but that also means that you don't have to do that hard work of trying to collaborate, because it's not always natural to collaborate.

The other is infrastructure, and I'll give you a great example. Pittsburgh, I think you all have been, or most of you have been, to Pittsburgh, and we have a very large campus with lots of buildings, and people are spread all out.

Again, even within that campus, it's difficult for people in different branches, or teams, or buildings, just to interact. And when I first came to NIOSH, I had these roundtable discussions with employees and one

of the consistent things I kept hearing was, I don't know what the team next, the building next to me is doing, or what that branch does.

We've taken some, I think, really good steps towards trying to give that, kind of, cross-pollination, but again, this is just something that we live in.

Frequent reorganization. This is one I'm extremely sensitive to because I'm now saying, oh, we're going to go reorganize again. I've been through them many, many times in my career. I know how incredibly destabilizing they are; I know how anxiety provoking they are.

And so because of that, we need to make sure that we move into this one with a lot of communication and, again, we're trying to do that, I'm sure we could be doing more, honestly, we also need to make sure that we're really thinking this through very carefully, and that we're doing things very intentionally because the costs of reorganization can outweigh the benefits if you're not careful.

And so I just want all of you to know that we're not doing this quickly, so that we have time to really think it through, and we're not doing it casually, so putting a lot of thought into it.

So, and again, with frequent reorganization, we have that kind of same behavior or culture that I talked about earlier where when people feel anxious or like their resources may disappear because things are not stable, trust erodes, or a lot of things that can happen, so that makes it harder, actually, to collaborate.

Another thing is perceived lack of transparency and trust, and we see this in our employee viewpoint surveys, and this is something we work on and we, you know, it's kind of a perpetual challenge.

Something we're aware of, I don't think we've cracked the nut, but I think that also feeds into this idea of, you need to have a really safe space, a safe environment, to feel that you can collaborate, and it's hard to create that in an organization.

The other one that I wanted to mention is how we do our performance evaluations. The way it's setup for us, and I think a lot of this government related, I think anybody in the government will tell you this, this is not unique to us, is that, it really awards individual performance and that, in turn, will disincentivize collaboration.

And so, I think there's some things we can do there. We are somewhat limited though.

So just sharing those just so you know, what the constraints are, and, sort of, where some of the boundaries are, and the ones that I feel like I hit my head up against a little bit more than I would like, but I come from the private sector, so I have to learn these things.

So my message here is that success will require that we work together. We have a shared mission and together it means, as I said before, internally as well as externally. We have lots of resources that we can tap into.

But I'd like to focus a little bit now on just within our program and how do we manage this. How do we make this work so that we don't step on each other's feet and so it's really clear what we're doing.

So first of all, it's important to recognize that each division has core areas of expertise and we need to think about these core areas of expertise as complementary and not as independent. We need to look at it as a whole.

The other thing is, is that, what will happen as we particularly introduce new areas of research and standup new programs is, one division will take the lead, the other division will support that, and the division taking the lead does not have the exclusivity, it's just a matter of how you organize your resources to make these things happen.

So I already said it, each divisions will support the other. And so this spirit of collaboration has to go beyond just what we're doing internally, it has to reach out to other NIOSH DLOs, other divisions, laboratories, and offices, and also, outside of the institute.

So this is an example. This is for illustrative purposes and I can tell you that we've had a lot of debate amongst leadership about this, and not everybody would have made it this way, it's evolving, and we will be going through these exercises for other areas, but I wanted to show it to you as an example of -- you know, because part of it's having this discussion.

So emergent technologies and automation research will be conducted by both divisions, and we're at the early stages of this, as you all know, and each division will have a different, but complementary focus.

So what we're showing here on this slide is, what are the core areas of expertise for each of the two divisions and how do they complement one another?

So, PMRD, I've already mentioned, human factors is a very strong core expertise, and I've listed some of the things. There could be additional things added to this list.

Very strong in electro and mechanical engineering, so that shows up, and you can see the areas where there's real strengths. This list, again, could have been much longer, but I am just trying to pick areas to illustrate this idea.

If we look over at Spokane, also, electromechanical, and you can see some of the areas where they have core expertise. And you can see how they complement each other, but there's also overlap. It's more complex than, maybe, what's shown on this slide, but it gives you the idea.

Wearable sensor technology is a strength, and then of course, mining ground control methods for western underground metal mines is very much a core strength in Spokane.

We could have made one of these for miner health, and we will, we could do the same thing for ground control, because we do ground control research at both divisions, so we will be going through those exercises as well.

A lot of background, a lot of trying to setup for what we're planning to do, so now we'll get into some of the details about what the reshaped organization looks like.

So it's going to have a traditional hierarchical structure for the administrative purposes, because that's what works, so we don't want to throw away what works, and that's what we really have to do.

We'll have 5 branches in the new organization that have 15 teams distributed amongst those branches. We will then have a matrix-like structure for research and research support. Matrix structures, this is -- matrix structures and hierarchical structures are kind of two different end members, and we're going to kind of blend them, and that's where matrix-like comes in.

Because we really have to have the hierarchical for administrative purposes and that's going to also flow into the research, but then we're going to add the matrix component, and I'm going to show you a slide that hopefully clarifies that a little bit.

Some examples of what we're doing, we're going to have a shared services function that's going to be distributed among our three organizational units. And I'm starting to go a little bit quicker because I haven't been paying attention to time.

CHAIRPERSON NELSON: Well, I think you should take all the time you need in order to get your points across.

DR. KOGEL: Okay. All right. I won't worry about it. Thank you, Priscilla. So I'll talk a little bit more about shared services and the logic behind that when I get to the next slide. The other thing that we can do is establish communities of practice and this is something the CDC has done.

And I think it's a really interesting idea, and basically, with these communities of practice, professionals within our organization that have shared research interests can form these informal groups, and it kind of goes back to the tech forum that I described for 3M. And we have a lot of areas that, I think, would really lend themselves very nicely to creating these communities of practice.

And these would be self-organized. I think the first one that we'll probably standup is the emerging technology community of practice, and we'll invite people, you know, volunteer to join these communities of practice.

And so that's something that I think will start nurturing and establishing this culture of collaboration. They're not formalized, they're not going to have a particular goal, it's just really bringing the community of people together to start communicating and working together.

The other thing we're going to use is dotted and solid-line reporting. And I'll get back to that on the next slide, I think. Okay. So this next slide is the organizational structure. This is also an evolution. This is not finalized.

So there's some people in the room who haven't seen this yet. I'm going to be doing an all-hands meeting and sharing this with the employees. We've made some tweaks to the last one based on employee feedback and some other information as well.

So nothing at this point is completely solidified, but we're getting closer. So we can see OMSHR sitting at the top, that's my office, and then the two divisions in blue, and then in orange are the shared services. This is basically health communications, computer and data analytics, and statistics and surveillance are shared services, because these are things that support our research.

In the OMSHR box are the ones that support the overall program, and then each division will have their own dedicated resources in these areas. This is where the dotted and solid line starts coming into the picture.

So the solid-line reporting goes into the Director's offices for the two divisions, dotted line goes into OMSHR shared services so that we can make sure that there's coordination across the entire program. Jeff.

DR. BURGESS: Jessica, this is great. Were you going to add in how this coordinates with the greater NIOSH?

DR. KOGEL: The bigger NIOSH? I'm not planning to, but I can talk about it.

DR. BURGESS: I think it would be really nice because, you've got respiratory -- and all those bits that work

DR. KOGEL: Absolutely.

DR. BURGESS: Yes.

DR. KOGEL: Yes. So I'll walk us through that and then I'll try to talk to that, so great question, because it absolutely does. So just so that everybody here, if you aren't familiar with dotted and solid-line reporting, basically, the solid-line reporting is your traditional, supervisor who is responsible for the administrative things, like timecards, approving leave, performance appraisals, et cetera.

The dotted line is, and somebody may have more than one dotted line relationship, depending on what projects they're on and how many teams they're on, the dotted line -- well, it's not supervising, the dotted-line manager, I don't know what term I want to use, is responsible for setting priorities for research and working with the solid-line supervisor to allocate resources.

Also, the dotted line has input into performance as well, but basically, more of a, kind of, research rather than purely administrative role. The two dotted and solid share.

So then, you see the branches, the five branches I mentioned, and basically, the branches are aligned with our three strategic goals. We have both divisions -- so both divisions have a branch that focuses on miner health, they both have branches that focus on mine safety, and then we have a human systems integration branch.

These are, I'm going to say, hardwired in the government. If we want to change these, we have to go through lots of paperwork, so we can't change these readily. Teams are not formally recognized as organizational units, and we can change these.

And so you can see that we have a number of different teams. These teams can change as our research priorities change and we don't have to go back and do a formal reorganization to do that. So these are kind of the fluid piece of the organization.

That doesn't mean every year we're changing teams, by any means, but over, you know, five, ten years, these can be tweaked and changed as needed; if needed.

Okay. So to answer your question, Jeff, about how this works across the institute is an excellent question, because as you know, we work very closely with the rest of NIOSH, particularly with respiratory health division in Morgantown, NPPTL, the health effects laboratory division, we work with all of these groups, and others as well.

And so we have to -- you know, my view is that we take this model, and we're already doing it, but we're not always as well-coordinated as we need to be, and we sometimes, because we aren't used to working this way, will forget to talk to people that we should in another division that might have expertise, so we've got to build a similar kind of structure, and I think these communities of practice is another way.

I'd love to see NIOSH-wide communities of practice. I'll give you an example. There's a lot of us in the institute that work with crystalline silica, or elongate mineral particles in asbestos, not just the mining, and we don't always know what's going on in the other divisions.

So if we can start building things like communities of practice, or whatever you want to call them, then we can at least get all the people at the table that need to be at the table.

So I sort of see this as kind of a mini model of something that could then be extended out across the institute. So that's just, kind of, my -- I haven't had any conversations with anybody else in the institute with it -- you know, about this, but I think that can work much more broadly.

Does that answer your question?

DR. BURGESS: It does. Thank you.

DR. KOGEL: Okay.

DR. MILLER: Jessica, so the division would be creating that shared service kind of structure across the institute and then be able to use that?

DR. KOGEL: Yes, so let me backup, and I was talking more about research, but the shared services, I think, is an interesting one to bring up and talk a little bit about.

So, you know, I mentioned that NIOSH has been in this phase 1 reorganization for over a year now. Early on in that reorganization, all of the leadership across the institute got together for a number of different meetings to have these kinds of conversations, to talk about, where are there efficiencies, what can we do?

And so we did have those kinds of conversations. We're not moving towards that right now, but there -- you know, there's a recognition that we could do things like that, where we say, we can create, you know, a shared service-type function that is related to healthcom that is across the institute where you have pooled resources.

You know, at this point, like I say, we're not moving towards that on an institute level, but I do want to move towards that within our program. So that's, I think, an interesting model.

All right. So this is a slide that I hope articulates that matrix-like structure, because it's not a pure matrix, so that's why I like matrix-like. Are you excited? All right.

So let me see if I can walk us through this. So what I've put here are the five branches, miner health branches, two of those, one in Pittsburgh and one in Spokane, on the left side, and then human systems integration branch in the middle, and then the two safety branches on the right side.

All right. So the way this works, so those are administrative organizations, so to speak, that's the structure for the administrator, so that's what this axis is about. I'm debating on how the axis should go. We can argue that.

And then the research organization, that's where the matrix comes in. So across the top we have our administrative organizational units. For this purpose, I used the branches. I could have put in teams, I could have put in divisions, what have you, just an administrative organizational unit.

And then along the side, we have, I called it, research area, it could be a research topic, maybe Amia has some other ideas on how -- because I think this is your area, isn't it? I should have consulted her.

So I thought about, okay, so what are our research areas, or topics, or focus? So it could be a strategic goal, which is how I chose to do it here, it could be an intermediate goal, it could be a project, and then et cetera. I'm sure there are other things we could put there.

So what this is showing us is that there will be resources drawn from each of these, not every one of them, but from multiple branches, to work on projects, strategic goals, which is what we do now, but in a very collaborative way, so that's what this is illustrating.

And the thing we need to remember is that research -- that's our mission, that's our main focus area, so this really has to be focusing around, how do we accomplish research? And we have to remember that administration, that supports our research, so we have to be very careful not to let our administrative organization drive the research organization, if that makes sense.

So the next slide -- what happened? There we go. Oh, that's right, I animated it. So the next slide then now takes that matrix idea and starts superimposing these communities of practice on it. So this is just to show, kind of, where that community of practice would sit.

So this first one is the miner health community of practice. So there would be resources and individuals doing work as members of this community of practice who probably would be within those three organizational administrative units, if you will.

Does that make sense? Okay. And then we can --

CHAIRPERSON NELSON: I guess what I'm thinking here is that this would be an opportunity, because of the discussion on community of practice, to have a strategic goal or research area, with your horizontal dimension being your intellectual --

DR. KOGEL: Right.

CHAIRPERSON NELSON: -- mapping of who's involved in what and what are the questions that they're trying to work on. Doesn't matter what branch there's in, and so there's an opportunity there to actually deal with the individuals.

DR. KOGEL: Yes.

CHAIRPERSON NELSON: And say, which individual in which branch is actually a part of miner health community of practice, regardless of what branch they're located in.

DR. KOGEL: Exactly. Yes.

CHAIRPERSON NELSON: And so that means that people can self-map their intellectual interests into this.

DR. KOGEL: Yes.

CHAIRPERSON NELSON: Which is helpful, perhaps.

DR. KOGEL: And I think that really kind of goes back to this idea that these are self-organized and this is where people self-map, like we said, because they say, look, that's one I want to be a part of. It's not management picking.

And I like your idea of the intellectual -- how did you -- I want to write it down.

DR. KRAMER LUXBACHER: Can I ask a quick question about the communities of practice?

DR. KOGEL: Sure.

DR. KRAMER LUXBACHER: This isn't a criticism, because I think it's a great idea, but in the last few years, in fact, we were encouraged to self-organize into these destination areas.

DR. KOGEL: Okay.

DR. KRAMER LUXBACHER: Which was a similar idea. But the incentives weren't clear and nobody had any idea who was in charge of each area.

DR. KOGEL: Okay.

DR. KRAMER LUXBACHER: And they were a disaster.

DR. KOGEL: Okay.

DR. KRAMER LUXBACHER: And so I just wonder if you thought about maybe have some organization where somebody's sort of leading the charge for each community.

DR. KOGEL: Yes.

DR. KRAMER LUXBACHER: And there's some kind of incentive for people to say, I want to be part of this community of practice.

DR. KOGEL: Yes. So thank you for bringing up the incentive question, I think you're right, and I think that's a really good thing to make sure that we articulate what the incentive is and so appreciate you sharing that experience.

I completely agree with, even though I say these are self-directed, there has to be a structure, and that's how 3M set it up. It's very structured in terms of, I think they called them, senates and their senators, and so we would look at something like that.

So even though it's self-directed and self-organized, there has to be a structure, because without a structure, it's like --

DR. KRAMER LUXBACHER: It's a mess.

DR. KOGEL: Nothing will happen. And so, yes, there will be some kind of structure to support that to make sure that it doesn't --

DR. KRAMER LUXBACHER: Devolve.

DR. KOGEL: Devolve. That's a good word. Yes. So I'm really open to hearing people's experiences, particularly people who've been through this sort of thing and seen it succeed and seen it not succeed, which is one of the reasons we're benchmarking against other organizations, because we want to learn from them, and hopefully approach it with the idea that we won't make the same mistakes, because that would be pretty easy to do.

I'm going to put one more community of practice up. This is the ground control community of practice. So you get the idea. This is very conceptual, but it's just, you know, to illustrate, kind of, where we're headed and what it might look like.

All right. So this is a slide that I shared with employees back on August 9th, that's when we first introduced what we're thinking about doing. So we presented the proposed organization, which was not exactly the one that I showed on the earlier slide, but was very, very similar.

And then we -- so we would like your feedback, so we moved into the gathering feedback phase. This timeline has changed since what I showed the employees, and we've communicated that the timeline has changed, and that's partly because we didn't want -- NIOSH did not want to submit phase 2 package while the phase 1 package was already in the pipeline for review and approval at CDC, and then HHS, so that's still happening, so that pushed our timeline, which is a good thing, because I think we need more time.

I think we need, like I said, take this very deliberately. And so our feedback phase has been a little bit longer. I have employees up here as well as MSHRAC. We need your feedback.

And so then once we get the feedback, we will finalize the organization and then we will submit the MASO package, and I realized this morning when I was looking at my slides, you all don't know what a MASO package is. So basically, this is just the paperwork that we need to submit for approval to do this.

What I have on this slide, I made this slide, what last week, which was January 15th. That changed as of the day before yesterday. It's probably going to be February 15th before we'll able to submit it again, because of phase 1 still kind of moving through the approval process.

That's why there's a question mark there. Totally out of our control, so it is what it is. And then the package will be approved, has to go through two levels, CDC and HHS, the HHS approval is new. That's new at this administration. We don't have any idea how long that will take, so question mark.

We would like to implement this, what would make sense, is the beginning of our next fiscal year. So that's what I have on the slide, but I'll also reserve the right to change it, because we don't have control of the timeline necessarily.

So that's it.

CHAIRPERSON NELSON: So you can begin operating in this philosophy before the phase 2 process.

DR. KOGEL: We can. Yes. There's certain things we can start setting up and when we're at the point where we have finalized where we're going exactly with the teams, and how this is going to look, and we're not quite there, there's some things we can start doing.

CHAIRPERSON NELSON: So thank you, Jessica. Let me just introduce a comment here. This is very reminiscent of the basic problems that academia has, and academic institutions can say, we value interdisciplinary activities, but in the performance evaluation on an annual basis, in fact, such collaborative interdisciplinary activities are rarely asked about or valued explicitly.

So the care and feeding of this process of valuing interdisciplinary work and cross-ties is something which has to be explicitly paid attention to.

DR. KOGEL: Right.

CHAIRPERSON NELSON: You can go from the extreme to, say, a school like the University of California Davis, where they valued interdisciplinary activities so much, they created what they called graduate groups. The graduate group of the environment.

People from all of the administrative departments and programs, all the faculty, moved to those graduate groups to develop their research professional areas.

More than half of the graduate students and graduate degrees come out of the graduate groups, not out of the departments.

DR. KOGEL: Interesting.

CHAIRPERSON NELSON: So they explicitly value the whole thing, and reported to the provost. So the administrative structure of the departments remained, largely because of ABET and other things, that you don't want to muck around with, but the value added by going to a graduate group became clear to the faculty, and that's where their professional lives were really invested, and they had to work at it and keep it going.

So it's very hard to make that culture change, but the value that's added at the end is, I think, potentially, phenomenal. So I'm very happy to see your thinking going in this direction, so thank you. Bruce had a comment.

MR. WATZMAN: Yes, Jessica, I sat here waiting for you to address an issue, and that is, how does this make it better for the stakeholders? How does this improve things for the stakeholders? Because ultimately, that's who you're providing product to.

DR. KOGEL: Yes.

MR. WATZMAN: The mining community. It seems to me that this was entirely internally-driven and constructed, with no external input. You're presenting it to MSHRAC. We are a small segment of the mining community.

And I think that before this is ultimately implemented, and I get the impression from this that this is complete, quite honestly, that there isn't going to be the opportunity for external input into this process, and I think it's going to suffer as a result of that, because I think the stakeholders may say to themselves, why?

DR. KOGEL: Yes.

MR. WATZMAN: Merely because the White House and OMB issued a guidance document, hell, the White House -- OMB issues guidance documents weekly, that aren't implemented, let's all be honest here. At the end of the day, the question has to be asked, is this better for the stakeholders.

DR. KOGEL: Right.

MR. WATZMAN: That has to be the test.

DR. KOGEL: Yes.

MR. WATZMAN: And I don't think that aspect of that has been discussed or addressed. Maybe it has and it wasn't presented, but I mean, I think you're lacking an important constituent in this discussion.

DR. KOGEL: Okay. I appreciate that, Bruce. So the first couple of slides, I tried to address that upfront. Maybe I didn't do that clearly enough and I agree, OMB and NIOSH made the decision to go down that path. I can't really speak to that.

MR. WATZMAN: Understood.

DR. KOGEL: So that is what it is, but I think the way we see this is that, it will be a benefit to the stakeholders for -- and I could go back to the first couple of slides where I kind of lay it out that, you know, the mining industry is changing, we need to be proactive, we need to embrace some of these new areas of research, we need to be able to respond.

And, you know, with the flat funding, you know, my concern is, is that, we're going to be in a situation where we're not going to have enough funding to continue to do the level of work that we do today. And so I think that's really where the stakeholder comes in as well, because we want to continue to deliver the, really, high quality, relevant research that has impact.

So we're looking at a way to take the organization in a slightly new direction. This isn't like, I don't think, a huge change, so --

MR. WATZMAN: Well, let me give you one example that concerns me.

DR. KOGEL: Yes.

MR. WATZMAN: And this is really a follow-on to a discussion we had in the runup to the automation workshop. When I expressed a concern that that workshop had an almost singular focus on --

DR. KOGEL: Right, on metals.

MR. WATZMAN: -- the metal-non-metal sector, and NMA is the only group represented here that represents a broader spectrum of the industry, coal, metal, non-metal, not the industry entirely, I understand that, but a broader perspective of the industry.

And when I looked at one of -- your Slide Number 18, and there was a branch called miner safety branch, and an automation and technology team, that is going to be housed singularly in Spokane with no similar function in Pittsburgh, that troubles me --

DR. KOGEL: We do have -- yes.

MR. WATZMAN: -- because where is -- and it's difficult, if it's there, then I apologize.

DR. KOGEL: It is here. It's not here by name.

MR. WATZMAN: Okay.

DR. KOGEL: And I'm trying to find it right now. Hang on. The mining systems. Mining technologies team, right here, is where it is.

MR. WATZMAN: Okay.

DR. KOGEL: Yes. So it's in there, Bruce, it's just, we broadened it. It was originally, I think, emerging technologies, is that right, R.J.? So we've broadened it to mining technologies because we don't want to focus just on emerging technologies.

And, you know, especially -- Pittsburgh has such a strong background in things that are broader. You know, there's listed some of these here. Right now, Spokane is kind of leading the effort because our --

as you and I talked on the phone, and I understand your perspective on that, and the fact that this workshop was focused on metal/non-metal, was really stakeholder-driven, because we had a number of stakeholders that had come to Spokane, and had met with us, with some real needs.

And so we felt that it was important that we focus on what was happening in the metal/non-metal, not at the exclusion of what's happening in coal. So that first workshop was around metal/non-metal.

And I think as you and I spoke about, there will be future workshops, and we might do them sector-specific. Our next one might be coal. We could do something broader, but we haven't done stone, sand, and gravel yet either, so I'm sure that Dale might have a similar --

MR. WATZMAN: I think you just ought to avoid the perception or the reality, that this is robbing Peter to pay Paul.

DR. KOGEL: Right. Absolutely.

MR. WATZMAN: I mean, the fact of the matter is, today, and we all know it, that coal production is down.

DR. KOGEL: Yes.

MR. WATZMAN: We don't know if that's a long-term trend of whether -- what it means, but the risk profile in coal is still higher than the rest of the industry.

DR. KOGEL: Yes.

MR. WATZMAN: And we have to continue to recognize that.

DR. KOGEL: Absolutely.

MR. WATZMAN: It's not that one should benefit to the detriment of the other.

DR. KOGEL: And I hope that I addressed that by saying that we are not getting rid of our traditional strengths. Coal will continue to be a very core part of our research, and we've worked in the area of coal and coal automation around long walls and that sort of thing for a long time.

The metal/non-metal is kind of new on the scene, and so for us to be ready -- I feel like we're better positioned to address coal at this point because of the depth and breadth of the research that we've been doing in the area of coal for decades at PMRD versus with metal in the Western U.S., that's suddenly, kind of, coming on and it's coming on quickly.

We don't have the knowledge, the depth, the breadth, we have some of it to start addressing it, and that was really what led to the workshop, and I think Kray's going to, you know, talk about that, and we just felt we had to have a really focused effort looking at what is happening so that we can be positioned to address the issues that stakeholders were coming to us about.

And so it was not robbing Peter for Paul, it was saying, okay, this is an area where we need to apply some focus and how do we get up to speed on what's happening? And that's what it was about.

So I'm sorry if it looked like we were doing -- you know, taking away from coal, because absolutely not; not in any way.

CHAIRPERSON NELSON: So I enjoyed Bruce's comment because it brought up a couple issues, every one of the stakeholders, I think of it as has a piece of cheese.

DR. KOGEL: Right.

CHAIRPERSON NELSON: And you're in danger of moving their cheese and you have to tell them where that cheese went.

DR. KOGEL: Yes.

CHAIRPERSON NELSON: Or else they don't know what's going on, and they don't --

MR. BOWERSOX: The core mission is still there.

CHAIRPERSON NELSON: But it needs to be --

DR. KOGEL: Clear.

CHAIRPERSON NELSON: -- made very clear.

DR. KOGEL: Yes.

CHAIRPERSON NELSON: Because you brought up transparency. The one thing I felt on this slide when I saw it was, oh, dear, what are you doing? You're mapping your existing expertise and then you're going to make your goals fit whatever your expertise is.

DR. KOGEL: Right.

CHAIRPERSON NELSON: And that's the danger. You can do this in an explanatory way --

DR. KOGEL: Right.

CHAIRPERSON NELSON: -- but I think what you want to do to have a culture change is to actually have those compelling intellectual drivers. So related to that, if the mechanism for those compelling intellectual drivers is something like a community of practice, and there may be teams in there, there may be projects in there, but they make up, add up to, a community of practice.

Do you think of that as being something that's not just internal to NIOSH and not just internal to the Federal Government --

DR. KOGEL: Yes.

CHAIRPERSON NELSON: -- but that it is actually opened up to include all the stakeholders as well?

DR. KOGEL: Yes. Absolutely.

CHAIRPERSON NELSON: To explicitly become a part of the community of practice, in which case, the community of practice may be the entity that initiates workshops, rather than a top-down decision about what the workshops are, the community of practice --

DR. KOGEL: Practice initiates those.

CHAIRPERSON NELSON: -- can seek those opportunities.

DR. KOGEL: Yes.

CHAIRPERSON NELSON: And then, on Slide 14, you have barriers. You put the word, barriers, up.

DR. KOGEL: Yes.

CHAIRPERSON NELSON: And I wish you hadn't put the word, barriers.

DR. KOGEL: Okay.

CHAIRPERSON NELSON: Because I don't see these are barriers. I think they're challenges, but in some cases, they are opportunities.

DR. KOGEL: Okay.

CHAIRPERSON NELSON: And so the idea of performance evaluation, for example, if you're going to value collaboration, you better have, in your performance evaluation, the requirement that employees tell their supervisor how they've been collaborating, because if it's not there, nobody will do it.

DR. KOGEL: Right.

CHAIRPERSON NELSON: So anyway, there you go.

MR. SEYMOUR: Jessica, can I add some possible perspective to the reorg?

DR. KOGEL: Yes.

MR. SEYMOUR: Bruce, in Spokane, we don't have any branches there.

DR. KOGEL: Not right now. Right.

MR. SEYMOUR: So the team leads and the senior researchers are forced to provide the leadership for the research goals. What this new structure is going to do is take the heat off of researchers, allow them to do research and have management or support staff then read the research and develop the program.

So it will relieve the, I guess --

DR. KOGEL: Administrative burden. Yes. Good.

MR. SEYMOUR: -- the burden on staff of doing that work.

DR. KOGEL: Yes. Good.

CHAIRPERSON NELSON: Well, from another analogy, the idea is, having people down in their foxholes. What will bring them out of a foxhole to make an army, which is far more capable than a bunch of individuals in a foxhole. And it can be the hierarchical, you must do this, kind of thing, but if you hit the right intellectual drivers, people will climb out of their foxholes, because there's the intellectual value associated with the synergy of coming together.

And I think that's the kind of culture change that you seek to have happen. So the care and feeding of this community of practice really needs to be thought about.

DR. KOGEL: Yes, I think that's a great point.

CHAIRPERSON NELSON: Because it can be very bad.

MR. BOWERSOX: I just want to go back what Bruce was saying, because I was sitting here wondering, is coal going to be losing?

DR. KOGEL: No, we'll make sure. No.

MR. BOWERSOX: So I guess I'm maybe jumping ahead, but they're still replacing Lakelynn as --

DR. KOGEL: Yes. Lakelynn's still in the future. Another process that's ongoing and we don't have a lot of control over that timeline, but yes, that's still happening, and we're making progress.

DR. KRAMER LUXBACHER: I had a question. I echo Bruce's comment, I think it was good, but along the lines of infrastructure, when you talk about changing the culture and having communities of practice, and I may be wrong about this, but my impression is, NIOSH is an older workspace that's very traditional in that it's conference rooms, offices, and labs.

DR. KOGEL: Right.

DR. KRAMER LUXBACHER: Do you have any plans, on the chart, to build some sort of casual collaborative spaces?

DR. KOGEL: Yes. We have for the last two years, actually, had -- and it wasn't office spaces, but it was more of a -- and this was for Pittsburgh, Spokane doesn't suffer this problem because they're all in one building, so in Pittsburgh, we're hopefully, maybe it'll happen this year, because I think the budget may

have the money for it this year, but it's basically a community space for everybody on the Pittsburgh campus.

So that includes PMRD and NPPTL, where there'll be limited food service. Right now, if anybody wants to eat onsite, they have to go across the hill to DOE, to the cafeteria there, and then it'll also be convertable into a conference room, you know, meeting space.

The other things we've talked about, which is just an idea that we haven't pulled the trigger on, is creating some sort of Zoom or some other media for having an opportunity for people in Spokane and Pittsburgh to say, hey, let's all gather together virtually in our meeting room so that we can have these exchanges.

So this space will have, you know, multi-purposes, but it's really to create -- because right now we don't have a good place for people to just kind of casually interact over lunch or --

DR. KRAMER LUXBACHER: Yes, that's been my impression, like, even where the coffee maker is, it's often in the hall or --

DR. KOGEL: Right, yes, so this would be that kind of casual gathering space where people can either just bump into each other or they can say, hey, let's all go meet for lunch and have, you know, a team meeting, or whatever.

CHAIRPERSON NELSON: So that gets into findability. You're not going to figure out who's doing what unless you can find out them.

DR. KOGEL: Right.

CHAIRPERSON NELSON: And so there's electronic ways of doing that too.

DR. KOGEL: Right.

CHAIRPERSON NELSON: We have the same problem on campuses though, Web sites are notoriously poor at trying to find out who's doing what on campus, all the time.

MR. WATZMAN: So could I go back, looks like, to where I began?

DR. KOGEL: Sure. Yes, please.

MR. WATZMAN: And that's the question in your timeline of if there is a mechanism to solicit external stakeholder input into this process.

DR. KOGEL: Yes.

MR. WATZMAN: I mean, this is a very tight timeline. You know, even with the additional month, you're saying February, we're now into December, which is a lost month because of the holidays.

DR. KOGEL: Right, because of vacations.

MR. WATZMAN: I'll be gone in two weeks, so I don't care.

DR. KOGEL: You can leave your comments with Tom. He can pass them on.

MR. WATZMAN: You know, I think if you don't have external input into this, there's the potential for people to criticize it from the get go.

DR. KOGEL: And we don't want that. I appreciate you bringing it up, Bruce. I think traditionally, and again, I'm maybe not the best person to speak to this, because I haven't been around long enough to have that historical view, but I don't think we have typically solicited stakeholders.

Like, when we did the 2015 reorganization, you were around, did we solicit stakeholder input through some kind of formal process beyond, like, MSHRAC, are you aware of?

MR. WATZMAN: I don't know. I'm getting to that point where I forget things, so I don't recall.

DR. KOGEL: Okay. So honestly, it didn't occur to me. I kind of felt like, okay, we have MSHRAC, we can present it to MSHRAC, start getting, you know, feedback. I also have to admit that I've been very internally focused. I felt that it had to be -- and just doing that internal focus and internal communication is -- takes tremendous time.

MR. WATZMAN: No question.

DR. KOGEL: And that sort of was the first piece that we have to take care of, and so I completely appreciate your comment and you're right, we have not focused externally on getting external input at this point.

And I will find out -- I mean, I know we published it in the federal register, but at that point, it is basically a done deal. And I think that happens after the approval? I don't know. I'm looking at others that have been around for a while.

So I don't know what the processes or what's available to us, besides, you know, obviously, MSHRAC, and bringing it to you here. But I can look into that, Bruce, and find out what we can do to -- you know, it might be a federal register --

MR. WATZMAN: I mean, I think the overall effort would benefit by that.

DR. KOGEL: Yes. Okay.

MR. WATZMAN: And the stakeholders may say, this is great. You know, this will improve efficiency and make the work product and the help the institute provides to the industry that it so desperately needs, better at the end of the day.

DR. KOGEL: Right.

MR. WATZMAN: That may be the outcome.

DR. KOGEL: Yes.

CHAIRPERSON NELSON: And they may see their piece of cheese as bigger.

DR. KOGEL: Yes.

CHAIRPERSON NELSON: You can tell the story, right?

DR. KOGEL: Yes.

CHAIRPERSON NELSON: Any other comments, questions?

CHAIRPERSON NELSON: I'm sure we'll have additional dialogue at some point on this. And thank you very much for presenting a complex possibility. Good. All right. We are not on schedule, but that's okay because it's our schedule. We are -- let us do the -- RJ, are you ready?

DR. MATETIC: Yes, I'm ready.

CHAIRPERSON NELSON: We'll see how things go. I would like to take that break at 10:15. So if we slip it, we may slip George, and go after the break. Okay, George?

DR. GEORGE LUXBACHER: That's fine with me.

CHAIRPERSON NELSON: Good, thanks.

Mining Research Program Status Updates:

PMRD Update - Dr. RJ Matetic

DR. MATETIC: Okay. Good morning to all of you. I'm always glad to see all your happy faces. I think I know most of you in the room and you don't know who I am, I serve as the director for the Pittsburgh Mining Research Division.

Jeff, one comment you made earlier. You apologized for the 50 degrees. I'll take that considering --

MR. BURGESS: Yes, that's right.

DR. MATETIC: -- I just left 20 degrees, snow and blow and ice. So I'm okay with 50 degrees. And Bruce just left. I was going, where's Bruce. But he just left.

So let me give you hopefully a quick update on what's happening at the Pittsburgh Mining Research Division. Okay. A couple things we'll discuss is organizational updates that are ongoing in Pittsburgh.

CHAIRPERSON NELSON: And you do have to speak just a little bit loudly --

DR. MATETIC: Louder?

CHAIRPERSON NELSON: -- than you might.

DR. MATETIC: Okay. What we'll discuss is some organization updates regarding Pittsburgh. We'll look at the overview of our research portfolio as it currently exists. We'll look at program highlights since our last MSHRAC meeting, impacts, outcomes that have occurred since the last time we met, and then hopefully some time for discussion.

What you see here is a chart that I show you every MSHRAC meeting. This is kind of the state affair of Pittsburgh in its current state. What you'll see is total staff and also people eligible to retire. So if you look at '18, the number is 154 staff, 43 of those are eligible to retire which is about 28 percent of our work force. And every year, we keep talking about this concern.

We are done talking about this concern, and we are trying to move forward with getting people into the door in nontraditional ways which I'll explain to you in the next couple of slides. Because realistically, the heart of what we do is the people that are there to make that happen. And I'm not only the director directing it. People have to do the work.

And I think Bruce mentioned that we have to meet the expectations of our stakeholders. And currently, we are working in 23 program areas which are relevant to the stakeholders. And we need to figure out ways to get people in the door in innovative and creative ways. And I'll explain what our plan is moving forward.

One of the other things I need to mention is there's certain people in the room that promised me through their paychecks that this will happen in 2019 and 2020. So some of those are in the room. So just had to throw that out there.

The federal hiring freeze caused major problems too. And the federal hiring freeze occurred for three months, January through April. The bad news about it with CDC is -- what's that? Oh, I thought somebody said something. The bad news is that CDC continues some hiring controls after the freeze was lifted.

And they still have hiring controls in place, but we're finding out day after day after day that they're lifting a lot of those. So hopefully, there's some light at the end of the tunnel to be able to recruit what you need, how many you need to meet the expectations of the stakeholders. So I'll talk about that in the next couple slides.

What you see here is a waterfall plot. If you look at 2018, that's currently where we're at. We know how many people leave the program over the last 10 or 15 years. So on average moving forward, we're looking at 17 people each year leaving the program through retirements and other things. We need to make sure that we're doing everything possible to not replace them one to one. So I'll show you a slide on how we do that.

But we need to make sure that our core expertise is there, the relevant program areas are being met, and our stakeholders are happy with the result of our work. So we're looking at 17 departures, 30 hires, 17 departures, 30 hires. So by the year 2020, if this all works itself out, we're at 180 people.

And I know that's a very lofty -- sometimes somebody would think crazy goal. But we're going to push to do everything we can to kind of make that happen because it's absolutely necessary. And every year, I just see this trending line going down and I worry like crazy, how are we going to meet the expectation of our stakeholders? So that's the plan.

Here's for '19. So as far as the hiring. We have 30 positions as I showed you on the waterfall plot. How we look at those is we have succession planning in place. We have five-year project plans, ten-year project plans. And we kind of know through succession, through potential retirements, what has to occur given program areas, gaps in those program areas moving forward, and the positions that we need to fill to meet expectations. So this is just a snapshot of that with program areas, gaps, and positions.

Better recruiting campaigns. We say we recruit, but I'm not sure that we recruit in a way that we need to be innovative and creative in what we're doing. So we're looking at different ways of getting the word out there and recruiting the way that we need to be. And one of those is this CASY for Veterans which stands for Corporate America Supports You.

It's a nonprofit organization that reaches out to veterans around the world to fill positions through the veteranship. And I think last year, there were 8,000 positions filled by using this approach. So this is something newer to us that we're going to actually use and implement to make sure we have opportunities.

Social media, we're all familiar with that. We need to pound social media relative to bringing people into the program. Personal contact with former employees who might know others. Presentations at universities, I mentioned a few that we're actually going to go visit.

However, it's just not the mining departments. Our program has more need of competencies in other disciplines as well. So we need to actually go out and we're going to hit the mining programs. Don't get me wrong. But we need to actually visit other departments as well based upon the needs that we're trying to fill.

Nontraditional hiring mechanisms that we typical have not crazily been involved with in the past but we're trying to do. You're familiar with the fellowships. We continue to do that, the Presidential Management Fellowship Program, direct hiring authority now has been provided through CDC. But it's limited to certain positions. And those positions are general engineers, physical scientists, and statisticians that would actually benefit or help our needs of the program.

Student programs, Pathways summer student program, Student Worksite Experience Program. These are high school students coming in, learning new things relative to hopefully when that situation is over, we can bring -- they go to school in areas of interest for our needs.

Commission core internships, the Oak Ridge Institute for Science and Education, ORISE, is through the Department of Energy. We used to hire several people through that mechanism. I'm not sure why we kind of gone away with it. I know it's a little expensive, but we're looking into that as well.

And also contractors, you've got to figure out how the work needs to be done. The competencies need to be there. These are kind of the nontraditional ways that we're thinking of bringing in people to the program to meet those goals that people would not lose their paychecks. Right, Adam? Just a joke.

CHAIRPERSON NELSON: Let me just ask one thing. That focus on recruitment makes sense. There's all sorts of things you can do. But what are you doing about retention? Why do people leave? Do you do exit interviews? Do you really understand why people are leaving?

DR. MATETIC: Yes, we do that. We have exist interviews in the branches and then every employee that's leaving the program has a meeting with me and Adam as my deputy. Usually, it's just retirement. They're retirement eligible and they're done.

CHAIRPERSON NELSON: But the framework of saying what could we do that would make you think this is a good professional place for me to grow. And salary is part of it, but it doesn't have to be the only thing.

DR. MATETIC: Yes, and one of the limitations we have regarding salary is we are the government. So high flyers in the program that can make more money elsewhere could leave. But in my history, and it's probably eight years now in the front office of Pittsburgh, we don't see much of that where we have young engineers or what have you come into the program and leave to go somewhere else for more money.

But we do have retention activities going on. Branch chiefs are always talking with their employees as well. What is it that we're not doing? What should we be doing? Are you happy? Are you happy in what you're working in? Is there some other program area that you think you would be interested in?

We have implemented in Pittsburgh kind of a presentation circle if you will where we have people from different branches. And as Jessica mentioned, we live in 14, 15 different buildings in Pittsburgh, not one building. So we have to do things, as Jessica mentioned, to get that interaction going on because we want to make sure that -- I mean, we're 155 employees. We want to make sure that all employees know what others are doing.

So we have these presentation circles that we work to make sure that researchers are standing up, explaining what they're doing, the impact their work is having. So all other researchers can hear that as well. So we do things like that to make --

CHAIRPERSON NELSON: So when you talk about --

DR. MATETIC: -- sure people are aware.

CHAIRPERSON NELSON: -- recruiting, I mean, it would make sense to include your efforts on retention. But Marifran?

DR. MATTSON: Yes, I was just going to kind of make that same point. Because from the beginning when you were talking about the need to kind of hire people -- if we want to be high tech like other areas, other industries, we need to hire good people. But we also need to be able to retain them.

So trying to intersect with them, and it sounds like you have some efforts toward that. But intersect with them on a regular basis to make sure that you're doing all the things that you can possibly do to keep the great people is really, really important.

DR. MATETIC: Yes, that's really important. Adam?

DR. SMITH: So I'll just mention two examples of things within the program that we do, and this available across the federal government is the student loan repayment program. So we bring recent graduates in

and we're authorized to give them student loan repayment which ties them to federal service for a length of time. So we've implemented that and that's been successful.

Another thing that we have done and do is there's a long term training program where the federal government will actually pay if you go to a university, pay your full salary and have you get trained in a specialized specific area. And then they're also then committed to federal service for length of time. So those are two examples of programs used to retain employees.

DR. AUBREY MILLER: And another one that a couple of our researchers in Pittsburgh and there's one in Spokane also, the Public Health Service Commissioned Corps. And Aubrey knows about that, he's in the Commissioned Corps. But there's certain benefits that come along with that program that are different than for, like, the civil service employees. And hopefully we'll get a few more Commissioned Corps at both Pittsburgh and Spokane too.

DR. KRAMER LUXBACHER: The problem is -- and I just said to Bruce I wasn't going to say it at the meeting. But the problem is not the people in this room. It's the CDC hiring practice. I've got a student who graduated in May and still isn't on with you guys. And I don't know that there's anything NIOSH Mining can do about it. But that, to me, is the primary problem. And I say it every time and everybody nods, yes, it is. So I'll just say it again for the record.

MR. DRYSDALE: When did they start the process? That's an interesting --

DR. KRAMER LUXBACHER: In May.

MR. DRYSDALE: They started in May?

DR. KRAMER LUXBACHER: And that's pretty typical, right?

DR. MATETIC: Six months would be, like, pretty good. I can't --

DR. KRAMER LUXBACHER: So I just think that needs to always be on the record when we have this conversation.

DR. MATETIC: Right. And what we try to do is understand the barriers and limitations that we're going to deal with moving forward with a candidate and truly be open and transparent with that candidate --

DR. KRAMER LUXBACHER: And you are.

DR. MATETIC: -- so there's no, like, wait a minute. What's going on? And we've lost people that couldn't wait.

DR. KRAMER LUXBACHER: Yes, and that's what I see. When I see a really good graduate student who wants to go to NIOSH, they typically can't wait.

DR. MATETIC: That's right. They have bills to pay. They need to get a paycheck. I'm hoping with that direct hiring authority, it's supposed to bring people in faster. This is limited to those three positions. Faster meaning maybe within three months which is better than six, nine.

DR. KRAMER LUXBACHER: Much better, yes.

DR. MATETIC: So yes, we're dealing with that too. And this is an uphill battle. But I'm just to the point where we need to try everything and anything to make sure that we're sustainable, knowing in the future we're going to meet the expectations of our stakeholders, knowing relevant program areas that we continue to work in, knowing people retire and they're going to retire. And what are we doing to make sure that nothing slows down, and understanding the barriers and limitations that we have with bringing them in the door. Okay. Moving on here.

What you see here is the number of outputs PMRD produced since our last MSHRAC meeting. And the number is 119. And I mentioned to you all before we break those into science outputs and translational outputs.

Just so you know, at the last meeting, the output was 111, 50 of those were science and 61 of those were translational. And why I noted that is I wanted to make sure that every given six months or a year, how are these actually being distributed regarding science and translational. And it's good to see that the numbers are up in both, especially in the science outputs as well.

One would think if you have a tendency to focus on the translational piece, your science numbers will go down. But it's good to see that our science numbers are actually up.

The reason for the translational outputs are simply translating solutions and findings from our research to be used in industry. And we've implemented this probably two years ago, two and a half years ago maybe. And I personally can see a change in our products in an overall sense actually being used in industry. And I do believe the translational piece helped that. And we'll continue to do that and I'll give you some examples at the end of the presentation on how people are using what we're doing or what we're providing.

This breaks up the sectors as far as the output you saw previously given the different mining sectors. Really, it was -- from our last MSHRAC meeting, it was pretty similar. I think we had a 13 percent increase in stone, sand, and gravel for that six-month period as far as outputs are concerned.

I spoke about the new project starting in FY19 at the last MSHRAC meeting, but here they are. We won't go through each one of those in detail. But specific program areas that we're looking at is elongate mineral particle exposure, inexperience related to injuries in the mining world, improved float coal dust in underground mining, electromagnetic interference, electromagnetic compatibility considerations in underground mining. And we spoke about those concerns at the last MSHRAC meeting.

Mitigating fire and explosions hazards using lithium ion batteries, manual materials handling injuries in mining, and haul truck health and safety issues. So these are starting in FY19, these projects, the seven that we went in detail at a previous MSHRAC meeting.

This is what our portfolio currently looks like as far as the percentage of PMRD projects related to the different mining sectors. Just things to note here. A little increase in stone, sand, and gravel, a little decrease in metal. But this would be if you took the 23 projects in our portfolio, categorized them into the sectors they're addressing, here's what it would look like. In '19, with the seven new projects within that data set and how it looked in '18, '17.

Okay. Going into some highlights and impacts since our last MSHRAC meeting. Okay. This guidance document, I think I spoke about it last MSHRAC meeting is now available on our mining program website. This is a document that's a compilation of probably a decade or more of research in cad filtration and pressurization systems.

What we're happy to hear is Caterpillar just recently sent us a note that they're using -- in their filtration systems with their new lines, they're using the recommendations that we provided from our research. And they're using those for their filtrations and pressurization systems in their new design. So that was awesome to hear.

Also J.H. Fletcher contacted us to work with them on a filtration pressurization system for their metal, nonmetal mining equipment moving forward as well. So that was good to hear. So this is a translation piece I was talking about. If it needs to be translated and you won't have any impact if someone isn't using what you're actually doing. So this is just an example of that happening.

I think we're all familiar with FAST. If you're not, it's the field analysis of silica tool software. The beta version of the software for the coal sector is now available on our mining website for download. A press release of the software occurred in October of this year.

Since the release, the software has been downloaded 68 times according to our records. And the interest in the software was not only from the mining industry. But oil and gas and construction also have been downloading the software since its release.

The news of FAST and end-of-shift have shown up on nine news outlets since its release. And I'm told these outlets encompass over 300,000 subscribers. In addition, we've had numerous interviews with NPR, Bloomberg BNA, and most recently, AsphaltPro Magazine on the use of FAST and end-of-shift for monitoring silica exposure. So it's completed. It's out there. People are using it. It's in the news, so that's a really good thing.

We did have our webinar for Colombia in September. We had eight different NIOSH speakers present to the Colombia representatives. There were numerous mining officials from Colombia that attended the webinar and they involve a bunch of different organizations in Colombia including Colombia's national mining agency, Ministry of Mining and Energy, the National Hydrocarbon Agency in the government of Cundinamarca.

After the webinar was presented, representatives from Colombia sent us a note interested in conducting an international conference with us and them and others regarding health and safety. So that was a good outcome of the webinar as well.

CHAIRPERSON NELSON: Was there any involvement with the artisanal or informal mining in Colombia?

DR. KOGEL: I don't think so.

DR. MATETIC: I don't think so.

DR. KOGEL: This came from a request from the government. And it was one of our early conversations, how can we start incorporating the artisanal mining population into this? And those government -- RJ mentioned the government of -- what was it?

DR. MATETIC: Government of Cundinamarca.

DR. KOGEL: Cundinamarca, thank you. Those were the guys that actually go out and do interact with those miners. So this training was to really help the government officials who then interact with and have some sort of jurisdiction although limited. But ultimately, I think that's one of their interests as well. RJ, I don't know if that came up here.

CHAIRPERSON NELSON: Colombia, the policy of -- they want them to organize to become small scale mining collaboratives.

DR. KOGEL: Collaboratives, and they're starting to do that, yes.

CHAIRPERSON NELSON: But I feel a fundamental misunderstanding of exactly what's going on with artisanal mining expecting that to happen. Anyway, go ahead.

DR. MATETIC: Okay. Thank you, Priscilla. And the last thing with the webinar is it led to the creation of ten new pages of Spanish content which is now better integrated from our English piece on our website. And that's -- if you see the link on the slide, that's the link for the content and some examples on the slide in Spanish.

I'm not going to steal her thunder, but I have to mention it. Dr. Harris will be presenting her research being conducted in fires and explosions, but I wanted to make sure we all were aware. We made a second trip to Poland in collaboration with the Central Mining Institute to look at treated versus untreated rock dust and the inerting performance of that rock dust in comparison.

And we did full scale tests in collaboration with the CMI. And I know Marcia will go into more details tomorrow. But the gist of it is that the treated rock dust performs as equal or better than the untreated rock dust. And if you're --

MR. WATZMAN: Is this a good point to get an update on Lake Lynn, or do you want to hold that given the time since you had to go to Poland to do this?

DR. KOGEL: We can just do that maybe right after lunch maybe because we'll have that slot maybe still --

MR. WATZMAN: Okay.

DR. KOGEL: -- from Bob Glenn --

CHAIRPERSON NELSON: That's fine.

DR. KOGEL: -- to give you a Lake Lynn update. It's not going to take long, but we'll talk about it, yes.

DR. MATETIC: So it showed very good promise. For those that are not familiar with rock dust, standard dry rock dust, when wetted and dries -- when wetted and then dries, it coheres to a cake. And if that cake doesn't disperse, it will not inert a fine propagation.

So treated rock dust when wetted does not cake. And we wanted to make sure that if we look at treated versus untreated, obviously it doesn't cake. That's one good thing. The second thing is will it inert a flying propagation as equal to dry rock dust. And the results were that it does and sometimes even better. So that was good news from Poland.

We just recently did our in-mine testing of cryogenic cooler for refuge alternatives. The purpose or reasoning behind this research was to determine the survivability of miners if they entered and built in place refuge alternatives using this type of system in high heat and high humidity situations.

Lo and behold, the system worked very well. But there was one caveat to it. It kind of lacked in the last part of the 96-hour test. So our recommendation would be to obviously improve on or add more liquid air based upon the 96-hour requirement for survivability in a refuge alternative.

We're going to look further with this kind of approach as well with breathable air, carbon dioxide scrubbing, and also purging requirements based upon a cryogenic system. We think this has some value. I mean, there's some tweaks that need to occur. Results have shown that it did cool and it did maintain a temperature over a long period of time. And this is just another option or potential use people can use for refuge alternatives.

EXAMiner, I think I spoke about this software at the last MSHRAC as well. The good news is it's currently in review. And it will be available at the end of this calendar year as a software download from the mining program website.

If you're not familiar with EXAMiner, it gives the training, the ability to perform a virtual workplace examination but also let them create custom training scenarios. Or if they don't want to do that, they can use the NIOSH developed scenarios that are a part of the software itself.

We demonstrated the beta version to numerous groups related to coal, gold, sand and gravel, and underground stone operators. Those groups represented approximately 65 different mining companies. In addition, MSHA has major interest in this software as well.

We do know that district managers in western and southeastern districts are actually using it. We have recently heard that the superintendent of the MSHA Academy is planning on using it as a training tool for training and retraining of his instructors.

And we also demonstrated this to Assistant Secretary Zatezalo when he was up in Pittsburgh for the partnership meeting. And he wants us to work in collaboration with other districts that we make sure that they have an opportunity to use this tool as well. So I'll fill you in at the next MSHRAC on how well it's doing. But people are already using this. They like it. Other industries are using it as well. Construction, oil, and gas are actually using this tool, so that's good.

We've had a lot of internal awards through CDC, HHS. But I just wanted to highlight some of the significant external awards that people in our program received based upon the research that they're actually conducting. Several researchers received the Martin Herschorn IAC Best Paper Award at the NOISE Conference on their paper on the development of noise controls for longwall shearer drums.

Another group of researchers who developed ErgoMine -- I think you're all familiar with ErgoMine, I presented that to you at a previous meeting -- won the International Ergonomics Association Liberty Mutual Medal for the collection of ergonomic audits that were used to develop actually the app or the ErgoMine.

Dr. Emily Haas recently received the Arthur Flemming Award. If you're not familiar with what that is, this award honors outstanding federal employees within 12 categories. She won in the science clinical trials and translational research category. I went back and looked at previous winners, and one of the previous winners of this award was actually Neil Armstrong.

DR. MATTSON: They're Purdue grads.

DR. MATETIC: There you go.

DR. MATTSON: And Emily was my student.

DR. MATETIC: And last but not least. Dr. Sammarco on his elimination research was a finalist regarding the Sammies. If you're not familiar with the Sammies, it's like the Oscars of government service. He was nominated in the category for exceptional public service on record.

So we're very proud of these people. Their research is getting out there. They're having impact and we're happy to see they're receiving these high visible external awards.

The last couple slides, this is all of the stakeholder interaction and engagement that has been going on since the last six months. I'm not going to go through each one of these. Some to note, we had the briefing on the National Academy of Science report for respirable dust. I think you're all pretty familiar with that.

We are currently in the process of putting together the comments related to the recommendations from that report. We had a Black Lung Briefing with two senators regarding control technologies, resurgence of PMF, end-of-shift silica monitoring. And those are Senator Warren and Senator Brown.

We provided an update to the committee on the Hill regarding education and workforce. The reasoning behind that briefing or the information provided there was the resurgence of PMF, the end-of-shift silica monitoring tool, the FAST software. So we provided that on the Hill as a briefing to that committee.

One of the things we did most recently, I think it was in October, is we conducted a NORA Mining hearing loss webinar. And it's interesting because I'm not sure that this has been done before. And Amia might correct me and say I'm crazy and you're wrong. But in the NORA realm, there are sectors and cross sectors.

Well, we got together with the mining sector and its representatives and the hearing loss cross sector and its representatives and provided a mining hearing loss webinar related to personal protection devices, control technologies that people can use in mining to reduce or eliminate noise, fit test programs that they can use to make sure that if they're using hearing protection devices, they're actually attenuating as they need.

So there was a lot of things discussed in there, and I thought it was unique because we took the cross sector and the sector and joined them to present the webinar.

And last but not least, we did an Underground Stone Seminar occurred in October. I think I mentioned to you this last MSHRAC meeting that we had record attendance, 225 people attended the Underground Stone Seminar in Kentucky. Last year, there were over 200 attendees again this year. And several of our people provided presentations. They conducted webinars for all of the people attending the conference. So that's really going well, also.

And we conducted three partnership meetings in November as well. I know some of you attended those that are in the room, so thank you for attending. These were related to refuge alternatives, proximity

detection, and rock dust. And you'll see Assistant Secretary Zatezalo on the right. He was at the partnership meetings as well, and I mentioned that we also provided him a tour of the facilities also.

Coming up, these are just the most recent things coming up. I will present a keynote in Turkey regarding health and safety mining research. There will be a webinar on end-of-shift silica monitoring sponsored by the NSSGA in January. SME conference is coming up as you're all aware. PMRD has 29 papers and 29 presentations at SME.

AGG1 is coming up in February. We're going to provide two workshops there, one on end-of-shift silica, control technologies for silica, and also health and safety management systems approach to managers and leaders of organizations. And the unique thing related to that will be two people will do it. One, Emily Haas who I mentioned earlier, and also Oldcastle Minerals is going to tag team with Emily and present that webinar which I think is really cool.

And last but not least, we'll conduct another webinar in March on hazard recognition and risk assessment sponsored by the NSSGA. And a shout out to the NSSGA for providing us an opportunity to translate our research findings so people can use them.

CHAIRPERSON NELSON: So what kind of feedback do you get on your webinars? Do you do an assessment?

DR. MATETIC: Yes, we do. And we do that through the NIOSH OD. Once over, there's kind of a questionnaire that's sent out to the people that attended the webinar to get some feedback regarding, what'd you like, what didn't you like? If we were to do this moving forward, what would you like to see?

CHAIRPERSON NELSON: Could be interesting at some point --

DR. MATETIC: So there is feedback.

CHAIRPERSON NELSON: -- to see an analysis of that feedback at maybe the next MSHRAC meeting.

DR. GEORGE LUXBACHER: There was more on the webinar. Just we didn't have time to really statistically give you an answer to that.

CHAIRPERSON NELSON: Yes. Well, that's part of what I would like to hear about.

DR. GEORGE LUXBACHER: Right. At that webinar, we try to promote that webinar through SME, through NMA, and all these various different venues. And I think we were disappointed in the response. We thought with the webinar, with the amount of effort we put into it --

CHAIRPERSON NELSON: Yes.

DR. GEORGE LUXBACHER: -- we had very few people in attendance. The one benefit to that webinar is on NORA. It will be reporting and posted to our NORA web page so anybody can watch that webinar at any time. And my hope is that despite disappointing attendance for the webinar, it can find a use as a resource going forward.

CHAIRPERSON NELSON: Well, it might be interesting to have a discussion about that aspect of outreach.

DR. MATETIC: And I think the most important thing of partnership meetings and webinars and translational reaches is understanding the audience that you're trying to make sure receives the information and then going and recruiting that audience to make sure they attend.

And for example, the webinar that George was -- the mining hearing loss webinar. Most of the information that was presented in that webinar was all about applied research. These are things that you can use right now in industry or whatever, your work place. And they will benefit you.

But if you look at who attended the workshop or the webinar online, it was more like academics. It doesn't mean they shouldn't listen. But it's like, well, who needs to be listening to be able to then take what we're telling them and then use it in their own situation?

And I think moving forward, that would be one thing that I would recommend is what is the information we're providing, who really truly needs to hear about it, and then market and promote to make sure people actually join it.

CHAIRPERSON NELSON: Well, it's an opportunity for stakeholder input as well in terms of what kind of webinar would be appreciated by the stakeholders.

DR. GEORGE LUXBACHER: That particular webinar topic was chosen because Mark Ellis who serves on our NORA committee mining sector company. Mark had asked for an outreach with regard to hearing loss prevention. And so that's why we picked that particular topic to start. Our hope was to see how this was perceived and see if we should use that as part of the NORA sector council outreach going forward.

Based on Mark, through IMA-NA, he publicized it. It was publicized through the stone, sand, and gravel group. So we really thought we would have more people in attendance. But all the participants I think were NIOSH people who were interested in listening to it too. So it was disappointing, Priscilla. I think we --

CHAIRPERSON NELSON: Well, each time, it's an one-off. It's very hard to get it through. So I mean, there are communities in practice, for example, that devote the sequence of webinars or discussions. They could be marketed more coherently.

DR. GEORGE LUXBACHER: Right. That would be -- this was an attempt through the NORA mining sector council to deal and work with that cross sector council. It's the hearing loss cross sector council. And we'll see where this goes. We haven't given up.

CHAIRPERSON NELSON: Ron?

MR. BOWERSOX: I just wanted to comment on my partnership meeting --

DR. MATETIC: Yes.

MR. BOWERSOX: -- in Pittsburgh. Great presentation. I think we broke a record here of 78.

DR. MATETIC: We did. We broke a record. And appreciate your attendance and, yes, it went very well, all three of them.

CHAIRPERSON NELSON: That's good. Aubrey?

DR. AUBREY MILLER: Yes, I was -- you had a very busy November. And maybe you can comment a little bit about those partnership meetings and how that comes together and where you guys are going.

DR. MATETIC: Each one -- the way we conduct our partnership meetings is there's specific topics that are being addressed at each one. I mentioned proximity detection, rock dust, and refuge alternatives. We have other partnerships too, breathable air, diesel. So they're ongoing as well. But we did the three in November.

Now how did they -- we have a great collaboration with the mining community if you will. We kind of know who needs to be in the room to actually make changes or make something happen.

For example, if we're talking about control technologies, well, the manufacturers need to be there. And they need to hear what the research has found to potentially improve their technology or whatever they're selling to the mining workforce because they're all in it for the same reason for the most part, improve mineworker health and safety.

MSHA is there, trade associations, NMA, NSSGA, IMA, they're all there. The operators most importantly are there because they're the ones at the ground that need to implement these things to improve mineworker health and safety.

So, Aubrey, it's an array of different disciplines, trying to hit and target those disciplines that make the most sense regarding not only what we're talking about but what we're actually going to present there as well. So that's kind of how we do it. And it takes a huge effort to, like, make all that happen, not only to give all the presentations and demonstrations.

So yes, November was really, really, truly crazy. But as Ron mentioned, those three partnerships that was held in Pittsburgh, big time huge success. And then it's working together to solve a common problem. And I'll give you an example.

We used to have a noise partnership. The industry realized miners by the age of 55 have a hearing impairment. So what are we going to do about it? So we got the manufacturers. We got the operators. We got MSHA. We got everybody that needed to be in the room and then divvied out pieces, parts of who's going to do what.

For example, roof bolting machines while drilling, 101, 102 decibel levels. We need to figure out control technologies to reduce that noise. Well, who got together? The operator, NIOSH, the researcher, J.H. Fletcher, the person that sells most of the pieces of equipment. And we worked together to develop control technologies and then being used in other mines.

So that's kind of how we approached the partnerships of like we're all working on the same common goal. We need to, and we have different agendas obviously. But it's the same common goal. And let's try to work together to improve mineworker health and safety by all helping operators. Operators, we need a site to test treated rock dust. We'll do it. You know?

DR. AUBREY MILLER: It's really a community practice type approach that Jessica was talking about before getting that collective community practice that goes beyond NIOSH, obviously a larger community in having this kind of ongoing discussion which I think is really great.

DR. MATETIC: Yes, and sometimes I think we lose sight from the hierarchy of here to here, this piece. And I understand they're working. They can't take a lot of time. I get all of that. But we're working on figuring out even more improved ways of getting to this level, and that's the operators themselves.

We used to -- when we were the Bureau of Mines, do open industry briefings. Remember them, Bruce? We travel all around the country and have like regional workshops on mineworker health and safety. And operators would come and attend those. And they can just, from there, take it and use it at their site.

So we're looking at thinking of reinvigorating something like that as well to, like, make sure that we're translating the research and the findings to the people that are actually going to use it. But the partnership is a prime example of that.

CHAIRPERSON NELSON: Any other comments or questions for RJ? Okay. Thank you very much, RJ.

DR. MATETIC: Thank you all. Thank you all.

CHAIRPERSON NELSON: We're going to take a break now and we'll come back to Todd. You okay with that?

MR. RUFF: Yes, that's fine.

CHAIRPERSON NELSON: All right. We are broken. We will reconvene.

(Whereupon, the above-entitled matter went off the record at 10:10 a.m. and resumed at 10:30 a.m.)

Mining Research Program Status Updates:

SMRD Update - Mr. Todd Ruff

MR. RUFF: I'll just go right into it. Can anybody on Zoom respond if you can hear us? Okay, thank you. We're ready to start again. And I'm Todd Ruff, Division Director for Spokane Mining Research Division.

CHAIRPERSON NELSON: You do have to speak up because --

MR. RUFF: Okay. I'll project.

CHAIRPERSON NELSON: -- I think I've been in too many blasts. Sorry.

MR. RUFF: All right. So thanks for the opportunity to give you a quick update on what's going on in Spokane. Just a couple of slides on how we're organized in Spokane. Just basically some information on our program areas that we work and plus some details on staffing.

We have four major program areas that we work on in Spokane. Historically, these first two, the Underground Metal Mining Ground Control and the Mining-Induced Seismicity and Mining Stability program areas have been our strongest and our most developed areas of research. And those deal with both the underground metal and underground coal and some surface mining areas mainly around mining stability and local ground support techniques.

Two new areas are emerging technologies and automation, and miner health and chronic disease. And both of those areas are growing, staffing up, and building our research portfolio in those two areas.

This is how we're organized. We're small enough that I have the advantage of actually putting an organizational slide with pictures. We're organized by four teams, and those four teams address those program areas I just showed you. So we have a Mining-Induced Seismicity and Stability Team, Automation and Technology Team, Metal Ground Control, and Health Exposure Assessment and Monitoring Team.

So roughly about 41 employees today. That fluctuates it seems week by week. But they're split between the teams as shown here with a group in my office and then we have four student interns and two distinguished consultants that work part time but also contribute to the research.

So RJ mentioned some concerns about attrition. We have the same deal, 20 percent of our employees are eligible to retire either right now or in the next year.

Over the next fiscal year, we have plans to hire 11 more technical employees. It's a bit optimistic. Some of the issues that we've already talked about, about CDC hiring freeze and their oversight of approving our hiring plans. But that's what we would like to do. That's going to build up automation and technology. That will take care of some of the retirements that we'll have in our ground control team and then also building up the health program.

We have made some progress since the last time since the last MSHRAC meeting. We brought on three support people, secretaries, and one public health advisor. So we're making some headway.

One thing that kind of keeps me up at night, though, is that you can kind of tell from the pictures, maybe, maybe not. We have a large number of employees that I would consider early career, so zero to five years. And then we have a lot of employees that are the older employees of 25-plus years. We don't have much in between.

And so the succession planning is a challenge. We're trying to address that in the hiring plan for this year by targeting some of the more seasoned professionals, trying to get -- asking for those higher grades when we do our announcements. And also one thing that we do, we do cooperate with the other NIOSH divisions, especially PMRD.

When an announcement goes out for a new position in another division, we try to piggyback on that so that we streamline that effort. We're not putting out multiple announcements. We're riding on the other announcements that go out nationwide.

All right. So I'd like to highlight some other activities and the impacts, both on the division and the team level. For outputs which includes publications and other training materials and such, we had 47 total outputs for the last fiscal year.

Much of our work applies to all types of mining, all commodities. So that accounts for the output focus labeled as All Mining, a large focus in metal mining, of course, in our ground control efforts. That's mainly focused on underground metal. And then we also have efforts in underground coal.

We're split up pretty evenly between translational and science outputs. RJ described the difference between those and you really see an emphasis on the translational is towards training materials right now and towards getting our research introduced to mining school curricula. So that's kind of where we focused this last year.

And then as far as science outputs, really we use the science outputs as the basis for our feedback and the validity that we received back from the science and the engineering communities through conference proceedings and journal articles.

So over the next year in '19, we're trying to make that transition to more translational outputs looking at new opportunities and training materials and some webinar efforts that we'll be increasing to try to get the word out to the mining community.

So we had two new initiatives that were led out of SMRD, but they apply to the mining program in general. Miner health program, that was kicked off last March with this workshop that the national academies led. So really the goal of that was to communicate the intent of the miner health program to our stakeholders and get their feedback. And that workshop went very well, and we've got buy-in from our stakeholders. And we continue to work and develop that. Dr. Jerry Poplin is here. He's going to talk more about that today.

And then emerging technologies in automation in metal mining, familiar with the efforts in that area, MSHRAC from the work group to look at this and also kicked off with a workshop in Denver this September. And that was well attended and continues to inform our research. We're looking forward to the report that the work group will be submitting to the committee here this year.

So to highlight some of the things that are happening on the team level, and I don't cover everything here. Just I'm going to touch on some of the highlights on some of the highlights for activities and impacts.

The metal ground control team, there's this move. Jessica had mentioned this move towards going after deposits that might not have been economically viable in the past. But that means going deeper. It means surface mines are now going to underground operations.

One of the questions that we're getting from our mines that are moving underground or have been mining in weak rock mass in Nevada is this question about how to best support that weak rock mass that has challenges for coming down even after support is up.

So there's questions around installation sequence. And so we use rock bolts, shotcrete, mesh, and what order do you install those and what's most effective for those rock conditions?

So we did a series of tests on our test machine in Spokane called the high energy, high displacement test machine where we can build -- you see on the upper right there. We can simulate the installation of those components and then put them under stress and find out exactly how much they can deform without failing. And those recommendations have been published and presented, and Turquoise Ridge has implemented those recommendations.

We also have efforts -- we talked about the translation efforts. It's really important to get tools into the hands of the miners so that they can have an easier time using some of the recommendations that come out, say, like, in a peer reviewed article aren't necessarily in the best format for using them in the field.

So the software design tool, the efforts to develop those are high importance to us. And we have a beta version of a tool being tested at two mines right now that looks at rock bolt length and spacing depending on the dimensions of the opening.

An important example of the partnerships we form, there's this question around support components and their integrity in highly corrosive environments. We have bolts and mesh really having in some lines the integrity of those is really in question when they're subject to these corrosion effects. And we have a partnership with the National Association of Corrosion Engineers. They're helping inform our research. We hosted their regional meeting in Spokane last summer.

Again, for outreach, large efforts in bringing industry folks together around the seismic data collection and analysis. We had a workshop in Nevada. And also as you saw in the previous slide, we target the universities as far as providing guest lecturers, getting into the curricula of them. And examples are at Utah and Montana Tech.

For mining-induced seismicity and stability team, this group is working both with western underground coal mines and with some surface operations. Some of the work to highlight here is we've been invited to coauthor a two-volume book on blasting techniques and smooth wall design.

This was Steve Iverson's work and based on the DRIFT software that is this software that helps with the optimization of blast hole layout to prevent overbreakage which has productivity and safety implications.

We completed the installation of a permanent seismic monitoring network, one of our partner mines in underground coal. And they're using the feedback from that seismic system to monitor seismic activity during mining and make changes to their mine layout and the progression of their mining based on the amount of seismic activity that they're getting back from that.

One of the challenges that we've had historically in working with western underground coal is while we have really good access to the surface for seismic monitoring, putting in seismic stations, some seismic monitoring, we've had challenges in getting underground in some of these mines. And that's due to a number of reasons.

There's some data confidentiality concerns that the mines have. There's some manpower issues with helping and committing people to help us get the instrumentation installed underground.

But one thing I want to highlight is that we talked about the importance of collaboration. And SMRD and PMRD got together. They did a mine tour really of western underground coal and presented to a number of mines a joint research effort. And that really helped the mines understand how the work in Spokane history is tied together and opened some doors as far as getting into the underground

instrumentation. And so this is a really important step forward and will move this team's work forward for this next year.

CHAIRPERSON NELSON: What are the blue triangles?

MR. RUFF: Those are seismic monitoring stations at the surface.

CHAIRPERSON NELSON: At the surface?

MR. RUFF: Yes.

CHAIRPERSON NELSON: So this is a plan view?

MR. RUFF: Yes. Seismic events are represented by those circles, magnitude and timing.

For the automation and technology team, last MSHRAC meeting, we had Dr. David Parks here and he presented some work on the conveyor maintenance safety system. That was in a prototype stage at that point, and we've made some advances and some enhancements to that system. It's also moving into a full proposal and be a full project this year.

So that system, he's expanded the number of points that are being monitored on the conveyor as far as are guards in place, lock out-tag out, is that procedure being followed. They also have introduced electronic maintenance forms to track maintenance activities.

Dr. Art Miller is here today. Today he's going to be talking more about the efforts towards improved diesel particulate matter monitoring. Sorry, hard to say. And so I'll let him expand more on that. Some advances in technology have allowed a possibility for real time and, in the future, portable diesel monitoring.

And I already mentioned the workshop on emerging technologies, and that work will be informing our future research. And we're also going to be putting out a request for information published in the Federal Register hopefully this calendar year still. And that is really to reach out to those stakeholders that weren't able to attend that workshop to get more input as far as this health and safety concern around automation in mining.

CHAIRPERSON NELSON: Do you have any document produced from that workshop?

DR. KRAMER LUXBACHER: Yes, Todd. I owe you a document and I planned to get it out last week. And I hope to get it out before I leave Tucson.

MR. RUFF: Yes, so Kray can give an update on it.

DR. KRAMER LUXBACHER: Not Todd's fault at all.

(Simultaneous speaking.)

MR. RUFF: Okay. So for the miner health team, we have Jerry is going to give an update on what's going on with the miner health program. So I'll let him take that. But we were able to find some short-term priorities for the miner health program, research projects that were targeting some hot topics. That's around heat stress, fatigue management, and also alternative data sources for miner health data.

One of the advances that has been made that I'd like to highlight is this idea of the wearable sensor technology. One of the challenges that Jerry's team had identified early on in the heat stress study is how do you get biometric data off a person and also the associated cognitive reaction tests that were a part of that study. How do you administer those without being intrusive to the miner and their job? And that was really a challenge for understanding heat stress in mining, especially in an underground setting.

So we developed an app on a phone that collects biometric data wirelessly and also prompts the test subject to enter in data. How are they doing? And then take -- there's a cognitive reaction test that they can perform right on that phone. So this is a huge improvement over what we were doing before, and it'll be useful as we move into a bigger field study.

We also had a pilot project on looking at the possible effects of vibration and its translation through the body, through the arm in particular to the hearing canal, to see if there was an additive effects from vibration to hearing loss. And so really a first step in that pilot study was just to determine if we could measure it, if we could measure the vibration translation through the arm to the hearing canal.

So we have some initial data collected. We're analyzing that now. That will inform future research if any is needed. And we can provide an update probably at the next MSHRAC if the committee is interested.

Just wanted to highlight some awards that we have received from our peers. We had three best papers, two from ARMA, American Rock Mechanics Association, and one from the International Conference of Ground Control Mining. And we had a science communication award presented to us for our work in heat stress, some of the fact sheets and the posters that we created.

And just to highlight, I know I covered last time the new projects that are starting in FY19. So I won't go into a lot of detail, but I will just remind you of where we're going in this next year.

There's this project to start looking at new technology for collecting ground control and seismic data and global stability data for underground mines and analyze that data and present it in new ways. So there's new technology available. We need to be moving forward in this area, especially as mines look more towards automation.

We have, as I mentioned, a conveyor safety project that's going to be moving into a full project this year, looking to expand the work that we're doing with the maintenance safety system. And we also have a pilot project. So we've identified conveyors.

And as I already mentioned, haul trucks is standing out in machine safety areas as high priority issues. But we also want to look at some of the other general scale as far as machine related injuries in other types of mines, especially stone, sand, and gravel.

Now, a new project as I mentioned that is building on or looking at alternative sources for miner health data, mainly looking at, like, worker compensation claims, some of the state based mining clinics, trying to build our baseline data for the miner health program to make decisions on future research.

And then the last one here is looking at mining applications for interventions for fatigue. So looking at other industries, what they're doing in fatigue, especially around equipment operation. Some of the other industries such as transportation and manufacturing, we've made some advances in this, studying how these can be applied to mining.

That's it. Any questions?

CHAIRPERSON NELSON: Thank you. Any questions or comments from the committee? I could bring up one thing. Just regarding the comments on the corrosion, there was an overture that came to the National Academy Committee --

MR. RUFF: Yes.

CHAIRPERSON NELSON: -- from the Federal Highway Administration that was having concerns about corrosion. And they were very interested in perhaps initiating something related to corrosion in earth systems.

MR. RUFF: Right.

CHAIRPERSON NELSON: Have you connected on that or --

MR. RUFF: We have. So we attended --

CHAIRPERSON NELSON: -- tell us anything more?

MR. RUFF: We haven't made any progress towards formalizing that relationship, but we did attend so we know what the direction they're going. We have researchers that'll stay in that loop. So maybe we can give you an update next time.

CHAIRPERSON NELSON: Yes, that might be interesting just to know what the differences and similarities of the problems are --

MR. RUFF: Right.

CHAIRPERSON NELSON: -- across industries --

MR. RUFF: Sure.

CHAIRPERSON NELSON: -- could be interesting.

MR. RUFF: Okay. Thanks for your time.

CHAIRPERSON NELSON: Okay. Thank you very much. George, do you want to tell people to mute themselves.

(Pause.)

MR. WELSH: I just wanted to mention one thing too. Jennica will have a virtual reality demo in the front over near the door that they'll be showing throughout the day, whether it's lunchtime or at breaks or after the session. So that's available to take a look at. It's pretty cool.

Mining Research Program Status Updates

MINER Act Contracts and Grants Program - Dr. George Luxbacher

DR. GEORGE LUXBACHER: Okay. Thank you. I'm going to talk for just a few minutes here.

CHAIRPERSON NELSON: More loudly, please.

DR. GEORGE LUXBACHER: Okay. I'll hopefully bring us back on schedule a little here. I just want to talk --

CHAIRPERSON NELSON: We got plenty of time.

DR. GEORGE LUXBACHER: Plenty of time. Okay, Priscilla.

(Laughter.)

MR. WATZMAN: Make up your mind, Priscilla. We're either running behind or have plenty of time. Which is it?

CHAIRPERSON NELSON: We have plenty of time.

DR. GEORGE LUXBACHER: I'm going to talk about our extramural contracts and grants program. It's always intriguing to pick a slide or pick some illustrations to put on the opening slide for this. And knowing that Marcia is going to talk is going to talk later on today about coal dust explosions, I decided to put up a piece of -- a couple figures from a final report from the University of Maryland.

We had a contract with the University of Maryland that actually continued some work that we had done through -- it started at Penn State at the Penn State Naval Research Laboratory facility there, then moved on to the Naval Research program, and then to the University of Maryland on coal dust explosions.

So I just threw this one up here. This is some computational work related to mixed granular gas reactive fluid dynamics. And I just wanted to point out this particular model that was developed by the University of Maryland looks at how the coal dust explosions initiated, how it propagates, the impact of rock dust, and how rock dust is lifted up into the air.

But just to run one model on the particular computer on here takes 30 computer hours which actually relates to 60,000 processor hours just to do a two dimensional problem. It's really interesting to see what it takes to do these.

So we've made significant advances through this contract, and hopefully Marcia is going to at least mention that in her -- although I haven't looked at her slides. But that's just one example of an extramural contract. Okay. Let's see here.

In terms of grants, we're going to talk just briefly about grants. Our grants are administered out of the Office of Extramural Programs or OEP. And we only have a few extramural grants right now. The bulk of those are the two U60 grants that we have with the University of Arizona and Colorado School of Mines. We also have two investigator initiated grants that are completed and they're on a no cost extension for reporting purposes.

So really, the only grants we have currently that are complete mining related grants are the two U60 grants. The only thing that I'll mention about that is we're going to have an annual meeting. Let's see. I think we're in our ninth contract year for these. And the contracts call for an annual meeting. And I believe this will be our first annual meeting that we've had in that nine year term.

But we have an annual meeting scheduled for next week and following this MSHRAC meeting and then the SME Arizona conference. And Jeff's actually hosting it here on campus.

DR. BURGESS: And I just wanted to mention we got the new RO-1 on alternative fuels that was awarded, George, too.

DR. GEORGE LUXBACHER: Okay. I wasn't aware of that. So that's a new one. So we are picking up a couple slowly.

DR. BURGESS: New ones, yes.

DR. GEORGE LUXBACHER: New ones.

DR. BURGESS: Just in this last cycle.

DR. GEORGE LUXBACHER: Yes, and I constantly get -- we're constantly contacted by universities asking about whether they have a submittal that should come under a grant or should be submitted in response to our BAA. Typically, we'll point them to both sources to maximize their chance of funding.

So we will be having our U60 meeting here on campus next week. And the hope here is to get a little bit more program involvement with NIOSH between NIOSH and the universities.

In terms of contracts, we do the bulk of our contracts through either an RFP or a BAA, broad agency announcements are by far the prevalent technique we use. Everything is announced on FedBizOpps.gov. That was our 2018 solicitation for broad agency announcement.

Our current portfolio of contracts, we have 18 BAA technology contracts. Eleven of those are continuing contracts. We typically award contracts for 12 to 48 month range. The maximum for any contract is five years. At the end of five years, we have to terminate the contract. And we do have at least one contract bumping up against that five year limit.

But we have eleven continuing contracts. We issued seven new contracts in fiscal year 2018. I'll talk about those in a minute. We have one continuing RFP contract and we have 12 BAA capacity build contracts that if you remember my past presentations, those are contracts with the universities with the idea that we're going to develop faculty and graduate students in certain areas.

So we have 31 contracts total that we're currently managing. And we closed out 9 technology contracts in 2018. And I'll talk about what we anticipate happening in 2019 in a few minutes. But we'll be doing another technology solicitation in 2019. We'll probably do another capacity build solicitation. I'm going to talk about that. And then we'll have some contract completions. So we have 11 technology BAA scheduled for completion this year and 7 capacity builds.

To show you what happened in response to our last solicitation, I had talked about that solicitation briefly at the last MSHRAC meeting that we hadn't issued any contracts yet. This will give you an idea of what we actually did.

These were the topic areas that we chose, personal gas monitor to assist breathable air, SCSR communications, the extension, the reduced size CPDM and its extension to silica, UAVs underground, and the helmet cam technology. That shows you how many concept papers were received, the full proposals that we requested based on those, and the number of contracts that we funded.

Other, we always encourage submittals from other parties that are interested in other technologies other than what we show as the focus areas. We had 18 submittals and we funded one of those. But we did request six proposals.

Now, when we request full proposals, these full proposals are all evaluated without regard to the focus area. So in other words, if we solicit a full proposal, we evaluate those based on the strength of the proposal. And it just so happened that we funded primarily within our focus areas this time around.

MR. WATZMAN: Hey, George. Can I ask about the reduced size CPDM work?

DR. GEORGE LUXBACHER: Yes.

MR. WATZMAN: I see that you funded Thermo who is the current manufacturer of the CPDM --

DR. GEORGE LUXBACHER: Correct.

MR. WATZMAN: -- for 2018.

DR. GEORGE LUXBACHER: Yes.

MR. WATZMAN: But you got three proposals. One, of course, was Thermo. Can you share anything about the other two proposals without divulging anything that is --

DR. GEORGE LUXBACHER: We funded all three proposals --

MR. WATZMAN: Oh, you did?

DR. GEORGE LUXBACHER: -- Bruce. If you look here --

MR. WATZMAN: Oh, yes.

DR. GEORGE LUXBACHER: -- we've got six concept papers that --

MR. WATZMAN: Okay.

DR. GEORGE LUXBACHER: -- that turn into three proposals, and I'll talk about those briefly. I can tell you that of the six concept papers that we got, three of those we did not ask for full proposals from. One of those requested 1.5 million dollars from us. Our maximum clearly stated in our solicitation is 650,000 dollars, and they submitted a request for 1.5 million. So we didn't even evaluate that.

The other two submittals were technologies that we felt we didn't feel had the capability to move forward, at least in the stage of the proposal that was submitted to us. And I believe both of those were from universities. The 1.5 million dollars was from a company.

CHAIRPERSON NELSON: So you said we evaluated. So my question is who's we?

DR. GEORGE LUXBACHER: We --

CHAIRPERSON NELSON: And the second is --

DR. GEORGE LUXBACHER: Okay.

CHAIRPERSON NELSON: -- is this number up or is it down from previous years?

DR. GEORGE LUXBACHER: This number? Okay. First of all, the we that I refer to, we is subject matter experts within NIOSH to evaluate the --

CHAIRPERSON NELSON: So it's an internal --

DR. GEORGE LUXBACHER: -- proposals that are submitted.

CHAIRPERSON NELSON: -- evaluation?

DR. GEORGE LUXBACHER: It's an internal evaluation. We have in the past, if we get a submittal that we feel we don't have the expertise internally to evaluate, we will retain external reviewers as well. In the last two years, we haven't had any proposals that we felt that we didn't have sufficient expertise internally to evaluate.

In terms of numbers, you can see here that we got 44. Our average is 48. We were down a little bit. But in the ten years we've been doing this, we went all the way from 35 all the way up to 68. So with that, the 44 is reasonable.

CHAIRPERSON NELSON: Do you wish you had more?

DR. GEORGE LUXBACHER: We always wish we had more. What we'll do here -- and I was going to talk about that in a minute. But what we attempt to do as soon as we put out these solicitations, we attempt to let most of the university know, we reach out to the university community. We'll reach out to companies that we feel might be interested in our focus areas. We obviously can't reach out to people that are outside the focus areas because we don't know who's out there that may be interested in submitting something.

But we do attempt to publicize this. As soon as we get the solicitation out, it will be on the NIOSH web page under funding opportunities. We get solicitations -- I just received an unsolicited proposal the other day which I didn't open. I returned to that party and suggested that they consider submitting it under the BAA because I didn't want to prejudice my ability to evaluate that proposal.

CHAIRPERSON NELSON: Ron?

MR. BOWERSOX: Maybe hard to say, but are we getting close to reduced size? That is a big issue.

DR. GEORGE LUXBACHER: Yes, I'll talk about that in a minute. As a matter of fact, I believe that's the next slide. So here's the contracts we awarded under 2018. One of those contracts went to Thermo Fisher. So the whole goal of that contract is to develop the next generation CPDM using the existing technology, the existing TEOM technology and trying to reduce that.

I know you're aware, Ron, but the form factor for the current unit was based on the fact that it also had a battery to power the cap lamp. And so when it became the mandate of technology for regulatory purposes, they kept the same form factor. Well, things can be done immediately to reduce the size of this. But there's noise issues. There's weight issues. And all those things are to be addressed under this proposal. So we are funding that.

We also are working with Thermo. Again, Thermo gave us a proposal we felt had great possibility with regard to a silica monitor. They were going to take a technique that NIOSH has pioneered and try to downsize that using an existing unit. So we funded Thermo for that purpose too. So we gave Thermo two contracts out of this.

We also funded BioMarine who had another concept that I think is probably a little bit further out but may have some potential as well for a reduced size CPDM. Now, this would be a competitor to Thermo. They're a long way out.

And you're probably aware because I talked about this several meetings ago. But we're also funding University of Illinois, Chicago. And we had taken a contract to come up with a miniaturized CPDM, a micro machine. And we had extended that contract to include silica. And now we're talking about giving them another extension possibly to take silica out, focus on the miniaturized unit, and then add silica in after they've completed the miniaturized unit. So we're looking at ways to address some of the issues out there.

We also gave GE a contract for a personal gas monitor following some technology we've done with them on some other contracts. And then we have two UAV contracts that we did. And then we have another contract on pressure relief valves for refuse alternatives. So those are the contracts that we awarded in 2018.

CHAIRPERSON NELSON: So this was -- I mean, I know that there's only one university funded out of this.

DR. GEORGE LUXBACHER: Yes.

CHAIRPERSON NELSON: What would you comment on university response to the BAA?

DR. GEORGE LUXBACHER: University response to the BAA is always high. I think last time I had some statistics on that. If you'd like, I'll bring those statistics back next meeting. The issue with the universities is typically we're looking for technologies that are a little bit further along. A lot of the university submittals are more basic in nature.

We had at least one university proposal was rejected because it was over the 650,000 dollar amount which is clearly stated in the BAA. We don't have a mechanism to go back and give feedback. For example, out of the -- okay, we got 48 submittals and concept papers. And so ten of those people will

request a debrief as to why we didn't choose to ask for a full proposal or why we didn't ask to go from a full proposal to funding.

We have to do that under the auspices of CDC. We're not allowed to communicate directly with those submitters. And it's been very difficult to get the CDC contracts people to set up meetings, conference calls where we can discuss that. And it has nothing to do with our program. I'd love to talk to each one of these people individually. I'm just precluded from doing that.

DR. BURGESS: So George, just along those lines, when FEMA does this because I think they have similar issues, they have a contractor that talks with people for them. So I don't know if that'll work for NIOSH. But again, it works -- that's the way that FEMA runs it.

DR. GEORGE LUXBACHER: That's an interesting concept, Jeff. Knowing what I know about what I've been told by our contract people --

DR. BURGESS: Yes.

DR. GEORGE LUXBACHER: Our contract people would still have to administer that process.

DR. BURGESS: Okay.

DR. GEORGE LUXBACHER: And that would limit our ability. We're still trying to have debriefs on the 2017 BAA round through our contract people, much less the 2018 ones. Okay. So those are the 2018 contracts.

I want to point out that our 2019 BAA solicitation, the pre-solicitation was posted on November 14th. So this is not in your packet. At the time we prepared your packet, the pre-solicitation wasn't out yet. And we were precluded from publicizing this. But these are the topic areas that we're going to use.

We're continuing for a non-regulatory personal measurement of coal dust or silica with the idea if we can give an individual a frame of reference as to the dust, it doesn't necessarily have to meet regulatory compliance. So we've included that as the first.

The next is a next generation underground communication systems. We really feel with a lot of the things on 5G and things like that, that are being done in metal mining right now, there's a path forward in coal and we'd like to investigate that.

We continue to helmet cam, but we limited it to video recording -- intrinsically safe video recording. We had a very large section in this BAA directed toward the National Academy report. The National Academy report includes a number of recommendations, and we've included that in the BAA to solicit input from outside parties to deal with that. We have strata horizon monitoring for mining, continuous miners, longwalls. And then we have the assessment of underground multi-cell battery power systems.

One of the things we did is we beefed up the wording to encourage -- I think this is what you've been asking about, Priscilla. We've beefed up the wording to note that we strongly encourage people to submit other topics outside this focus area, and they'll receive equal consideration. So that was a deliberate.

So I anticipate we'll have the full solicitation publicized on 12-15. I think that the due date will slip. I think it'll probably be later on in that month. So we are going forward into our 2019 solicitation.

CHAIRPERSON NELSON: I'm sorry. I couldn't hear. You think by the end of January you're going to slip it?

DR. GEORGE LUXBACHER: I said I think it'll slip to the end of January because we were late in posting. Not us. We had all this in, in time. But the CDC contracts people were a little bit late in posting. I can make that slide -- well, you can go out to the solicitation website on FedBizOpps and see all that.

I want to switch over to capacity build. We have a capacity build contract. The 2014 ventilation capacity build contracts will end. The five-year term on those will end at the end of this fiscal year. So we'll be going out for another capacity build round. I want to talk about that in a minute. But I just wanted to show the impact that we've had through this capacity build program.

We've issued 27 contracts. We've involved 62 different investigators, co-PIs, or other faculty. We funded 70 complete master's level students, 47 doctoral students. And you can see, at the end of the day, we've impacted 100 people once we get some of these others finished up, 100 master's and 75 doctoral degrees in ventilation and ground control. So there's no doubt that this program has accomplished what we set out to do with which is raise the expertise in both ventilation and ground control across the industry.

I threw these in. I'm not going to go through these. I just wanted to show you the different types of focus research that we're funding at the different universities. So this is for the current ones that are ongoing. So that's the ventilation and this is the ground control. So this gives you an idea that this covers the realm from coal as well as metal-nonmetal.

There are 14 currently accredited mining engineering programs in the United States, soon to go down to 13. And this just shows the funding that we've given to those universities. Each X represents one contract. So several of these universities have two contracts for one round. But this will give you an idea.

We haven't been funding Montana Tech because Montana Tech only has a master's program in mining engineering. The criteria for the capacity builds requires the ability to have a PhD program. Theirs is a multi-disciplinary PhD. New Mexico Tech, I have question marks. I'm not sure that they have a master's level program or a PhD program.

CHAIRPERSON NELSON: And mineral.

DR. GEORGE LUXBACHER: Mineral. And then SIU is down here. SIU is in the --

CHAIRPERSON NELSON: They're gone.

DR. GEORGE LUXBACHER: They're not gone yet. They still exist on paper, but they're on their way out the door.

CHAIRPERSON NELSON: They're gone.

DR. GEORGE LUXBACHER: So that just shows how we have touched the majority of mining engineering programs in the United States.

I showed this slide last time. I added one more line to this. I just wanted to show that even those individuals that we've hired through NIOSH have moved on. And the two individuals we've lost have moved on to faculty at University of Alaska, Fairbanks and West Virginia University. So it does show that we continue to hire from the capacity build program. We'd love to get more.

I wanted to show that there are several different sources for university mining program support. We have done this through these capacity builds. SME is the Society for Mining, Metallurgy and Exploration also has what they call their faculty pipeline. And they support students through PhD fellowship grants and career development grants.

You also have the Alpha Foundation out here. While Alpha does not specifically target faculty and faculty development and things like that, they are a significant contributor to all this. The one I don't have up here that I probably should've added was also the Brookwood Sego grants that MSHA gives as well because a number of those go to universities and to support those university efforts as well. So probably another one I should've included.

Now, we're looking at what we're going to do for the 2019 BAA capacity build solicitations. So during this year, we will have a solicitation probably in January for the next round of the BAAs. Typically, this would be a BAA solicitation in mine ventilation. We have decided that we're going to deviate from doing that.

This is all draft. It says, under consideration, because we have not firmed up our plans on this. We will not firm up our plans until you see the pre-solicitation posted on FedBizOpps. But we're giving consideration to doing this on mine design research with the idea that mine design encompassing both mine ventilation and mine ground control.

So we're going to broaden the topic. Our focus is still going to continue on producing MS and PhD graduates from accredited mining engineering programs. But we're going to encourage collaboration. We're thinking back to the U.S. Bureau of Mine Minerals Resources Institutes where we have multiple universities together, working together. And we're trying to decide how we can set this up.

Since each one of these awards is an individual award to a university, how we can tailor this to perhaps university groups that wish to work together. And we're still giving some thought to how we're going to do this. That's why I say draft under consideration. We may just decide to come back and do the mine ventilation capacity build. We may decide to skip a year. Those are all different things we can do here. But we haven't firmed this up. But this is what we're thinking right now. So I threw this up in case there's any comments that the group may want to give.

CHAIRPERSON NELSON: You received comments previously from this group about broadening the topic. So I applaud your consideration of broadening the topic.

DR. KRAMER LUXBACHER: I think that's better. A more competitive proposal that way.

DR. GEORGE LUXBACHER: Well, and part of the thought here is how do we do this so that we get multiple university -- we'd obviously have to contract with each university individually. How do we encourage two or three universities to submit together for this?

Because we really believe when you look at the east-west divide with SIU going down, there's a benefit to eastern universities and western universities collaborating on these topics and actually having graduate students that may spend a little bit of time at each campus. And if we can encourage that collaboration.

If we could encourage collaboration between departments outside of mining. For example, here at Arizona, the mining department has collaborated with Jeff's department, and we've actually hired one of those students who came to our capacity build program in that way. If we could get more of that, there's a benefit to us and the university. So we're trying to figure out how we do that contractually through NIOSH.

CHAIRPERSON NELSON: Yes, so I thought Rick has some input ideas about how that might get set up. But I also think it'd be really good if you come to the department head meeting at SME and perhaps explain to the department heads the intentions of whatever comes out and what your hopes are.

DR. GEORGE LUXBACHER: That's a good point, Priscilla, because I hope to have this posted in January if I follow the traditional base that we've used on this. So this will be posted. That's a good point, as to go to that department meeting and explain what we're trying to get to.

CHAIRPERSON NELSON: Yes.

DR. GEORGE LUXBACHER: Great.

DR. KRAMER LUXBACHER: Well, I'm conflicted. I currently have one of these and probably would apply. But to me, it seems that it would be fairly easy to do what a lot of federal agencies do and just, we

encourage collaboration. Somebody has got to be the boss. Let one university lead and sub to the other.

DR. GEORGE LUXBACHER: Right. And actually, I have that sketched out on paper with the thought of asking for that.

DR. KRAMER LUXBACHER: Then the burden is on the university --

DR. GEORGE LUXBACHER: Right.

DR. KRAMER LUXBACHER: -- and not really on NIOSH.

DR. GEORGE LUXBACHER: To come together with the understanding that we'll probably contract with each university individually.

DR. KRAMER LUXBACHER: Oh, you wouldn't subcontract?

DR. GEORGE LUXBACHER: We probably wouldn't. That's subject to some discussion as well. But I think I would -- we're still giving thought as to how we do this and how we structure this.

CHAIRPERSON NELSON: So whether you require collaboration at the time of submission, the danger there is that you end up having some excellent proposals that are personal proposals because of the way they're packaged.

DR. GEORGE LUXBACHER: Right.

CHAIRPERSON NELSON: So if you could imagine because you're setting the topic up for mine system design that involves this, you might think about forging the marriages after as a consequence of how you put the project -- well, I've seen it work.

DR. KRAMER LUXBACHER: I just sent --

CHAIRPERSON NELSON: I've seen it work.

DR. KRAMER LUXBACHER: I mean, I think successful collaborations are about the people that collaborate.

CHAIRPERSON NELSON: Yes, some. I mean, it's not required. You can do this.

DR. GEORGE LUXBACHER: Under the government contracting mechanism, when you submit a contract and you've outlined your deliverables, you're held to that. We don't have the -- I'm used to working in private industry. We give you a contract and we change that contract 50 times during the time of the contract. That is not how contracting in the federal government works.

And so really the idea of having one university take the lead and subbing to the other or a joint proposal from all university with one lead may be the way to go on this. That's something I'll investigate.

DR. FRAGASZY: So NSF does it both ways, either two collaborative proposals funded as two awards or a subaward.

DR. GEORGE LUXBACHER: Right.

DR. FRAGASZY: And my experience personally is it's really better to have a subaward because then one university is in charge has some control over what the other university does. And it really makes it easier to enforce. You actually have to collaborate.

DR. GEORGE LUXBACHER: And that was how the original mineral institutes were set up. Jessica sent me a presentation for NSF from -- that's something she recently attended. I only wish we had the kind of money that NSF has because we could do a whole lot with a little bit more funding.

DR. AUBREY MILLER: Has NIOSH ever cofunded with NSF?

DR. GEORGE LUXBACHER: No, we haven't investigated that. That is an interesting thought, though.

DR. AUBREY MILLER: Yes, we've done some stuff with them too on certain projects, and it's been cool.

CHAIRPERSON NELSON: Really --

DR. GEORGE LUXBACHER: Interesting idea.

CHAIRPERSON NELSON: -- it's very effective to do the joint funding. It's a leverage case.

DR. AUBREY MILLER: It's nice.

DR. GEORGE LUXBACHER: Okay. With that, this is my final slide. I just want to point out our focus in 2019 is really going to be on our next BAA solicitation and our next capacity build solicitation. You noticed my asterisk. I have to put the asterisk there, subject to funding and program priorities. We may or may not do either one of those. But that's going to be the focus in 2019.

And I think that's my end slide, yes.

CHAIRPERSON NELSON: Do you make these contracts as annual appropriations or as full price out of a --

DR. GEORGE LUXBACHER: So that's --

CHAIRPERSON NELSON: -- given fiscal year?

DR. GEORGE LUXBACHER: -- interesting. So the university, the capacity build contracts that we do are severable. Each year stands alone, and we can make a determination during any fiscal year to terminate the risk of that contract. We've done that on -- we had one instance where the principle investigator left the university. No one else was willing to step forward at that university. We terminated that

award I think in year four. We had another one we terminated in year four or year five -- year four. We terminated another one as well for nonperformance.

But all the other contracts are done as non-severable. So when we give the funding, that covers the whole term of the contract.

CHAIRPERSON NELSON: So you fund a multi-year contract in the year that it's funded?

DR. GEORGE LUXBACHER: Yes.

CHAIRPERSON NELSON: So that would be like a standard versus a continuing grant?

DR. GEORGE LUXBACHER: Yes.

CHAIRPERSON NELSON: So most of your -- the capacity building they've done is continuing grants with annual --

DR. GEORGE LUXBACHER: Annual.

CHAIRPERSON NELSON: -- allotments?

DR. GEORGE LUXBACHER: Yes, they're annually renewed, and that comes out of that fiscal year appropriation. All the other ones are done -- now we're trying something new here under one of the UAV contracts, the drone contracts. We did that contract with options that we're going to exercise in the second year of the contract, and that will be funded out of the following fiscal year's money.

We tried that because we wanted to see something different for us. And we wanted to see what they did in the first year before we committed to moving forward in the second year. So we set it up in that fashion. That's the first one of those I can remember we've done like that.

DR. AUBREY MILLER: So each of the different program reviews and progress reports that are required for each of the contracts?

DR. GEORGE LUXBACHER: Yes, yes.

DR. AUBREY MILLER: Or how does that work?

DR. GEORGE LUXBACHER: So we have a -- if you remember my last presentation for the last MSHRAC meeting, we have a contract officer's representative, a COR for each one of these contracts. And the COR monitors that. We meet -- we being the OD group, we meet with those CORs to review that. We also attend some of the reviews.

For the capacity builds, we do an annual review for the ventilation contracts. We do an annual review with the SME annual meeting in February. For the ground control ones, we do an annual review in Morgantown at the International Ground Control Conference.

And so we have all the universities together. And I like that format. It gives each -- each school gets up and gives their presentation. The other students, the other faculty can ask questions. It's really a good development tool for the students.

One thing I should point out, we'd like to get more of those students. So if you note here, I added at the bottom here, opportunities for internships at NIOSH during the tenure of these capacity builds. We'd like to see more people spend time at NIOSH, get exposed to our subject matter experts, hopefully hire a few more of those people too at the end of the contract.

CHAIRPERSON NELSON: So can people propose to have postdocs included in the grant rather than postdocs down there or postdoc people? Because that's a capacity building as well.

DR. GEORGE LUXBACHER: That's a capacity build as well. There's nothing that precludes us from taking on postdocs right now.

CHAIRPERSON NELSON: But in the contract for the proposal?

DR. GEORGE LUXBACHER: We --- I'm going to see if people propose that. I'm not going to specifically spell that out, but I'd like to see if that's proposed. We're just going to -- we're going to add some language to this effect and we'll see what we get back.

CHAIRPERSON NELSON: Yes.

DR. GEORGE LUXBACHER: Okay. Any further questions?

CHAIRPERSON NELSON: Because that might be -- the reason I bring that up is sometimes students who are not doing a PhD in ventilation but they may decide they want to move in there. If they could do a postdoc, they could maybe make a significant contribution.

DR. GEORGE LUXBACHER: Move into another area, yes. Okay. No further questions?

CHAIRPERSON NELSON: Thank you, George. Okay. So Jerry, are you here and ready?

DR. POPLIN: I am here. I'm always ready for something. I'm ready.

CHAIRPERSON NELSON: Okay. So we will listen to you and then Art and Casey can be after lunch.

DR. CHOSEWOOD: Sure.

CHAIRPERSON NELSON: Is that okay? Good, thank you.

(Pause.)

Engaging in the Miner Health Program - Dr. Jerry Poplin

DR. POPLIN: I'm going to talk really softly on this one. Just kidding. Good morning, everybody. It is still morning. So the beginning word here is engaging. So it's going to be a little different. I'm going to force you guys to engage. I haven't met everybody formally. Hello, good morning. Good morning. It's still morning. Hello, welcome. Hello, how are you doing. Hello, good morning, good morning.

(Simultaneous speaking.)

DR. POPLIN: So consider yourself engaged. And one of the things Jeff when he first talked to you guys starting this meeting off, if you haven't been here before, this is the desert. You need water. I lived here for 13 years, and I just came back. Obviously, yesterday, I'm already dried out. So pay attention, drink water before you realize it. It's usually a bad time if you start realizing it.

So earlier, I presented that I'm an epidemiologist and I'm a team lead in the Spokane Mining Research Division. We've talked a couple times before, if not myself, someone else on my team. Kristin Yeoman kind of presented what the miner health program is, where it's at in its evolution.

So we're going to kind of continue that today. But as I said, I want to try to use this committee a little bit more to my advantage. So I'm going to kind of force a little bit more engagement because that's a really big component of this program. We're coming up with new ways of kind of eliciting feedback from all our different stakeholders. And so this is one I'm just going to try out, see if it works. And you guys give me direct feedback if it works or doesn't work.

It's almost similar to how comedians try out their material on the road. This might not be too amusing to everybody. But again, we're just trying to figure what's working and what's not working.

So you see the outline of today. I'm just going to give you a quick little refresher on why we're doing all this and then where we're at since last we met and really talk a little bit more on strategic planning, get into the engagement part of things. And we're going to end up talking about a proposed charge that we have for this committee.

So I'm going to throw that objective out there right now. You guys need to know this going into the talk or the presentation or the engagement conversation, whatever it's going to be, is by the end of this --

DR. BURGESS: Sorry to interrupt again. Could you share your screen so we can see your slides? Thanks.

DR. POPLIN: I could try.

DR. BURGESS: Great, got it.

DR. POPLIN: Good. You see today's objective?

DR. BURGESS: Yes, we see it.

DR. POPLIN: All right, cool. Thank you for telling me. You missed all the fun. All right. So again, by the end of this conversation, we really want to talk about this particular -- this charge to the committee in the formulation of a potential work group around this topic. And this is really actually -- I'm going to go back to this real quick.

This is going to be something that what you guys experienced I think in Denver over the summer with the metal mining automation and advanced technologies work group. That's kind of what I'm thinking about here and what we're talking about if you need context.

So again, we're going to do a quick little non-PII survey and really to help remind us of why we're pursuing this. So I'm just going to do a quick raise of hands. Who here in the room knows somebody, it doesn't have to be yourself, that is currently dealing with some sort of heart disease, cancer, diabetes, arthritis, obesity, any of those things? It doesn't have to be yourself.

I'll give you some PII of my own. I have two of these. And so that's really why we're here. This is a highly prevalent issue, chronic disease. This is how we define in the CDC. A recent report by Rand in 2017 showed that 60 percent of Americans have at least one chronic disease. Quick math, we're above 60 percent in this room. And then beyond that, 42 percent have multiple chronic conditions, 12 have five plus.

And then this accounts for nearly 90 percent of the U.S. healthcare expenditures. It's a pretty large proportion. If you want to put it into context of GDP, it's about 18 percent. It's equivalent to 18 percent of the GDP. So not insignificant.

And how does this -- this is just us in the room, in the U.S. So how does this translate in the mining world? And then time spent. The average American, depending on what survey you're looking at, spends about 8 hours, 45 minutes at work each day. Miners spend more, nearly 9 and a half, a little over 9 and a half plus their commute times to and from work.

So a significant portion of their days are spent at work. So Total Worker Health, a nice quote. It looks like the worksite is a nice opportune environment to really engage with the miners, engage with the staff and help improve our individual health. We're spending so much time there.

Whether the work environment is contributing to it or not, it's an opportunity to really start paying attention to individual health because it will benefit the productivity. It will benefit the performance at the worksite itself. So that's why we're kind of focusing on the environment of the workplace.

And then I presented this at -- Todd mentioned we had a conversation about a workshop in March with National Academies of Science. Workshop is a big word. And so that conversation with all the mining stakeholders in the room, some of you guys were there. I presented this information. I think it's a worthy thing to talk about. And so I'm going to take a little bit of editorial liberties with the 1970 OSH Act which did formulate NIOSH as a federal agency. And I'm just going to read the following.

So the Congress declares it to be its purpose and policy to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources by exploring ways to discover latent diseases, establishing causal connections between disease and work in environmental conditions and conducting other research relating to health problems in recognition of the fact that occupational health standards present problems often different from those involved in occupational safety.

And it's really this last point, this last statement that I hope we can focus on, as I hope we can kind of achieve the similar success and gains in this program that's focused on health that NIOSH has been really successful with respect to safety. I think we own safety pretty well. I'm not sure we can say the same thing when it comes to health.

And so throughout the process that Jessica and myself and Todd have been going around talking to folks about this program and getting feedback, we've kind of settled in on this one slide, this one take home message. So that everyone in the room when somebody asks you, what is the miner health program, we can kind of narrow it down to this structure where we can say it aims to engage with mining community partners to establish a systematic approach for understanding and improving the health status of miners and also become a long-term initiative for the whole nation that's led up by NIOSH.

And you guys have seen the short and long term goals. And fortunately, I'm very happy to say I haven't had to change this yet. And so we are actually making progress, especially in the short-term goal arena and to make progress with that and with the long-term scope and future. We've kind of done these steps. So as shaded out, 2017, 2018, at least the first half of it.

So again, we had the National Academy's facilitate conversation earlier this year in March. Where we're at right now is formulating a detailed strategic plan and then try to come up with creative ways to continue what we started in March and getting good stakeholder involvement and collaborative involvement.

After that meeting, we had all those NIOSH people that were in the room and largely just listening. We had our own little call just to digest everything that we heard. And Dr. Howard was there at this meeting as well. And he chimed in and asked the question of how do you exactly plan on doing this, Jerry? And that one was a good question.

And so it was a very similar question that an old advisor of mine once asked me when I was proposing some research. He asked, so what? That man sitting right over there. It's one of those pointed questions where you kind of pause and you're like, I wasn't ready for that question.

But that's really the meat and potatoes of everything. How are we going to do this? How are we going to implement this strategic plan. So that's really what we're going to talk about today is kind of focus on these two areas of where we're actively engaged. And this is where we're at in the strategic planning process.

If you've ever involved yourself in a strategic planning process, it always seems to start off with coming up with a mission statement. That mission statement simply states the intended purpose of the program. That is why are we here doing this. The vision lays out an image of the future provided that we are successful in executing this plan.

And the values underlined and established the foundation by which the plan is to be executed. And so I've laid out what I feel based off of our various conversations the mission, vision, and values should at least be.

And so mission, very easy. Develop and promote health and safety solutions that maximize worker protection, minimize exposures, and prevent disease.

The vision, this is something I've taken from -- and I presented to you guys -- from my days doing firefighter research. The vision I see, basically the future that I have in my mind is improved functional health for the entire mining population.

And the values that underlie this. If you know me, this is kind of a lot of my personality coming into play here. So quality, utility, communication, judgment, honesty, and selflessness. A little bit of altruism there, but I really want that to be embedded within this program.

So I'm going to stop right here for a minute. Given that this is supposed to be informed from our stakeholders, any sort of strategic planning initiative. It shouldn't just be one person or two people informing this. So again, I formulated this based off of some feedback but not strategically from this committee.

So this is your opportunity. I'm giving it to you right now in the next 30 seconds to have some input. What do you feel is missing from this? Do you agree with this? Let me know. I mean, the floor really is yours right now. We've got more to talk about, but I'm going to initiate some interaction right now. And I'll throw Jeff under the bus first. This is my chance to get back to you. How do you feel about this honestly?

CHAIRPERSON NELSON: To develop and promote, that assumes that one already knows what the safety problem is and you're going to go solve it. And I think one of the biggest problems is that you don't know what the problem really is.

DR. POPLIN: So possibly to inform.

CHAIRPERSON NELSON: So I would like to see that somewhere in there.

DR. KRAMER LUXBACHER: Maybe to identify, develop, and promote.

CHAIRPERSON NELSON: How do you know that what you want to solve is what is needed?

DR. POPLIN: No, I agree. Yes, that's good.

MR. ZIMMER: I think this goes back to what we were talking about in March about the cultural change of workers. And do we really know what the issues are? Yes, we kind of have an overall umbrella of what the issues are and where it's going. We know the data. It's now taking that data, whether it's addiction, suicide prevention, all of those issues.

It's taking that data and molding it into something that connects with the workers. And that's what we need. This is not your typical safety issue where it's tangible. Okay? Hearing protection is tangible. It's a change of mindset. And as I'm getting into it with the operating engineers and the building trades, everybody is kind of dancing around the issues.

But I think Jerry is on the right track, that we kind of know what the issues are with worker health. But it's sitting down in a room and hammering out, how can we get these programs out there that are useable to the workers.

I had a conversation with a clinician not too long ago, and she was offended by the way I talked to one of our members. Now think about this and don't take this the wrong way, all you academic people. Academics talk one way. Workers talk another.

If I use the word, clean and sober, or swear at them, that connects with them. It's not worrying about hurting their feelings and things along that line. So I think those are the type of conversations we need to have. I hope you get that.

Because on a job site or in a mine, you're not going to say, well, let's talk about your problems. No, you're screwing up. You've got to get your "S" together. And that's what connects with the workers, not changing the terminology so it's not as offensive or something like that. But those are the conversations we have to have so it connects with the people. And that's my feeling, and I think you're on the right path. But we've got to figure out how to get there. I agree with you.

DR. POPLIN: Yes. Aubrey?

DR. AUBREY MILLER: Yes, I just want to pick up from where Kyle was. And I appreciate the holisticness of this, right, in terms of being inclusive, other health contributors that are threats to the population in general. But looking at it in terms of the mining population and which issues, whether it's cardiovascular disease or whatever that may be more prevalent or more of a problem. But also using the worksite as an opportunity to go out for total health.

But going back to kind of what you were bringing up, Kyle. The issues of understanding what are the data gaps. So we know about certain conditions. We know certainly that respiratory conditions seem to be picking up again. Where are the gaps that we need to increase understanding going back to the identification that you were just bringing up and then translating that. And then obviously the variations in the workforce that you need to be able to go after.

So I would put in that understanding of what do we know in terms of the general population health indices, what are some of the ones that are specific to the mining industry, and then where do we need to gain additional information through some analysis and other extant forms of data collection, whatever you want to think about over the next year to increase that understanding. While your parallel, you're trying to develop a program that's going to go back creating relationships and addressing communication in a way that you begin to engage the workers in going after some of these things. So I think I like it.

CHAIRPERSON NELSON: But bring back up what Kyle was mentioning in that mission, it's not just to promote. It's also to -- or maybe the word "effective". Something that works.

DR. AUBREY MILLER: To address.

CHAIRPERSON NELSON: Not just any solution but the solution that works in the context of the workers needs to be there too.

DR. AUBREY MILLER: But the workers will help you get that to some extent, right? So having that active engagement will help to translate effective programs, buy-in from -- the issue will be obviously buy-in from industry as well.

DR. BURGESS: I mean, I think this slide itself is fine. I think that from my perspective the issues are who you're partnering with, how do you do that. And that may be on a subsequent slide that you plan to get to. Because obviously, I think again implicit in the discussions we've had so far is the idea that you're working in partnership with the company and addressing the labor-management concerns.

DR. POPLIN: Yes, and it compliments what Aubrey was talking about too. One time I presented this, I presented more of like a public health model that has this kind of cyclical feedback. And I'm actually steering clear of that right now because it's a little bit too linear. And I think I talked to Todd and Jeff and Jessica about this. I'm thinking about it more in terms of a multi-lateral trade. All right.

So we've got a lot of things kind of heading in the same direction at the same time that are operating at different levels but complement that end goal. So we're going to be operating on different levels simultaneously because it has to exist that way, I think. But I'm still trying to articulate that a little bit better and especially visualize that, a way to visualize that for everybody.

DR. AUBREY MILLER: Do you have an idea, like a pilot project or something, a test bed for this in terms of an actual workplace? So we'll dedicate work through maybe Kyle's group or something that you could say, well, we want it totally. We want to think about all your health issues and try to have that.

DR. POPLIN: Yes, and I won't name names or anything like that. We are trying to engage with a workplace or a couple different workplaces to see that the first obvious initial kickback I get is the legality issues and the liability issues and we talked about during the conversation in March. That's a real one that we need to hash out and better inform each other on.

And so that's usually where things start. Most people I talk to about this effort like it. They're doing things on it. They don't have the capacity for it, so they kind of need some involvement with it. But then just as we -- as you probably heard from the division updates, are resource limited. So are they.

So then a lot of it is building that trust and that partnership thing right now. That's kind of my world right now. Because it is health, it is complicated. There are some PII issues with it. Right now, a lot of my time is just building that trust in order to find the right person in the right organization at the right time to do something a little bit more active in this area.

MR. WATZMAN: And recognize that there are some companies in the industry who are well down this path already who have very proactive, forward looking, aggressive worker health programs, especially those that have an international footprint. They've had to do this. The companies that are working in South Africa and the AIDS epidemic had to put in very aggressive programs because they didn't have workers. They had to change the culture in those communities.

So I think there are examples out there and some people to work with. I don't want the impression to be left that there's an indictment of the entire mining industry that there's nothing going on because there is a lot going on. But you're exactly right. A lot of this is dealt with in a very confidential private manner. And there's a general reluctance to talk about it because of those considerations.

DR. POPLIN: Yes, and to your point that I totally recognize there are groups and organizations that are already doing this. And part of this program, part of that multilateral and multilayered approach is to identify who's doing what and that's effective.

MR. WATZMAN: Right.

DR. POPLIN: And can we kind of be a medium to get that information out to other people who don't have the resources who aren't as far along. So to try to find out those and given the opportunity to

share where their successes have been that other folks can emulate it. That's definitely a part of this effort as well.

MR. WATZMAN: Yes.

DR. AUBREY MILLER: There's also a lot of work on your backside, I mean, whether it's HRSA or CDC or others that you don't have to develop all of that.

MR. ZIMMER: A lot of it is marketing --

DR. AUBREY MILLER: You just have to figure out to connect it.

MR. ZIMMER: -- the stuff that's out there now, rebranding it and marketing it. One of the things that we're doing, the operating engineers on an international basis. And this came from -- I'll give him some credit. This came from RJ and his presentation. I think it was in the spring with the packet that he gave us for the employers.

We're actually taking your idea and tweaking it a little bit and coming up with a lifestyles packet with the stuff that came out from CPWR and NIOSH on opioids. So we can make it available to our local unions, our employers, anybody that wants it so that they have a starting point on educating themselves on the issues that are going on out there.

And I know this encompasses more than the lifestyle issues that I'm talking about, but that's what's facing me right now. So that's the immediate need, suicide prevention and all of that is in that packet. But at least it's a starting point getting it out there.

DR. BURGESS: So in that regard, have you talked with Kyle or with Casey who will be presenting afterwards about the opioid stuff specifically yet, Jerry?

DR. POPLIN: I've talked with Kyle before, like, just on a conversational level. And I know that Jessica has been brought into a few conversations on the opioid topic. There's been some new information that's been released through NORA's conferencing that NIOSH helped do. And I know Casey is going to hit up on it.

So I know it's coming if it's not already here. So I've been waiting for it to be real on my desk. I know it's coming. So yes, Casey and I will be best friends probably soon. But I anticipate there's going to be more activity on that front. But yes, Art?

DR. ART MILLER: Jerry, I have a question about how you sort out miner health and you're making a miner health program. And the reality, other than silicosis and black lung, all the other things we're talking about really don't have much to do with mining. And I like the idea of this lifestyle choices. But how do you train people in lifestyle choices under the guise of a miner health program when in reality it's about a lifestyle program.

DR. POPLIN: There's a lot of areas that this overlaps in terms of what CDC does elsewhere and a lot of behavioral choices. And honestly some of the human factors, things that we do for engineering, will play a role in this.

And that's an easy way to cross over in where we've been successful for engineering design and how we design the workplace to help make better choices and whether it's behavioral choices outside of work or when we bring it into work. There's an opportunity to do that. It's a really big question what you just asked, and that's kind of a long-term initiative, I think. But we do have to build that foresight into this type of program.

So yes, I don't want to get too much into the weeds on that one because it's a big topic. And I do have an objective to get to in the next five minutes from what my phone tells me. Yes?

MR. BOWERSOX: How about fatigue?

DR. POPLIN: Fatigue, yes.

MR. BOWERSOX: You said the average worker maybe works eight and a half hours. I mean, in mining, it's more like ten hours a day.

DR. POPLIN: Yes, so that was the average per miner. For right now, it's 9.6.

MR. BOWERSOX: They travel long distances now. We've had miners tell us they've almost been killed by this.

DR. POPLIN: Yes.

MR. BOWERSOX: That's a big problem. How do you address that? That is an issue.

DR. POPLIN: I did not prompt this question or topic. We actually have an active project that just started this year that's looking at miner fatigue and the management of miner fatigue. There's been some real headway in both transportation and Allied Health, specifically nursing, that look at these issues.

The components that relate to fatigue, there are a myriad of components that relate to miner fatigue because all of those factors exist, shift work, long distances, odd shift scheduling, things like that. And there's a lot of technology that's been produced that are looking to monitor fatigue and how that's utilized. It's quasi-validated.

What we'd like to do in the next couple of years is try to figure out how those tools and what we've learned from other industry can be applied to mining. And so, say, your mine versus a mine over in the western U.S. or northeast U.S., they can evaluate what components are related to their workforce, what issues are real for their workforce, and then give them some guidance documents that, like, what can we put into play as a management system to help mitigate the potential for miner fatigue or worker fatigue or whatever have you.

So we just started this project this fiscal year after doing a year's pilot project. So we're going to be attacking this issue for the next four to five years. So if you know folks who actively have those concerns or doing anything on that front, we're definitely looking for collaborative opportunities there. It's a big hot topic right now, and we are actively pursuing it.

DR. AUBREY MILLER: A quick question. Have you engaged with OSHA and MSHA with respect to kind of this larger vision in terms of --

DR. POPLIN: MSHA, yes. OSHA, I don't think so. But yes, they were present in this March conversation, and they'll continue to be. So yes, they're definitely a player.

DR. KRAMER LUXBACHER: Bruce and I were just talking. We had seen the news on a CDC report about men who work in construction and mining having the highest suicide rates that was out recently. But I haven't seen the actual report from the CDC. Does that break out miners as we know miners? Because I think they're kind of lumping construction, oil and gas, and miners all together.

DR. POPLIN: True story. You're right.

DR. KRAMER LUXBACHER: I don't know if you have data on actual miners rather than --

DR. KOGEL: Yes, we've talked about this and this has come up a couple times around opioids as well and exactly what you stated is what's happening. So we've been talking about -- and this is where Jerry is going to get plugged into the opioid work and probably Dawn's workgroup. And she and I have had a lot of conversations about this, how do we extract that miner data. And if MSHA doesn't have it, we don't have it and we definitely don't have it on a national level.

DR. KRAMER LUXBACHER: What does CDC get then? How are they --

DR. POPLIN: For mining, so there's a couple different national level surveys that exist, right, that look at all industry and break it down by large component industries. Construction, that's a very populated industry. There's, like, many, many, many --

DR. KOGEL: Right. Many orders of magnitude.

DR. POPLIN: Right, and the mining of it. And so usually in those national level surveys when it's a strategic design, they really only get 100 miners in that, say, phone survey that supposed to represent all of mining. And when they break things down and stratify things, so they can't report on individual mining typically. And so it usually gets lumped with construction and oil and gas. And so that's a big challenge when it comes to health outcomes with these national level surveys.

We're looking at that issue and trying to see if we can tease it out by looking over many years and aggregate for mining over many years rather than just single years. And so that's one of our new projects that Todd presented to see if we can better utilize some of those national level surveys.

But as a legitimate issue, what we need to do is empirically show it's an issue. So we need to start hunting after better sources of data. Because right now, it's a low hanging fruit.

CHAIRPERSON NELSON: You've got two minutes, right? So you're going to get to the --

DR. POPLIN: Unless we have plenty of time.

CHAIRPERSON NELSON: We have plenty of time except you've had enough.

DR. POPLIN: Understood. So just to give you -- I'll give you the highlights. So we're going to continue to do the stakeholder engagement. One of the things that came out of that two-day -- or that four-hour meeting was that we want to do more of this. We want to have this expanded out to one, two-day workshop on miner health.

Now, how do we best do that? And really that's my question back to this committee. And one of my questions specifically is to ask you guys if you want to do this, similar to what was done recently for the automation technology workgroup in Denver.

And so earlier this week, we formulated a draft charge that we'd like this committee to consider. We shared it with Dr. Burgess and Dr. Nelson. And basically this is kind of what it looks like. And we would like this one to two-day workshop.

Basically, we want to formulate a workgroup to initiate the agenda and drive the facilitation of a workshop that can address at least these three questions that are presented here. And the outcome of that workgroup is to plan and address these questions. The outcome of that workshop is to produce a summary report that will inform the miner health program strategic plan. And then also to help come up with ideas and ways to continue sustainable communication through partnerships, through collaborations that you were talking about, Aubrey.

And so those are the outcomes of this workshop just to show you what the two differences are. And Jeff and Priscilla, you guys had the opportunity to see this hopefully earlier this week. So I will kick it back to you, first get your initial thoughts on it, share with the rest of the committee. If you guys have questions on this, please let me know in the next 30 seconds, I guess.

CHAIRPERSON NELSON: And Jeff has already said that he would be involved in it. And anyone else who wants to do it, wants to volunteer to be part of that summary report effort. I think Kyle has been speaking very strongly. The one thing I want -- I mean, I think it's fine. I think it's great. But I'm not certain that by looking inward into mining that you're going to find best practice. So I want to make sure that you're also looking outside of mining --

DR. POPLIN: Absolutely.

CHAIRPERSON NELSON: -- to identify the best practice that should be coming into mining.

DR. POPLIN: That a good point, yes.

CHAIRPERSON NELSON: Any comments or questions about this concept?

MR. ZIMMER: Yes, this transcends all of the -- I mean, it's not just mining. It'll transcend everything. I feel it's long overdue.

DR. POPLIN: Anybody else? What do you guys need or what do I need for you guys to do in order to make this real?

MR. WATZMAN: You need to get Jeff to agree to chair the workgroup first.

(Laughter.)

MR. WATZMAN: Does somebody need to propose a motion or anything like that?

CHAIRPERSON NELSON: So we have a charge document which has Jeff being the leader of the charge. And it allows other people to self-nominate. So we check with Kyle to see whether he was prepared to self-nominate which he is. So we have a document. The full document has not be circulated to everyone. Right. But these are the goals of it, right, to come back to this committee with a report of the workshop that has these questions addressed.

So if these are the right questions, I would propose that we do authorize the creation of this. I guess it's an ad hoc workgroup that's really focused on one particular task completion and recognize that Jeff has agreed to be the chair.

DR. BURGESS: Whatever the term.

CHAIRPERSON NELSON: Chair. The chair of this working group on our behalf. So the working group would be chartered by us, MSHRAC.

DR. BURGESS: And I would say it would follow the successful model that Kray had done with mining operation.

DR. KRAMER LUXBACHER: Well, and I've got some things I'll mention that I wish I had done differently.

DR. BURGESS: And we can learn from that too, yes.

MR. WATZMAN: But the one that Kray chaired was narrower in scope and focus. And the difficulty you're going to have with this one is the geographic reach and the diverse interests. When you talk about a two-day workshop that's going to include coal and stone, sand, and gravel and Kyle's folks, I mean, it's going to be an organizational challenge. That may be the most difficult part of this.

DR. BURGESS: I'll have to bring you back from retirement, Bruce.

(Laughter.)

MR. WATZMAN: That's why Tom is sitting back there.

DR. POPLIN: Are there any other questions, concerns?

CHAIRPERSON NELSON: If there are no more concerns, then we can introduce this motion that this workgroup be created as chartered under MSHRAC. So do I hear someone putting that motion forward because I think I'm supposed to do that? Somebody want to so move and second and then we'll vote?

MR. WATZMAN: So moved.

DR. AUBREY MILLER: Second.

CHAIRPERSON NELSON: Any additional discussions? Then --

DR. KRAMER LUXBACHER: Can we give the workgroup permission to develop the number of workshops they want to have and that sort of thing, maybe not exactly follow the automation one? Because I think Bruce's point is well taken. This is a broad issue.

CHAIRPERSON NELSON: And I think that that is fine. That's why we're focusing right now on the questions to be answered. The draft document that we've seen is focused on one model. But if the working group committee feels that there's another way of doing it, then we leave that to them. We're not overdefining exactly what it is that must be done except for we want a report that has the answers to those three questions, right? In whatever way they want to do it.

Any other questions or discussion? Okay. Then we'll call the vote. All those in favor, say aye.

(Chorus of aye.)

CHAIRPERSON NELSON: Those opposed, nay? It is unanimous. Thank you very much. You have all the information you need?

MR. WELSH: I do.

CHAIRPERSON NELSON: He does. All right.

MR. WELSH: Well, the other thing, if there are other members of MSHRAC that would like to be on the workgroup.

CHAIRPERSON NELSON: Right. Self-nominations for the workgroup and Jeff is going to be the lead. Great. Thank you very much.

DR. POPLIN: Thanks, guys. I think Jeff has some information --

CHAIRPERSON NELSON: Jeff is going to tell us --

DR. POPLIN: -- for lunch.

CHAIRPERSON NELSON: -- where to go get fed.

MR. GREEN: Can I ask a quick question before we go to lunch?

CHAIRPERSON NELSON: Of course.

MR. GREEN: Is there any opportunity for stakeholders other than committee members who want to participate in this task group?

CHAIRPERSON NELSON: This is a working group that is chartered by a federal FACA committee. So they have much more flexibility than the FACA committee does. So it may.

MR. WELSH: As far as having other people on the workgroup, we can bring in subject matter experts to the workgroup.

CHAIRPERSON NELSON: Well --

MR. WELSH: They can participate in different ways too, yes.

CHAIRPERSON NELSON: Good. Okay. How did that go for you, Jerry? Did you get where you wanted to get?

DR. POPLIN: Good. How did it go for you guys?

DR. KRAMER LUXBACHER: We were engaged.

DR. POPLIN: It's more important. It's not about me. It's about us. So Jeff has a couple of announcements for lunch.

DR. BURGESS: Do we want to hold the meeting for the rules type of stuff? Do we need -- are we --

CHAIRPERSON NELSON: Do we want to do what? Art? After lunch, I think. Can Art do that after lunch?

DR. KOGEL: That's Casey.

CHAIRPERSON NELSON: That's Casey.

DR. KOGEL: We were going to do Art before lunch, but he says okay.

CHAIRPERSON NELSON: You okay?

DR. ART MILLER: Yes, whatever you want.

CHAIRPERSON NELSON: Okay. So I think that we should go to lunch now.

DR. BURGESS: Okay. So just how much time do you want, Priscilla, to give the group? What time do you want them back?

CHAIRPERSON NELSON: Well, is it possible to go somewhere, have lunch, and be back in an hour?

MR. BURGESS: Probably need at least an hour, 15 minutes I'm guessing.

CHAIRPERSON NELSON: Do you want to reconvene at 1:15? Do you want to do that?

MR. BURGESS: We can try, yes. I believe that would be possible.

CHAIRPERSON NELSON: Okay, 1:15 we will reconvene.

(Whereupon, the above-entitled matter went off the record at 12:07 p.m. and resumed at 1:21 p.m.)

CHAIRPERSON NELSON: Do we have everybody, Jeff?

MR. WELSH: Yes, all on mute.

CHAIRPERSON NELSON: Yes, the only person we're missing is Bruce and we still have a quorum. So we can start.

MR. WELSH: Yes.

CHAIRPERSON NELSON: All right. We're going to get a special treat today. We're going to be shown around the NIOSH website.

MR. WELSH: Cara, are you on the telephone or Zoom?

DR. HALLDIN: Yes, can you hear me okay?

MR. WELSH: Okay, I can. And can you see our screen?

DR. HALLDIN: Yes.

MR. WELSH: Okay, good. Everyone, I have Cara Halldin on remotely, she is an epidemiologist and a supervisory program management officer for the Coal Workers' Health Surveillance Program in the Respiratory Health Division of NIOSH in Morgantown. Today she is going to talk about a request for information that has been posted.

DR. HALLDIN: Thanks so much. And thanks for giving me a few minutes. I wanted to let everyone know about the Request for Information that's currently live on the website because it's only up for a short period of time. With the FY19 budget, NIOSH was asked to report on barriers to participating in the Coal Workers' Health Surveillance Program. So that's the screening program that's offered to coal miners for black lung.

So what we have done, we have to provide the report within 180 days. So it's due in March. We have posted a Request of Information in the Federal Register, and you can get to that RFI through the mining page here or by just googling black lung RFI. And I think it should be the first hit.

And there are several questions that we would like addressed on the RFI. So you want to go ahead and click on the link there. Once you get to the Federal Register, this is what you'll see. It has a description

of sort of what we're about and what we're asking for. And then this is where you can submit a formal comment. And if you have any questions, my email is listed as the person to contact.

Essentially, we are encouraging all interested stakeholders to consider reviewing the questions that we have listed in the RFI and provide responses. The RFI was posted to the Federal Register about two weeks ago, and it will be open for a total of 60 days closing on January 14th. And unfortunately, because of our deadline in March, we cannot offer any extensions.

So we will be submitting our report to Congress based upon the responses that we receive by January 14th. The official search number for this is CDC-2018-0110. So I'm happy to take any questions, and my email address is vgx5@cdc.gov. That's victor, gulf, x-ray 5 at cdc.gov if you have any questions.

CHAIRPERSON NELSON: Thank you. Any questions at this point? Good. Do you want to show us anything else?

DR. HALLDIN: No, I think that's it. Thank you very much for your consideration and a little bit of your time today. And please feel free to share this link with whoever you think would be interested in responding.

CHAIRPERSON NELSON: Great. Thank you very much.

DR. HALLDIN: Thank you.

CHAIRPERSON NELSON: Yes.

MR. WELSH: Thank you, Cara.

CHAIRPERSON NELSON: Okay. Thanks, everybody, for coming back. We have Art Miller coming up followed by Casey. And we ask you all to help us approach, asymptote our original schedule.

DR. KOGEL: Jeff, you're going to say something about Lake Lynn?

MR. WELSH: The search and acquisition of a property to replace Lake Lynn Experimental Mine is still progressing. Since my last report, the property owners did some core sampling and we, CDC, also did a couple core samples to see what the geology is and the consistency of the geology.

And just recently, the land owners had contracted a company to do an evaluation of the property, what it's worth. And I believe they have submitted their offer. I have not seen that offer, so I don't know how much it is.

So the next step is for GSA who is managing the process for us, to let a contract to also do their evaluation of the property. And they'll see what the land owner is asking for the property and what our evaluation is to see if they match up or not. So that's the current status.

So I would think that it's a couple months away before we get their report back and match up what they're asking for the property and what GSA's contractor comes back with.

MR. WATZMAN: So the long and the short of it is we're still some period of time till phase one is completed which is securing the property.

MR. WELSH: Yes.

MR. WATZMAN: Have you started to focus on phase two which is building this place out, securing the funding for? Have these discussions begun internally with CDC?

DR. KOGEL: Yes, so we're fairly far along in the discussions with CDC. The first part was putting together a phased plan for the actual design and construction and then also a budget to go with that. So that's been completed and then discussions have been had with CDC. We've begun discussions with stakeholders as well. And so obviously we're going to have to go back and raise this additional funding.

CHAIRPERSON NELSON: Any chance -- what guess for the end of phase one timewise?

MR. WELSH: Well, they've been working on the environmental impact study. And that is coming close to being done. And they're having another public meeting in January, GSA. And at that point, the environmental impact study will be done and the public meeting will allow residents in the area to come and ask questions about what's in the environmental impact study. So that will be done.

And as far as securing the property, since GSA has not let the contract to come up with their value, I've got to think it's at least a month before they get the contract awarded and probably another month before they get the report back. So that's a couple months away.

MR. WATZMAN: Jeff, was there any subsequent conversations with the Lake Lynn landowner after you pulled everything out of there to see if that person had a little dose of reality at that point?

DR. KOGEL: Yes, there were conversations and those fell apart. But there were multiple conversations, and that was the direction that we would've preferred to have had. But we just couldn't come to an agreement. And this was before my time as well, so I can't really give you much detail about it. That's what I know about it.

MR. WATZMAN: So they're sitting there with a property that they can't mine and no money in the bank. Wow.

MR. WELSH: Yes.

CHAIRPERSON NELSON: Okay. Any other questions on Lake Lynn? All right. Well, thank you very much, Jeffrey.

MR. WELSH: Art Miller is next.

CHAIRPERSON NELSON: Nice flags, yes.

Real-Time DPM Monitor - Dr. Art Miller

DR. ART MILLER: All right. Welcome back. I can't promise I'm going to be as engaging as Jerry was. I'm going to talk about a project in which we're developing a field portable monitor for diesel particulate matter and it's in our new automation technology team out in Spokane. It's slated as a four-year project, and we're one year into it right now.

So we might ask why field portable real time. This is the way that MSHA currently regulates diesel. Maybe some or all of you are familiar with this, taking a sample from the air into a filter, send it to a laboratory. The laboratory method quantifies the elemental carbon and organic carbon on the sample. Add the two together to get total carbon.

Regulatory limit is 160 micrograms per cubic meter in the air that was sampled that day of total carbon. This can take a while which is one of the reasons why we want to have some kind of a real time monitor to measure this in real time so people can react to that.

One comment I want to make about this is that there are some real time diesel monitors, quote-unquote, in the market right now. You might have heard of them. None of them measure both organic and elemental carbon which is the reason why I wrote this proposal.

Outlined in my presentation a little bit about the DPM sources we're using. Mainly I'll talk about assessing existing portable methods and exploring alternatives that mimic both the EC and the OC as the 5040 method does. And then at the end, I'll talk just a brief moment about research practice efforts.

Really there's two ways to collect information for this project. We have a quiescence chamber in which we can generate diesel using an engine, dilute it, control the dilution, put it into a chamber. And we take multiple samples that are identical which is kind of handy for the lab. We can vary the engine mode to vary the elemental and organic carbon ratios. We can use different fuels, et cetera.

Of course, the gold standard is real mine samples so that we can make sure that we assess for in-mine confounders to our measurement techniques, et cetera. We've been out in a couple mines already and we plan to do more in the future.

When you look at existing portable methods, they really fall into two categories, light extinction and light scattering. The light extinction methods, we basically collect the sample onto a filter media and

you shine a light through there. And if the material on the sample has black carbon in it or soot, it will absorb some of the light. And then you can determine how much soot is on that filter.

And so it's really used for elemental carbon, and the two monitors that we tested in our preliminary study is was FLIR Airtec and AethLabs MA200. And you'll see a little bit more about that in a minute.

For light scattering, really light scattering is exactly what it says. It just shines a beam, scatters a light, and says, whoa, there's some particles here. And we can measure how many particles by how much scattering. And this is typically what's used to monitor dust in real time.

And if you use submicronic cut point, then you can monitor, quote-unquote, diesel because it takes out all the big dust. And that's what we did in this case. We used a PDR-1500 thermal and then this new product called Pinssar which is coming out of Australia and they're trying to market it here in the states. It's that big stainless steel bucket that's on the lower part of that bench there. It says D.P.M. monitor on it.

And during this particular assessment, we used the NIOSH Method 5040 as our gold standard. So first, I'll just cover the two light extinction monitors that we tested, the AethLabs and FLIR Airtec. They're both very portable which is nice. The graph on the upper left here shows the correlation between the NIOSH 5040 on the y-axis and the two monitors on the x-axis.

And as you can see, when it came from the back, it actually worked pretty good. It didn't give us a one-to-one correlation, but they did give us a linear response for elemental carbon. And then we use that data from that first set of tests to recalibrate the instruments.

And then we did more tests which are shown on the right, and we can pretty much one-to-one estimate the elemental carbon on the 5040 method using these two devices if they're properly calibrated. So that's kind of nice. They're really good for elemental carbon, but they basically tell us nothing about the organic component.

Similarly, for the light scattering instruments that we tested, the thermal and the Pinssar. When they came from the factory, they both showed linear response but not nearly one to one. We recalibrated -- and then did some more tests and we found that they had a pretty decent linear correlation.

And again, this is an estimate of the total carbon simply based on correlating the scatter to the 5040. If any of the particles had been something besides total carbon, we still would've given this response. So the limitation of the use is that they don't know what they're looking at. They just scatter from whatever is there.

And then we call it total carbon. Well, that's kind of a stretch really. I mean, it works for a diesel engine with a submicronic impactor. But in a mine, it would have its own set of confounders. Welding, for example, blasting fumes, anything like that would be there would also register.

They're also very sensitive to humidity. I was in the field recently with one of these, and a fog bank came. And I don't know what created the fog bank. Something vaporized rapidly for a short period of time. And the thing went, like, haywire. It was, like, 50,000 micrograms or something.

I want to show this data because it's also related to what we're doing. So my colleagues in Pittsburgh did this work. And they tested the Airtec. All of these are elemental carbon methods. Airtec, Airwatch which is another device being developed by NIOSH. Magee Scientific AE33 which is commonly known as Aethalometer.

And then also they tested a new product being developed by Sunset Labs. I don't have a picture of that. It's not really on the market yet. But this data is a little bit busy. But what it shows is that for the -- they took simultaneous samples of all these instruments over an hour and a half and the light blue bar that's perfectly horizontal, that is the time weighted average of the 5040 filter samples that were analyzed.

The little red bars are the quasi-real time Sunset Labs TWA for those little short periods of time. And then the black line which is also kind of horizontal is the TWA from the Airtec. So all of those were all kind of similar, between four and five hundred micrograms per cubic meter of elemental carbon. So they all kind of work in the field.

The green and the blue are real time monitors. And if you use your imagination, you can see that their response was predictable and the TWA was similar to the other ones. That's about all I'm going to say about that data. The point is that all of these instruments are somewhat useful in the mines for elemental carbon. Jeff?

DR. BURGESS: So you're monitoring pretty high concentrations there. So what about, like, below 150, below the standard or at the standard? Do you have other information on that?

DR. ART MILLER: Yes, this is not my data just so you know that.

DR. BURGESS: Okay, thanks, yes.

DR. ART MILLER: But yes, that is a big issue because when you get down in the low -- that's really what you're interested in --

DR. BURGESS: Particularly, like, below 10.

DR. ART MILLER: -- 50 to 100.

DR. BURGESS: Yes, because the California standards are --

DR. ART MILLER: I'm totally with you on that.

DR. BURGESS: Yes, okay.

DR. ART MILLER: And that's a really good point. And again, these techniques will all go down to below 50. For sure they will. But their limits of detection are down in the teens or 20s of micrograms per cubic meter. So they all have that little bit of a limitation. But they will still work. So I'm not going to argue about that. But the data that they use, they work better at high concentrations. Let's put it that way.

So a summary of the methods that we tested. The light extinction ones are great for elemental carbon, but you really have to estimate or guess your organic carbon in order to get to your total carbon numbers.

Light scattering, if diesel is the only thing in your air and you absolutely can prove that and you know that, that total carbon number will be reasonably accurate. But again, I'll remind you it's not a total carbon number. It's just a scattering number that says, this many particles were in my scattering volume.

So the real bottom line on all this is that if we really want to mimic the 5040 method that's being used by MSHA and we want to do it in the field, we have to find another way to do it. And that's why we started this research.

So the first alternative we explored was FTIR. The little cartoon on the left is sort of a classic FTIR. You have a beam. You shine it through the sample. You have a detector on the other side. And based on what is lost in the sample, you can quantitate what was on the sample.

The cartoon below is what's called Transflectance spectrometry, similar infrared spectrometry. The beam comes in an angle, goes into the material, comes back out and diffuses. And then you have a collector collecting all that diffuse reflection. And then you quantitate using that.

The reason this has a 1, 2 and a yellow bar on the bottom is that if you use that diffuser reflectance mode and you use a really thin sample like we're doing with thin filter, the beam goes through the sample, hits the back side of the sample, and comes back through the sample. So now you went through the same twice. So it's a little bit different, and they call that transflection spectrometry. And that's what we're doing with our diesel samples.

And this is what a transflectance spectrum looks like from one of our diesel samples. And the stuff on the right is all mostly related to silica which the filter is made out of quartz fiber. And then the two features of great interest to us that took us a while to come to but this is a shortened version of a long story is the CH stretching band right around 3,000 -- a weighed number of 3,000.

These little peaks that you see there, the aliphatic CH, are very predictable or correlate very strongly with the organic component of diesel. And we've done that with lab samples and field samples.

On the left, notice that that whole spectrum kind of rises up above the baseline. And that rise is due to an effect that's called electronic absorption. It has to do with graphitic carbon. Graphitic carbon has

this property of chronic absorption. And so it raises the baseline, and that raising the baseline can be quantitated and correlated with elemental carbon.

So this is what that correlation with elemental carbon looks like from that rise in the baseline at 4,000 weight number. A really good prediction of elemental carbon for all their samples. This is 87 samples from both the gen set and two different mines.

Similar set of samples, 87 samples, same ones. This is how we predict organics. In order to get this good of a correlation, we did have to stand on our head a little bit. We did some kind of a Monte Carlo simulation. We chopped up the spectrum into little bits and did a regression analysis on that. Long story but point is we managed to tease out organic carbon pretty accurately with that technique.

So we were pretty happy with that bottom line as we think we have pretty good -- at least our preliminary data shows pretty good correlation for both organic and elemental carbon.

The next alternative we explored was laser induced breakdown spectrometry. And we're really heading down this road. It's an elemental method which is not necessarily the best. But it's super sensitive, like, at least an order of magnitude more sensitive than FTIR which is an order of magnitude more sensitive than some of the other instruments that we looked at previously.

So this is super sensitive. We get down to microgram levels in the air. We're doing this in collaboration with Seattle University. What you see there is -- we called it a LIBSAM, laser induced breakdown spectrometry air monitor. We developed a few years ago in collaboration with those guys. And we're using this instrument to do our analysis.

But in order to do it, we had to modify the instrument. This instrument was designed to take a sample out of the air and pull it onto a tape and analyze it with a spectrometer. And then it would advance the tape every several minutes.

And what we did was we just disarmed that, and we built this little fixture you see on the lower left. It has a little pinwheel there so we can take 16 shots of each sample which is kind of nice for laser spectrometry. Because one of the things about lasers is they don't produce a perfect plasma ball every time.

So you have about a plus or minus ten percent error by the method itself. Even though they're super sensitive, they still have this ten percent error. It has to do with the imperfection of the plasma ball. So we take 16 shots per sample, and that helps us get better statistics on our data.

First thing we did was just try to measure total carbon by choosing -- there's a myriad of peaks in the spectrum. It's I don't even know how many thousands of peaks. But the point is everyone stands for a different decay event that's happening as the plasma cools.

So we chose this three wavelengths of light that were emitted during that event, and they all represent carbon. And if we add the three together, we could predict total carbon fairly well. And that was kind of our preliminary research we did before we decided to go down this road.

Here on the left is our elemental carbon predicted from the same set of samples, the 87 samples that we talked about before. And we can predict elemental carbon really accurately using those carbon peaks from the spectra.

Organic, a little trickier. Because it's an elemental method, we had to look at oxygen, hydrogen, carbon, and some ratios of all those peaks and try to come up with an algorithm that would predict organic carbon as measured by the 5040 method. Right now, we're at about 0.8 per yard squared. Not the best, but we're trying to work on that and improve it. So again, to repeat, even though it doesn't do well for organic carbon, we're still very interested because it's super, super sensitive.

The next step in our research of course will be to try to find one of these methods that we're looking at and take it down the road toward a real time monitor. And the key parameters we'll be looking at are the accuracy of the method, the sensitivity of the method, and the potential size of the gadget that we could develop.

And for FTIR right now, it's pretty accurate, pretty sensitive. It's about the size of a lunch bucket or so. It's not really belt wearable. We would like to imagine that we could get there if we chose that horse to ride.

LIBS, not as accurate for organic for sure. Super sensitive which is its biggest bonus. Size of a microwave right now. There exist smaller versions of laser spectrometers, and we're actually looking into those to try to borrow some technology from them to shrink ours down. That's a whole other long story, but we're not throwing that out yet. And we're also thinking about looking into Raman and attenuated reflected spectrometry, maybe something else if we think of it.

If we go down the road with any of these, toward a real time spectrometer, we'll want to figure out a way to easily collect a large quantity of aerosol in a really big hurry. It we're going to do a real time monitor, we want to collect enough aerosol to actually measure it within seconds or minutes. And that's going to be a challenge. And then also the substrate that we use has to be such that it won't impede the quantitative process.

So those will all have to be studied. Once we take kind of that set of data, we're going to look at finding a company who's interested in developing an instrument, create it with them, and develop a prototype, hopefully license it. That's our goal.

In conclusion, FTIR LIBS are looking good. A little work to be done on standard OC. We'll have to explore the confounders. We do have a lot of more mines this year than we did last year and then

possibly explore other options. The goal, of course, is an actual field portable device that can mimic the 5040 method.

So questions, or you can answer my questions. I have a bunch of questions for you guys because I would like to hear your thoughts if you have any on what we're doing, why we're doing it, whether it even makes sense to do it.

CHAIRPERSON NELSON: Good. Thank you very much, Art.

DR. ART MILLER: Sure.

CHAIRPERSON NELSON: Any questions, comments?

MR. WATZMAN: Let me start with, does it make sense to do it? If I understand this correctly, this is geared towards the metal mines, not coal.

DR. ART MILLER: I mean, that's where we started and that's where it really is geared. But there's no reason why it couldn't be -- well, there are some reasons. You know what they are, right?

MR. WATZMAN: Yes.

DR. ART MILLER: But I don't think it's out of the question.

MR. WATZMAN: That's a loaded question.

DR. ART MILLER: Yes.

MR. WATZMAN: But the reason I asked the question, Art, is because my sense and you talk to mines and other people here talk to mines is my sense is that I can't tell you how quickly it's going to happen. But the underground metal mines are looking to alternatives to diesel. And they're looking very seriously, and some are already heading down that path.

So that's the question I have is the relevancy of this. If its application is somewhat limited, knowing that the future for underground metal mines is not diesel equipment, even the big diesel equipment manufacturers are now bringing online suites of electric equipment.

DR. ART MILLER: Two answers to that. One, I totally agree with you. That's why I wrote that right here.

MR. WATZMAN: Yes.

DR. ART MILLER: Second answer is this one. This thing, if we went with FTIR, even a little bit if went with it. But definitely FTIR, we can measure both diesel and silica at the same time. So that kind of puts that question in a different light --

MR. WATZMAN: Yes.

DR. ART MILLER: -- and makes it maybe more viable. And that's actually one of the reasons why I'm still doing this. I probably would've thrown in the towel on it if it weren't for that because I think that there's some possibility there. And in fact, today when I was listening to the presentation earlier about coal dust and silica and the PDM, I'm thinking that device right here, FTIR, could measure coal dust, diesel potentially, and silica all at the same time and could potentially be belt worn. So that throws a new angle at everything.

MR. WATZMAN: True.

DR. ART MILLER: Jeff?

DR. BURGESS: It may not be as pertinent perhaps to mining. But I will say that for the general population level exposures, you can get something that gives you accurate measurements around five which is more or less the California standard again for general environmental exposures. Now it can be used in ports. It can be used at surface mining applications, et cetera.

And sure, they'll be moved towards electric. But now you've just opened up a much larger area. And honestly, the 160 micrograms per cubic meter was a standard set on what was achievable. It wasn't necessarily set as a health standard. So I think you have to anticipate that at some point that level will come down as it's achievable to reduce the exposures. So I think again this accuracy -- precision and accuracy at lower concentrations is something that would be widely applicable.

DR. ART MILLER: I have two different collaborators, one at Seattle U and one at UC Davis. And they're both really interested in atmospheric monitoring. And that's their interest in collaborating with me because they are trying to develop something very similar to this to real time monitoring of the atmosphere as opposed to taking a sample and sending it in which they do.

MR. WATZMAN: Yes.

DR. ART MILLER: So yes.

MR. BOWERSOX: The Tier 4 engine, what's that at right now?

DR. ART MILLER: I don't know the numbers. But the way I like to think about it is when I started doing diesel research in the late '90s, I would walk into a mine and there would be, like, a milligram or more diesel in there. And now we've come down to, like, 100. So by a factor of ten, right? And a lot of that was due to engine technology. Now, with Tier 4, we're going to be down to another factor of ten in terms of the cleanliness of the engine. They're extremely clean. They're, like, 100 times cleaner than what was running in 1990s.

So another thing that I always think about is NIOSH -- But NIOSH developed all this incredible research about diesel 20 years ago. And the engines that are in use today are nothing like the engines on which that research was made. So that's just a little side note.

MR. WATZMAN: But remember, Ron, the Tier 4s aren't going to come to mining that quickly.

DR. ART MILLER: Yes, yes.

MR. WATZMAN: The off road market is truly the tale of this.

DR. ART MILLER: Yes, and that's why I think that I kind of threw that up there. How long is it for Tier 4? It's going to be a while.

MR. WATZMAN: Yes.

DR. ART MILLER: For electrics, it's going to be a while. If we accelerate this effort, we might actually see some use in mind, yes. But I agree. As a scientist, part of my drive is that there's other people out there that want this kind of technology and are excited to work with us and collaborate with us on this kind of stuff. And all four of the last papers I wrote, I had collaborators from outside NIOSH that were interested in this.

DR. AUBREY MILLER: That would be my comment, what Jeff was saying. I think you have a wide interest in the community and across environmental health, et cetera, in air studies and investigations. I think you'll find a large uptake.

CHAIRPERSON NELSON: Okay. Thank you very much, Art. Casey, you're up next.

Opioid-NIOSH Research - Dr. Casey Chosewood

DR. CHOSEWOOD: Great. I appreciate everybody being here and obviously giving up your time to NIOSH is definitely very much appreciated. It's great to meet some of you that I've heard your names before. So to see you in person is great.

DR. CHOSEWOOD: I've been, at least for the last ten years, at the worker health program. So I was really happy to hear Jerry's presentation and see a lot opportunities and avenues for really close collaboration there. And I think opioids is a really additional great example of how it is so important for us to take a look at both work and nonwork factors when we're considering the work of a population -- the health of a working population.

So this is, I think, a really great opportunity for us to further understand how people are not a work self and a home self. They're one person that comes to work every day. And there's a tremendous amount of overlap and challenge that we bring from those two areas of our lives into the workplace. And opioids I think is a really good example of that.

So my goal today is to tell you a little bit about the NIOSH framework and to set the stage on some of the work that we're doing currently, some of the traditional work we're doing and then maybe some of the new work we're doing in this space.

DR. CHOSEWOOD: Let's try this. Just a quick refresher on Total Worker Health for those of you who already know about our program. We certainly want you to learn more about it. The bedrock, the foundation of Total Worker Health is, you have to keep workers safe, right? It is lawful that workers who come to work in the morning should go home with the same level of health with which they arrive. That's protecting their health and well-being throughout the day.

But we think that there's an opportunity missed if you don't take that a step further. So Total Worker Health says, yes, you've got to keep workers safe. But there's really benefits for the worker, for their families, for our economy, and the organization itself if you take that next step and establish those work-specific policies, programs, and practices, the 3 Ps of Total Worker Health that grow the health of those workers. That's good for them, their families.

And if they go home at the end of the day with more health than when they arrived, they bring that back to work the next day in the form of increased productivity, decreased risk for injury and illness, more engagement, more likely to be retained in that work for a longer period of time. And more control over the working life span, how long they may chose or need to continue to be employed. So that's really the promise of Total Worker Health.

We have this sort of common catchall metric that we're interested in at the end of the day that we're taking, I think, some good strides to better define, and that's this concept of worker well-being. So if we're keeping them safe through the work they do and we're investing in their health throughout the day, how can we grow their overall well-being and what are the best ways to measure that?

So soon, we'll be coming out with a survey tool that will actually allow both individuals and organizations to measure the overall well-being of their workforce and to break it down into certain components where they know how to intervene if that number isn't where they want it to be. So we'll come back and tell you about that survey when it's ready to hit field.

You guys already know this, but we already know that work is extremely influential and it's important things as people's health trajectory through their lifetime, how long they're likely to live, their experiences with the medical system, all extremely related to the job they do.

One that I would just put on your radar is this bullet here. Work equals time away from other pursuits. And this is especially true for low wage working populations.

If you have to piece together a number of jobs in order to create a living or to provide for you and your family, that means there's a lot of time at the end of the day taken away that could normally be invested in health pursuits, like adequate physical activity, like shopping and preparing foods that are healthier for you as opposed to just grabbing fast food on the way home from work. Time away from important meaningful relationships with family, with loved ones, with a social network that we know is extremely important for our health.

So work that really consumes so much of our time, we call it time poverty, is a significant risk for the overall health and well-being of our population as a whole.

I told you about the 3 Ps of Total Worker Health, programs, practices, and policies that integrate protection from work-related safety and health hazards with promotion of injury and illness prevention efforts to advance worker well-being.

So what about this connection to this opioid crisis that we're in the middle of? We know that opioid use has both work and nonwork implications and certainly those in both those environments are impacted by a significant number of workers who have substance misuse disorders. And the potential for addiction may be preceded by injuries that happen in the work place.

We have much better understanding of this second bullet now than ever before. Some of the studies that I will share with you directly draw the connection between those occupations in industries that are most hazardous with also very, very high risk of substance misuse and opioid overdose death. So this is an important finding from some studies that have both been done at NIOSH as well as some of our state partners.

A couple of quotes from Dr. Howard. A worker's interaction with and exposure to opioids can take many forms, from risk factors like excess stress on the job, job loss and pain that lead to potential opioid abuse to workers who are accidently exposed to the drug when working to detect and decontaminate an affected area.

So here, you really see two populations of interest to NIOSH. The first, all workers who have the risk based on certain working conditions to have initiation of opioid use and then the potential for misuse as well as those workers who have to enter crime scenes, overdose scenes, places where drugs are being manufactured, repackaged, reprocessed, and the potential exposures to those workers.

The potential for addiction can be preceded by injuries that happen in the workplace with the consequences of it affecting an individual's work and home life. Clearly, certainly the case that we're seeing.

In fact, if you look at the gateway to illicit substance use and you look at the drugs that are responsible for that trend moving to heroin and misuse of prescription drugs, it isn't marijuana as the gateway drug as was oftentimes predicted. It's prescription opioids very much the gateway drug to illicit substance abuse.

And then lastly, it says, NIOSH has collected data, conducted research in field investigations, and is committed to the principles in Total Worker Health to better understand the epidemic and recommend policies, practices, programs that address specific conditions of work.

So just a quick review. Here, we can see some of the natural opioids. Morphine and codeine are probably the most commonly prescribed and referenced ones in that. The semi-synthetic ones, prescription drugs like hydrocodone or oxycodone. OxyContin is perhaps the most common drug in this class. And then heroin is also considered a semi-synthetic opioid. And then the new ones on the scene, methadone, tramadol, fentanyl, and an analog of fentanyl, carfentanil, these are much more powerful, especially the last two. And now fentanyl is responsible for the vast majority of overdose deaths from opioids.

This gives you some information. First of all, you can see that this is an issue in both men and women, but we can see higher rates in men. You can see that across all age groups, we have an increasing problem. These are overdose death rates by sex for people in the working age group of 15 or older. And we really think this really sharp uptake that we see around 2008 -- rather 2010 through 2012 is because of the arrival on the scene of the very powerful street drug, fentanyl.

Here, you can see that there's some geographic instances in this epidemic. In fact, Appalachia is really considered the modern sort of epicenter of this crisis. And this really points to what we would say is an important antecedent. So why are certain parts of the country more impacted by this crisis than others?

And there's quite a bit of evidence to show that it really is lack of economic opportunity in certain parts of the country that are driving this trend. So places like Appalachia where there is a lot of job loss, a lot of displacement of work, the rust belt, areas there was tremendous impact from the 2008-2009 recession. That tends to be where we see highest rates of opioid overdose death rates. This is definitely still a trend that's continuing.

So also important to know that around that same time that we saw fentanyl become more of a problem, we saw a shift in the number of deaths happening in rural areas compared to urban areas. So this is a very significant shift in the epidemic. And in many ways, because oftentimes rural areas have been sort of not followed as closely, not in the mainstream media, this may have slowed down the actual public health and local and national response to the epidemic in many ways.

Another thing that's absolutely slowed down the response has been the stigma associated with substance misuse in general, definitely a significant issue. Here you can see the drugs involved in overdose deaths over this roughly 20 year period. No doubt about it, synthetic opioids other than methadone, clearly here fentanyl is the leading cause you can see responsible for the vast majority now. About two-thirds of the deaths now in more recent data are responsible for these very powerful opioids compared to some of the others here.

So if we take a look nationwide, drug overdose death rates especially from opioids continue to increase. You can see more than 630,000 people have died from overdose in this period of time. The rate of

deaths per year now exceeds the deaths for motor vehicle accidents. It also exceeds the number of deaths from HIV at the very height of that crisis.

So we're talking about a very serious, significant number of deaths. And about two-thirds of the 63,000 drug overdose deaths in 2016 involved an opioids. So of all the drug overdoses, opioid definitely responsible for the vast majority of overdose deaths. As you can see, the rate is increasing five times higher than in 1999. About 115 Americans die every day from an opioid overdose. And the number of overdose deaths increased from 42,000 in 2016 to 49,000 in 2017.

You can see that our data is lagging a year or so behind. This is collected from 50 different state systems to come into one surveillance tracking system. And in general, toxicologically related deaths are delayed because of the testing for cause of death.

Let's put it now in perspective of opioids and workers. About 95 percent of the drug overdose deaths occurred in people in the working age group. So this is definitely something that is happening. About 1 in 20 or 1 in 25 people 18 years or older reported illicit opioid use in the past year. So this really represents a good estimate of the number of people in the average workplace, 1 in 20 to 1 in 25 have used illicit opioids.

Now what does that mean? It means either heroin or some other illegal drug or misuse of prescription drugs. That would be captured together in that roughly four to five percent of people in the working age population. And about two-thirds of these self-reported illicit opioid users were employed full or part time.

Thirty-eight percent represents from BLS statistics the percent increase in overdose deaths at work. So workplace overdose deaths reported in 2016 accounting for about four percent of occupational injury deaths that year. That's compared to two percent in 2013 roughly.

So we already talked about how opioids are oftentimes prescribed initially to manage pain from a work injury. In fact, some of the reports that you were sharing with me earlier some of the stories from workers really squarely put that as a major risk factor for initiation and then ongoing misuse of opioids.

Prescription opioids can be certainly associated with risky workplace conditions, slips, trips, and falls, heavy workload, and also increasingly more evidence now that jobs that have more insecurity or precariousness built into them. We also see evidence of increased rates of drug misuse and overdose. So this would include lower wage work and hazardous work in general.

Let's take a look at some of the data. This is an MMWR article, and I'm going to tell you. We are specifically going to look at PMRs or proportional mortality ratios so that we can start to break down are there occupational or industry differences between the rates of overdose deaths. Take a closer look.

And this is the one that someone referenced earlier where it shows that construction and mining have high rates of fatal opioid involved overdoses. So first, let's take a look at what PMRs are, though.

So let's say PMRs, this is the proportion in yellow of let's say accountants given the way this figure is dressed. He died of opioids. Okay? So this is in yellow the proportion, if you will, of accountants given the look of that individual with the briefcase who died of overdose.

We're going to divide that by the proportion, the average across all workers, the proportion that had died. And this represents the PMR, the proportional mortality ratio. And that's how the statistical analysis was done for the MMWR.

This used national occupational mortality statistics. That's data that's collected by NIOSH, the National Center for Health Statistics in about 22 states that participate in this. So it's not national data, but it is from 22 states. And here basically are the results.

PMRs from drug overdose were highest for six occupational groups. Construction was the highest followed by extraction. This included both mining and oil and gas. And you can also see in parenthesis the type of drug that was most commonly involved in the overdose death, and that varied also by occupation as well.

And then these next four were also elevated above the average rate across all occupations including food preparation and serving, health practitioners and technical occupations in the health care setting, health care support, and personal care service. They also found that the PMR was significantly elevated for those who either engaged in unpaid employment or were unemployed as well.

Let's take a quick look at the Massachusetts finding. They also did a similar study looking at opioid overdose deaths in this five-year period between 2011 and 2015 in the state of Massachusetts. And they found some pretty dramatic differences.

Construction, again, six times the overdose opioid related death rate than the average of all occupations. Agriculture, forestry, and fishing was roughly four to five times higher. Specifically, this was a large group of fishing workers, people who did ocean going fishing. They also found elevation, though, in transportation and warehousing, admin support, and accommodation and food service as well.

So clearly, there seemed to be some connection between the overdose death rate and occupations themselves. They took it a step further, though, and they looked at the association of these higher opioid overdose death rates with the work related injury and illness rates. And they found a strong correlation.

So in those occupations where they had high rates of work related injury and illness, they had high rates of opioid overdose death. Rates were higher when workers in occupations with low availability paid sick

leave, lower job security. And it raises the question, do the employment arrangements and unemployment have something to do with this hopelessness, with this lack of opportunity that may be driving part of the opioid epidemic as well.

This bullet here really makes you think that oftentimes people who are in pain may take opioids in order to be able to report to work each and every day because they don't have paid sick leave. So they must go to show up for work even if that means taking a pain pill to be able to do so.

We think this is really calling for a more comprehensive view of how we look at the opioid crisis. What really started as probably getting some of its origins in the undertreatment of chronic pain and then maybe a sort of reversal to overtreatment of pain in general, overprescribing of pain medications by the medical community really now has evidence that there's some occupation, some social, structural, and economic antecedents that are at play.

And we're clearly seeing the shift from typical drugs to far more dangerous ones, illicit fentanyl and its analogs. And many believe that this shift from prescription related overdose deaths to these illicit ones is largely because of now the new prescribing guidelines that are tightening the supply of prescription drugs in general in the nation. So that's leading people --

MR. ZIMMER: We've created our own monster with that.

DR. CHOSEWOOD: There you go, so --

MR. ZIMMER: Because a lot of people, even the ones that I deal with, that have been long-term opioid users correctly.

DR. CHOSEWOOD: Right.

MR. ZIMMER: Taking a prescription and never know. And the doctors are getting scared. They're cutting off the prescription, and now they're turning to different avenues to get it.

DR. CHOSEWOOD: Right.

MR. ZIMMER: And I don't know about any of you, but I never met a drug dealer that has a quality control department. And that's what has happened, with a lot of what construction does.

DR. CHOSEWOOD: So the legal supply, if you will --

MR. ZIMMER: Yes.

DR. CHOSEWOOD: -- dries up with --

MR. ZIMMER: It dries up and they go to the illegal.

DR. CHOSEWOOD: -- our intervention, with our prescribing limits and interventions. And then that forces users into street supply where there is no predictability about the potency.

MR. ZIMMER: Typically, the chain goes legal, buying legal prescriptions illegally, that drying up for a dollar a milligram. So that dries up. They can't fund that anymore. And then the drug dealer says, well, I can do it cheaper. Here's heroin. And of course, obviously, you don't know what you're getting with the heroin. And they're doing it much cheaper, and the doses are all over the place with it. And then it's --

DR. CHOSEWOOD: Yes, in fact, most of our HHEs, we go into a setting to investigate exposures in a health hazard evaluation. What we'll find is illicit mixtures of drugs. So both opioids including heroin and some of these more powerful things like fentanyl as well as stimulants, cocaine mixed in. In fact, it's common to combine the two so that you can stay awake and enjoy the high longer or take higher doses of the opioid if you have a stimulate on board as well.

CHAIRPERSON NELSON: Where does unemployed show up in your previous slide? Is there a very high rate in unemployed people?

DR. CHOSEWOOD: Yes, absolutely so. Both the Massachusetts' data and the earlier MMWR show correlations with unemployment as a significant risk factor.

CHAIRPERSON NELSON: I'm struck by 1999 to the present, the idea of a number of military activities that have returned people to the U.S. Is that a separate thing that needs to be thought about?

DR. CHOSEWOOD: Yes, it's interesting. I don't think either of those studies specifically looked at that issue. But if you think about it, after Vietnam war, we had a significant heroin addiction problem. And there was definitely a high usage rate. PTSD is definitely recognized as a risk factor for opioid initiation and misuse.

CHAIRPERSON NELSON: With Iraq and Afghanistan, I'd imagine.

DR. CHOSEWOOD: Yes, in general, the Department of Defense has been sort of on the leading edge of some of the early interventions for opioid misuse. Some of the new therapies and treatments have been piloted there. So absolutely I think they recognize that it's a significant challenge as well.

Let's pick up speed. So this is a quick overview of the NIOSH framework. If you look at the bottom, sort of the baseline, this is where NIOSH has really traditionally been. Protecting workers and responders, so police and fire, EMTs, law enforcement officers who have to go into these crime scenes.

So what kind of personal protective equipment do they need, how do they protect themselves when they're exposed to these dangerous substances on the job. And then helping us develop better methods for detection and decontamination. Because it would be great to have a real time way to see if

a powder has fentanyl in it, carfentanil, if it's heroin, if it's cocaine. Having that information would be really valuable in real time.

And then the upper is sort of I would say newer work for NIOSH, identifying these antecedents if you will that are related to occupation industry, what type of employment, unemployment, and how they are contributing to this crisis. And then helping better understand these risk factors and developing interventions to address them.

We're taking a life cycle approach from antecedents all the way to decontamination of workplaces. So determine those antecedents as I've been mentioning, identify opioid use conditions that affect workers. So we're specifically now developing a few documents around drug testing and medication assisted therapy, the primary treatment for misuse and how those impact employment and working opportunities.

We developed a naloxone fact sheet for those workplaces that want to have a naloxone rescue program to treat overdoses there in the workplace. We're developing strategies for protecting and assisting workers involved in the opioid crisis response, how an employer or a responsible employer can help instead of just fire someone. How they can actually help them through this process. Labor partners, really strong in this area. And then continue to develop those methods for detection and decontamination and protecting those front-line workers.

We're going to continue to obtain relevant data to characterize and address the crisis in workers. We're already shown you a couple of examples of doing that, but we need better surveillance systems, no doubt about it. And we have this data delay and lag, so more funding is coming from CDC around surveillance. And examine those work related factors and exposures as direct risk factors for opioid use.

In general, the public health response has been not to look at work as a significant contribution here to the crisis. We see strong evidence that it is.

We'll continue to do the bread and butter of NIOSH to conduct those investigations. We have more than a dozen active HHEs underway related to law enforcement, first responder exposures in the field for these dangerous substances. We're developing methods and approaches to keep those workers safe. And then continue to develop information, fact sheets, other useful tools that employers can keep in mind. Find better ways to transfer those.

I mentioned the Naloxone document that we released about two months ago. Within the first week, it was downloaded 3,000 times. So there's a tremendous amount of interest in this kind of issue.

We hear case reports of people overdosing at work on a regular basis. They're found in restrooms. Parking lots are common places for people to be found. Public places that are workplaces like libraries,

fast food restaurants, those are also common places where workers are called upon to intervene when a member of the public comes into the workplace and overdoses.

We have, as I mentioned, 12 active field investigations ongoing. About 6 of them are published and you can read the reports. And these would be of particular interest to our first responder law enforcement community.

We mentioned the important change in the number of deaths. Fentanyl is extremely important, 50 to 100 times more potent than morphine and also no quality control. So once it's a street drug, there's no way to know how much is there, has it been cut, how potent is it. This is really the game changer here.

There's also reports that drug dealers will spike the first dose or two sold to someone with fentanyl so that their demand for more increases more quickly. So they call it hot packing the dose so to speak, so that then they will come back trying to sort of recover that first very potent powerful high.

And when you have in a community people who overdose, other users try to seek out the dealer of that victim so that they can also experience a higher dose. So we're dealing with a fairly difficult setting in which to intervene.

Just again showing that dramatic increase when fentanyl came on the scene. Most fentanyl illegally comes from China, some from Mexico, across the border illegally imported, very little made here in the U.S. China, South America, and Mexico are the main sources for that. We do have the fentanyl web page because it is so important. This is largely, though, geared to how to protect first responders, law enforcement who might be exposed.

And then the naloxone document that I mentioned earlier. This is the rescue drug that can either be given by injection or nasal spray. NIOSH is recommending that if a workplace chooses to have a naloxone program that they go with the nasal spray. That's just one less needle to worry about, a blood borne pathogen exposure. And we have some research that shows that people are more apt to intervene with a nasal spray than with an injection.

But for those who are interested in that, we have developed a number of resources around these, both fentanyl and naloxone. You can see some of our other web pages, one on data collection, the field investigations, our ongoing research, and some resource pages.

This just shows you a screenshot of all the resources that are available currently. We have at least another six, eight documents under development now that will be added to the web pages.

We also have an archive webinar that featured the Massachusetts report that I just shared with you, Dr. Tish Davis and Chris Cain from CPWR were our main speakers on that. This is archived and available and it really does a good job of diving deeper into this relationship between occupation industry and the risk for overdose death.

So with that, let me pause. See if you have comments, questions.

CHAIRPERSON NELSON: Thank you. So I keep thinking about the show House. And I wondered if there was any influence from House of a totally non-desperate use --

DR. CHOSEWOOD: Right.

CHAIRPERSON NELSON: -- of these drugs.

MR. CHOSEWOOD: Yes, it's amazing. There are many would say the medical field in general is quite culpable in this crisis. Others would say pharmaceutical companies are really incentivized. The prescribing and overprescribing of these drugs is involved.

You may recall that for two decades that the AMA, the American Medical Association, said that we were really doing a bad job of treating chronic pain and that pain should be added as the fifth vital sign.

So whenever you had a patient come in, you'd either want their blood pressure. You would take their pulse and respiration. And the fifth vital sign was, are you in any pain? And it was below the standard of care if you didn't take steps to address that pain.

So we have this tremendous push in the medical field to prescribe and to treat. And then there was the backlash, as you know, when the prescribing tightened. CDC just released prescribing guidelines that are really quickly being developed as the standard of care and malpractice. And that dried up the legal supply for many people as Kyle mentioned. And that's certainly probably part of the issue.

DR. AUBREY MILLER: Okay. So it's my understanding too that this comes across all socioeconomic --

DR. CHOSEWOOD: Absolutely.

DR. AUBREY MILLER: -- categories. But how does it stratify by race, African American versus Hispanic? Does it seem to be predominant in particular groups, or is it pretty much equally distributed? What's the kind of trend?

DR. CHOSEWOOD: Really great question. In general, this is a white problem more than any other race or ethnicity. And there's some interesting reasons behind that. Partly rooted in some institutional racism in the medical community because -- exactly. They were more apt to give larger, longer, and prescriptions to white patients than patients of color. And that's an interesting finding. It's one of those places where racism in some way protected a segment of the population against this crisis. But that's an interesting side note to the epidemic.

MR. ZIMMER: Do you want the street level look at that? I had an opportunity to talk to a person in recovery who was from the inner city. He was a drug dealer. And his explanation to why that

separation is, is because the people in the inner city have been doing it for years. They know what it can do to you.

Now as elementary as that sounds, it makes sense. They know what will kill them. And he explained it when him and his brother were mixing up batches, there would be one for the people in the neighborhood, and there would be one for the kids coming in from the suburbs. And kids in the suburbs wanted the bang for the buck. The other ones maintained. Think about that for a minute. That's pretty powerful.

DR. AUBREY MILLER: That is. That's interesting.

MR. ZIMMER: And you start to see that in the data that's coming out now.

DR. KRAMER LUXBACHER: When you showed the rural versus metropolitan plots --

DR. CHOSEWOOD: Yes.

DR. KRAMER LUXBACHER: -- there was a decrease right after the big spike in the rural. Do you know what you attribute that to?

DR. CHOSEWOOD: I'm not sure about that. I don't know any additional details than what I shared on that. Let's take a closer look --

DR. KRAMER LUXBACHER: It was early on.

DR. CHOSEWOOD: -- if we can find it.

DR. KRAMER LUXBACHER: It was the gray and black. See that big decrease right before it starts back up? I just wondered if there was --

DR. CHOSEWOOD: Yes, you don't see that in the large metro areas that same sort of decrease there. So I'm not certain what that is. There have been cases where there were some disruption of supply rings in certain areas, big arrests in the Baltimore area and in the western part of the state of Virginia that temporarily dried up supply in some of those really heavily impacted areas. I don't know if that represents that change or not.

DR. AUBREY MILLER: So in terms -- I mean, that's what we're measuring. But the morbidity must be outrageous, right? There's 630,000 deaths during that time period. Do we have any feel of what that ratio looks like? Is it ten to one?

DR. CHOSEWOOD: There have been some national surveys that have been done around just drug use and health in general. In fact, SAMHSA and other parts of NIH do specifically ask those types of questions. The data I've heard if you look at just sort of the burden if you will of the disease would put it on par in our medical GDP, our spending to that of diabetes. So that's significant.

They estimate that there are roughly 25 or so million people with diabetes and 25 million people who misuse a substance of one type or another. Now that's not only opioids, but that will give you a sense of the scale of this issue. And you saw roughly four to five percent of more than age 15 population in general is misusing a substance of some type.

CHAIRPERSON NELSON: Okay. We have to move on. This is something that certainly can be a part of the working group, though, in terms of thinking about worker health.

DR. BURGESS: Yes, I think it would be really nice to have information about your plans for actual intervention. So these were all descriptive data, very useful. But to really get that idea, where are going to go next as NIOSH for this particular issue? Are you going to do partnerships, what you have in the hopper?

DR. CHOSEWOOD: Right.

DR. BURGESS: That's the stuff where I think we really need to hear that --

DR. CHOSEWOOD: Great.

DR. BURGESS: -- for a future presentation would be fantastic.

DR. CHOSEWOOD: Super.

CHAIRPERSON NELSON: That's great. Thank you, Casey.

DR. CHOSEWOOD: Thanks a lot for the input.

CHAIRPERSON NELSON: Okay. We're going to keep on going. Robert Glen? He's not here. So we're up to Kray. The famous working group report. Wait, We need to switch the order, Ms. Bellanca will be next.

Virtual Reality for Mining Research - Dr. Jennica Bellanca

MS. BELLANCA: Well, thanks. I'm real happy to have the opportunity to talk to you guys a little bit about some of the work that we're doing. Will and I are here. We have the demo set up. So only a couple of you guys got to try it out. So we'll hang out to be able to do that sort of depending on timing.

Some of you I know got to see it at the proximity partnership work two weeks ago or so. But for those of you who haven't, I encourage you to stop by and check it out on one of the breaks. But I'm just going to sort of talk to you a little bit about all of the rest of the work surrounding virtual reality that's going on in our working group, particularly with the human factors branch. We've done a lot of work collaborating with different researchers on site there.

And there's me. There's my superimposed picture. So I really want to start out with underscoring the point of why do we want to use virtual reality now. We've been talking about it before. I'm sure you've heard plenty of presentations, things we've done in the past. But what I think is really important is that right now we're actually getting to the point where, from a hardware standpoint, technology is there and really useful to be able to do what we want to do at the fidelity level that we want to do it.

In the past five years, head mounted displays have more than tripled in resolution. So you can actually see. You're not looking at a pixelated image. That's really helpful for immersion and actually using this. And 50 percent faster, rendering speeds are twice as fast. And video cards have three times more memory. So there's a lot of advances that have come across that make the ideas possible now that weren't possible before.

And from a software standpoint, we've really had a lot of improvements too. We've had improvements in lighting, physics, and fidelity thanks to support from the entertainment and gaming industry. We've had a lot of mainstream commercial development. And we can really use that and leverage that in a research domain as well as the applied domains for the mining industry and others.

Now here is just sort of a picture of some of our rendering capabilities. The backdrop you see here is just an image from our mining environment that we walk around. And the call out there is a render, not a picture of the cab of the model that we made. So there's really a lot of capability in this software that improves the fidelity of how it looks. And that's important in some aspects and not as important in others. But we need to have some baseline capability to be able to make this stuff effective.

Another sort of driving factor behind virtual reality now is that the industry is starting to become a little bit more mainstream. We're getting some uptick by large companies and acceptance by large companies. These are just two examples that I threw sort of on the backdrop here.

But as virtual reality is becoming more accessible, we're able to use it for more purposes. We're able to integrate sort of this visualization, co-visualization into design, planning, and monitoring within the mining industry. And that's taking advantage of lots of different use cases and realms that haven't previously been thought of or really been used for virtual reality basis.

The two examples up here is this one where they're using a 3D environment to co-visualize data. That's something we've been talking about, but now they're using it sort of on a high level. And they're also just using it as part of their design planning which is up there, Dassault Systèmes as well.

So just a reminder of some of the things we and our collaborators have done in the past. We've typically used virtual reality for training. That's been the main focus kind of coming out of our work, the work here, University of Arizona that's kind of based on some of the NIOSH work. And I think that we've had some success.

The BG4 Benching Trainer, we had a lot of uptake by the mine rescue workers. And they really love it. They love the availability of the software to pick up and access to pieces of equipment that they wouldn't otherwise have trainers and decision making moving forward. But I think that now given where we're at, we can begin to move forward and use this in many more ways.

And to take advantage of virtual reality, we need to understand sort of what we can do differently to be more efficient and effective with this technology and with this work. And like everything else, there are barriers or challenges, if we'd rather say it that way, to using virtual reality in research and in the mining industry.

And one of them is time and resources. If any of you have ever worked on or been a part of some of those training products and developments, we know that it takes a lot of people and a lot of time to sort of get it out, get it up and running.

And there's also issues with life cycle support. Sometimes, especially with government development, by the time you're done, it's antiquated. Nobody wants to use it. Wow. Games don't look like that anymore. You guys just spent three years, and we don't like it.

So it's really sort of a challenging problem for us, and it's something I think we need to take into account and understand as we work on developing products in this realm. And so some of the solutions that we can do to combat these barriers are really improve our strategic development.

We need to work together and have collaborative development, whether it's just with us as NIOSH, with our university partners, with the industry partners that are out there. Take advantage of other industries like Department of Defense that are doing this work to be able to streamline the application.

So we're not building just a one-off, here, this is a great trainer for mine rescue. This is a great trainer for this. If we can do it in such a way as we've created a workflow or an environment where when a need arises, we can very quickly meet that need and get it out to the right people as well as make sure we have the right communication to do that quickly.

Because sometimes we just don't know. Hey, where would this be a good use? Art and I, we were just talking about some of the other uses and that's kind of why I'm happy to talk to you guys today. Can we get some more ideas on how we can best leverage some of the work that we've already done in this area to improve the efficiency and return on investment for the assets and software that we've already developed?

Another thing that we can do to help meet this challenge of time and resource is we can support technical skills. So I think this really came out of some of the earlier presentations, not just supporting mining engineering as part of the mining program but supporting other areas of expertise.

Bringing in computer scientists to help us develop this graphic designer and making sure that our portfolio, either whether we're collaborating with them or bringing them into the fold or working with DoD people is really important for us to know and understand that we need these technical people to help us make that connection, whether it's they're doing it with us, they're doing it for us, contracting work, to make that, again, return on investment as big as possible and sort of get out of it the best of both worlds.

So to understand where we can go next, we kind of need to understand what virtual reality is good at doing. So from a very high level, you guys might know this. But I'm just sort of reminding you. From a research standpoint, virtual reality and simulation and modeling in general allow us to do things that are impossible to do in the field.

Sometimes it's just something that you can't do. You can't set the mine on fire and say, hey, have at it, right? That's just not going to happen. And sometimes things are too dangerous or too costly. I'm speaking of self-escape and MRs because I have a lot of experience in there.

But similar to that is it's very difficult and time consuming and costly to have MRs every year. But can we create some of those things, do them in simulation, or do them in part in simulation and build them into a larger scale program that couples simulation and modeling with real life training or real life experimentation?

And so taking those ideas specific to research, I think it's sort of important to understand that modeling and simulation can be used for various purposes. Some of the big purposes that I've identified and others in the field are talking about is this idea of using modeling simulation for data collections, whether that's human subject behavioral data collection or iterative simulation that we already do, the CFD modeling that we do for ventilation, anything. It can really be linked with a huge visual component of virtual reality.

Virtual reality can also be used for communication pieces. So as we are looking to make our scientific work more intuitive and understandable for those in the field, we can take advantage of it and say, hey, I don't know what proximity fields look like. They're invisible. How do I make that real for the mineworkers? Well, let me show them. I'm going to show them an invisible concept, which is I think really a powerful way to think about using it more as like an end product.

And another option is intervention. So this is training, but this is also anything else from a visualization communication that we can roll up to do so. And some of the very specific advantages of using virtual reality for this is that from a data collection standpoint, it allows us to have increased measurement capability.

So when you're in the lab, if you use modeling simulation or not in the real field, you can equip them with more sensors and have a better understanding so we can ground our data better. So from a

research standpoint, that helps us. It's great to have field validity and talk to people. But this allows us to have a specific measurement to go with it and have everything synchronized and coupled to increase our scientific rigor.

It also allows us to increase control. So we can, I suppose, do observational field studies. We can expose people to the exact same situations that might allow us to make more clear inferences from the data and it's sort of important from that standpoint.

Virtual reality can also be used to enhance engagement. So this is sort of the idea of serious games and gamification, but also just sort of diving into what we're doing. Sometimes when you're talking to somebody or just asking them to do a simple task, it can be very boring. So if we enhance the fidelity or enhance the immersion, we can increase the behavioral response, increase the investment that our participants are interested in doing and possibly increase their benefit outwardly.

We're looking to do data collection from a research perspective. But they might be using it as training. Though it's not intended as training, we're providing them with direct experience with situations that they wouldn't have otherwise seen in the field. So partnering this to make sure that their stakeholders are getting as much out of the partnership with us as we're getting out as well.

And another thing is to sort of improve validity of our research. So as we increase the realism, we are looking to increase the ecological validity of our research. We're not asking people to move blocks in the lab. We're actually asking people to run a roof boulder. So it's that level that we might not be able to do in the field, but this is closer. So it gives our data a little bit more credence in the end.

And then from the co-visualization standpoint, again, it increases the accessibility and intuitiveness where people have data overlaying on top of each other. And it allows us to increase collaboration. So because it's more available to people of different disciplines, that will help improve us work across our silos.

So not just this is an engineering output. This is what it looks like. It's really great for the engineers. But if you want some behavioral piece, it might be a little bit more difficult for some of your psychologists to understand that same viewpoint. If we can make it more intuitive and make it feel more realistic in that standpoint, we can improve that work and allow people to understand better what one person is talking about.

So sort of our efforts in this domain have been in development of what we call VR Mine. And this is really sort of a workflow that we've been working on. So it's a lot of the base development that will allow us to respond quickly. It's not so much as developing one particular simulation but developing sort of a Unity project, the underlying code, and the tools to be able to build a mine quickly. And I'll talk a little bit more about that.

And I'll talk about that with respect to two research projects that have been mentioned to you guys in the past. The one is the self-escape project that has recently ended. We were actually able to use VR Mine to help visualize and communicate some of the results. It's sort of the idea of the safe competencies which is the main output of that work. And we can walk through it in a little bit.

The other example I'm going to use to talk about the VR Mine is the proximity detection project that RJ also mentioned and that had ended this past year. And we're using VR Mine to look at and communicate interference, unintended consequences, as well as actually use it for iterative deterministic simulation.

So to give some idea, here's the video. This is why these files are so big. So VR Mine is sort of built up of modular components as I mentioned. It allows us to very quickly build mine geometry. And we've included features that allow us to build mine geometry of different levels of rock dust, different pieces, segments. And because we're using this tiled approach, we can very quickly create a mine or a different scenario, a situation based on what we're doing.

We also have the ability built into VR Mine to add in features, different ventilation controls such as curtains. We can place them, see where they're at, make them realistic in terms of positioning, change how they look, if there's any tweaks. We can also do different stoppings with and without man doors, phones. And we're working on sort of building that in, curtains, fly pads.

And if you'll sort of as this, there's a lot of different illumination effects with these. So they weren't just in one thing, but it's built in an environment.

Another capability in VR Mine is the placed cables. So we can place them along the roof, change the slack, have them set up differently, have them drop to the floor. I mean, these are sort of the base features you'd want to find in a mine. And then it's sort of built in. We have the lifeline here along it. We have various different configurations, how they're set up, where they're at, and linked to the machine and the equipment.

As far as proximity detection goes, we have the ability to sort of set up these fields, change their size, and then deform them. Specifically, there's a lot of work with electromagnetic interference that it hasn't necessarily been linked to mathematical models. But we can actually recreate the field measurements and data in our simulation.

So using that sort of workflow, here's some examples of how we're starting to use it. The first one is how we're integrating it with other domains. So in addition to sort of those base features that I walked you through, we've also integrated VR Mine with MFIRE. And here's sort of an example I'll just go through.

But we set up the code architecture so it handshakes with NIOSH's MFIRE simulation. And this is really important because it allows us to actually have realistic air flow which in a lot of the training simulations, it's just been, oh, it just goes wherever it's going to go. This would allow interaction and interface which is really important for human subject data collection.

So if you want them to do something and see the consequences because that's where simulation and virtual reality is really important is that you're doing something and you're actually seeing the feedback. You're watching the simulation change and your actions actually have an effect on the environment.

So in this case, we have the dots you see moving around are moving at the velocity that MFIRE has calculated based on the node network. And the simulation is progressing in time. The colors of the small dots are in this particular example methane concentration where blue is the inert, red is explosive, and then white is none.

So we had, like, a whole inundation of methane at the face. We removed the curtain, watch time advance. You can actually see how that moves and transfers throughout the mine. Sort of overlaid on that simulation, a part of that simulation we have a fire. And the yellow circles you see are the contaminants spread throughout the mine.

We've built this in such a way that if we choose to use another ventilation software, we can. We'll just have to rewrite the handshaking component. We recently met the people from Ventsim. So it is certainly a possibility of any other ventilation software that has a DLL, we could rewrite that. And we wanted to create pieces similar to this in a modular form again so we can meet changing demands quickly. And that's sort of our goal moving forward.

We picked MFIRE because it's a NIOSH product and it's great. A lot of people are using it. If that's not what we need for the simulation, we can easily pick something else to move forward.

Another example of us using VR Mine is actually doing test data. So here we're taking data that we have in the field. We have proximity detection on the scoop that we're driving around in the parking lot. That's super great, and we can use that to sort of validate it. But in simulation, we're actually able to create a model of this scoop and then extend the conditions out so that you would do with any sort of iterative testing.

So what's nice about doing it in VR is we have the mathematical modeling behind it because we're using a validated method. But then we can also have the visualization component which can help communicate the results with that piece.

And so to sort of give you an example, we took it from the field to VR and then we can run however many simulations we want and give people sort of an idea of what changing the zones would be like and understanding the results and the effects.

So in this case, the idea was to look at different factors such as slope, friction, and sizing of the system to be able to give recommendations on what mine operators and manufacturers could do to make sure that they had designed an effective proximity detection system.

And then the example of the results communication. So here you can see we actually have the proximity detection system modeled as the different fields where the yellow triangles on the outside are the warning zone or the slow zone where the proximity detection system actually slows down the vehicles. And the red zone is the stop zone so it actually stops when something enters in that.

But what you can see here in terms of communication and results is if you're looking at the face, what we're demonstrating is the fact that the presence of metal actually changes and expands these fields. So how much they expanded and what they're expanded by, we can use a simple video like this to help communicate that idea.

So we know from our research that the presence of the steel plate would increase the zones at least a meter. And our most recent results is the presence of mesh actually increases these fields by approximately two meters in some places.

So what does that mean in context really helps people understand. And this is just an overhead view, but you can see from the head mounted display some simulation that if you're standing at a certain place, what does two meters mean to you. That means that you're in the green zone before the car approaches and you're in the red zone when the car gets there.

And it sort of helps you understand what are the mechanisms behind the problems that you're having, what you can do about it as a mine operator. Because I know we have sort of a history in terms of the communication of, well, the mine operator says we're having a problem. Oh, it must be EMI because that's my buzz word. And then we do the research and we say, well, this is really what's going on.

A piece like VR or some sort of visualization mechanism put in between helps people understand. So the engineers aren't like, why are you blaming all this on everything and it's not true? And then the people in the mine are like, why are you not listening to us? We're having problems.

If we can use this together to communicate results, what they mean and understand, it can help direct further research so we know where is the area that we're not explaining what the phenomenons that are observed in the mine. And our stakeholders can actually take our results and implement and talk to their workers whether it's training or just even improving the understanding so you can get at that culture and get at that acceptance of the technology as you move forward with it. So I think it's a really important piece to what we're able to do.

And sort of related to that, we can use VR to be able to communicate different perspectives. So this is just giving you an idea from whether you're the pedestrian or the operator. You can't really see out of that. And being able to communicate that to different people can also be helpful.

We have the battery hauler first. We have a scoop model running second, just sort of seeing the difference in the fields, and stopping what that looks like. As we're working to improve the realism of the lighting, we can improve this and we can also go that direction with the research as well.

Some of the future directions that we're looking to do with this workflow technology as we move forward. There's a possibility of using it for an organizational intervention. Here we're sort of pitching the idea of being able to use the visualization to improve the pre-shift meeting.

So if we can improve the fidelity of what people are talking about and looking at as a pre-shift, we can help improve their cognitive representation. So we're calling it the VR pre-shift. So it would be something that would be easy to update. They could just update it for the day. Here's the plan. Here are the five cuts you need to make.

And actually showing people what those cuts are instead of just on the math that's on the wall. If you did this, almost every mine operator, not all of them, has a big TV, right? You could just throw this on the TV real quickly, talk to everybody. And you're giving the same message you would give anyone, sort of like the safety pitch.

But by including this visual representation, you're including the fidelity. So that makes it easier for them to understand and remember. You can include more information so they can be exposed to points, landmarks that they might not otherwise be exposed to.

So where is the refuge chamber? That might not be the point of the talk, but you've seen it every day. You see where it sits. You see the big picture. It helps workers do that. It's also more intuitive. Some of our research has shown that map reading is still a problem for mine workers.

And so doing something like this and relating it to different topics could help with that communication piece again. And really it just is by doing it in experiential learning, if you're doing first person or third person, you can have more immersive reinforcement for different ideas behind that. And again, this is just one possibility moving forward of how we can use that either as an intervention or communication of the research that we had before.

Another direction that we're looking to go to is, again, with the improved lighting is we could actually take physical measurements for a part of the work that we've done with this project. We are working with MCI. They actually did the measurements on their lights for us. And we took those physical measurements and were able to bring them into the virtual environment to improve our lighting profile.

Because that's really important as we're working forward whether we're doing data collection, communication, or anything else. If we improve the realism, we can better understand these concepts. Lighting is sort of some of those tricky ones as well, where you have different perceptions and understandings of what that means. And if we can do that through simulation, that can help more people be a part of the conversation and understand what it looks like in simulation and then again in the field.

So my overall take home message to you is that strategic virtual reality development can offer significant benefits to mining. We just need to figure out how to do that and keep collaborating across different workgroups to be able to get the most bang for our buck on this and keep working.

So with that, is there any questions or anything?

MR. WATZMAN: Jennica, when will this be in a form that -- or is or parts of it ready for prime time use by operators today?

MS. BELLANCA: So that sort of depends on how we're working with a project. We submitted a concept or we're in the process of submitting a concept this year how the sort of project cycle was working. We didn't have the resources to do it last call. But if that concept does go through, our proposal would be a year or two. I mean, but we're actively -- while we're waiting for that, we're actively trying to work forward with our partnerships to be able to get pieces of it in different people's hands.

So most recently, we've been talking with Komatsu and especially because we've been working with them directly for the model development to see if we can give them some pieces of it to help with -- they're interested in doing it from a sort of digital twin aspect. So immediately, we can sort of trade with them and get that up to speed. And that's something we're working with.

We've also been talking with university partners about setting up sort of an asset repository so people can use these pieces if you're a university that's also developing it. So with funding and with the direction, we hope we could do it very soon, but --

MR. WATZMAN: I mean, to me, this is something that should be expedited. This is phenomenally powerful. One of the drawbacks that we all knew about and I give NIOSH credit for the money you spent and the facility constructed in Pittsburgh, the virtual reality. But we all know one of the drawbacks is that it's not at the mine. It had limited utility in terms of people being able to get there and actually experiencing it.

And this really now takes us to the next point of taking the virtual reality to the people. And the sooner this gets in the hands of companies and miners, I think this really stands a chance to be a groundbreaking -- no, I'm not kidding -- a groundbreaking endeavor in terms of advancing miner safety.

MS. BELLANCA: Yes.

MR. BOWERSOX: That'd be great for new, inexperienced miners --

MR. WATZMAN: It's unbelievable.

MR. BOWERSOX: -- in training.

MR. WATZMAN: Yes.

(Simultaneous speaking.)

MS. BELLANCA: Yes, to build that, yes.

CHAIRPERSON NELSON: Is any of this going on with any of your grants, George?

DR. GEORGE LUXBACHER: There's supposed to be a grant in here in Arizona. Jeff Burgess has a group that's working on this. They're working on -- and Jennica showed that.

MS. BELLANCA:: Harry's Hard Choices.

DR. GEORGE LUXBACHER: Harry's Hard Choice, they've been working on that. They use a gaming platform. So they're taking a slightly different path than we've taken at NIOSH. NIOSH is using shareware. They're using some software as I understand.

CHAIRPERSON NELSON: Yes, so there's some -- I mean, if you get a chance to check it with Jessica Duschek (phonetic).

MS. BELLANCA: Yes, we've been talking with her.

CHAIRPERSON NELSON: She's not really in the grant that you have, but the idea of the common field of view of people on the ground and people in the lab actually co-communicating, coming to decisions collaboratively, involving building trust that you're both looking at the same thing and can understand it. Also I think the idea of having field experience for online teaching is an integral part of this as well.

MS. BELLANCA: Okay, yes, yes.

CHAIRPERSON NELSON: But I guess what I'm questioning is there's so much work going on right now in so many places, so many fields, it's really the caution is to figure out what isn't being done or what can be pulled together rather than necessarily always inventive.

MS. BELLANCA: Yes, that's right.

CHAIRPERSON NELSON: Because there's so much going on right now.

MS. BELLANCA: Yes, and that's why we're trying to work with -- I mean, so that's why we've been reaching out to some of the manufacturers because they're really interested too in developing assets. And then they use it for their training. Komatsu has their whole training department. They do their own training stuff.

And we're not trying to compete with that. That's not our goal is to compete with trainers. And I think that's sort of a difference with what we're doing. This is again research and leverage to how do we build this out, how do we get people in different places.

DR. BURGESS: Jennica, yes, great stuff. And I have two questions. One was you mentioned kind of partnerships you've had. Do you actually have research results that you've done so far even with the component pieces? Do you have kind of like outcomes of research other than just the development of the product itself?

MS. BELLANCA: In terms of -- so we're in the process of analyzing the results of all the stuff that we did with the proximity detection. So that was using PhysX as a physics model underlying it, doing a whole round of testing with those different variables. That's something we're still fine tuning. So we have it in the analysis phase. We don't have anything actually published yet. But that should be coming within the next couple months here.

DR. BURGESS: So what I would request of the MSHRAC group is that it would be really nice for some of these presentations where we saw the basic concept like the last presentation, too. And kind of have a follow up a little bit about the actual results of it now that we're familiar with kind of the system. That would be really helpful and educational.

The issue that we've been having to deal with our grant and we've had interactions with NIOSH, I'll be very explicit about this is some conflict of interest of commercialization issues that we're trying to work our way through. But I think that this idea that you mentioned at the very beginning of the commercialization plan. I personally don't have a conflict of interest with the commercialization. But the people that work for me in our grant do as you know.

MS. BELLANCA: Right, yes.

DR. BURGESS: So I think that that whole idea of being very explicit about you're generating this. And the idea of commercializing just like we're creating portable diesel particulate monitors is the idea it's going to the production.

So figuring out what that looks like so that everyone feels comfortable with the process I think would be really good unless you plan within NIOSH to continue to produce it and offer it yourself which would be wonderful. But if you continue to have the resources to do it.

MS. BELLANCA: Right, yes. That's why we're sort of exploring how to move forward with that to see what we can do. Like I said, we're just in discussions. We don't have anything set up. But as we're moving forward, we keep talking to people. And I mean, at least our sort of basic motivation and I think one of the big points I was trying to put across in this is I want to talk to you guys because we could just use this for our research right now, too.

So it sort of depends on which way we want to go. We can make assets available for people to move forward with commercialization and talk to them. But we can also keep building it in house and say, okay, hey, here's what we're doing. Like, with proximity, we're doing this.

RJ talked about it at our end of years' this year was we should really be making videos and getting them out there. Like, here's a 30-second clip that people could use and communicating our results in a different way. Because if we can find ways to generate more creative output quickly, that'd be really helpful I think to reaching our stakeholders --

CHAIRPERSON NELSON: So how big is your group?

MS. BELLANCA: -- more efficiently too. What?

CHAIRPERSON NELSON: How big is your group?

MS. BELLANCA: So let's see. We have myself. We have Will. We have Brendan, and then we have Tim and Jason who do sort of the graphic stuff.

CHAIRPERSON NELSON: So I guess what I'm wondering is, I mean, I think what's important here is the mining context. That's what your job is. So to try to think very carefully about where the contributions are that you need to do that others aren't doing.

MS. BELLANCA: Correct.

CHAIRPERSON NELSON: And there's so much stuff going on though that, I mean, it might just be fun to even have some kind of a workshop where you just start bringing together all the people who are doing something with VR --

MS. BELLANCA: Yes.

CHAIRPERSON NELSON: -- in an underground denied environment.

MS. BELLANCA: Right.

CHAIRPERSON NELSON: How is that being used in a dynamic real time way?

MS. BELLANCA: Yes.

CHAIRPERSON NELSON: And that's really what you want to get to. And it's very expensive. You break your budget on the equipment trying to stay up on what is the state of the art.

DR. KRAMER LUXBACHER: But it's becoming so affordable right now. I think it's really beginning to move.

CHAIRPERSON NELSON: Well, the basic vanilla is becoming more affordable. But the state of the art stuff that's moving on, I don't think it's all that affordable right now. And to keep it up, it's almost like surveying. I mean, if you're going to teach surveying with a transit, nobody uses that any more.

MR. WATZMAN: Yes, but let's not overlook. NIOSH can talk and research until they believe they have the perfect. But we've lost the good that they've already accomplished in getting it in the hands of the people that need it. And that's what concerns me that this is going to go on for two or three or four more years. And that's two or three or four more years when we don't have this in the hands of people who need it.

So I think that should be what the focus is. How do we expedite this and get whatever you can through whatever mechanism in the hands of people that need it. And maybe it's not commercializing it. Maybe it's not licensing it. Maybe it's NIOSH making this available to the industry. That's been done in the past on products that you've developed where you make the software available.

I mean, they'll have to provide the VR capability on their own if they want to do it. But you're providing the platform for them to utilize.

MS. BELLANCA: Yes, and I mean, maybe it's making even just modules available for people to use as part of it or something like that with the base. We spent a lot of time sort of laying the groundwork. And this is the idea to make the workflow again.

I mean, so, like, right now, I showed you everything that's all based in underground coal. But moving forward, we sort of are exploring, doing it in underground stone. And that involves material changes. But sort of that puzzle piece, build a mine category. As long as your tiles are the same, could work really well for underground stone. And I think that's why we put the time to sort of do that to make that flexibility in there. And whether it's getting out in videos or something.

Because the other thing I'm concerned about and sort of related to that is how are they going to use it. Because when you talk to people, unless there's going to be full content support, they don't want to invest in even a tablet to be quite honest. I mean, so that was sort of very unrelated to this presentation.

But my work on EXAMiner which you already talked about. When we went out and talked to people about what do you want. Like, what is a useful product for us to be able to communicate to you, their issue was, okay, this is super awesome but it's good for one training. We need things that we can keep building on.

And so unless there's sort of like a threshold of content going to be available by people that's in an affordable range, you have to decide what you want to do. So I don't know if we're not there yet as an

industry, maybe the most effective use is keeping it as a research thing and then supporting people as they're continuing to develop.

I think it's got to be a combination of both because it's a really effective research tool and it's a really effective end user tool and balancing that. And maybe somebody else is moving forward to that. So I think it's sort of an interesting question as to where we're at and who's got what where.

CHAIRPERSON NELSON: So thank you very much. A final question but then we're going to have to --

MS. BELLANCA: Yes, I'm sorry.

CHAIRPERSON NELSON: -- go to break.

DR. KOGEL: I was just going to make a comment, not a question. I think where MSHRAC can probably help us, and following up with what Bruce was saying, is helping us define what the priorities are from industry's perspective. Because I think you've identified we've got all these directions to go. We aren't really clear as NIOSH what would have the most utility and acceptance and value for industry.

MR. WATZMAN: Yes, I think convening a dialogue.

DR. KOGEL: So if we can maybe come up with a way to do that, yes.

MR. WATZMAN: And it doesn't have to be industry-wide. It could be selected individuals. But convening a dialogue to get their sense of where this should go and how they would use it and how best it can be deployed.

DR. KOGEL: Yes, I think that's a great suggestion.

DR. AUBREY MILLER: You can do an RFI --

DR. KOGEL: We can do an RFI. We can do an informal --

DR. AUBREY MILLER: -- type of scenario and get a lot of input from stakeholders, then even do an RFA on it, too. And people can kind of send their ideas in.

DR. BURGESS: And simplistically, for the next MSHRAC meeting, I think have a little bit more time to revisit this again. Now that we've gotten the background, you could get that. You could really spend most of the time talking about applications as well.

MS. BELLANCA: And we're going to -- we're presenting two papers on this work, just like the background stuff at SME. So there will be more room for dialogue there as well.

MR. SEYMOUR: Another example that's off this. We've used the same Unity gaming software in conjunction with Tim Orr and Brandon McDonald out of Pittsburgh to model the Lucky Friday mine. And

there we're trying to compare seismic advance with deformation in the working stopes and stress within the back of those working stopes to try to visually relate what's going on with different cut mining advances.

So Hecla has used that look for demonstrations at their mine site, community demonstrations for just telling people -- explaining to people how their underground mining method works. And they've also come up with a similar program, I don't know whether it's Unity or not, for their new mobile miner.

So they're going to use this software as training for their miners with this new automated miner tool. They'll have it at the mine here within the next couple of years. And that's for the underground metal side. So it's got a lot of uses. It's really important.

MR. WATZMAN: Absolutely.

CHAIRPERSON NELSON: Okay. So we are broken.

(Whereupon, the above-entitled matter went off the record at 3:13 p.m. and resumed at 3:29 p.m.)

MSHRAC metal mine automation workgroup report - Dr. Kramer Luxbacher

DR. KRAMER LUXBACHER: All right, so first of all, Jennica thank you for taking up my slack, I appreciate it; and second, I apologize for not having a draft report to you guys. So what I'm presenting here is very much a first draft. So, I'm looking forward to hearing your input.

All right, so I thought I'd tell you a bit about the workgroup and our charge, a little bit about what we learned in terms of best practice, our outcomes, and then there's time for discussion. I certainly won't take the whole 30 minutes for myself, so that should help catch us up.

This is our workgroup members of this committee, of course, and then we also have two ad hoc members, Robin Burgess-Limerick, from the University of Queensland, and Joel Haight from Pitt.; both have significant expertise in human factors and they brought a really good perspective to the work group. So I would recommend doing that as you put together work groups signing people with the right understanding of things. And Jeff and Todd did a lot of the heavy lifting on my behalf which I appreciate.

So this is our charge; you can see we have three questions similar to what was presented earlier, and our questions were, "To what extent will automation and smart technologies be implemented and in what time frame?" And this is in metal mining. To Bruce's point about this only being metal mining; I actually think that was fairly appropriate for a couple of reasons; it allowed us to know exactly who our stakeholders were without this getting too big; and also the metal mines have some freedom in terms of regulation; they can enact some of these technologies a lot more quickly than the coal guys can; and in

terms of capital projects they tend to have some really big capital projects. So, this was -- I felt an appropriate first set.

"What are the related, emerging health and safety concerns and what gaps exist?" And then we said we would facilitate this meeting open to the public to discuss all of this. And as it turned out this first question is very difficult to answer, and I'll talk more about that in a minute.

So, this was our time line and this is where I wanted to talk a little bit about what we learned, or what I learned; we were charged in May and had our first meeting in June, so we were charged at the last MSHRAC meeting, if you recall. We spent July and August doing a lot of pulling and planning, so we gathered up all of our contacts we could come up with in metal, and then we developed a poll to see where they wanted to have the workshop and when they wanted to have it, and I spent way too much time on that. We should have just picked a place, picked some dates and moved on.

(Laughter.)

We spent a lot of time agonizing about this, and it turned out we picked three locations that were good for metal miners -- either Spokane, or Phoenix, or Denver -- and they were all fine with that. And none of the dates suited everybody, so really we should have just picked one and moved on. That would be my advice to the next workgroup. And then we had the workshop in September, which given our time line, I think Jessica would have really liked to have seen us have it in early August, which would have been difficult. You need a little bit longer time line than what we were given.

And then we hoped to have a draft to you by this meeting and that is entirely my fault and not the workgroup's, but I will have one out before I leave Tucson, and then we'll have December for input and editing and pass it along to NIOSH in early January, hopefully that first Monday back, I think it's the 4th. So lessons learned were really about what you spend your time on and how to move quickly. So we had the workshops September 10th and 11th at the Anshultz Medical Campus at the University of Colorado; it was a great location for a workshop and we had about 40 attendees which was pretty good considering the invitation went out at about less than a month before the workshop. So that was good and this was a good number of people to have a workshop where you're really engaging everybody. We had lots of different people represented from labor to academia, to of course the operators and the equipment manufacturers, so we had a good cross-section.

It was a day and a half workshop, and I know this is small but I wanted to give you a flavor of the kinds of presentations that we had; we left a lot of room for discussion and we used all that room for discussion, so I'm glad that we did. We had Robin Burgess-Limerick talking about state-of-the-art in Australia, we had Rio Tinto talking about autonomy and sensing; autonomous and semi-autonomous systems on surface mining from Komatsu. And then we had a panel discussion. So this sort of set the stage; this

was broad discussion. Then we got into some sessions that we had determined were the most important issues we needed to talk about. And then we broke it down into human factors, and so we had Joel Haight from Pitt. talk about that, and he was a really engaging speaker and a lot of companies were really interested in what he had to say. So, again, bring in some of those specialists from other industries who maybe have different perspective. Sensor technology is Noma Mayes (phonetic) from here in Arizona and Rob Bushman Halvan; autonomous haulage we had Hardline (phonetic). We had a discussion at the end of the day on health and safety issues and gaps, and we made a discussion document and we posted it for all the participants. And Kyle and Jeff were the two members of the work group who could attend, and they were very helpful in leading those discussions and making those documents.

The second thing was a half day and we had risk management assessment with Freeport McMoran and then again we had Robin Burgess-Limerick; since he came all the way from Australia we worked him pretty hard. And data analytics we had Pratt Rogers from Utah and Craig Ross from Hexagon. And then finally we had another discussion where we sort of talked about the entire day and a half; and again, that was led by Jeff and Kyle and we really appreciated their help.

If you look at this link right here -- I'm sorry you don't have my slides but this links you to everything that I gave the people who attended at the end of the workshop -- so what we did is any PowerPoint that people agreed to make public, they didn't have to. We posted, and we also posted our discussion documents there for everyone. And the nice thing about a workgroup is we don't have to do that under the auspices of NIOSH which is more difficult. So, since I was the chair, I did it personally on just a Google site.

So back to that first charge question which I mentioned; every time a panel would end I would say, "Okay then, when do you think all of this will be implemented? When will we reach full automation so-to-speak?" And no one would answer the question, but the consensus was certainly that all the mining operators are going to move cautiously and deliberately, which I think is good. And there were lots of discussions around this, actually; Rio Tinto mentioned that they had tried to do some automation earlier in -- as these technologies are emerging -- and they didn't take the time to get buy-in from their people, and it was a failure. And they said we will never move quickly like that again because that's why it failed, they didn't trust their automation. And we didn't have it set up, so they couldn't trust it; they were getting alerts that weren't necessarily needed and that sort of thing. Another example that came out -- and I can't remember, I think it was Joel Haight who said this was Tesla -- so we're all aware there have been two fatalities with Tesla, right? It's in the news; it's a big deal. In 2010 there were over five million car accidents -- two and a half million injuries from those car accidents and 30,000 fatalities -- they didn't all make the news, but Tesla made the news -- those lives weren't more important than the other lives; what was important to people was automation had failed. And mining companies are unanimous in saying we will not set up systems that will fail because then they will fail across the board. I thought that Tesla example was a really good example of that; people don't have the capacity to see

automated systems fail the way they do to see humans fail, right. We're used to people dying in car accidents, unfortunately; we're not happy to see an automated car get someone killed.

CHAIRPERSON NELSON: Or an example of the airplane that went down.

DR. KRAMER LUXBACHER: I was listening to that on the radio on the way to the airport and I was hesitant to say it, but what Priscilla is talking about is the Lion air crash, and what they found was it was a sensor problem that was forcing the nose of the plane down. The pilots tried to override the sensor 11 times and the plane still crashed. So, and as I was driving to the airport I thought, why does that bother me more than a poorly trained pilot does -- but it does; it really did bother me more. And so if you think about the fact that that really bothers the public, then by extension you can bet it really bothers the workers in the same way, and I don't blame them for that. So, I was impressed that everyone was unanimous in saying we'll proceed slowly. I think that if we had to answer the question, we could say when we look at leading-edge technology right now, at the best operations, we will see more of that by the end of the decade, right. It won't be everywhere, but it will be in a lot of the bigger operations, would be my best guess there.

Among a lot of thought-provoking conversations -- and these slides are posted on the website -- these came from Robin Burgess-Limerick and everybody from all the operations said we want a copy of these slides -- and it was clear he put a lot of time into thinking about these questions, and I'm going to include them in my report, too -- they say 14 automation research questions, but I think he had like 17 -- and one of my rules is not to put so many words on a slide -- but every rule was made to be broken, right -- so I'll just sort of go through them so you can think about how you would answer them -- because he didn't give answers; they were just sort of thought-provoking questions. How do we ensure that decisions regarding automation take human capabilities and limitations into account, what lessons can we learn from experiences in other industries of human systems integration -- and I'll talk more about that in a moment too -- how can these methods most effectively be employed during introduction of automation, what design and evaluation strategy should be employed to ensure alarms and other interfaces are optimized, how can isolation for maintenance be ensured and confirmed. What's interesting is people address all these questions in their various technical presentations. What strategies can be employed to introduce automated components into mining systems, how can we create rewarding jobs for people to undertake within this increasingly automated system, if you're sitting in a control room all day, how do we select line managers in the workforce for their roles in these systems, how do we train workers for these systems, how can the competency of people working be assessed and demonstrated, what are the utility and limitations for virtual simulation and design processes, and within training and competency, how can we unlock additional productivity gains through optimal use of automation, how do we ensure that unanticipated consequences of automation

and consequential risks are identified and managed -- she gave me a tongue-twister there. How can the wider societal impacts of increasing this automation in the resources industry be managed most appropriately. This is the last one, I promise, but I think this really gives you a flavor of the whole workshop -- what verification processes can be developed to ensure industry regulators, unions and the public of the safety of the systems. What are the appropriate risk management frameworks and tools, what is the role of standards and guidelines -- and we did talk a lot about that, too -- and Komatsu brought that up repeatedly, and that they're already saying we need some standards around these huge automated haul trucks, for instance; what is the role of these standards; what role do regulators play in facilitating implementation of safe and effective automation. Automation is coming online so fast, we don't have necessarily have the technical capabilities in our regulatory system to deal with it.

So these are some, not all of the areas that we've identified for NIOSH, and I'm missing one which I'll tell you in a minute, and there are two glaring omissions which I'll also talk about. Tracking the degree of automation in the commodities along with best practices I think is important and not necessarily easy. But I think saying this is leading-edge and these are the people doing it best, and we want to show everybody else how it's being done, is something the industry will get on board with. That's always been a precedent there's sort of a no secrets in safety attitude amongst our industry. Human computer interfaces to include leading practice, cognitive overload and feedback strategies; we talked a lot about cognitive overload which I hadn't really given a lot of thought to but was fascinating. And one of the things that Joel Haight presented was some other industries where this has been a problem for a while, and one that he mentioned was air traffic control; you can imagine the cognitive overload difficulties they have. And in particular, you can go from a beautiful sunny day where all the pilots are doing what they're supposed to do, to an emergency, and then the cognitive overload was really severe, and how do you manage that. And you could see the same thing happening in mining; everything's clicking along and then suddenly it's not.

And the other example that he gave there was there are operators who monitor patient vitals in hospitals, big medical systems, and he gave an example of a control room operator who was monitoring 800 cardiac patients, and there were a couple of fatalities as a result of missed problems in those cardiac patients -- 800 cardiac patients is clearly a cognitive overload for a single operator. And we can actually say what cognitive overload looks like in terms of bits that a human is required to process. So I thought that was very interesting and something that could easily be translated to more and more of these really complex control rooms that we're seeing in mining.

We also talked about things like feedback strategies, so we were talking about taking operators out of say their haul truck and putting them in a control room where now they're operating haul trucks. And some of the varied experiences, operators said I need to hear the noise of the engine, or I need to feel the rumble of the seat; whatever it happened to be because that's how they got feedback in that piece

of equipment. And after several months they said I don't really actually need that feedback, but initially they did which I thought was interesting.

Unmanned vehicles for improvement of health and safety; drones have been a big deal and lots and lots of money has been sunk into mine rescue vehicles, right. But what was interesting was the guys from Rio Tinto, there were two engineers who had been playing around with drones, and they had been buying off-the-shelf drones, both ones that will fly and ones that are ground operated, and playing with them and modifying them. And they've been spending $30 to $50,000 on drones which is a lot of money, and they consider them sacrificial; they said if we have to take a drone inside a ball mill to check it out and we can't get that drone back out, who cares; we'll start with the ball mill; it costs us $200,000 an hour to keep it down, right. And so I thought that was interesting in that the way technology is moving, we can take some of this off-the-shelf stuff and really modify it and do interesting things with it.

Characterization of the efficacy of automated systems in terms of health and safety -- and this came from Freeport McMoran -- and what he was saying is how do we begin to put numbers to automated systems in how they're performing, what constitutes a near miss, how do we count near misses, how do we count safety in automated systems, and how do we begin to assess it and make things measurable, characterize these measurable metrics. And he said it's really not being done right now, which I thought was sort of a critical area that NIOSH could contribute to.

Technology transfer and leading practice from automated transportation and existing mining systems, especially for these small operators; right now the automotive industry is driving a lot of the collision avoidance in the sensors that are going on vehicles and they're getting cheaper and cheaper by the minute. So, these will become very quickly things that small operators can use and how do they use them effectively.

Mine design for safe automation, both greenfield and brownfield; how do you design a mine-like revolution for automation as opposed to a mine that's been around for 30 years, how do you implement automation in that mine, what's best practice.

The one that I forgot to put on here is loosely related to lock-out tag-out, but I think lock-out tag-out is a little bit of a narrow way to define it; but that is how do we interact with automated zones for preventive and for unplanned maintenance -- and so if you have fully automated an entire mining section, you can't just say okay, we're going to run somebody up there now to fix something because there are lots of hazards for a human in that environment now. So looking at what the best practices are for getting a person into a fully automated zone for maintenance type issues.

And then there are two really glaring omissions, and I could use feedback on these -- these are so broad that we had trouble deciding how to format our workshop sections around these because they sort of

overarched every issue associated with automation -- and so narrowing them down for NIOSH is also a little bit difficult because with automation, everything is sensing something and determining what's happening in the atmosphere, how the operator's doing, how the equipment's doing -- so I had not yet narrowed those two down a bit and made them sort of something you can bite off -- but they're critical to these emerging technologies.

So that is the flavor of the workshop and I really wanted to dedicate more time to discussion than me yapping at you.

Yes?

DR. FRAGASZY: So there's obviously some overlap with the underground construction and tunnel industry. I was wondering if there were any participants in the workshop, and in general if there is a lot of overlap and discussion in the work between those two industries?

DR. KRAMER LUXBACHER: There was not. There were not any participants from underground construction. I think that's a good avenue to explore, certainly. I don't know if anybody else in here has any experience with underground construction automation or --?

CHAIRPERSON NELSON: I almost think -- my first -- sorry, I couldn't get to your workshop -- I mean, it was in Denver, but I couldn't get there.

DR. KRAMER LUXBACHER: Well, we had a few people from CSM and we were awfully glad they attended.

CHAIRPERSON NELSON: Yes, I sent a bunch of people. What occurs to me is underground construction projects, the way they are right now, is they're very project oriented, a couple of years, short period of time, linear processes, you do the straight thing, they're almost manufacturing tunnels more than anything else, one tunnel at a time. And then you evacuate, then you go away, so this is a blend between that kind of thing and thinking about safety in underground space that's been completed; in which case you have the public there, not a trained workforce. So there probably are some overlaps.

DR. KRAMER LUXBACHER: I tend to think of mining systems as being a little bit more complex, but that might be because I'm biased toward mining, so I didn't want to say that right out of the gate, but you're right; in construction it's sort of linear advanced, and that's it.

CHAIRPERSON NELSON: Yes. I mean, until we get to the point where a city contracts with a mining company to come and mine out underground space en masse all at one time, which is like a mining for space operation, which I actually think is going to happen in the future, there's some areas of overlap. And I think the reliability of the equipment sensing, the strategies are probably somewhat similar, but the occupancy is just very different in the two.

But I wanted to ask about, there's resistance to change and you have a workforce that's been doing the same thing, and now you want them to change and do something else. Can you imagine -- I almost wish that there could be a blank space where you say we're going to start a greenfield project, we're going to start it from Day 1 at fully automated -- and now at that point, now you don't have retraining, per se, someone in the job -- it's a new job; it's a different job. So did that come up at all, the prospect of like white sheet of paper, let us plan an automated mine of the future that we don't have to do the retraining and the incremental plug-ins that are never quite so effective as a whole system that's designed to be automated?

DR. KRAMER LUXBACHER: It did, and I think the closest we'll see to that in the next decade is, or more than a decade, maybe is Resolution Mine in the United States. And certainly that's being designed for automation so that automation exists.

MR. WATZMAN: But outside the U.S. that's occurring?

DR. KRAMER LUXBACHER: You're right. I don't know what the newest mine is right now that is being designed for that underground. On the surface the Australians have really got some of the leading practice, and they were saying they designed a particular surface operation for a fully automated fleet -- and they changed the turning radii and this kind of thing knowing that they were going to be using this automated fleet, that they wouldn't be breaking as much and they would travel at more constant slow speeds. And still things happened that we weren't ready for, and one of my favorite examples of this was the trucks traveled the same path every single time -- and what happened was they had these huge ruts in the roads -- and so they had to build into the system to allow the trucks to bury their track a little bit so that the road maintenance wasn't such a headache. So there's always some unplanned event.

MR. BOWERSOX: That happens with drivers.

DR. KRAMER LUXBACHER: Yes. I think with training, everybody's worried about training, because it's one thing to take an experienced operator and put them in a control booth where they understand the equipment and they can say I'd like to hear it so I can hear what's happening, or whatever, and taking somebody whose never actually sat in the seat and trained them how to do that. I think there's --

CHAIRPERSON NELSON: There's something about trust embedded in that, too.

DR. KRAMER LUXBACHER: Right.

CHAIRPERSON NELSON: So the cognitive overload, even if you could go to some kind of a visualization framework where you weren't just getting barraged by things, noises and everything, but developed a way so the people could more smoothly understand what's happening and getting them to trust what they're seeing or what they're hearing is hard, I think, because they have to recalibrate their knowledge and their skills for this new world.

DR. KRAMER LUXBACHER: The other example I have of that not working was a mine I was at in Chile where they had about 400 underground fans and they decided to automate them -- and so in some cases the air quantity went down based on what's happening, they didn't need as much air, and the miners were really upset -- all they knew was the air quantity had gone down. Nobody told them why, nobody said actually we're entraining less dust now because we don't have this high wind speed, and we didn't have much diesel, so it was okay. Nobody bothered to tell them and they really didn't buy into it, and they were disabling the automation, they were turning the fans back up. And so what we heard over and over again is it's communication and education of the workforce about what you're doing, why you're doing it and why it's really improving safety for people.

I do think this is a good model for quick information gathering and people were very engaged, I would say, that attended.

CHAIRPERSON NELSON: Did you think about recontacting the people who attended and ask them for some kind of reflection or what was missing?

DR. KRAMER LUXBACHER: I actually thought when I post the report, I might say, "Hey, take a look at this and let me know what you think." But that's a good idea, too, to maybe do it just a couple of weeks later to say now that you've reflected on this or chatted with others about it, what do you have to say. I certainly said contact me anytime or send people my way, but I really didn't get much after the workshop.

CHAIRPERSON NELSON: Do you think it was different -- I mean, I think about Australia as being somewhat similar to the U.S. -- I know they're not, but somewhat -- but I think about developing countries versus more developed countries or things going on differently and international -- was there any discussion about if you had to choose one place to do a real good demonstration of an operation, where would it be?

DR. KRAMER LUXBACHER: The issue that came up again and again in Australia is there are so many varied remote mines and they're flying people in and out; that's extremely expensive and it's hard on people from a worker health perspective. So Australia was the perfect test bed; they were really incentivized to do this because they didn't want to keep flying people in and out of Perth to these remote areas. So in terms of developing countries we didn't talk a lot about that, and I think training the workforce will be a big issue, because these are people that have to be really technologically savvy now that are in these control rooms.

CHAIRPERSON NELSON: I almost think that Komatsu or Caterpillar people who provide the equipment, they might be very interested in some thoughts about how do you market, how do you do things differently in a developing country where the people are not necessarily trained -- because they can't come out with a high-powered piece of equipment and give it to somebody whose never used it, so their marketing strategy has to be different in different countries.

Any other comments?

DR. KRAMER LUXBACHER: Jeff and Kyle, did I miss anything?

MR. ZIMMER: No, we have a couple people from our international attend with us and one of the things that we talked a little bit about offline during the workshop was how it's going to affect the construction industry, and we also talked an awful lot about training our current members and the gap that there's going to be, and we're starting to gear up for that. So, for us it was very informative and beneficial, and we're going to start seeing that on some of the service wards around us, we'll certainly talk about the option that's here.

CHAIRPERSON NELSON: I'm trying to think of a situation where there is this cognitive overload potential. I mean, with real-time data flows, whether you try to handle them through virtual reality or anything else, you've got cognitive overload problems. So just simply trying to look at like the air traffic control job and what are their thoughts now about trying to avoid cognitive overflow right now, because if we're just moving into it and somebody's got a solution, we can try --

DR. KRAMER LUXBACHER: I agree; that's low-hanging fruit. We can look at some of the research that's been done around these kinds of jobs.

CHAIRPERSON NELSON: Yes.

MR. GREEN: Kray, I'm curious to get your sense as to what the reaction of the MSHA people present were. Were there MSHA people at your board?

DR. KRAMER LUXBACHER: There were not any MSHA people present.

MR. GREEN: The reason I ask is because -- oh gosh it's probably been almost ten years now -- about ten years ago we represented Caterpillar when they first started introducing automated and heavy machinery into the industry, and Caterpillar was concerned about the MSHA reaction after some initial field tests -- so we dropped the key CAT engineers into Washington and then in the upper folks at MSHA -- they were very enthusiastic at first; it was one of the better meetings we had and our CAT clients were ecstatic -- and then MSHA got cold feet and the whole thing fell apart. So I think the key question going forward is exactly what will the regulators think -- on one hand you've got obviously huge pieces of machinery, whether it's on the surface or underground with the possibility of being very safe, and on the other hand the Lion Air situation, which would put regulators in a terrible pickle if they see a problem happen, God forbid. So what's the thinking -- I'm curious to see what the thinking of the committee is?

DR. KRAMER LUXBACHER: My feeling is that in the same way you have to spend a lot --

MR. GREEN: I'm talking about this committee.

DR. KRAMER LUXBACHER: Oh, this committee. Go ahead.

CHAIRPERSON NELSON: You can still have feelings.

DR. KRAMER LUXBACHER: Isn't that the same way, you have to spend a lot of energy educating and communicating with your workforce. You got to spend a lot of energy with the regulators, too. I mean, it's the same issue of trust, because if something fails and someone dies as a result of your automated system, you can bet the regulator is going to be taking heat for it also. So I think it's a very similar issue of trust.

DR. BURGESS: I think just to address your question, Kray, and yours as well, they brought up change management. So I think that that's common in anything where you're changing things including automation, so that has to be addressed. So I think that partially answers your question. I just also wanted to say, though, what I think was powerful about this -- first of all, I appreciate the fact that the University of Colorado has made really nice facilities; that was a beautiful room. It really was a nice room. Like, I wish we had that. But it was the fact that the specific request came out of industry and that the industry was presenting the results of their experience; that was what made this such a nice session. And plus the academics, too, had their side in, but I really liked hearing that part of the experience of the industry and sharing the issues they had which were similar, the idea of how do you get people to -- or what are the unintended consequences like Kray had said, how do you move this forward, what are the fact that this is really broad or something or fully automated versus partially automated, and really talking about the partially automated where most of the activities are is the hardest one, right, because now you have people operating in those settings. So, it's really --

MR. WATZMAN: Ed, I don't think there's a clean answer to your question, and the reason I'll bring it up in the context of an underground coal mine that several of us are familiar with that have, it's a long wall mine that has removed everyone off of the face and the long wall is now being run from a control station off the section. So we have removed the concern that MSHA should have about overexposure to respirable dust, but there are still other considerations dealing with respirable dust and methane as an explosive mixture. So I don't think there's a clean answer; I think there are probably going to be instances where I would hope MSHA takes a step back because there is no risk at that point to miner safety and health, but there may be ancillary risk to miner safety and health. So it'll be an interesting one to watch.

MR. GREEN: I think that's right, Bruce; maybe what MSHA should do is take a step forward instead of a step back. I'll tell you, it's an enormous problem for rigging.

MR. WATZMAN: Yes.

MR. GREEN: It really is. So I think though NIOSH has an institution in this community as a part of the two NIOSH, you have to consider the attitudinal aspects of regulatory maintenance.

CHAIRPERSON NELSON: So my problem overall is more -- it's less whether they take a step forward or a step back, but whatever they do they make it very clear what it is that they're doing so that people know.

MR. GREEN: Well, it'll be more incentive for them.

CHAIRPERSON NELSON: I mean, that's murkiness solves a lot of problems sometimes and stops people cold. But if you really want to promote automation and experiments, you have to make it clear under what conditions they are going to be judged or regulated or permitted, or whatever the right word is. And if you don't make it clear, nobody will try anything.

MR. GREEN: Well, I think that's right. Mining is just one example of the problem a lot of society has.

CHAIRPERSON NELSON: Right.

MR. GREEN: It's an outlier in the respect that people are afraid of mining anything. So anything that goes on in mining industry is like a Tesla jack I think. So, it'll be very interesting to see how that sorts out.

CHAIRPERSON NELSON: It's like EPA and abandoned mine. I was just going to say you can do anything.

DR. KRAMER LUXBACHER: I think Jennica had a question.

DR. BELLANCA:: I just had a question about, did you guys involve the en-route trucking industry in your conversation? They have a huge community looking at autonomous trucking, I actually had the privilege to participate in an NSF workshop to our union. It was, I mean, tons of people and tons of point of views, and there was actually a couple other mining people there at that. They had very interesting dialogue with regulation and union there and I think that we can learn a lot from them, because they're really interested in our point of view. But I think that we should engage with them more actively because they're from a regulatory standpoint doing a lot and they're doing a lot more discussion, too, on use case, which -- I mean, I've kind of heard in --

DR. KRAMER LUXBACHER: Discussion on what?

DR. BELLANCA:: Use case, like what is the scope of what's being automated and where are we, like because I know you're going to talk about it at different levels, but I think for them that was really a big concern is to -- it relates to everything like Joel said and Robin said with the individual worker and where they fall. The scope makes a huge difference on what their tasks are, and then like the big thing with the trucking they had sort of questions about the driver of the haul truck or whatever you're automating, blah, blah, blah, more jobs than just driving a truck. And I think sometimes we forget those things, so it's looking to really get a huge issue that -- I don't know; it wasn't explicitly listed in the results.

DR. KRAMER LUXBACHER: And it was very hard to get your arms around, because I think smaller operators that can't afford big capital projects are going to be moving towards semi-autonomous areas; whereas the big operators are going to be looking at fully autonomous mines, and it's just kind of the nature of the industry, I guess.

PARTICIPANT: Absolutely.

CHAIRPERSON NELSON: But don't you think the small miner is going to be more likely to try more things? You don't think so?

DR. KRAMER LUXBACHER: Personally, I don't. I don't know of anybody -- Dale probably has a lot of experience in this.

CHAIRPERSON NELSON: You don't think so at all?

DR. KRAMER LUXBACHER: It's a big investment.

CHAIRPERSON NELSON: But you know, the informal artisanal mining people are going to be far more likely to be interested in using new technologies because it's not such scope of transitioning --- a big mining operation -- I mean, the capital investment for making significant change is huge, whereas the smaller miner might actually be able to do it.

DR. KRAMER LUXBACHER: It's possible.

CHAIRPERSON NELSON: Yes?

DR. DOWNES: I just wondered, Jessica, you were talking this morning about communities of practice and things like that and collaborating across the institute; I just wondered if you had spoken to the Center for Robotics?

DR. KOGEL: Yes, they were engaged with this group and they've been invited to attend.

DR. KRAMER LUXBACHER: Yes, I don't think anyone from there attended.

DR. KOGEL: No, they weren't able to; they didn't.

DR. KRAMER LUXBACHER: And one year the Center for Robotics came up because we were talking about nomenclature and defining the terms that we use around automation; some people say robotics, some people say automation, what does it mean, and it came up that the Center for Robotics has really already done that for NIOSH and that was kind of a relief, like oh that's there.

CHAIRPERSON NELSON: Do they discuss what the priorities -- what are the most likely kinds of automation and advances -- that they think, is it going to be trucks; is that the most common?

DR. KRAMER LUXBACHER: Yes.

CHAIRPERSON NELSON: What's the second most common? I mean, where are the priorities?

DR. KRAMER LUXBACHER: Trucks and then loading. And then there was a lot of talk about how to get into hazardous areas, robotically expect those areas, and get out work, work -- like I said, sacrifice your robot.

MR. ZIMMER: Your drone.

DR. KRAMER LUXBACHER: Drone, yes.

MR. ZIMMER: Just kind of off the subject.

DR. KRAMER LUXBACHER: Drones. Oh, yes. Maybe drilling, sorry.

MR. ZIMMER: There was a thing on 60 Minutes about cleaning up a nuclear disaster in Japan; did you see that?

PARTICIPANT: Mm-hmm.

MR. ZIMMER: And the advances in the robotics that they're coming up with; that's going to transition very quickly. Because you think about, you think about automation, what's the easiest thing to automate -- a truck -- what's the second most easy -- loader -- because it has defined movement -- and then you get into the excavators where you have complex movements, and then other pieces of equipment, whatever they may be. So you can see the evolution. Now, with the robotics and the way that they're changing it, they're getting those movements down, and you'll see that transition into different equipment very quickly.

DR. KRAMER LUXBACHER: And there was a lot of discussion about you know maintenance can't really be automated easily and that we need to be educating workers in electro-mechanics, you know in these one, two-year type programs that if you come into the industry and you work with this equipment.

MR. WATZMAN: Yes, I mean, there are jobs that we have people perform that are putting them in arms length, like walking a bleeder.

PARTICIPANT: Walking a bleeder.

MR. WATZMAN: Walking the bleeder.

DR. KRAMER LUXBACHER: That's an explanative example of put us into there.

MR. WATZMAN: Nobody should be in the bleeder. And if we can have robotics to examine a bleeder --

DR. KRAMER LUXBACHER: Shall I turn it over?

CHAIRPERSON NELSON: Okay, anything else?

So your schedule is that you're going to give us something out before you leave Tucson?

DR. KRAMER LUXBACHER: I leave Tucson on Saturday, this Saturday.

CHAIRPERSON NELSON: That's right. And you're going to request for --

DR. KRAMER LUXBACHER: What I would like to do is have feedback by December 23rd -- if anybody wants more time, just let me know, but then that way I could work on it, let the committee take a quick look and turn it back to Norma.

CHAIRPERSON NELSON: Is it okay to send this to others beyond ourselves?

DR. KRAMER LUXBACHER: Absolutely, yes.

CHAIRPERSON NELSON: Okay.

DR. KRAMER LUXBACHER: And they're welcome to call me, email me, contact me anyway they want to.

CHAIRPERSON NELSON: Okay, any other questions, comments?

Nope. Okay, thanks so much, Kray.

DR. KRAMER LUXBACHER: Sure.

CHAIRPERSON NELSON: Yeah, I know, at the end of the semester is a very hard time to pull something like this together.

MR. WELSH: So will that be something on the agenda for May then? We'll have reports Saturday, feedback to you the 23rd and then second draft report, and then discussion of recommendations back to NIOSH.

DR. KRAMER LUXBACHER: Yes, we can discuss recommendations back, or even you will have had the report maybe how you would like to implement recommendations, if you've looked at that yet. Does that seem reasonable?

CHAIRPERSON NELSON: Is there an opportunity to do something more with the report, other than just have it report back to MSHRAC which gives it to you? I mean, the report may be good enough --

DR. KRAMER LUXBACHER: Well, we can do anything we want with it.

CHAIRPERSON NELSON: We could actually have something like a -- I don't know what -- I'd like to build off of that. You can carry it more --

DR. KOGEL: No, I agree; I don't want it just to be a report. I mean, I think we mentioned earlier, Bruce and I were talking about the coal versus the focus on metal here that we would like to have follow-up workshops that go beyond just this one, because this was very focused, very -- I think we got really great information out of it, but I think the next step is now to go --

DR. KRAMER LUXBACHER: There's a lot more, yeah.

DR. KOGEL: -- perhaps to do another workshop in another area; it could be another focus area, it could be another commodity. I mean, I think there's a huge number of directions we could go with this.

CHAIRPERSON NELSON: I'd love to get this. I mean, if the report comes out in good shape and it's articulate, it ought to be on the web, it ought to be somehow available. And we might even think about just having maybe a webinar to talk about the outcomes of this, which goes along with the report. That might actually get some good industry listening.

DR. KRAMER LUXBACHER: Yeah, I know, and I'll absolutely post it to the website where we're communicating with the people that participated in the workshops.

CHAIRPERSON NELSON: Yeah.

DR. KOGEL: And I think we can probably put it on the NIOSH website, because it's coming out of this, and I'm assuming that's a public document.

CHAIRPERSON NELSON: It could be MSHRAC's fault.

DR. KOGEL: Isn't MSHRAC public documented, though?

MR. WELSH: Yes, once the MSHRAC full Committee would approve it.

DR. KOGEL: Approve, yeah.

CHAIRPERSON NELSON: It seems like it could be done that way.

DR. KOGEL: Yeah, I think we have some choices.

CHAIRPERSON NELSON: Yeah, I think that's a good idea.

MR. WELSH: Yes, another thing we're looking at doing is a RFI for automation, and I don't know if these two can be tied in anyway or not.

CHAIRPERSON NELSON: I think it should certainly reference it which means it should be available.

MR. WELSH: Yes.

CHAIRPERSON NELSON: At the time you come out with an RFI if you do that.

Yeah, thank you.

DR. KRAMER LUXBACHER: Well, again, I'm sorry it's late.

CHAIRPERSON NELSON: No, thank you. I'm sorry that I didn't show up, so I'm sorry, sorry, sorry.

Okay.

Contribution analysis and framework to measure impact - Dr. Amia Downes

CHAIRPERSON NELSON: So we are going to hear now about contribution analysis. One more -- thank you.

And are you Amia?

DR. DOWNES: Amia.

CHAIRPERSON NELSON: Amia. So, welcome, Amia.

DR. DOWNES: Thank you.

CHAIRPERSON NELSON: And what is your doctorate in?

DR. DOWNES: I have a doctorate in public health specializing in evaluation. So, I realize I am the last person standing between you and that door, so I will try not to get too excited, but I am a little bit of an evaluation nerd. So, please bear with me.

CHAIRPERSON NELSON: Well, we could have been even slower and it would be even later before you got up. So, personally, I think it's just right; it's perfect.

DR. DOWNES: All right. Thank you,

So, thank you for having me here today. I'm Amia Downes and I work in our Office of Policy, Planning and Evaluation in Atlanta. And so I want to talk to you a little bit today about how we're starting to look at NIOSH's programs and review them. So, as some of you may recall, in 2005 we were actually using the National Academies. Anyone familiar with our reviews back from when we were doing them with the National Academies, we did mining, those in the back are very familiar with that -- about to suffer through it again -- just with a different group -- but in 2005 we commissioned the National Academies to review eight of our programs and they developed -- we had a committee from the National Academies develop a framework document, we developed a NIOSH logic model which you'll see here on the left side of the slide, with component definitions for inputs, activities, outputs, intermediate outcomes and end outcomes, and the scoring criteria for both impact and relevance. The programs, one of them being mining of the eight that were reviewed, developed evidence packages that were -- each chapter in the evidence package was organized around some occupational safety and health outcome, whether it be hearing loss, MSDs, falls -- and within the chapter, the chapters were loosely organized around these logic model headings at the top -- but what the real difference is between those previous reviews and the ones that we're doing now is previously with the National Academies -- and I say this with all the love in the world because NIOSH is and still -- or was and still is a leader really in evaluating research programs, and specifically occupational safety and health research programs is that it was really just an

exhaustive list of every output, every outcome, every activity that we did. So we have like 5-600 page documents of lists of, and descriptions of activities and outputs that we've done. It's kind of like throwing spaghetti on the wall and seeing how much of it stuck, and asking this panel to review it and telling them, or asking them to tell us how much impact we had.

So we wanted to do something a little different when we started doing program reviews again, so we thought about what we learned from those previous eight reviews, we looked at other theories that were being used in evaluation -- even theories that were, before we started the national academy reviews that had existed and were being applied -- we also had to look at how we were going to sustain doing these rigorous independent reviews over time, and we also had to be cognizant that we do have that Government Performance and Results Act target around program reviews, that we had to be responsive to. So while we came up with contribution analysis -- and somebody asked me if this was some way to increase return on investment because they saw contribution analysis, and I said if it was my way of trying to tell you how to increase your return on investment, then I wouldn't be standing here telling you about it, I'd be out making a whole lot of money. So no, this has nothing to do with financial gain; actually, it talks about what you're actually going to learn about, impact that you've made on an end outcome, specifically in this case some occupational safety and health and outcome. And it's really a theory-based approach. And so the idea is it's a probable theory that the programs build around how you get from your inputs on the one end of your logic model to outcomes on the other end of the logic model, and you're actually looking to find evidence as you're building your theory to support that theory, we're also looking for alternate explanations; the alternate explanations being like we don't operate in a vacuum; we have great partners such as EMSHA whose making regulations, we have foundations that are providing money to support training and things like that, we have our partners in academia, that are doing additional research. So NIOSH does not operate in a vacuum and we need to give credit where credit is due to partners who also help us.

So, this panel that we put together for each of these program reviews were actually asking them as experts, and as reasonable people, based on these theories and the evidence we're providing to support these theories, do you believe that NIOSH contributed to this end outcome. So, while we can't -- or it's very difficult to show causation because we don't really do controlled randomized studies -- this is a way to show plausible association, so that's really what we're using contribution analysis for.

So, John Main was the one who actually first came up with contribution analysis back in, I believe it was 2001. So we actually modified his model, so I'm going to walk you through it from the perspective of what we actually do with the programs when we're getting them ready for review.

This is a step of the model that we actually added to the model, and this was completed by evaluators at NIOSH, and first we did an evaluability assessment of all the programs at NIOSH, and it was a really rough evaluability assessment. We actually created a standardized form and put all the programs

through that standardized form to see who was actually ready to be put in front of a review panel and have their impact evaluated. And so we came up with a list of programs, we've evaluated four so far and mining is getting prepared to meet with a panel next spring. So this is what that first step is, this cause and effect issue is actually identifying which program within NIOSH's portfolio will be reviewed. This second step is actually where once we have the program identified, we meet with them and we start to develop logic models around these occupational safety and health outcomes. So, for example, in construction they have a logic model around falls, one around MSD, one around hearing loss. Mining, I'll let Jessica, you can go ahead and tell everyone what the three topics --

DR. KOGEL: So we've got ground control, we've got respiratory health, and disaster prevention and response.

DR. DOWNES: So we met with them to develop logic models of how the theories change happen, how for each one of those they got from inputs to outcomes, and so that's really what we're doing when we develop a theory of change for them. The second bullet about assumptions and risks, based on the way we do this, we largely, significantly I'd say, reduced these assumptions and risks because one of the things we do is we don't allow the programs to put in intermediate outcomes unless we can verify that they actually occurred. So, we can't just generally say that a company adopted X intervention without having proof or some sort of substantiated evidence that it happened. So these assumptions that companies adopted something, we really don't assume that because we substantiate it, we actually have in the evidence package references to whether it be an email, some document or regulation, something that substantiates that it actually happened.

Then the next step for the program is really gathering that evidence; so as I said, maybe it's a document, maybe it's emails, there could be a number of sources they're getting that evidence from. And they're actually assembling that in these evidence packages and trying to write up that information, the different activity descriptions, the outputs. And so in the logic model what you'll see is underneath the logic model in the evidence package, everything that's referenced in that logic model is going to be explained in the narrative underneath in the evidence package. Once they get to a certain point, we stop and assess, well is there something that was in the logic model that now we can't substantiate, or is there a gap where we've described this activity and there's no output associated with it, there's no outcome associated with it, or did something happen between now and then that we're missing in here, that would intuitively not make sense to a reader that wasn't part of the program. So, we look for those things. People in my office read them because we're not part of a mining program, so we don't share the same perspective.

The first, I guess, we consider when we're developing these evidence packages is obviously the panel that's going to review them, but they do get put up on the web and used for other things. So we also

need to think about the broader audience when we're writing them. Finally, we ended up with what we call our contribution claim, and this is the finalized evidence package which the panel will have to sort of make some sort of judgement on how much of an impact they believe that the program has had. And the last step is where we actually ask an external group to take a look at that evidence package to try to give us a score on a scale of 1 to 5 for relevance and a score on a scale of 1 to 5 for impact.

CHAIRPERSON NELSON: What about unintended impact?

DR. DOWNES: Well, that's a really good question, actually, because we're applying these to a previous, like retrospectively, so the last ten years, so we can capture unintended consequences that way because we're looking retrospectively. Well maybe. And that's the other thing we tell the panel; we don't have -- we have to use evidence that we already have -- so what they're seeing in the evidence packages are the most conservative estimates -- I don't want to say estimates because they're not estimates -- the most conservative evidence that we have or the most conservative compilation of impact that we have. It's happened every time so far that we've had a panel member in one of the meetings with the different programs and undoubtedly somebody says, "Oh, I used X, Y and Z." Well, this person represents some union, for example, and we had no idea that they were using it, because we don't have --- right now we're working on it, because this process has really taught us that we need to, a systematic way to collect these intermediate outcomes that we didn't have before. So, all we can use now is what we have available that we know that happened, but there's a lot beyond what we know that has happened that we don't have evidence of.

CHAIRPERSON NELSON: So, this is something we actually talked a little bit about at lunch; the idea that if someone develops an experiment to test the theory, and they put the sensors which are sort of like opportunities for outcomes, or however you might say it, observations to be made, and it may be a steel structure and they expect it to yield. And so they put the sensors where they think there's going to be yielding, and then they run the experiment until it yields. Well, meanwhile there perhaps was fracture, or all other sorts of things that occurred, but that wasn't part of their theory, so it wasn't observed. So, that's what I'm after, so the looking at something and saying, Okay, fine; we're looking for our intended impacts based on evidence, but were there unintended impacts so that the next iteration we need to change our evidence because we have a different theory. Does that make sense?

DR. DOWNES: Yes. I don't know that we've only applied this in four programs, so I don't know that we've gotten to that point, but that's a really good point. I never thought of that before to be honest with you.

CHAIRPERSON NELSON: Because lots of times you're not in control of what those impacts are. And somebody comes over and says, "Oh, we're using it this way." Yeah, and you weren't looking for evidence there so, but you'd certainly like to capture that.

DR. DOWNES: Well, I think as Jessica mentioned at one point, it's come up a number of times here, we reviewed the construction program and there were a couple of things that they had originally gotten from mining that they've talked about how they've tweaked and it ended up in their reviews.

CHAIRPERSON NELSON: But it didn't end up in mining's impact.

DR. DOWNES: Well, I'll let Jessica.

DR. KOGEL: I can't remember where we ended up in that discussion, because that was one of the discussions we had, should that end up going in mining impact. Did we decide that it wouldn't or that it would?

DR. DOWNES: We decided we'd leave it open.

DR. KOGEL: Oh, we did. Okay, so does that mean it's another question or -- Thank you for reminding me about that. So it sounds like it's an unsettled question.

PARTICIPANT: It's like a footnote.

DR. KOGEL: I think my feeling was that it should show up because we're demonstrating impact more broadly on, if you're looking at just the mining population, that by definition is a fairly small number, and if you're thinking about it in terms of quantifying impact in terms of numbers, workgroups would really make sense for us to be showing how these things that we develop actually do translate into larger populations of workers in other sectors. But, yeah.

DR. DOWNES: So this is actually one of the logic models; we don't have any completed yet for mining; they're still in the process of developing their evidence package. So this is one for, it came out of the construction evidence package and it's for highway work zones. And so as you can see, your inputs they go from anywhere in the national construction agenda, to stakeholder meetings, OSHA alliances, and the evidence package and the actual narrative text, for example, where it says OSHA alliance is here, in the text you would see they had two OSHA alliances, the names of them, what they did and what exactly their input was, those would be described. But in here, the idea is really for the reader to get a visual depiction of, in one page, of here's how this theory actually works.

Over here, their activities, you'll see these were actually section headers in their chapter, then their outputs. They had a ton of outputs but we decided to just take their most significant ones and put them into these boxes. They had, obviously, tons of publications and they had blogs, different social media, they had a couple databases, but those really were outputs of a lot of these different activities. So we chose to put them in this larger box so we can connect them to all the activities.

This box right here will be your translators; these are the people that are really taking the actions of adopting something. So over here in your intermediate outcomes, maybe they adopted a case report,

maybe they adopted recommendations, maybe they've used the Blind Area Diagrams. So as you start kind of looking at the different strands across here, you have different things going on. So maybe they were working on -- this came actually out of mining, as we were speaking about that, it's timely, proximity warning system; they did quite a few activities here; they were both developing and they were also evaluating different proximity warning systems. But one of the things that came out of this was the hazard intervention. So that was actually used and transferred to an equipment manufacturer who then commercialized it. The idea being that if it's commercialized, people will buy it, and since it's been tested and proven effective, that there'll be a reduction in highway work zone injuries and fatalities, because if they actually have pictures of where it had been installed and different companies had adopted it, that if it was effective, then there wouldn't be as many people getting run over and cause of injuries and deaths because of it.

So, that's kind of how these strands, or just one of the strands work across.

MR. WATZMAN: Kray and I were discussing if we didn't know better, we'd say somebody found a creative way to modify a bowtie analysis.

(Laughter.)

DR. DOWNES: So, so far we first -- these are very recent; we just started using this approach very recently -- in 2007 we evaluated our healthcare and social assistance program and our exposure assessment program -- this year we did our emergency preparedness response program and the construction program, and currently mining is actually getting ready to be reviewed. So, generally the lessons learned from this; we found that it's a really good fit for NIOSH. We've done presentations at the American Evaluation Association Conference, we've actually written this up and it's been published in a journal, and we've actually had a former director of an office within one of the federal agencies say I suspect there are many other government agencies that would benefit from this approach. It's provided us with flexibility and scope in subject matter, as you saw from the previous slide, we've applied it to a very historically large program like construction to something very small like emergency preparedness and response that hasn't been around nearly as long.

We've also applied it to basic science, which exposure assessment, more basic, to something like healthcare in construction that kind of runs the gamut from basic to intervention and translation research. We've also found that we're getting more targeted, actionable recommendations than we had previously, because this particular approach tells you more about how and why because you're describing this theory about how you think things have happened, than we have with the National Academies, because it was just kind of like, we just gave them all this information, but there was kind of no theory or anything behind it.

CHAIRPERSON NELSON: Well, they don't make recommendations anyway. But where do the recommendations appear on your previous chart? Where is the -- if you go back one -- no one more -- yeah, there.

Where's the sense of recommendations coming out of this process?

DR. DOWNES: So, this is just the logic model --

CHAIRPERSON NELSON: This is evidence-based analysis, right?

DR. DOWNES: Yes, this is just the logic model that we present to the review panel. They give us a report back at the end with their findings and their recommendations.

CHAIRPERSON NELSON: So, this external review panel has to give you the recommendation?

CHAIRPERSON NELSON: So, do you know who your panel is? Is your panel feds or are they external?

DR. KOGEL: They're external.

DR. DOWNES: There are several things that we've discovered in terms of process improvements, from the first two program reviews that we've done, to the second two, and now to the one that we're going to do for mining. And one of the things was improving the organization of the evidence package; we actually followed Main's approach a little too to the letter with the first two programs and it was a little bit too difficult for some of the readers to follow in terms of intuitiveness, the way we had things organized. So we've improved that. We needed to improve the balance of the representation of the review panels; we wanted to make sure we had labor, industry and academia represented on the panels, but we had a little bit of imbalance in particular on one of our panels, so we really worked hard to make sure that we got a better balance with the second two groups, or group we did. And then including at least one current or former federal employee, has been really helpful, because there are some things that just are inherently governmental. For example, one of our first groups, they were under the assumption that government can just put out a survey tomorrow and why not, why wouldn't you do that. And once we explained to them what the process was and they can take well over a year to do a survey just to get it out of the door; that made them sort of reconsider maybe what their recommendation was. So, we've kind of built that in as well.

And then build more opportunities to ensure that our reviewers understand what contribution analysis is; when they first come onto the panel we have a kick-off meeting with them to explain what contribution analysis is, we have several examples, but what we didn't do was once they actually have the package to meet with them again, to just check in and now that they can see the application of it, is this making sense -- because if you're anything like me sitting through a biostatistics class, I just want to get out of there whether I understand it or not --

(Laughter.)

And so sometimes I'll be like, "Yeah" just to, you know -- or I think I understand it when I really don't understand it, so actually having some time to sit with it is helpful. So, having that second check-in meeting with them really helped with the second batch of programs we put through review.

So as far as the mining review time line, they'll be meeting with their panel once we have it assembled April or May of next year. The panel will have their draft report by August, sometime of August of next year. In September we always have a debrief with the panel, they can present their findings, and NIOSH can ask any questions based on that draft report, and then we'll get a final report from the panel in October.

CHAIRPERSON NELSON: Is there an opportunity for the panel to ask questions of the agency?

DR. DOWNES: Yes, at this panel meeting, what happens is they've had the evidence package for a month and they come to Atlanta for two days, and the first day is all day with representatives from the panel -- I mean, not from the panel but from the program -- and the program will go into more detail on certain projects or activities that they want to discuss, but that panel has all day to ask any questions they would like. There's also an opportunity for them to submit, through their chair, questions as they're trying to write their report.

So, questions for you guys, we've also presented this to our Board of Scientific Counselors, but it seems appropriate now that mining is going through this review, is these evidence packages really represent the first time that all of this impact information is going to be in one comprehensive place. You've heard throughout the day stories of impact, but they're all kind of individual stories of impact, and these chapters are going to be organized by these outcomes, these health or safety outcomes. And they'll all have intermediate outcomes in the chapter, so what can we do with these evidence packages so they don't just sit on the shelf? Kind of like what Priscilla was just talking about with this report; a lot of time and energy goes into this, so whether it's the whole package that gets used, some piece of the package that gets used, what can we really do to bring attention to the work that the mining program does using the work that's in this package. And the other thing is how would the panel, or how would the committee, like to be kept informed of maybe what the panel finds, of what our -- NIOSH's -- responses and implementation plan is going to be, because that will occur once we have the report. So those are my questions to you all.

CHAIRPERSON NELSON: Well, thank you. It's painful having just been through an ABET review.

PARTICIPANT: That's what I was just thinking of.

CHAIRPERSON NELSON: And we have in between ABET reviews, every three years we have visiting committees. I mean, Jessica has been on one of our visiting committees and that was a 3--

DR. DOWNES: Well, see; then they could offer you there -- ten years, it's been ten years, Jessica -- every three years.

CHAIRPERSON NELSON: It's a 300-page document. But I will tell you, to close the loop, I think it's good that recommendations that come from the panel are returned to the agency who responds to the recommendations, explicitly. And so I think maybe, to me, we don't want to interrupt while the panel is doing its deliberations on your process, but as soon as there's something available, I think MSHRAC would really like to see it, and to get briefed on it, and on the recommendations. As a matter of fact, how big are the panels?

DR. DOWNES: Five to six people.

CHAIRPERSON NELSON: It would be really interesting, perhaps a year from now, to see if we can have the panelists, those available, to come here and meet with MSHRAC and talk about the overall process and what came out, but that could be an invitation at that point. They're not likely to consider us as evidence, are we? Are we evidence?

DR. DOWNES: You're an input in the logic model.

CHAIRPERSON NELSON: We're evidence, so --

DR. KOGEL: No, I think that's -- I mean, there's no reason why we couldn't do that, is there?

DR. DOWNES: Mm-mm, no.

CHAIRPERSON NELSON: Any questions or comments, or answers to these questions that you might like?

MR. BOWERSOX: They need to put a panel together why it takes six months to ask someone.

(Laughter.)

DR. MILLER: That's an ask; six months is quick.

(Laughter.)

MR. BOWERSOX: That was a great ensemble.

DR. DOWNES: Yeah, maybe we need a logic model for that.

CHAIRPERSON NELSON: You can do a self-assessment, because that's really what these are.

(Laughter.)

DR. DOWNES: Well, thank you. I appreciate it.

CHAIRPERSON NELSON: Thank you.

All right, well done. Quite a bit of information today. And tomorrow -- is everybody here tomorrow?

MR. WELSH: Yes, starting at 8:00, and John Howard will be available at 8 o'clock on the phone.

CHAIRPERSON NELSON: Okay. And the public should know that at 11 o'clock, we will stop for public comment.

(Whereupon, the above-entitled matter went off the record at 4:41 p.m.)

Adjourn

MINE SAFETY AND HEALTH RESEARCH
ADVISORY COMMITTEE (MSHRAC)
November 29-30, 2018

CENTERS FOR DISEASE CONTROL AND PREVENTION

+ + + + +

MINE SAFETY AND HEALTH RESEARCH

ADVISORY COMMITTEE

+ + + + +

COMMITTEE MEETING

+ + + + +

FRIDAY

NOVEMBER 30, 2018

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The Mine Safety and Health Research Advisory Committee met in the Room S215, ENR2 Building, 1064 East Lowell Street, Tucson, Arizona, at 8:00 a.m., Dr. Priscilla Nelson, Chairperson, presiding.

MSHRAC COMMITTEE MEMBERS PRESENT

PRISCILLA NELSON, Chairperson

RONALD BOWERSOX, United Mine Workers of America

JEFFEREY BURGESS, University of Arizona

DALE DRYSDALE, National Stone, Sand & Gravel Association

RICHARD FRAGASZY, National Science Foundation WILLIAM FRANCART, Mine Safety & Health Administration

KRAMER "KRAY" LUXBACHER, Virginia Polytechnic Institute and State University

MARIFRAN MATTSON, Purdue University

AUBREY MILLER, National Institutes of Health

BRUCE WATZMAN, National Mining Association

MICHAEL WRIGHT, United Steelworkers of America*

KYLE ZIMMER, International Union of Operating Engineers

COMMITTEE MEMBERS ABSENT

STACY KRAMER, Freeport McMoRan

ATTENDEES PRESENT IN PERSON

JENNICA BELLANCA, NIOSH

PAULINE BENJAMIN, NIOSH

DONOVAN BENTON, NIOSH

CASEY CHOSEWOOD, NIOSH

AMIA DOWNES, NIOSH

ED GREEN, Crowell & Moring

MARCIA HARRIS, NIOSH

WILL HELFRICH, NIOSH

JESSICA KOGEL, NIOSH

GEORGE LUXBACHER, NIOSH

RJ MATETIC, NIOSH

ART MILLER, NIOSH

JERRY POPLIN, NIOSH

CECILE ROSE, National Jewish Health

TODD RUFF, NIOSH

BRAD SEYMOURNIOSH

ADAM SMITH, NIOSH

JEFFREY WELSH, NIOSH, Designated Federal Officer

PETER ZHANG, NIOSH

DEBORAH GONZALEZ, Digital Court Reporter

STAFF ATTENDING VIA ZOOM CONFERENCE

MARIE CHOVANCE, NIOSH

CARA HALLDIN, NIOSH

JOHN HOWARD, NIOSH

BOB RANDOLPH, NIOSH

* Appeared via telephone

M-I-N-U-T-E-S

(7:59 a.m.)

MR. WELSH: Good morning. This is our Day 2. I was just checking if we have a quorum today and we do have a quorum. Dr. John Howard is on the phone, so, instead of keeping him waiting I'd like to turn it over to him.

Good morning, John, are you on the phone?

DR. HOWARD: I can barely hear you, Jeff, but I am here.

MR. WELSH: Okay. We can hear you very good, John. So, I have the MSHRAC Committee here for your opening remarks.

DR. HOWARD: Well, thanks, Jeff, and thanks everybody. The first question I have for you guys, what is the temperature there?

MR. WELSH: Well, the high today is 61 and cloudy. It was nice and sunny yesterday but cool and cloudy today.

DR. HOWARD: Cool and cloudy, yes, well.

DR. HOWARD: Yes, it's like 33 this morning here --

NIOSH Director's Opening Remarks - Dr. John Howard

DR. HOWARD: So, thanks everybody for going out to beautiful Tuscan for the meeting. So, I'll just give you a few little highlights here and then happy to hear what you guys want to talk about.

So, our budget is very positive. As you know, the President's proposed budget for '18 and '19 was a reduction in the overall NIOSH budget of 40 percent. But the Congress did not take that suggestion and our budget remains flat from FY17.

We did get some additional funding this year. A million dollars to start, launch a firefighter registry. A cancer registry.

And also, an additional $100,000 to look at how we can increase the uptake of the coal workers' health surveillance program. Which operates out of the Respiratory Health Division in Morgantown.

And they just put out a Federal Register notice recently on that issue that you may have seen.

MR. WELSH: Yes, We had Cara Halldin of RHD participate yesterday to talk about the request for information.

DR. HOWARD: Oh, great. Thanks. So, the FY20 budget is not out yet, so we'll wait and see what that looks like.

As some of you know, in the FY19 proposed budget there was an idea to realign NIOSH with the National Institutes of Health, from its current location at CDC, but the Congress didn't think that was a good idea. Either primarily because, as they stated in the conference report, the types of research differs so greatly between what we do and what NIH does.

So, that idea we don't expect to see again. It's been rattling around for many, many years but we don't expect to see it again. So, we'll wait and see what the FY20 budget looks like.

Meanwhile, in the mining program I'm happy to report, I'm sure Jessica has told you about our efforts to replace the experimental mine, the Lake Lynn Mine.

We have some positive movement in a site near Mace, West Virginia. Which I don't remember if Jessica has told you all about that or not.

MR. WELSH: John, we did talk about that yesterday.

DR. HOWARD: You have?

MR. WELSH: Yes, we had an update.

DR. HOWARD: Okay. So that's very positive. I think the challenge will be, of course, is actually constructing a mine, this mine would have to be built, excavated, whatever the right term is.

But having a property that the federal government owns for this purpose is really a great first step, one which the Bureau of Mines failed to do and put us in a very difficult situation.

The other thing I wanted to mention in terms of the mining program that I'm sure you also talked about is the renaissance going on in the Spokane mining research laboratories in Spokane, Washington.

We now have a total of 62 FTEs in the building, plus a number of contractors. Forty-two of those are in the Spokane Mining Research Division.

So, it really represents a tremendous turnaround. And not only that, but in the scientific and research products and interventions and mine studies that the staff is doing there in Spokane.

I just want to give a shout-out to Todd and to Jessica and everybody who is making that possible. It's just a wonderful thing to see. And to have the support, both within CDC and HHS for our Spokane location, which years ago was a matter of some instability.

So, that's great. I think that's wonderful.

The NIOSH is still, you know, still is working hard in many different areas. You know, we're always trying to get ahead of the curve.

We now have an individual, Charles Geraci who's in Cincinnati, who has been designated as our associate director for emerging technologies and chiefly is involved in this new advanced manufacturing, which includes a lot of really interesting types of new manufacturing, additive manufacturing, functional fabric, photonics, nanomaterials and others. And has developed lots of relationships with the Department of Defense and DARPA and the National Science Foundation and others. So, we're very excited about that.

Also, very excited about our new center for robotics safety research, which is hosted by the Division of Safety Research in Morgantown.

This is just going to expand. And I know the mining program is looking at automation also. It's something that we're all going to have to learn about how to deal with both robots that -- and robotic devices and intelligent systems that are run by computer science programs.

So, I think it's going to be a, we just started in September of 2017, but already we've developed, with OSHA and the Robotics Industry Association, a collaboration.

We were, for the first time, we were invited to the robotics, the robo business conference in the Silicon Valley this past fall. It was the first time they ever had a panel on safety of robotic devices. Chiefly, the fixed arms that are used in laboratories and other manufacturing sites.

So, they're beginning to understand more about the value of robotic safety. And that was very positive.

We're also, our Center for Worker Compensation Studies, continues to develop partnerships with not only the National Compensation Insurers Council, which represent 34 states, but also, we've taken all the claims data for the state of Ohio, which has been our partner for many years, and trying to, in our effort to try to figure out how worker comp data can be used for prevention purposes.

And we're starting to develop those relationships with other states also. As you know, workers comp is primarily 99 percent a state functions so we'd have to develop those relations state-by-state.

So, I can go on and on but I just thought I'd give you a little snapshot into some of the things that we're doing. And happy to take any of your questions that you guys may have.

MR. WELSH: Okay. Priscilla.

CHAIR NELSON: Great. John, this is Priscilla Nelson. Good morning.

DR. HOWARD: Good morning, Priscilla.

CHAIR NELSON: I wanted to tell you just a few things about the meeting that we've had thus far here in Tucson.

We heard about a plan for reorganizing the work to be done, which is some kind of a hybrid matrix plan. And we found it exciting and I think provided some good input to Jessica from the Committee. But we're very interested in seeing that evolve through the NIOSH group here.

And we've also completed a workgroup activity that was chartered at our last meeting, that had to do with mine automation. One of our people here, Kray Luxbacher, took that on, along with some other Members, and had a very good meeting which we expect to come out with a report that can actually be used beyond the purposes of MSHRAC, and it's very exciting.

And we also chartered a new workgroup on miner health, which we're extremely excited about and we expect there to be some workshops, maybe more than one, in the 2019 period.

So, the idea of identifying important areas and actually being a part of addressing those areas is the way MSHRAC is thinking right now.

DR. HOWARD: Well, this is great news. I know Jessica and the group had been working on their own version of how best to be organized and positioned to take on some of these newer areas so I'm glad to hear that you all have heard about that and are supportive of that and provide your help and input there.

And I'm really delighted about the workgroup issues. You know, for a number of years, as you know, the MSHRAC was somewhat in a quiet period.

And I don't think you are something that NIOSH has taken as much advantage of that we should have over those number of years in the talent that exists within MSHRAC. So, I'm delighted to see that work. We're putting you guys to work in these workgroups.

I've learned about the automation one and I'm happy to hear that the miner health is something that the Committee is interested in.

You know, as the number of workers shrinks in the United States, both in terms of the demography as Baby Boomers leave the workforce, they're just starting to do that now, as the labor participation rate declines, expect it to reach a low of 59 percent sometime in 2025, 2030, according to BLS.

As we see the unemployment rate drop and lots of jobs go vacant and as we see a lot of other issues relative to the workforce, the investment that we should be making in miner health is really something that I think will help the entire workforce.

So, I'm glad to hear that you guys are interested in that. So, those are great, good news. Thank you.

CHAIR NELSON: All right. And we're also aware of the tsunamis of big data being something of interest. And the idea of lower grade ore and going deeper and hotter. Mines actually presenting new kinds of problems for worker safety is interesting.

And I personally am interested in the idea of informal mining, artisanal mining. Which is really not organized as well. And may not be so huge in the United States where it is in so many other countries.

But it would be interesting to just pay attention to artisanal mining in the United States and see exactly what kind of a workforce there is regarding this small-scale mining. Unorganized in many cases but with their own special safety issues.

DR. HOWARD: Right. Right, exactly. Exactly. Thank you.

MR. WELSH: Are there any other questions from Committee Members? John, it doesn't look like it.

But our first speaker today is Cecile Rose and she will be talking to us about the NAS respiratory coal dust study report. So that's how we'll kick it off today.

And then we have a number of other presentations today. And then this afternoon we'll go to an open pit copper mine and mill for a tour. So that's --

DR. HOWARD: Oh, that's great.

DR. HOWARD: Yes, I wanted to thank Cecile for her participation in the National Academy report. And also, see, I don't know whether it was her idea or whose, but the academy did a video that really helps, I think, get the word out about the report.

Sometimes they're voluminously written, hundreds of pages. And in this day and age, nobody reads that kind of stuff anymore. People barely read the executive summary.

So, the Academy starting to do a video, a YouTube video or whatever, I think really that would make these reports accessible to miners. People who actually should be reading this stuff and understanding the direction that the industry is going in and some of the issues.

I just think that was a tremendous step forward.

MR. WELSH: Yes, definitely. And the other of note, this will be Bruce Watzman's last meeting, he's retiring.

And we also have a new member, Marifran Mattson, from Purdue University, that has joined us --

DR. HOWARD: Well, welcome. And, Bruce, please do not be a stranger. We've relied on you for so many years, decades, and we can't afford to lose you. So, please don't retire entirely.

(Laughter.)

MR. WATZMAN: I am.

(Laughter.)

DR. HOWARD: All right, well, we'll know where to find you.

(Laughter.)

MR. WATZMAN: No, you won't.

(Laughter.)

MR. WELSH: Well, thank you very much, John, for joining us. We appreciate your comments and discussion.

DR. HOWARD: Okay, thank you, everybody. Have a great day and mine tour today.

MR. WELSH: Okay, thank you.

CHAIR NELSON: Thank you.

MR. WELSH: Okay, Priscilla, are we ready to start with Cecile?

CHAIR NELSON: Sure. Do we have any new people here that weren't here yesterday?

MR. WELSH: Yes, one person. Mike, were you able to join us today, Mike? Okay, I guess not.

CHAIR NELSON: Okay. I just want to remind everybody to sign in if you have not done so as yet. Okay.

NAS Respiratory Coal Dust Study Report - Dr. Cecile Rose

So, we are reconvened and we are ready for our first speaker, Cecile on the respiratory coal dust report. And tell us about that video.

DR. ROSE: I should have brought the video.

CHAIR NELSON: There you go.

DR. ROSE: Yes. Sorry I didn't do that. First, I want to thank you all for letting me come and present. It's fun to be back in Tucson and be with you.

My son graduated from UA. And, I did not bring the video because I didn't think I had time but it really is worth watching; it's really well done.

What I'm going to do is talk about this monitoring and sampling approaches to assess underground coal mine dust exposures report by the National Academies.

This is what the report looks like. It's actually not that long, and it's probably worth taking a look at.

I can tell you that before you all asked me to come and present, I hadn't really thought about what role MSHRAC should play in terms of thinking about this report. But I think that actually the report committee members were very serious about trying to kind of tackle this scope of work.

And now I think MSHRAC could step in and help think about how to help NIOSH prioritize and address some of the recommendations from this consensus report, which was released actually, I think, in June of 2018.

In the Consolidated Appropriations Act of 2016, Congress directed NIOSH to arrange for this National Academy study on monitoring and sampling approaches for assessing underground coal mine dust exposure, and they also directed the Mine Safety and Health Administration to provide assistance and data for the study.

And the statement tasked to the Committee was actually taken from the congressional language. And the Committee was then directed to compare monitoring technologies and sampling protocols currently used and required in the United States and similarly industrialized countries to assess the effects of rock dust mixtures and their required application for controlling mine explosions on respirable coal mine dust measurements; to assess the efficacy of current monitoring technologies and sampling approaches, to develop science-based conclusions regarding optimal monitoring and sampling strategies to aid mine operator's decision-making related to reducing respirable coal mine dust exposure; and to identify important research gaps regarding monitoring and sampling.

So, the statement of task of was really very broad and a challenge to the Committee. The Committee was, consisted of people with a lot of commitment to this and a lot of expertise in the area.

It's shared with Thure Cerling, who was at the University of Utah, geologists. We have international experts there, particularly Dirk Dahmann from Germany. We had industrial hygienists, mining engineers, exposure scientists, people with expertise in mine health and safety regulations. This was the Committee.

So in 1969 the Federal Coal Mine Health and Safety Act was intended to protect, it was enacted to protect the health and safety of the nation's coal miners. I know you know that.

The regulatory focus on controlling respirable coal mine dust concentration has really not changed since then, really focused on mass concentration.

And that was, that approach was associated with a decline in rates of coal workers' pneumoconiosis. This is from 1970 to 2000.

But since 2000 there's been an increase in cases of progressive massive fibrosis and rapidly progressive pneumoconiosis.

And I think this slide is probably familiar to you. It shows you this kind of rolling five-year data in terms of the percentage of underground coal miners with coal workers' pneumoconiosis, beginning in 1970.

And then with the rolling five-year averages, showing that around 2000, there was this uptick in cases of coal workers' pneumoconiosis and more severe forms of the disease, particularly in miners with over 25 years of tenure, which is shown in that black line.

The Committee had the sense that changes in mining methods have likely increased exposure to respirable crystalline silica and that that may be playing an important role in this increase, in the more severe cases of disease and in the higher rates of disease, particularly in the hot spots in Appalachia, mainly in West Virginia, Virginia, Kentucky and, I'm missing one. Western Pennsylvania maybe.

So, the idea is that changes in the mining practices, for example, increases in equipment size and horsepower, and then the mining of thinner-seam coals, coal seams, have likely increased the extraction of overburdened rock.

And there's some early data to suggest, based on the lung pathology in U.S. coal miners that have rapidly progressive pneumoconiosis or progressive fibrosis, that implicates exposure to silica and silicates.

And what you see here in A, in Square A, is just an explant of a lung from a miner with coal workers' pneumoconiosis.

And under H&E staining of the lung, and you get progressively increase in the magnification of the microscopic slide of the lung, you see areas that clearly show silicotic nodules. And that's a particularly nice example down there in Frame C.

Small case series, we're not really sure what accounts for the increase in rates of more severe and rapidly progressively disease in these hot spots areas, underground mining in mainly the Appalachian area.

I'll also note that in 2004 MSHA prepared this final rule lowering miners' exposure to respirable coal mine dust. And including the use of continuous personal dust monitors.

The final rule was fully implemented in February of 2016. It decreased the permissible exposure limit for respirable coal mine dust from two to one and a half.

It also required the real-time personal monitoring using the continuous personal dust monitor, and it required full-shift sampling and redefined a normal production shift.

Interestingly, between August 2016 and May of 2017, as the Committee was preparing this report, MSHA reported that over 99 percent of over 25,000 viable samples that had been submitted to show compliance or noncompliance with the new MSHA standard, were in compliance.

The Committee felt that the real-time continuous personal dust monitoring device was an important technological advance because in the past when gravimetric sampling was done, the samples were set at the end of a regulatory monitoring shift and it would take weeks to get the results back.

Now, using the continuous personal dust monitor, you can collect measurements over a full shift. And if those exceed the allowable limits, then the mine operators can take corrective actions immediately. You get the data in real-time. And, again, I know you all know this.

Also, miners wearing the CPDMs get information about their personal exposures. And they can sometimes modify their activities or locations within a mine in response to these elevated readings.

But the Committee, in looking at this, in kind of understanding our task, our statement of task, also acknowledge that there are real limitations in CPDM monitoring. And one of the concerns was that only a small fraction of miners are required to use the CPDM to assess whether the respiratory, the respirable coal mine dust levels are within the allowable concentrations.

And the miners using the CPDMs may not reflect dust exposures of other miners who are not using the CPDMs because, when miners who are using the CPDMs react to high readings and then reduce their personal exposures, for example, by altering their locations, the required respirable coal mine dust measurements may no longer actually be representative of the miners with the highest exposures.

And so, in thinking about the new rule and the increase in rates of more severe disease, particularly in Appalachia, the Committee asked the question, is compliance with the allowable respirable coal mine dust concentrations being achieved only for miners who are wearing the CPDMs or can this really be generalized for all miners in the work area.

The Committee also addressed the fact that particle size distributions and types may have changed since the first Federal Coal Mine Health and Safety Act was enacted in 1970. Changes in mining technologies during the past several decades might have led to changes in typical particle size distributions of RCMD.

And this may have actually changed the relationship between the measurements from the CPDM of the respirable coal mine dust mass concentrations and the health effects that may in fact not be simply associated with mass concentrations but with other things like particle size and particle type and deposition in the lung and effects in terms of driving lung inflammatory responses based on perhaps some shift in the types of exposures that are now occurring in underground coal mines.

So, optimal monitoring and sampling is needed to protect miners' health, and the report states that such strategy should be designed to reduce coal mine dust exposures that cause disease while also recognizing that there are practical constraints such as cost, availability of technology, regulatory

requirements which the Committee was explicitly instructed not to address, and then of course, program acceptance by various stakeholders.

So, what I've done is try to select some of the recommendations that come from the report. There are six chapters and thirteen recommendations.

And I selected particular ones that I thought would be of most interest to the MSHRAC group here, and really have not gone at all into the chapter on international findings or frankly, the chapter on rock dusting.

And I would say that probably the most important and the most challenging recommendation from the report is to identify challenges and implementing optimal monitoring and sampling strategies, sampling practices.

So, the report recommends that NIOSH and other organizations, such as NMA and miners unions, should conduct a comprehensive investigation to identify challenges that coal mine operators face in implementing an optimal and beyond-compliance approach to monitoring and sampling for respirable coal mine dust to actually inform exposure control efforts.

There was a sense, again, that because of changes in technology and perhaps changes in exposures, that simply showing compliance, regulatory compliance, with the new MSHA rule might not, at the end of the day, protect coal miners from developing disease, and that NIOSH, in collaboration with these other organizations, should recommend practical solutions for overcoming these challenges.

Another recommendation was to assess respirable coal mine dust exposures of mine workers who were not wearing the CPDMs.

Again, there was a sense that in the designated occupations, that the high face workers, the longwall shearers and the roof vaulters and the people who we know are at highest risk for developing coal workers' pneumoconiosis, that if they are altering their exposures based on the real-time outputs that they get from the CPDMs, it's actually important to evaluate exposures of miners who are not wearing the CPDMs to ensure that the approach of detecting and mitigating high exposures for those designated occupations actually relied on the results in mitigating high exposures for all workers.

Another recommendation, and I know that MSHRAC deals with issues related to education and training, and that NIOSH has people who are really trained on how to do this well. But it may not have been as much of a priority as some of the other priorities.

There was a sense, from the NAS report, that we need to improve worker training and education programs and really carry out a systematic examination of the content and implementation of training and education programs with respect to respirable coal mine dust exposure.

And that training and education on minimizing and limiting these exposures and using the CPDM need to really be done by people who know what they're doing, not people like me who think we're good teachers but who really aren't trained at all in how to teach adults and how to develop curricula in this day and age; that there needs to be an effort to implement effective and consistent education in training programs across the industry and that the programs should be relevant to the mine workers, not just the ones who wear the CPDMs, and to the operators and the regulators; and that there should be, as part of that process and effort to look at the effectiveness of the programs.

Another recommendation was that NIOSH and MSHA should evaluate whether the current relationship between particle size distributions of the coal mine dust samples and the particles deposited in the lung that are implicated in the development of lung disease are similar to the relationships that were established decades ago when the monitoring devices were used for sampling when the regulation was first adopted.

And, again, there was this sense that we're not sure, the Committee was not sure that current monitoring methods were adequate to percent coal mine dust lung disease, and it would be too bad if 20 years from now this increase in more severe disease in these hotspot areas were not prevented.

The CPDM does not monitor real-time crystalline, respirable crystalline silica exposure. It really monitors total respirable coal mine dust exposure but does not look specifically at the silica fraction.

And NIOSH has been engaged in efforts to develop an end of shift silica monitor and the Committee felt that those efforts needed to continue and that efforts to develop a real-time crystalline silica monitor should probably be prioritized.

Another was to facilitate the use of personal monitoring devices for engineering studies. We heard a lot from different stakeholders about the fact that the CPDM is ergonomically challenging.

It's heavy, it's bulky, it gets in the way. And it would be helpful to try to develop a less costly and less ergonomically stressful CPDM.

And there are limitations in how the CPDMs that are available at mine sites can be used. The operators can't use the CPDM without MSHA's permission.

And there was a sense that the CPDMs might be useful to monitor and to actually do beyond-compliance monitoring studies to facilitate what we understand about exposure.

Another recommendation was to explore the broader use of area monitoring devices for trend-gathering on respirable coal mine dust concentrations and particle characteristics that the switch to CPDM is helpful but it is absolutely important to continue to do area sampling so that you get a feel for what's happening beyond the individual exposure in the designated occupation.

And then another recommendation was to assess the association of changes in mining activities with the occurrence of the disease hot shots, to really try to conduct a systematic evaluation of changes in mining technologies and activities to try to understand the extent to which those changes have actually increased the extraction of rock, the overburden rock and the extent to which perhaps past rock extraction had been co-located with disease hot spots.

Again, we don't, we have clues, we think, about what may be driving this increase in more severe disease in these hotspot areas but we're not sure.

And then another was to monitor the respirable coal mine dust characteristics in future exposure studies to really, again, get a sense for different particle characteristics, characterize and quantify the source contributions, including rock dusting and the extraction of rock strata adjacent to the mined coal seam and assess how those dust characteristics may have changed over time and then try to consider at least tracking temporal trends to figure out what is changing in terms of the particular exposures that may be driving disease risk.

Another is that NIOSH, MSHA and other organizations should set priorities for addressing the committee's recommendations and develop a strategy for addressing them. There were a lot of recommendations. I mentioned that there were 13.

And there was a sense among the, not NAS Committee Members, but there would need to be some effort from NIOSH and MSHA and its advisory committees to really help think about what the priorities can be, what the low-hanging fruit are, where resources need to be placed.

The Committee also recommended that there should be the capability for research in an experimental underground mine. I know that Lake Lynn has been a concern for a very long time and I was glad to hear John Howard's update on the likelihood that a new facility, a new experimental testing facility is coming along.

And that, importantly, federal, academic and coal mine researchers should seek opportunities for conducting collaborative research and development activities.

So, I'd like to hope that we have a little bit of time for some questions.

MR. WELSH: Sure. Yes.

DR. ROSE: Yes, okay. But, the brief summary is that coal workers' pneumoconiosis continues to affect U.S. coal miners. It's too early to know whether compliance with a 2014 dust rule will prevent disease.

Reliable data on dust exposures in underground coal mines is crucial for predicting, reducing and preventing miners' disease risks. And medical surveillance of miners combined with comprehensive

exposure assessment are needed to understand disease trends and risk factors and to assess whether exposure control efforts are working. I think that's it.

CHAIR NELSON: So, thank you very much. So the question about whether things have changed over -- I don't like it over time because that makes it sound like something that's time-dependent as opposed to punctuated changes.

Whether it's a change in the coal, interbed coal being mined or whether it's change in the equipment. But the issue of change is, initially, seems to be pretty significant to determine whether there is a change or not.

There has been nothing done in a logical scientific approach to actually determine whether there has been change in the dust produced and do you make any recommendations on how to do that?

DR. ROSE: The report goes into a little bit of detail on the importance of looking at particle size distribution and particle size, the components of the particles. That there is, for example, a sense that the mass concentration, which has been the, kind of the foundation of doing exposure sampling for respirable coal mine dust, just looks at total mass concentration. It does not look at particle size distributions, it doesn't look at particle types.

We don't know whether there has been a change in the component of respirable silica that may be included in the coal mine dust or in the size distributions. There really appears to be very little historical trend data that the Committee was able to find regarding those changes over time.

DR. KOGEL: I guess to add something to that, and that's exactly right, I think the key here is, is there's not been a really systematic study of this, that they're bits and pieces. You know, MSHA collects data that we could go back and look at but we don't necessarily have, especially the particle size, distribution and shape information. So, there's a lot of gaps.

And I think the report does a really good job of really pointing out what those gaps are and what we need to understand to be able to then have some confidence that we're measuring and addressing this issue before it manifests itself ten, twenty years down the road.

CHAIR NELSON: Yes, so the issue of mass, not versus, but mass and grade -- particle size and particle --

DR. ROSE: Composition.

CHAIR NELSON: -- material, right?

DR. ROSE: Yes.

CHAIR NELSON: Whatever the mineralogy is.

DR. ROSE: Exactly.

CHAIR NELSON: If we're only measuring mass, we know nothing about the other things and they have different effects.

DR. ROSE: And it was really a foundational conclusion --

CHAIR NELSON: Yes.

DR. ROSE: -- in terms of the needs and recommendations by this National Academies Committee.

CHAIR NELSON: Yes. Aubrey, did you have --

DR. MILLER: Yes. Great presentation, Cecile.

DR. ROSE: Thanks.

DR. MILLER: Is there an opportunity to do some kind of case control series on some of these and try looking for practices or areas?

Is there a cohort out there that could be examined?

DR. ROSE: You know, I don't know that I'm the right person to answer that question. I think that that would be something for NIOSH to kind of think about. For you to ask Cara Halldin and David Weissman, is there a way to move forward in terms of the research and understand what factors may be driving more severe disease in particular groups.

DR. MILLER: Right.

DR. ROSE: I mean, they've done some work looking at, for example, NIOSH has done really fine work actually looking at sizes of companies and the smaller companies are more likely to have higher rates of people with more severe disease. And there are obvious reasons for that in terms of access to resources --

DR. MILLER: Right.

DR. ROSE: -- and the ability to prioritize health and safety.

So there has been work done by NIOSH, but I think there's a sense that more needs to be done than just hoping that this new MSHA rule will protect people downstream and how do you go beyond compliance.

I mean, this concept of a beyond-compliance approach to understanding risk I think is one that NIOSH and probably MSHRAC could grapple with.

DR. KOGEL: Can I just add a comment to that too? Did we actually do, to your point, David Weissman is putting together a proposal for a cohort study just like what you described.

And what actually stimulated this was, we had the pleasure of hosting Dr. Redfield, who is the new CDC director in Morgantown, then he came up to Pittsburgh and visited PMRD. And so, we talked about your report and he got an opportunity to visit with the black lung surveillance program and he keyed right in on that and he said that should be a priority.

So, just so that you know, that that is something that has been identified by our Director and so we are putting something together on whether or not that will result in funding is kind of the question now.

So, and I don't know what the process is, but certainly I think if at the next MSHRAC meeting, depending on whether or not this thing is continuing forward like would be expected, well, maybe David could come and brief the Committee on that. Or the proposal --

DR. MILLER: And then NIOSH is going around and screening surveillance in the global system, right?

DR. KOGEL: Right.

DR. MILLER: All of that is ongoing. The training and education was fabulous. Some of the stuff I had seen.

CHAIR NELSON: Jeff.

DR. BURGESS: So, Cecile, thank you very much for that. Along Aubrey's lines of Aubrey's questioning, I think, the whole idea of screening and surveillance.

So a lot of the stuff you talked about was the exposure site. Very appropriate, but not so much data on the screening surveillance.

And there are certain things that are out there that I realize are very technically difficult. I was talking to Phil Harbor, who is also familiar with this.

As you know, about the idea of, can you use the digital chest radiographs to be able to get additional information. Apparently, it's very difficult.

I think you probably know much more about that than I do, but that whole idea of improving our screening so that even if we have excellent control, there may be people that escape the controls in terms of the exposure.

Can you talk a little bit about that, of kind of what the Committee discussed in that regard?

DR. ROSE: I would say that we didn't spend a huge amount of time talking about that question, although I would have been happy to do that.

DR. BURGESS: Yes.

DR. ROSE: But, the statement of task and the scope of work for the Committee was really to focus on optimal exposure monitoring and sampling strategies to prevent coal workers' pneumoconiosis and not so much on kind of the aspects of the medical screening program or the medical surveillance program.

We did hear from NIOSH. The Committee did hear from the Morgantown NIOSH folks about both the Coal Workers Health Surveillance Program and also the enhanced Coal Workers Health Surveillance Program, which now has moved from not just looking at chest imaging, but also looking at spirometry and collecting more data about exposures and occupational histories and that kind of thing, which I think is actually really important in terms of this last point of linking the medical surveillance findings with the exposure assessment, looking at concentration and size and particle type, exposure shifts in the dust.

DR. BURGESS: I truly think, again for NIOSH, I think this is a critical part to really not forget that because, again, people will, there'll be somebody who's not monitored appropriately for some reason. Maybe a maintenance guy or whatever that kind of escapes this, I think, otherwise.

CHAIR NELSON: Okay, Ron and then Bruce.

MR. BOWERSOX: I just want to know where you got the video. Where do you get it at, the video?

DR. ROSE: On the National Academy --

MR. BOWERSOX: Okay.

DR. ROSE: -- website. Yes. Yes.

CHAIR NELSON: If we can send around the link, that would be useful.

DR. ROSE: Yes.

CHAIR NELSON: Bruce.

MR. WATZMAN: You know, Jeff, you've touched upon something important and that was our view of the report, that it didn't, it wasn't complete. That there was a whole element of the report that was missing.

And I understand the tight statement of task and you were limited, but the issue you brought about, up about surveillance is critically important if we want to finally eradicate this disease.

And secondly, if we want to help miners during their working career, because there are steps that can be taken during their working career, but without that surveillance data, we can't do that.

It's unfortunate that today only about a third of the workforce participates in the surveillance program. To me, that's a failing of the program and something that has to be addressed in a comprehensive manner if we are going to finally eradicate this disease.

It shocks me. I'm shocked that 40 years into this program that we still don't have good information, surveillance data, on every working miner so we can address their health concerns during their working career. It's a failing.

We've all failed in that regard in my view. I know there are people who disagree with me. I don't know what Cecile, so I'm not going to put her on the spot, but to me it's just a failing.

And if we don't address this and those who follow us are sitting here 20 or 30 or 40 years from now and we're still in the same situation we are today, then, folks, we've all failed the workforce.

DR. KOGEL: Bruce, will you be sure to respond to the RFI that was mentioned yesterday on this topic?

MR. WATZMAN: Oh yes.

DR. KOGEL: Okay.

DR. ROSE: And I just want to respond.

DR. KOGEL: Before you retire.

DR. ROSE: I want to respond to that. I don't disagree with you. I think that the more people who participate in medical surveillance program the more reliable the data are.

The rates of participation, my understanding is that they have been very stable.

MR. WATZMAN: Yes.

DR. ROSE: They've been very stable, but they're incomplete. And there are obvious reasons for that. I mean, people don't want to know about their health problem or they are afraid of job loss.

One of the things that the report does do is recommend that NIOSH explore reasons for the low participation rates. And including low participation rates in the Part 9E program, which is the program that MSHA has for miners who are found to have early coal workers pneumoconiosis can go into low exposure jobs with rate retention.

But there is a very low participation rate in the Part 9E program. And there are good reasons for that.

MR. WATZMAN: Yes.

DR. ROSE: But, somebody needs to look at that systematically and start to really tackle the low participation rate and --

MR. WATZMAN: Absolutely.

DR. ROSE: -- see if we can drive those rates up. There's no doubt about that.

CHAIR NELSON: So, let me ask you to be thinking momentarily about what you think MSHRAC should move forward with, armed with this report. But, before I come back to you, I want to make sure we get Ed's comment.

MR. GREEN: Thank you, Priscilla. Hi, Dr. Rose, nice to see you again.

I want to particularly supplement what Bruce said about mandatory surveillance. This is something that is totally within NIOSHs --

MR. WELSH: Debbie, can you hear Ed?

MR. GREEN: I can speak up.

MR. WELSH: Yes. You can't hear Ed?

COURT REPORTER: A little bit.

MR. WELSH: Okay.

MR. GREEN: Okay. This is something that is totally within NIOSH's authority, the regulation that deals with surveillance is NIOSH's regulation. And there's no reason why NIOSH cannot change that regulation to require mandatory surveillance.

I've had discussions with various NIOSH employees over a couple of years who say, well, we can't do that. The answer is, well, you can do that.

First, you have to go through rating. And now that you've got this RFI that is asking for input with regard to how to get more miners involved in the program, that can definitely be answered. And no doubt that comments that come in that will support that particular initiative.

And as far as how MSHRAC can be involved in the NAS report is a great question, Priscilla. And I think, to me, the answer is, you guys are beginning to break up and start doing ample work in your subgroups and working groups.

And if this is exactly the kind of situation that calls for an MSHRAC working group, not only for members but also for stakeholders, and I urge the Committee to reform that for the working group and begin to implement the recommendations of the report.

Otherwise they sit there and 20 years from now we --

MR. WATZMAN: We're going to be right where we are today.

MR. GREEN: -- are not going to be the same.

CHAIR NELSON: Thank you.

DR. ROSE: So, I will try to answer that question. I, again, as an occupational pulmonologist, I think it's wonderful to have chest x-ray and spirometry data and epidemiologic studies, but looking for disease after it's occurred for something that's not treatable, doesn't seem like the highest priority to me.

And one of the things that I think the Committee struggled with was how to prioritize some of these different recommendations. My sense is that this is probably the highest priority is to identify the challenges in implementing optimal monitoring and sampling practices, that if the only monitoring and sampling that occurs is for regulatory purposes, then we have failed.

PARTICIPANT: Right.

DR. ROSE: That is not going to answer that questions that need to be answered vis a vis exposure risks and exposure control.

And so, I think that you want to really focus on primary prevention not kind of early disease detection and removal from exposure, but what is it that needs to be controlled in the first place to prevent disease.

And so, moving beyond this kind of regulatory compliance, which we know based on MSHA data, is everybody's perfect. And yet, there is this nagging feeling that I suspect you all have, that the Committee had as well, that that regulatory compliance may not be perfectly linked with the expectation of disease prevention.

So that, getting to understanding the exposure and controlling the exposure is really where I would urge MSHRAC to kind of prioritize and tackle the methods for doing that or the way of helping NIOSH think about how to do that. Particularly with industry.

CHAIR NELSON: So, I mean, there's various factors associated with exposure and it can be mass, it can be grain size, it can be mineralogy, it could be a lot of different things. And it, and evidentially it's not clear exactly which one of those, or all of them, are the drivers in this case.

So, there's no point in having, in my opinion, some kind of compliance when you do not understand exactly what the driver is. So, there's just some fundamental work that needs to be done to begin. Jessica, did you want to talk?

DR. KOGEL: Well, I was just going to say, we are working on right now drafting a document where we've taken a look at each of the 13 recommendations, and I'm going to just thank the Committee for the work that you did in really fleshing these out and articulating them in a way that we can start focusing on them.

And our big question is, how do we, because you saw, I think the Committee saw the kind of the scope and the depth of these recommendations. And so, for us to say, okay, we're going to address all 13 of these is not practical.

And so we really, the whole priority issue is really important. And I think this discussion we just, and the fact that you feel that this is really the highest priority and the fact that there is really basic research that we need to do to understand the positive effect, and that's really what this, I think, focuses on beyond compliance issue.

So, where, just speaking from the NIOSH perspective, what would help us the most is understanding what this Committee feels is the priority so that we can then marshal our resources, whether they're internal or we fund things externally or we do some sort of combination approach, that's what we need to know.

And I think what we had already landed on, and if we were to circulate the draft response that we have today, you would see at the very beginning of our responses, we need to form a partnership. But Ed's idea of doing it as a MSHRAC workgroup is also another, I think, very viable alternative to forming another partnership.

But, that's what we need because everyone of the recommendations that I think you all make, involve NIOSH working with NMA, with MSHA or some other organizations. This is not a problem we can do on our own or solve on our own.

And so we need this partnership or workgroup and we need a lot of other people who can bring their expertise to the table.

So, I think for us that would also be, I'd like MSHRAC to think about, one the priorities, and two, does MSHRAC want to take on something like another workgroup or do we want to do some other kind of mechanisms. I think that's going to be what we need to address this.

CHAIR NELSON: So, has everyone looked at the report? Not everybody has looked at the report, so I'm trying to suggest a path forward because this is important and I think action is possible and required of us to respond to this report.

What I'd like to do is to ask all the members to review the report, participate in the RFI response and then we can gather information from all of the members about the priorities and about what might be a charge that MSHRAC could take on.

DR. MILLER: So, are you looking to create a cohesive response from MSHRAC that we -- or just individual responses?

CHAIR NELSON: Well, I'm thinking, I think we need to discuss to have a coherent MSHRAC response so I don't know that we can do that very effectively right now with our meeting schedule that we have. So I think it can be individual.

But I would ask this to be homework. To respond to the RFI and then to think about the report, about priorities and about what we might charge ourselves to take on regarding an MSHRAC activity. Send it back to me and I will massage, echo and we should be able to come up with at least a draft action that we can do at this point.

And we may be able to initiate that before the May meeting or April meeting, whenever that is. So if -- when's the deadline for the RFI response?

DR. ROSE: January. January maybe.

DR. KOGEL: Yes, it was January. I think the end of January.

CHAIR NELSON: I think it was 15 but it's --

MS. CHOVANCE: It's January 14.

CHAIR NELSON: January 14th, so that's very quick. So, we ask the MSHRAC Committee Members to review, comment by the deadline, which is January 14th, and then --

MR. WATZMAN: Wait a minute. Are we talking about the RFI that's currently out there related to participation in the surveillance program?

MR. WATZMAN: Well, that's totally different from this.

CHAIR NELSON: So, I thought the RFI was related to, I'm sorry.

DR. BURGESS: Is there a different RFI?

MR. WATZMAN: Not yet. There is not an RFI, as I understand it, yet --

DR. ROSE: No, not related to these recommendations --

MR. WATZMAN: -- related to this.

DR. ROSE: -- specifically.

DR. BURGESS: Right.

CHAIR NELSON: Okay, so I was -

DR. KOGEL: Yes. No, we can write --

CHAIR NELSON: -- because I thought it was.

DR. ROSE: We still want you to respond to it.

MR. WATZMAN: Oh, no question but we need to be clear on what we're responding to --

DR. ROSE: Right.

MR. WATZMAN: -- at this point.

CHAIR NELSON: Okay. So, that's my fault because it was not clear to me what was going on.

So, the members should be encouraged to respond to the RFI. But also in the context, and we can give ourselves a deadline, we would like to have each of the members review this report, comment on priorities and provide input on what an activity might be that MSHRAC could take on, which may be another working group, it may be some activity with the panel, in fact, that engages stakeholders and provides some additional prioritization guidance to NIOSH. Jeff.

DR. BURGESS: So, I have a question on that. So, this is a health issue. You've got a health subgroup. What is the overlap on that?

I mean, is this a separate issue, is it a joint issue between these two or not?

So, that's a question I guess for you, Jessica, and --

DR. KOGEL: Yes.

DR. BURGESS: -- and NIOSH in general. And then the second bit, as Priscilla was having an excellent suggestion for us to move forward, I would just like to hear what you kind of wanted to have.

And one thought I was thinking that might fit with that was to dedicate our next meeting, I know it's a while away, but rather than going through all the ways we have been doing, which are nice reviews to understand things are going on, but to block out more time. Let's say a four hour session, on a topic to really get, if you want input from us as MSHRAC, that we could have more time to really get in detail and prioritize, et cetera, during a session.

You would just have less bandwidth. You'd have to focus down on this issue. So that is a possibility, too. I just don't know what your priority is in terms of what, how you would like this and when and what format.

CHAIR NELSON: Yes.

DR. KOGEL: Well so, to go back to your first question about what's the role of the miner health program. Jerry and I just had this discussion yesterday, and clearly there is overlap.

And we're working closely with our RHD and all these things we talked about yesterday. This is a collective effort and response.

We haven't really formally brought in Jerry's team into this at this point, but yes, I think that's a really relevant and valid question. And so, we're going to integrate that group as well into this.

I can't tell you exactly how that's going to look right at the moment.

Second question about, I think if we want to spend some time at the next MSHRAC meeting, I think timing wise that's not a problem. These are big issues.

They're going to wait for when we're ready to address them. I suppose I can say, I don't look at them and, you know, if we have to wait several months or six months before we start addressing some of these, I don't think that's going to be an issue.

And I would rather have MSHRAC's input and engagement on this. And if the best way to kind of facilitate that to make that happen is to have these face-to-face interactions and have some proper time set aside in the agenda, I would be completely fine with that.

MR. WATZMAN: But, let's be clear. Ultimately this is MSHA's responsibility. This group, Jessica, NIOSH, serves as a resource to MSHA who has the ultimate responsibility through their regulatory regime, to implement a sampling program or a surveillance program or whatever the case may be, or monitoring.

So, it's a multi-stage process, Jeff. I mean, just because NIOSH comes out with recommendations doesn't mean that the next day those are going to be implemented in the mines. This is going to take some time.

I think your idea of committing more time to a discussion of this, bringing in NIOSH folks, and they're with RJ in Pittsburgh, I mean, they have the history of sampling. They understand sampling protocols, they understand how it's been managed.

Particle differentiation. I think you have to start because not everyone on the Committee is at the level that some of us are, who have dealt with this for 30 years.

So, I think you're going to have to start from a -- so that everyone has a basic understanding of the issue, what we've done to get up to this point, to get to where we are today.

CHAIR NELSON: I appreciate that. And you always tell me things I don't know, which is an important thing to have you do.

(Laughter.)

CHAIR NELSON: But, what I feel like there's some basic and compelling information that's been identified as needed from this report. And your comment about what is known, that may be in the collective database and knowledge base of NIOSH the way it is right now --

MR. WATZMAN: I agree.

CHAIR NELSON: -- is I assume what you're assessing in preparing your prioritizations in the response.

So, if we, as a Committee, can familiarize ourselves with this report and give thought to the priorities, what you find the most compelling thing that is in the NIOSH realm, and potentially in the MSHRAC realm to act. But if we can do that, then perhaps when do you think you would have a response that could be however drafty --

DR. KOGEL: However drafty.

CHAIR NELSON: However drafty --

DR. KOGEL: We have an --

(Simultaneous speaking.)

CHAIR NELSON: -- for us to think about for the NIOSH response. And then we could focus on maybe our thinking on what your response is.

DR. KOGEL: Yes. And I think that makes sense, Priscilla. So, our draft is, draft moving externally far along and we have gone through a number of iterations internally and I would say close to having something we could probably circulate.

And also I'm planning to send it to MSHA as well to get their input and response. So that was going to be our next steps.

So, maybe what would make sense is we send the draft that we have, let MSHA preview it and add anything that they wish to add, and then maybe come to the Committee so that you can certainly see what we're, that could be, I think --

CHAIR NELSON: Okay. So, the trigger on putting priorities down for our thinking would be the delivery of the draft NIOSH response. When do you think that would be?

DR. KOGEL: I'm going to look at George. Where is George?

DR. LUXBACHER: Next week.

DR. KOGEL: There he is.

DR. LUXBACHER: I mean, right now we're --

DR. KOGEL: We're pretty close.

DR. LUXBACHER: -- for internal comments. The final, the draft final. I've received some comments from some of the internal group that is working on this. The answer was probably early this week, so probably before -- I'd say before the end of next week.

CHAIR NELSON: All right. So, if before the holidays we actually receive something, right, then we could focus on that.

And what I'd like to do is to get an iteration back from the Committee so that then we can talk about what we might do when we meet again. Right.

DR. KOGEL: Right.

CHAIR NELSON: So we have that iteration.

DR. KOGEL: And then you'll determine at that point whether or not to have a block time set aside.

CHAIR NELSON: Yes.

DR. KOGEL: Okay.

CHAIR NELSON: So, when we send that out, we could send it out with a request for a response deadline, which might be the end of January, the end of February. Something like that for people to get their feedback on. Kray.

DR. KRAY LUXBACHER: I had just one quick comment. And I think this report hits on that well that we don't understand the problem --

CHAIR NELSON: Right.

DR. KRAY LUXBACHER: -- entirely, and that is our problem.

I hope that in trying to understand the make-up of dust and how it's effecting health, that we won't abandon the really good work that NIOSH has done and the competency they felt in engineering controls for dust and assessing the efficacy of those controls.

Because, I think if we spend five years trying to figure out the problem and then we no longer have that competency, well, it's going to be really hard to develop controls to address those problems.

DR. KOGEL: Yes. I understand.

DR. KRAY LUXBACHER: So I hope that remains a priority.

DR. KOGEL: Yes, it does.

DR. KRAY LUXBACHER: Okay. And I agree with that.

DR. KOGEL: And when I look at what's in here, it's really kind of out of our area of expertise quite frankly.

DR. KRAY LUXBACHER: Yes.

DR. KOGEL: We can address a lot of it, but doing this really in-depth systematic kind of study, we would have to hire some people to do that. And the people that we do have that are, have the expertise in that area are already working on other projects so we would have to make some decisions about pulling them off. And then we would have to have some new hires.

So, I think a lot of what I see here, especially with regards to looking at that sort of more basic research of teasing out this problem, is something that we would think about funding outside of NIOSH. That we could go to a university or to some other entity and fund that work.

So, just to --

DR. KRAY LUXBACHER: And continue to do a lot of the engineering --

DR. KOGEL: Right. Because that's our core thing, right? So, unless something changes and our budget really changes and we can hire lots of people, we don't have the capacity just to do it now.

DR. KRAY LUXBACHER: Yes.

DR. KOGEL: We've got to find, that's why I've been talking a lot about collaborating outside of the program as well as within NIOSH because we can't get these things done that we're being asked to do. We already have a full plate now.

And so, either we're going to say, all right, we're not going to do these other things any more, these things come off our plate, or we're going to not be able to do what's being asked of us.

And these are important issues and I think we need to address them. So, we've got to be a little bit creative in how we pull the resources. But we have the ability to do that, and so that's what we have to look at.

It's a little different model for us, but I also think it harkens back to some of the Bureau of Mines way of doing things. And George mentioned, what are they called, the --

DR. LUXBACHER: The mineral institute --

DR. KOGEL: The mineral institutes.

DR. LUXBACHER: -- dust --

CHAIR NELSON: Where there can be focus.

DR. KOGEL: Yes. Right. So that's the model we've been talking about using.

DR. LUXBACHER: If you remember yesterday, on solicitation, the pre-solicitation that's out, one of the topics on their line item topic is responses. So, I think I picked out three or four recommendations that we felt we needed outside help for and we included that in that BAA solicitation --

CHAIR NELSON: Yes.

DR. LUXBACHER: -- that kick start this while we were talking about how we were going to respond and how we were going to fund, do things.

So, that was an intent to get ahead of this process. So that's why that's in the BAA solicitation this time around.

CHAIR NELSON: So if we, as a Committee, focus our response to comments on your draft and added the input from the Committee, is that useful for you?

DR. KOGEL: Yes.

CHAIR NELSON: Okay.

DR. MILLER: My concern was that this will hijack you guys to be looking at the exposure in trying to get representative data out of highly variable exposure that is changing over time and putting a lot of resources when you can be done with this.

Cecile mentioned toward the primary prevention aspects and the engineering control, which would be obviously more health beneficial to the members.

CHAIR NELSON: Yes.

DR. KOGEL: Yes, focusing on the primary is --

DR. MILLER: Yes.

DR. KOGEL: -- I think --

DR. MILLER: And that's where you're --

DR. KOGEL: -- really critical.

CHAIR NELSON: Well, it's the combination of the engineer control and the burden. The particulate characteristics. And if they're changing over time, the engineer control may need to change over time as well.

DR. KOGEL: Right.

CHAIR NELSON: So they're together.

DR. KOGEL: I think Ed earlier was trying to get your attention.

MR. GREEN: I just wanted to offer some perspective, if I might. And I think where we're coming from, and we were getting to, Priscilla, is a great, a great team plan and I'm delighted to hear.

The potential of perspective point, the Federal Coal Mine Health and Safety Act of 1969 was signed by Lyndon Johnson on December 31st of that year.

Your mine was charged with writing the respirable dust regulations within a six month period of time. They just missed the deadline and the original was published that summer in 1970.

I was a baby boomer just getting my toe dipped into the wonderful world of respirable dust and everything else, dealing with the safety and health.

The great industrial hygiene success story took place in terms of really dealing with dust levels in the coal mines. We're still dealing with the issue, but it's no way near the epidemic that it was back then. And we should never forget that and never let the public forget that.

The next milestone was just about 20 plus years later when Gavin McIntyre (phonetic) formed the dust advisory committee, which Bruce may recall vividly. And that went on for, it was for a year and a half before it was issued.

And all sorts of recommendations in the form of the rules. Then another 20 years passed, then another 20 years passed before the document was published in 2014.

And I think the point of this one would suggest to the Committee is, we shouldn't have to wait till 2040 to get this done. So, this is a job that this Committee can play a seminal role in.

And I would encourage anybody sitting around the table, as well as stakeholders, to engage. This is something we can resolve and we have the capability to do it. And we certainly have the capability, the question is whether or not my community has the will.

CHAIR NELSON: So, we have been charged by Ed.

(Laughter.)

CHAIR NELSON: Thank you. Okay, thank you very much, Cecile.

DR. ROSE: Yes, thanks for listening.

CHAIR NELSON: Okay.

DR. ROSE: And I just want to say too, you know, Mike Wright I think is on the MSHRAC.

CHAIR NELSON: Yes, he is.

DR. ROSE: And he was on the Committee as well.

CHAIR NELSON: Right.

DR. ROSE: And I think that speaking for myself, probably for other Committee Members, if there is any interest in having us help or reflect in more detail what the deliberations were.

But, maybe, I think all of us would probably be happy to --

CHAIR NELSON: That's right.

DR. ROSE: -- help inform the Committee if you need us.

CHAIR NELSON: There is always important discussions that didn't make it into the report as well.

DR. ROSE: Right. That's right.

(Laughter.)

CHAIR NELSON: Okay. Well, thank you very much. Our next presentation is Marcia Harris talking about explosion and fire prevention. And we're at 9:15.

So, Peter, we may take a break before your presentation, okay?

DR. ZHANG: Okay.

PARTICIPANT: Or not.

Recent Research in Coal Mine Explosion and Fire Prevention - Marcia Harris

MS. HARRIS: Well, good morning everybody. The good news is, I have more of a voice today but the bad news is, is there's something that, I still have my cough so --

CHAIR NELSON: Can you use that mic? Does that mic work?

PARTICIPANT: Not for her, I tried.

CHAIR NELSON: Oh. So there isn't any mic in the room.

MS. HARRIS: Can you hear me at all?

COURT REPORTER: It doesn't amplify.

MS. HARRIS: Okay. Well, so, I'm probably going to push through this real quickly here to try to cover everything before I start coughing again.

I'm going to discuss some of the recent research that we've been doing in the areas of explosion prevention and fire prevention. So, explosion prevention, primarily I'm going to touch upon the large scale testing, classified rock dust and foamed rock dust.

And then fire prevention, improving the AMS deployment strategies for underground diesel fuel storage areas, sensor evaluation under low air velocities, developing a predictive model for the safe reentry after blasting, gunfire improvements and upgrade in mine fire simulations using real-time AMS data.

So, first of all, this is something that was touched upon yesterday, was the large scale testing. We had gone over to Mikolow, Poland, to the Central Mining Institute, to use their large scale facility.

We tested some treated rock dust and untreated rock dust with their d38 coal. We used their Polish, their rock dust and we tested between the two rock dusts on a comparative basis.

Now, one of the reasons why we went over to Poland was we do have a rich history of collaboration with their researchers. And also, to the mine geometry. So very similar to the ones at Bruceton, so we do have some comparisons there as well as the, their Barbra SIMCOAL (phonetic) is very comparative to our Pittsburgh SIMCOAL.

So, what we have done for this testing was homogenous mixes of the coal and the rock dust. And you can see that mix in that coal right there.

So, on a comparative basis, we looked at the explosion intensities and you can see it's almost one-to-one for the 50 percent total and combustible content. But when you start looking at a higher end combustible content, is the red here in this graph, you can see that actually the treated rock dust is better. It performs better than the untreated rock dust.

And again, the basis for the treated is so that, anti-caking. So, basically what it boils down to is that the inerting properties of the treated rock dust are at least as good as those of the non-treated rock dust.

And as you go higher in percentage of total and combustible content, you're actually seeing better performance.

We also looked at classified rock dust. One of the issues of the treated rock dust, or questions was, since it's more fluidized and it doesn't cake, will it contribute more to respirable dust.

And so, we looked at, one of the suggestions was, we'll just remove the respirable component. So we did and tried to look at that, but it still needs to be as effective as the dry regular rock dust. And it should remain dispersible when applied to wet surfaces.

But when you look at the mass, there is 30 percent of the mass is actually equivalent to 3 percent of the surface area when you start looking at that component that is less than ten micron.

So, in this graph here you'll see, we were looking at the inerting effectiveness when removing the, that lower size fraction. So, typically the reference rock dust inerts at 75 percent in their 20 liter chamber, but when you remove the ten micron component of that, actually it's more along the lines of 20 micron here.

You need to increase that total in combustible content to 90 percent. So it goes from 75 percent inerting in the 20 liter chamber to 90.

So, consequently, you can't just remove that small particle because that's contributing the most to your inerting effectiveness. So we started to remove larger particles.

So we removed the 75 micron and above. So, you got inerting it at 80 percent but we're still shooting for that 75 percent in the 20 liter chamber.

Consequently, you've got a very narrow size distribution of 20 to 38 micron that actually inerted in the 20 liter chamber.

However, to try to manufacture something of this small size is going to take quite a bit of effort, and the costs are going to increase dramatically.

We also looked at the dispersion of this engineered reference rock dust using our dust dispersion chamber. And you can see it right here.

When we looked at these different size fractions, you can see on this graph here the reference rock dust is this dotted black line. That's what we're shooting for.

We know that this is inerted in our Lakeland testing. When you start to get down to that 20 to 38 micron, that inerted in the 20 liter, it does similarly disperse. But because it is larger in size, we still have question on the full scale explosion, if that's going to actually inert and lift with the coal dust.

When we had done some full scale dispersions, we had gotten 200 pounds of rock dust where we move the respirable component. However, we were unable to remove all of it so there was still about 6 percent remaining.

Consequently, I mean, it's no big stretch of the imagination, it went from like, say 32 percent minus the ten micron to 6 percent. The measured respirable component significantly reduced as well.

But basically, again, manufacturer is to keep it an affordable price. We can't produce this very small narrow size distribution.

Therefore, we've been looking at foamed rock dust. That's more of an attractive measure.

Ideally, it would be applied as a bed rock dust adhered to the ribs and the roof and dry and still remain dispersed, but once it's dried.

Using our dust dispersion chamber, we had three different types of foam from three different manufacturers. And you can see the before and after pictures right there. These were all created using different methods and different components.

As you can see, let me see here. You can see like Manufacturer B before and after there was basically no change in these trays here. And they show up here as like a flat line in the dispersion. This is not what we want. This is essentially a caked rock dust.

So, what we're referring back to, we're comparing it to, is that referenced dry rock dust, that's the scrunched curve here. And we found either Company A or Company C would be preferable.

Company A actually has an overall average that's slightly higher than our referenced rock dust. So that was one that we had moved forward with. That it showed the most promise. So, I mean, there is some promise in these application methods that we are pursuing.

And then along the lines of fire prevention, 30 CFR 75.1912 sets requirements for fire detection using the fire sensors, but doesn't specify what kind of sensors or where they should be installed in the diesel fuel storage area.

So, our fires group has looked at, they have looked at this issue. They have looked at a couple of different smoke detectors or sensors and then four different carbon monoxide sensors.

Here's just an example of the comparison between the carbon monoxide smoke and flame sensors and the CO sensor.

Pardon me, I have to look at my notes here. This is a little bit out of my groups.

So, basically, in both the small and the large fires, the flame sensor had the shortest response time while the smoke sensor had a shorter response time than the CO sensors.

Looking at improving the AMS deployment strategies, the sensor evaluation under low flow, air flow velocities, they examined this using diesel, belt and coal fires. And they looked at applying this to an operating underground stone mine.

So, what they had done was they used a multi-gas in their Leslie station (phonetic), and a return entry and collected data over a series of days. The results are specific to this particular mine. But, the intent is that it can be used to be applied to other mines after blasting.

And this is just an example of the predictive tool to estimate the after blasting reentry time.

The fires group has also been working on MFIRE 4 development, major improvements made to MFIRE. It's anticipated that this will be released in 2019.

And also they are associating a graphical user interface with the MFIRE simulation as well.

They've also been working on using some mine fire simulations with real-time AMS data to detect the fire and calculate the real-time fire size using that data. And again, based upon diesel fire or belt fire, they've calculated the heat release rate using that real-time data.

Also, this is an example of some of the data results that they've gotten. And they've managed to get good agreement in both situations of the belt fire and diesel fire.

So, basically, that's all that I had. I apologize for the interruptions here, but are there any questions?

CHAIR NELSON: I don't think there is any reason to apologize. My empathy as you're making me feel sick at this point for no reason.

(Laughter.)

CHAIR NELSON: Any questions or comments for Marcia?

DR. BURGESS: I do have a quick question. The foam, what is the foam component when you use foam rock dust, do you know?

MS. HARRIS: Well, it depends on the manufacturer. So, there was one manufacturer that had like a hydrogen peroxide and a yeast in their rock dust. So that when they added --

DR. BURGESS: Hydrogen and yeast?

MS. HARRIS: Yes. So that when they added the water, it would foam up and they could apply it.

DR. BURGESS: Wow.

MS. HARRIS: However, I know that they've been kind of pushing that so you can use it as a dry rock dust. However, we did test the dry in our 20 liter chamber, and it was explosive at 75 percent.

So, we're thinking that those yeast particles might be in that small particle size range that contributes more to the ignition.

DR. BURGESS: Oh.

MS. HARRIS: Otherwise, another manufacturer just used basically a surfactant to generate the foam. And there is another manufacturer that has like a surfactant and a stabilizer.

DR. BURGESS: Do we know anything about the toxicity of the surfactants?

MS. HARRIS: These are all supposedly safe.

DR. BURGESS: Okay. That's nice to hear.

MS. HARRIS: Yes.

CHAIR NELSON: They're magic foams, sir.

(Laughter.)

MS. HARRIS: But --

DR. BURGESS: I figured --

CHAIR NELSON: Proprietary foams.

DR. BURGESS: I figured that would be the answer.

MS. HARRIS: Yes.

DR. BURGESS: Yes.

MS. HARRIS: Yes. But basically what we have seen is the real challenge is to apply the foam and have it maintain its stable foam matrix until it dries.

So, sometimes if you don't get the formulation right, it just kind of slides off the rib and collapses and what not. But, again, there is two examples there that do indeed show promise.

DR. BURGESS: Thank you.

CHAIR NELSON: Any other questions or comments? Okay, well thank you very much, Marcia.

MS. HARRIS: Okay, thank you.

CHAIR NELSON: Yes, get well.

MS. HARRIS: I certainly will try.

CHAIR NELSON: Before the holidays come. Yes. So, shall we press on and --

CHAIR NELSON: I guess press on for one more presentation and then take a break. Okay, so, Peter, you're up.

Stability Evaluation of Active Gas Wells in Longwall Abutment Pillars - Dr. Peter Zhang

DR. ZHANG: Good morning everyone, I'm Peter Zhang from PMRD.

CHAIR NELSON: No, Peter, you have to talk more loudly please.

DR. ZHANG: That microphone doesn't work.

CHAIR NELSON: Nope, that doesn't work, you're going to have to do it yourself.

DR. ZHANG: Okay. I'm Peter Zhang from PMRD. Thanks for giving me the opportunity to present our research.

So, our project is stability evaluation of active gas wells in longwall abutment of pillars.

So first, this is a new research area, so first I'll give some background information. And then I'll talk about our research tools, goals and some of the results.

So, over the past decade, with the shale gas boom, over 1,400 unconventional shale gas wells have been drilled ahead of the longwall mining in Pennsylvania, West Virginia and Ohio.

So, this shale gas well is called unconventional gas wells because they are drilled much deeper than conventional wells. Also, the gas pressure is much higher.

In Pennsylvania, West Virginia and Ohio, Marcellus shale gas wells go as deep as 5,000 to 9,000 feet deep. And gas pressure can be as high as 30,000 psi.

Also, unconventional shale gas wells is drilled in clusters. So each well pad can have a few gas wells or up to 30-40 wells.

So, both starting cost and the completion cost very high. Each well go like several thousand feet and go horizontally for about 10,000 feet and then they do hydrofracturing. So the cost is very high.

But the gas wells are located using longwall pillars or barrier pillars, then longwall mining would include surface subsidence and subsurface deformation. So, those subsurface deformation could affect the gas well casing.

And if the gas well casing are compromised by the longwall, induced the deformation and the cause, cause the leakage. The high-pressure gas could migrate into the mining workings and potentially cause a fire or explosion. Also effect the longwall ventilation system.

So, that's the purpose of the research, to protect the coal miners and the gas well drillers from fire and explosion. But also to protect the gas well, high cost gas wells.

So, current regulation for gas well pillars is in 1957, Pennsylvania gas well pillar regulation. So, in 1957, Pennsylvania did a study for gas well pillars based on 66 gas well failures over a 25 year span.

They came up with guidelines for the gas well pillar sizes under different overburden attempts. But in that time, there was no longwall mining, just the room and the pillar mining.

So that regulation is not applicable for longwall mining. Even though both Pennsylvania and West Virginia use that regulation for longwall gas well pillars.

It worked for shallow covers less than 7,000 feet, but didn't work for under deep cover. Now, most longwall mines in Pennsylvania, West Virginia, all over about 1,000 feet.

So, PA DEP recognize that the 1957 pillar study was not applicable for longwall mining gas well pillars under deep cover and initiated the call for research on gas well pillars under deep cover.

So, in 2013 and 2014, CONSOL Energy and a few gas companies, like Range Resources, EQT, Noble Energy, and they did a comprehensive Gas Well Pillar Study.

They drilled four test holes with different gas well casing design then they monitor the deformation and pillar pressure in underground. They produce a report and made recommendations for guidelines for gas well pillar sizes under deep cover.

But PA DEP didn't except that recommendations as a general guidance because its study was based on, it was just a one site specific. So, in 2017 they actually initiated a Gas Well Pillar Study project to provide more scientific data and to develop guidelines.

Then since 2012, Pennsylvania DEP have been holding monthly Coal/Gas Workgroup meetings to discuss the unconventional shale gas well treaty issues intersecting coal mining and to develop a technical guidance for both coal company and gas company. For shale gas treaty through the coal seams.

And NIOSH has been participating in this meeting and present our research and results to the group. So this is just some background information.

So, you can see there's an urgent need for critical scientific data and engineering guidelines from both a regular through the agency and coal and gas industry. Both coal and gas industry want to know what happens in the subsurface after longwall mining and how that subsurface deformation effect the gas wells and how gas wells can be designed to accommodate those deformation to allow the coal mining to pass by the gas wells safely.

They also want to know the coal/gas reservoir characteristics for shale gas treaties to develop. So, to answer those questions we developed our research goals.

So these research goals for globally stability of the gas wells and the pillars. So, for design criteria, for gas well casing and improve understanding of the risk of the gas, high pressure gas liberating into the mines.

Here I'd like to mention, this four year project, the first year project was initiated as a ground control project. Then in the second year the inflation group joined the project.

So we look to expand our research goals to look at the bigger picture of how longwall mining effect gas well. Also, how the gas well failure could affect, in turn, affect the normal mining.

So, our immediate outcomes is to have coal mining engineer to use our recommendation like a safeguard distance and the pillar size to protect the gas wells. Also, gas well engineer will use our guidelines to design the casing to prevent casing failure.

So, we publish papers and give seminars and present our results to, at PA DEP meeting. But our outcome is to have mining engineer and gas engineer to use our research and results.

So, to achieve our goals, we need to understand what happens in underground. What happens in the subsurface. We need to understand how subsurface deformation affect the gas wells.

We need to understand how the gas well casing can be designed to populate the information. We need to understand the top gas reservoirs.

So, we developed five specific aims. The first three aims for ground control and the last for ventilation. So, I'll go through each specific aim. So, this basically will tell what we are doing and what we have done.

So, Specific Aim 1 is to understand and quantify the subsurface overburden deformation. So, we monitor the subsurface deformation using inclinometers, where we measure the pillar stress using BPC, borehole pressure cells, tensometers, and we also do surface subsidence survey.

We collect test histories of the gas well failures. We have two monitoring sites. One for deep cover, one for shallow cover.

So the first site is the CONSOL Energy Harvey Mine, 1,185 feet. This is the first of the year, we drill one hole from the surface in the ten pillar, in the big pillar.

Then we have six BPCs to monitor the pillar pressure. We also install inclinometers in the roof, just monitor roof flow convergence and roof deformation.

And the second year we have another consultant in the Fork Mine. We drill four holes. One hole for ground control to monitor the subsurface deformation. Other three holes, ventilation holes, to measure the water pressure change after longwall mining and to measure the permeability change after longwall mining. Because, permeability change. Will tell how, the risk of high pressure gas leaking into the mine, how fast and how much flow.

Specific Aim 2 is to use numerical modeling to study the general case of how longwall mining effect gas wells. Because instrumentation, the cost is so high so we have to use numerical model to calibrate with monitoring data to do parametric study to identify the critical parameters for gas well pillar designs.

So, this model we can model the -- so this model we use site-specific geology to model from the surface all the way, from underground causing level all the way to the surface. And we can model the subsidence, we can model the pillar pressure, we can model the interaction between the gas well and rock strata.

So, here I just show some results we get. So, this figure shows the surface of subsidence.

So, this side is basically the top. We can see this, the mining pipe, they mine seven feet of a hole in Pittsburgh C, then surface subside about 4.5 feet.

So, this curve is from the model, this is from the measurement. So, the model and the measurement data agree pretty well.

So, this figure shows the pillar pressure over ten pillars. So this one show the abutment pressure and so the pattern of the dot show the measured BPC data. This is for the Harvey site under deep cover. That site is for Enlow Fork Mine. It's a shallow cover. And also, you can see that the measured pressure and the modeled pressure, it matches pretty well.

So, this one show the surface, the subsurface horizontal movement from inclinometer. So, this, the Enlow Fork site, we can see that. And so that one shows the horizontal movement parallel to the panel. So, the maximum horizontal movement is about one inch, which happens about 100 feet, about the calcium level.

And from the model we get, we also get the maximum information, actually, displacement happens also about 100 feet above the coal seam because overburden that is 480 feet. So, we can see that parallel to the panel.

Horizontal movement is about one inch perpendicular to the panel, the horizontal movement is four inch. So this information could affect gas well stability, you know, cause excessive deformation.

Specific Aim 3 is to use our calibrated model to reevaluate 1957 study. So we have to, with calibrating model we can model those 66 cases from 1957 study and then look at their adequacy and the deficiency to understand why so that that regulation is -- works for shallow cover but doesn't work for deep cover, and how to update that '57 study for deep cover.

So, Specific Aim 4 is for, it's for the permeability study. So, we characterize, along with induced the permeability changes through in situ monitoring.

So, Enlow Fork Mine we drill three holes. Each hole drilled to the target depths. And we monitor the pressure, the water pressure change over time. And we did a smart test to measure the permeability.

This, for this year, the first longwall panel has passed and now we continue to monitor, gather data. And the second panel will pass next year.

Also, for 2019, our test is to drill a hole in Murray Energy 84 Mine, which is an abandoned mine, we drilled through to measure the permeability in the gob and measure the gas content in the gob.

So, this slide shows some of the results from Enlow Fork Mine permeability study. So, three holes each drilled in different, to different depths.

So, the first figure is for, this hole goes to 417 feet deep. So this graph shows the longwall phase was 230 feet away, in by the site.

Then after longwall passed for 2,000 some feet, you see that permeability change. That initial permeability was 30 mD, milLIDARcy.

And then after longwall mining it changed to 57 mD. You can see that. About 60 feet above the coal seam, permeability almost doubled after longwall mining.

So, that hole goes to 264 feet. It's higher from the coal seam. Then permeability, this before mining, after mining, not much change.

But the third hole is 135 feet, it's near the surface. So, permeability was too high. We couldn't establish the baseline data.

We smart test, we add water at ten feet, then water just dropped so quickly. So, that permeability changed a lot, but it's irregular. So, we continue to monitor those holes after the second longwall panel passed to characterize permeability change induced by longwall mining.

So, Specific Aim 5 is meant to do the ventilation modeling to investigate how high-pressure gas effect longwall ventilation. So we will do two models.

First, the physical model, physical modeling and also do numerical modeling. NIOSH also, NIOSH has set up a physical model, it's called the LIAM. Longwall instrumented aerodynamic model.

It's a scaled physical model. It has like scaled entries, longwall phase and shales and the top.

So with that model we can see behavior of air flow through the longwall ventilation system. We can have half pressure tracer gas injected in the system and look at, you know, in case there is high-pressure gas is leaking, where that gas go in the longwall. In the longwall ventilation system.

And we also use a numerical model, like network modeling. Currently we're looking at a ventilation model from Ohio Automation. It's a ventilation simulation software from Ohio Automation. Another software, it's called a Vent C, from Australia.

So the summary is, so this is a new research area. So we're dealing with challenging issues faced with both coal and gas companies.

So we look at the how coal mining effect gas wells and internally we also look at how gas valve failure could affect coal mining. Causing fire and explosion.

So, this is the only research in the U.S. Probably in the world. Other countries, like Australia are trying, developing their shale gas well, shale gas resources, they will face the same issue.

So, regular agency and coal and gas companies have a real need for scientific data and guidelines. So, we think that the results from this project will provide a complete picture of longwall induce deformation and how that deformation effect the gas well stability and how the high-pressure gas effect the longwall ventilation system.

So, our outlet goal is to safeguard coal miners and gas workers. Also, at the same time we also protect those high cost gas wells. Okay, this is all I have. Any questions?

CHAIR NELSON: So, let me just, can you go back to your 2. Your --

DR. ZHANG: Number 2?

CHAIR NELSON: -- FLAC model that you did in 2.

DR. ZHANG: Which one?

CHAIR NELSON: There. Forward.

DR. ZHANG: This one?

CHAIR NELSON: Forward one. Forward one. Forward one.

DR. ZHANG: One?

CHAIR NELSON: Go forward.

DR. ZHANG: Go forward?

CHAIR NELSON: Forward. Forward. Forward. Stop.

DR. ZHANG: Okay.

CHAIR NELSON: Okay. I look at this and I see, I question that the modeling is appropriate, is correct.

DR. ZHANG: Okay.

CHAIR NELSON: Because, to me, the difference between the measured subsidence and the FLAC3D model subsidence.

DR. ZHANG: Yes.

CHAIR NELSON: While the ultimate displacement agrees, that's fine.

DR. ZHANG: Yes.

CHAIR NELSON: But the shape of the curve indicates to me --

DR. ZHANG: Yes.

CHAIR NELSON: -- that the material is behaving far more brittle and with focused offsets rather than bending, which I think the FLAC3D is modeling a bending displacement.

This impacts potentially on the nature of the permeability increase that's likely to happen. Because if you have a sudden boom of displacement, that indicates that you have a discontinuity along which movement is occurring.

DR. ZHANG: Yes.

CHAIR NELSON: As opposed to the bending.

DR. ZHANG: Yes.

CHAIR NELSON: So, I just suggest that you think about that because it can change the entire mechanism for gas movement --

DR. ZHANG: Yes.

CHAIR NELSON: -- over a longwall panel.

DR. ZHANG: Yes. Yes, I'm glad that you notice this, but this test, you know, this is a shallow cover, Fork Mine. It happens that our monitoring site is in stream valley.

So in the stream valley, the overburden strata could be fractures. And you see the matter subsiding here is not normal. So is it 100 feet, that subsiding almost achieve the final subsidence.

That normally doesn't happen for, you know, normally it takes like 200 to 300 feet from the bottom. So --

CHAIR NELSON: Yes, so this isn't normal.

DR. ZHANG: The final --

CHAIR NELSON: So I just --

DR. ZHANG: -- to --

CHAIR NELSON: I just caution you.

DR. ZHANG: Yes.

CHAIR NELSON: This is actually a three-dimensional process entirely, right?

DR. ZHANG: Yes.

CHAIR NELSON: And point measurements are not going to give you a full picture of what the three-dimensional response is going to be. So the idea of having something more spatially sampling over a

longwall panel so that you can look at, are you getting brittle discrete fracture, are you getting bending, which will really change what the outcome is.

So, it's just a caution. And think about that so that when we meet again you can tell me the answer.

DR. ZHANG: Yes.

CHAIR NELSON: Thank you.

DR. ZHANG: Yes, thank you.

CHAIR NELSON: Any other questions, comments? Okay, thank you.

DR. ZHANG: Okay, thank you.

CHAIR NELSON: We are broken. Until a quarter after. Fifteen minute break.

(Whereupon, the above-entitled matter went off the record at 10:02 a.m. and resumed at 10:17 a.m.)

CHAIR NELSON: Donovan, the floor is yours.

Durable Support for Western U.S. Underground Metal Mines - Donovan Benton

MR. BENTON: Good morning. I would like to tell you all that I appreciate this very much, the opportunity to come represent our division, but our team, too.

I am excited to talk about some of the research we have been doing. You might be aware of some of it already, but hopefully there will also be some new stuff going on here, too.

This presentation itself is covering an entire project. Once I get into it, the project itself you'll see has a lot of different kind of parts on the surface don't necessarily match with each other, but that's been one of the challenges of the project that has actually worked out pretty well is kind of finding a unifying trend amongst all these different things.

MR. BENTON: So the project itself is in its third year and the full project, it started as a pilot in 2015, and it will continue for one more fiscal year after this, so we'll run through September 2020.

I actually came into the project during its second year and became the full PI at that time. So the overall kind of the way that I look at the project is it tries to approach the simple concept anyway of keeping the mine openings open but from three different sort of perspectives.

So there is this proactive using the right designs in the first place, there is the actual monitoring of the openings themselves once they have been supported, and then the final portion, you know, the sort of pivot point is determining when intervention is necessary and so the final portion is how to safely rehabilitate mine openings.

And you can see the NIOSH strategic goal there along with the intermediate goals and we have this cartoon down here. This is, you know, it's silly, but what it does for us is it kind of reinforces this idea that on this one extreme you are maximizing safety but at an economic cost it's just impractical, versus the opposite over here in trying to find this middle ground where we can make the mine safer but also have it still be attractive enough that the mines will use it and want to work with it.

So you can see some of our key stakeholders here, Barrick, Newmont, Hecla, we have been very involved with, the Doe Run Mining Company, we are beginning a relationship with them, I will get into that later, Stillwater, Sibanye, that one we had a good relationship and now we're just kind of trying to maintain it after Sibanye became involved, and then New Concept Mining of South Africa, actually, we have developed a good relationship with them.

And there have also been several other stakeholders that have kind of come and gone throughout the years since this project has been active, but these are the pretty consistent players in it.

And on the right you can see the kind of geographic spread of our activities, so anywhere from Greens Creek up in Alaska to the Lead Belt in southeast Missouri, we have done field work there.

So the way I organized this presentation is by task on the project and each one of the tasks kind of corresponds to the before, during, and after sort of, you know, monitoring the, or maintaining the openings, and then within each task just a little discussion of some of the primary activities and then the impacts of those activities.

So Todd mentioned this yesterday, our high energy, high deformation testing machine, this has been one of our most active portions of the project and it seems every year we get more interest from industry, different ideas, different ways to test things.

So how this actually started was essentially trying to build upon the ground determinant panel test and incorporate the actual rock bolts and the entire shotcrete based support system into this test so mines could get a better understanding of how the system interacts with all these different components.

So this has already gained some national and international acceptance and interest and we've actually with new concept mining and Hecla, we are adapting this machine to test just mesh only in this case.

Todd also mentioned this yesterday, too, another kind of key activity that we have had, and this came at the request of a lot of the Nevada mines, was what changing the order of component installation did to the system performance.

So to explain what that essentially meant, all of our previous tests for the first two years of the project had basically just been shotcrete laid down with mesh over top and then bolts placed, and that's just what we did.

We would use different types of reinforcement, different types of mesh, but it was also the same order, and in some cases mines said we can't really do that we have to get maybe a flash coating of shotcrete then we can put some mesh down and then we finish the reinforcement with more shotcrete.

So we did test all these different sort of installation sequences. And you can see here what we eventually developed was a sort of rating of support capacity versus the different component installation ordering and the Nevada Mines, in particular Turquoise Ridge, have already taken this and incorporated it into their design methods. Another --

CHAIR NELSON: Can I ask question? Are you after capacity or ductility?

MR. BENTON: Support capacity is the big --

CHAIR NELSON: And that's until failure or until a displacement criterion?

MR. BENTON: Well by the machine itself to this point has only had a 10-inch displacement. So in some cases we have been able to test these things until failure, in other cases, like up here, this one is still providing support.

So the modification we've actually done with the machine is to increase it to a 30-inch displacement so we can get a better understanding, and especially with really ductile materials like just mesh by itself to be able to actually test that until failure.

CHAIR NELSON: Okay.

MR. BENTON: So another component of this first task is ground support design software itself. The product that we have already developed, and this was just done in Excel, but what we hope to do eventually is get it transformed into a smartphone application.

This is based on Rimas Pakalnis's work and what we wanted to do essentially long term is take his sort of yellow book, yellow ground control book that he had, and digitize it and basically make it to where mines, whether they are using tablets or even their own smartphones underground, they have these design tools right there for use.

And so right now this is actually on GitHub, it's in its beta testing phase and we could provide a link to that if you would like to see it.

So Task 2 revolves around the actual monitoring of the ground support systems once they have actually been installed, and so there is some components using the Internet-of-Things, wireless data transmission and also some visual monitoring methods.

We have developed a full start to finish Internet-of-Things Sensor Network that's actually been deployed in mines and is producing data right now that could be accessed in our laboratory.

And so it basically starts with the sensor itself but gets routed to a node, that node takes everything to a gateway. Sometimes the mines already have this gateway anyway and we just tie into it, and then from there it goes out of the mine and they have access to real-time data if they want.

They can set the frequency that these sensors actually collect readings. In this case this is an instrument at rock bolt that can give strain readings.

We also have a time of wetness sensor that basically gives atmospheric data for particular portions of the mine. And as I said we have installed this, we have these systems in Greens Creek Mine, we have one in Golden Sunlight Mine, and we will be expanding to several different mines in Nevada, too, with these systems.

Our photogrammetric monitoring system essentially what happened was a combination of the work that Spokane had done and the work that Pittsburgh had done with photogrammetry gained the attention of the Doe Run Mining Company who had been trying to find ways of monitoring their pillars as they were essentially in the retreat mining phase and they wanted to use photogrammetry for that.

And so they contacted us about ways to optimize that methodology and we have done one site visit already, and now we actually have an MOU. It took a very long time to get that through, but we've finally broken down that wall.

So essentially we are going to work with them to develop a methodology of monitoring these pillars to know the safety of the mine as you are pulling out.

So Task 3, this deals with the rehabilitation portion. So if intervention is determined to be necessary we want to come up with the safest ways to do that.

The primary portion of this task has been our corrosion monitoring testing. So right now due to an impending retirement we are really pushing hard to finish this testing protocol that basically incorporates different factors on rock bolt performance in a corrosive environment.

So we're developing this machine, or this testing apparatus, and inside of this is actually a rock bolt that can be tensioned to whatever amount we want and a fluid is introduced to that to cause corrosion.

And we've also got this other component that will scratch the bolts because a lot of times what we found even if say a protective liner or a galvanized bolt is being used during installation it gets scratched, and it actually ends up performing worse than just a non-protected bolt.

And so that's what this test is trying to simulate and come up with actual corrosion rates based on different tensioning and scratch whatever, amount of scratching.

Another portion of this, and this actually was started, I was going to give R.J. a shout out, but he had asked a question five years ago simply if we eliminated jack leg drills, what would that look like in terms of injuries and we didn't really know.

So we thought, well, we'll just actually gather ten years of MSHA data and comb through all the narratives and see which ones mention jack leg drills and then from there try to come up with a way to understand what would happen if jack leg drills were to be replaced.

Now the reason why we wanted to do this is just through discussion with the questioned mines. A lot of them are trying to phase out jack leg drill usage.

So what we've planned to do at the end of this project is another 10-year survey and see if we can actually measure any, not measure, but detect any sort of reduction in injury rates that might be tied to a reduction in jack leg drill usage, where this particularly comes in is in the case of rehabilitation underground.

This is the one place where we think jack leg drills will maybe never actually be completely replaced because to move around the mechanized bolter for any sort of rehabilitation just seemed impractical in a lot of cases.

So we just want to measure if there is a difference and see if we can actually measure that difference.

There is a fourth task and essentially it's just combining the first three tasks and taking everything out into the field and using it and see how it works, and we have already done that with some instrument and rock bolts tied to these wireless data networks.

So we're in the process right now of finalizing a contract with the University of Utah to develop a split set bolt that can give three dimensional measurements, stress measurements, of the ground.

And really the point of this is essentially this is a bolt that can be installed and serve the purpose of the bolt while at the same time actually producing data about how the ground is reacting in this particular area.

And so it can measure the axial strain here. We can see just the strain gauge as welded on to the inside of it. And then it can also measure the squeezing of the bolt itself, the hydrostatic pressure change, and then also measure the shear pressure, or shear stresses that are acting on that bolt.

CHAIR NELSON: How does it measure shear stresses?

MR. BENTON: How does it measure?

CHAIR NELSON: Yes.

MR. BENTON: So what the design -- Actually I should say it will be designed to do that, number one. It hasn't been tested yet.

But the design is essentially to have these six little wings that kind of go around it and operates like a biaxial stress meter and these wings can pick up the differential between the hydrostatic, just the general sort of squeezing or strangling of the bolt and the actual kind of pinching of the bolt. And the mathematics are here --

CHAIR NELSON: So you are calculating it rather than measuring it?

MR. BENTON: What's that?

CHAIR NELSON: You are calculating it rather than measuring it?

MR. BENTON: Correct. Correct, yes, sorry. And then a last kind of component to this, too, several cases we have done this twice. We did it once at Stillwater and this is actually in the Golden Sunlight Mine an active heading we installed an instrument of bolts that we developed.

We installed alongside those yield point instrument of bolts and then extensometers and essentially we put those in and then the mine took around and we wanted to measure the ground reaction using all these different methods, included in this, too, was a photogrammetric component and then a computer modeling component.

And we wanted to use that to find out what the best performance of these different instruments would be. The actual full set of data is still not in, but we have this site that is active right now.

CHAIR NELSON: So were you planning a mine buy or something at that point to look at the ground response or what do you, how are you going to get the ground reaction curve?

MR. BENTON: So we installed that. They are going to take a round out and just advance the heading, and then in the case of our instrument of bolts, the NIOSH bolts, we can get in there and collect data from them wirelessly.

They will go in manually to the yield point bolts and MPBX's and just take the data from them.

CHAIR NELSON: So you're going to drill and shoot?

MR. BENTON: Correct.

CHAIR NELSON: Okay.

MR. BENTON: So on the scientific side of our outputs and kind of the highest impact outputs, going back to the HDHE testing machine, we have had some international papers done for it and I as mentioned earlier the Nevada mines have already been utilizing the results of this data and we've also had international interest in kind of modifying the machine and continuing that testing.

Our photogrammetric research has also had several international outputs. A month ago at this time I was in Singapore kind of talking about a combination of this HDHE and photogrammetry research that we have done.

As I mentioned, Missouri mines are wanting to integrate our methods for their mining process and we finally --

DR. FRAGASZY: I have a question. Why are you using photogrammetry instead of LIDAR?

MR. BENTON: Our personal experience with it LIDAR is very expensive. The machines have to be calibrated a lot more often than a camera does, and it also doesn't provide necessarily the visual information that a lot of mines want for actual texturing of the point clouds.

MR. BENTON: And then lastly our corrosion research has also garnered some international attention, and as Todd mentioned yesterday we are working closely with NACE. They have been very interested in the work that we have been doing.

Right now one of our engineers, Amy Chambers, she is the task lead for our corrosion work, is in Seattle at the NACE Western Area Conference presenting.

Regarding educational outreach, we worked with the University of Utah to develop a seminar series, and here is the list of people from our project team who have presented down there, and also right now Sean Warren is down presenting at their seminar class.

What we want to do eventually is turn this seminar series, use it to develop maybe an actual full workshop or webinar, and I'll discuss that in a little bit.

Further technical outreach, last year we spent a week down at the Western Australia School of Mines actually sharing our research with them and then vice versa and talking about ways to try to move forward.

We have been involved with Montana Tech both doing guest lectures in their SME student chapters. We have also been involved with just non-student SME local chapters around Spokane.

And last month when I was in Singapore I met with the President of ARMA, and she specifically mentioned that she wants a lot more mining involvement in what ARMA is doing, so, anyway, working towards that now.

In terms of future activities regarding corrosion we are in the process of writing three journal articles, one of them has actually already been submitted to this final, okay, to the final one there Materials Performance magazine. The other two, again, are in process.

And what we want to do again with our peer review journals and then the seminar series and everything that we have done with the universities is bring all this together and develop an actual workshop for western underground metal mining ground control.

Depending on the output, and this is actually the input I was hoping to get from you all, moving on from something like a webinar or some sort of educational series whether to move on to video production.

Jennica, the stuff you had was awesome. If we could tie that in to training modules I think that would be a fascinating thing.

And then also continual development of this ground design software, again just trying to digitize things that to this point a person really only has access to on paper.

So thank you, and any questions or input?

CHAIR NELSON: Okay, thank you, nice, comprehensive report. Are you doing any work on shotcrete design itself?

MR. BENTON: A little bit we were, early strength in particular in Nevada mines. We have actually done tests underground to try to maximize re-entry time, or rather minimize.

CHAIR NELSON: But have you been -- I mean I'm really looking at the mixed design and are you using somebody's recipe?

MR. BENTON: We are using other people's recipes.

CHAIR NELSON: Okay. I would really like to hear in the future something more on the corrosion. I think the issue of the fluids that you are introducing -- are you using mine water?

MR. BENTON: I am not entirely sure how they actually make this brine that they are using now. They are not collecting it from the mine, I know that, it's some sort of laboratory mixture that they have.

CHAIR NELSON: Well it would be interesting to see about the mine water and how it's different. Yes, okay.

MR. BENTON: There is a component to it where they have actually taken little coupon samples, so just little slices of rock bolts and mesh and with actual rock samples from the mine and put it in a tray, put these coupons in the tray along with that rock and then we've left them in a fog room.

I think the last one we just did was a 12-month trial. And what they are trying to do with that is actually do the mass loss over time.

CHAIR NELSON: Sure. But I mean the sense of the quality or the characteristics of mine water is really important and mine humidity I mean for corrosion.

DR. KRAY LUXBACHER: Yes, so really the chemistry of the mine water specifically.

CHAIR NELSON: Yes, and the humidity available is really important.

DR. KRAY LUXBACHER: Yes.

CHAIR NELSON: Anyone else have any questions?

(No audible response.)

CHAIR NELSON: I think it would be really good to think about carrying LIDAR through even though the mines may say they don't want it, it would be to carry the LIDAR through because it's going to become increasingly reliable, automated, and cheaper and I'd just suggest that, that LIDAR, even if mines want photogrammetry carry the LIDAR along with.

MR. BENTON: Okay.

CHAIR NELSON: And I could put out an offer, the ARMA meeting in 2020 is at Colorado School of Mines, and we're just arranging things right now.

MR. BENTON: Okay.

CHAIR NELSON: So if you and your group are interested in doing something like a workshop associated with that we would need to know over the next several months, two, three months, if that's of interest and then we can accommodate that, all right.

MR. BENTON: Okay. That would be fantastic, I think.

DR. FRAGASZY: So NSF supports a facility called Rapid Facility at the University of Washington that provides, loans instrumentation for reconnaissance and things like that.

They have quite a bit of LIDAR equipment and, you know, as a federal agency if you were interested you might be able to borrow some for, you know, short periods of time. Joe Wortman is the PI of the Civil Engineering Department.

MR. BENTON: Okay.

DR. FRAGASZY: They have really found that LIDAR is much superior to photogrammetry for the things that they are doing, maybe not for what you are doing.

MS. BELLANCA: In what way?

DR. FRAGASZY: Excuse me?

MS. BELLANCA: What is the technical advantage of LIDAR that they found that was improved, like --

(Simultaneous speaking.)

DR. FRAGASZY: Well they have a dataset --

MS. BELLANCA: I was just wondering what the characteristic is.

DR. FRAGASZY: They use it to provide 3D images in which you can interact with them and, you know, find strains and displacements and --

MS. BELLANCA: I mean is the characteristic the accuracy or precision, or what is the characteristic of the LIDAR sensor --

(Simultaneous speaking.)

DR. FRAGASZY: I think all of those things.

(Simultaneous speaking.)

DR. FRAGASZY: Yes, I think all of those. I mean you can vary all of those and, you know, the point cloud can be as large as you want depending on the particular LIDAR.

CHAIR NELSON: Yes.

MS. BELLANCA: I guess I was just trying to understand like because you can do that with all these types of technology, so in recommending it what is the reason you are recommending it, because people are using it or because there is a technical advantage?

CHAIR NELSON: I'm not saying exclusively, but I am saying that a lot of people are using LIDAR. It has a -- I think it has the potential for a real-time sense in the future of moving.

MS. BELLANCA: Because of -- you're thinking a streamline use case is your recommendation?

CHAIR NELSON: Yes, yes, but also because you can use it in VR environments.

MS. BELLANCA: Yes. I mean you can use all of these in a VR environment so I guess I was trying to understand what the technical gain was if it was truly accuracy or it was our adoption, and that's why we were pushing it. I wanted to understand that.

CHAIR NELSON: There are so many reasons why people choose to use it, but I think --

MS. BELLANCA: Well, yes. No, I was just asking what your guy's opinions were because you were pushing it so I didn't know --

(Simultaneous speaking.)

CHAIR NELSON: No, I was pushing that it be carried along with rather than one exclusive method be used all the time.

DR. FRAGASZY: Yes. Well, also I was because virtually all the people I am funding are using that after comparing the two.

MS. BELLANCA: Yes.

MR. SEYMOUR: So a lot of the reasons why it don't run, I think was interested in photogrammetry is because they have a visual rating system on their pillar system right now so when they look at those remnant pillars they are visually, they wash them down and they visually look at them for the amount of fracturing or swelling in the pillar, the geology of the structure --

(Simultaneous speaking.)

CHAIR NELSON: But I think that's perfectly fine for them because that's what they want.

MR. SEYMOUR: Yes.

CHAIR NELSON: But all I am saying is that this is a research organization and that to carry something that potentially might be more meaningful while you are working with them and what they want is fine.

So I think it's going to become my guess is the common basis. But unless you can get to multispectral, so if you can get to something multispectral in terms of what you are doing then the world is a little bit different.

Okay, the other thing I wanted, I would really like next time to hear more about what you are expecting to get out of the ground reaction curves as well.

MR. BENTON: Okay.

CHAIR NELSON: Right, because there is quite a bit of controversy I think in the mining industry about what do you do with the ground reaction curve really as opposed to a concept of this is how the ground is moving.

Nobody knows what that initial displacement is. You are picking up a ground reaction curve that's already been de-stressed to a certain extent so you're getting a re-distributed ground reaction curve which -- I mean you might do some clarifying things there that would interest the community.

MR. BENTON: Okay.

CHAIR NELSON: So, okay, any other comments?

(No audible response.)

CHAIR NELSON: Great. Thanks very much then.

MR. BENTON: Thank you.

CHAIR NELSON: Oh, also, finally, ductility, you need to have ductility, the area under the curve I think rather than capacity.

MR. SEYMOUR: So the only other thing that occurred was the change in the energy from those different systems, right?

CHAIRPERSON NELSON: That's ductility.

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: That doesn't --

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: Yep. Okay. Thank you. All right. Now we're going to hear about cemented backfill.

Cemented Backfill Presentation - Brad Seymour

CHAIRPERSON NELSON: Ed, are you okay with the public comment period extending until the end of this? We'll start it at the end of this presentation. Thank you.

MR. SEYMOUR: Okay. Sorry for the technical difficulties. Thanks, Jeff, for helping me out there.

The title of this doc is cemented backfill research. And I'm going to apologize right up front on this one. I've been doing backfill related research for the last 30 years. So I'm going to have a tendency to get into too much detail. So I'm going to rely on Jerry to come up here and shake my hand or at least stand up and wave me off if I wander off into too much detail.

The cemented backfill research is being conducted at our office in Spokane as a task under the Alternative Mining Methods for Challenging Ground Conditions project. And this is really a team effort. So you can see the name of a lot of different individuals that have been participating on this research at the bottom of this slide.

This is a photo of an underground access way in a gold mine in Nevada. And the mine span here is about 30 to 35 feet. The mine roof and the right rib are composed of cemented backfill. And the left rib is the host rock that you can see as reinforced with mesh and bolts.

So, if the backfill is designed, batched, and placed properly, it provides a very safe work environment, stable environment for the miners that are working beneath it or alongside of it.

So what are some of the purposes for backfill? Backfill has several advantages. One, it provides excellent surface, local and regional ground support. It's also used in the deep silver mines in northern Idaho to reduce rock bursts for their high stress ground conditions.

It limits surface subsidence. It improves resource recovery. It allows a more, a higher percentage of the ore body to be extracted. You don't have to leave ore pillars underground for support.

And it reduces the number of abandoned underground openings also. And it decreases the surface waste disposal requirements. So it's less material that has to go to a tailings impoundment or a waste rock dump.

There are several different mining methods that are used with backfill depending upon the configuration of the ore body and the competency of the host rock.

The lower diagram there on the left is for more competent ground conditions where there's, the rock will remain stable over larger expanses. So this is a sublevel benching or a long hole stoping mining method.

If the rock is weaker and it's not able to span long distances, then they'll use a drift and fill or an underhand cut and fill mining method, which is presented in the center there.

And for the weak ground conditions in Nevada, often the backfill will be stronger than the host rock. So it provides good ground support for the miners.

As I mentioned, backfill is also used for the narrow vertical veins of silver ore in the Silver Valley in northern Idaho. And that top schematic is an illustration of that.

Okay. So why is backfill important? In 2012, we had a pilot project at our office that looked at justifying future backfill research and prioritizing some of the research needs. And so the data that I'm going to present to you comes from that time span.

So, from 2006 to 2010, there was about 86 active underground metal mines that were operating on an annual basis in the U.S. About 25 percent of these mines use backfill. But these were some of the larger operations. So they employed about 72 percent of the underground metal mining workforce.

Now, as a result, these backfill mines accounted for a substantial share of the fatalities and injuries that occurred in the underground metal mines, about 50 percent of the fatalities and 65 percent of the injuries over this time period that we were looking at.

While ground falls were the leading cause of fatalities in underground metal mines in general, they were also the leading cause of fatalities in backfill mines during this time period.

The schematic at the, on the left-hand side of this slide shows the eight fatalities that occurred during this time period. So you'll notice that there were four fatalities due to ground falls, two to falling materials, and two to powered haulage.

Now, five out of these eight fatalities were associated with either a failure of the backfill itself or a breakdown in some part of the backfilling process. And what was surprising to us is 50 percent of the ground fall accidents were actually backfill failures or related to some backfill failure.

So we found that, although backfill ground falls did not occur frequently, they result in a much higher proportion of fatal injuries or serious injuries as compared to the host rock ground falls.

Now, this could be due to the reporting. Typically, ground falls that are of the host rock may be reported more often. But it surprised us that there was that high of a fatality rate for those type of falls.

And underhand cut and fill mining methods were involved in all of the injuries and fatalities associated with those falls. Most of the injuries occurred at or near the active mining face. And most of those failures were really associated with quality control or strength issues with the backfill or unintended and wider spans than they had anticipated.

And there was a recent fatality at the Lee Smith mine that exemplifies this. This occurred on October 25th of this year. There was a 42-year-old miner that was loading explosives at the face and he was caught in a 150-ton backfill collapse. MSHA figured about five tons landed on top of him.

And so their recommendation, again, was to look at the quality control issues, ensure that the backfill is actually placed at the competency that is was designed for.

Okay. For our research, we look at two different types of backfill, cemented rock fill, which is our weakly cemented concrete-type product. It's similar to concrete, but it doesn't have exactly the same properties, or cemented-based backfill, which is a material that has a paste-like consistency. And this is usually pumped into underground openings through a network of pipes where a CRF is mechanically placed. And then it's rammed tight to the back with what they call a rammer jammer.

Regardless of the type of backfill, it supports the mine roof and the back of the openings. And it also helps confine the surfaces of the pillars, abutments, and the mine floor and increases their ground support capabilities.

So, again, if the backfill is designed properly, if it's batched and mixed properly, it does a pretty good job.

Okay. So two of the research areas that we identified in this pilot project that needed further research were backfill ground support performance. Very few mines are instrumenting their fill and their host rock. So they really don't know what type of load or the amount of load that's being applied to the backfill.

It's also important to identify the critical failure mode for undercut and fill operations. The typical failure is in tension or flexural failure versus a shear type failure for some of the open stoping operations.

And then what is the backfill's design strength? And how does that reach that critical failure mode?

Another issues that's important is backfill in situ material properties. The mines will typically take 6 by 12-inch cylinders of backfill, and then they'll do compression tests, UCS tests at the mine site with that material.

But they don't really have a good idea about the properties of the material that's actually placed in the stope or the strength properties of that in place material.

And another issue, again, is the quality control measures, what quality control measures are being taken at the mine site to ensure that the design properties are actually the place properties.

And then a final issue is what environmental factors may be influencing the strength of the material.

CHAIRPERSON NELSON: So there's nothing here that explicitly says how the strength changes over time.

MR. SEYMOUR: I'm going to get to that in just a minute.

Okay. So here are the research collaborators that we're dealing with on this project, the Hecla Mining Company at the Lucky Friday mine in Idaho, the Barrick Gold Corporation at the Turquoise Ridge mine and the Cortez Hills mines in Nevada, the Stillwater mine in Montana.

And then we're also dealing with some backfill rock mechanics consultants that are active in the industry, Dave Stone, Rimas Pakalnis, and Rad Langston. And unfortunately, Rimas Pakalnis passed away here recently.

And you've seen this schematic of where our operations are at on the right-hand side in Donovan's previous slides, so I'm not going to go into that.

Okay. So the first topic I'm going to talk about is undercut and fill mining with CRF. This is proven technology. It's been used since the mid-1990s in Nevada. So they know that it works. It's been used at a lot of underground mines.

But there's some current trends in it that lead us to believe that we need to get a better understanding of the engineered properties of the place material and also look at wider spans and the long-term strength of the material.

One thing that's really driving this is that some of the mines now want to place their long-term mine infrastructure in entries beneath the CRF. So that brings up these two important issues that I just mentioned, what is the long-term strength in the CRF and what is the long-term stability of those CRF undercut spans.

Okay. So, fortunately, we had a previous study at the Turquoise Ridge mine that started back in 2000. At that time, the mine was operated by Placer Dome. And they were trying to come up with a bulk mining method that would increase their productivity and also eliminate exposure to ground fall hazards by their underground workforce.

So what they proposed to do is open up a wide undercut span. This was the largest span in Nevada at the time beneath a CRF sill. To create that CRF sill, they drove and backfilled six entries on an upper level. And you can see the sequence there in the numbering. And they drove three parallel entries beneath that to create a 45-foot wide by 100-foot span beneath that 75-foot wide by 100-foot CRF sill.

And this work started in the fall of 2000. The CRF sill was completed in March of 2001. And the undercut mining was completed in July of 2001.

To monitor the geomechanical behavior and the stability of the host rock and backfill, we installed several different types of instruments in the host rock and the backfill. We installed the biaxial stress meter that Donovan mentioned in the abutments to monitor stress change, multi-point horizontal and vertical extensometers in the host rock to get an idea of rib dilation and also displacements in the mine roof.

And then we installed earth pressure cells and small deformation meters in the backfill itself to monitor vertical loading and deformation within the fill.

CHAIRPERSON NELSON: And these were all installed back in 2001?

MR. SEYMOUR: Yep, starting in 2000 and continuing in 2001.

So we monitored these instruments through December of 2000 until the mine sold out and was bought by Barrick in January of 2002. So they wanted us to come in and remove our data acquisition equipment at that time, which we did, gave them a presentation that summarized the results of the study.

Since then we've been interacting with Barrick now at Turquoise Ridge. And so we've intermittently gone back to the mine and taken manual readings from these same instruments. So our last set of manual readings was in August of last year.

And now I'm going to give you a quick overview of the results of what those instruments showed us. I'm not going to go into a lot of detail.

But basically what happened is the mine roof was well-supported by the bolts and mesh on the upper entry, on the upper level, that 75-foot mining span. So the rock remained basically intact. And most of the stress was redistributed to the abutments rather than to the backfill.

So we measured very little displacement in the mine roof, about three-tenths of an inch over those, that 50-foot length of those large extensometers.

And we measured very little vertical deformation or loading within the backfill itself. And the backfill readings were difficult to analyze because they were hidden in temperature trends as that backfill hydrated and cured.

But basically we came to the conclusion that there was less than 30 psi on the fill itself. And that's pretty much the self-weight loading of the material that was placed over those instruments.

In addition, we also installed six extensometers from the undercut entries when they were driving those three entries and mining that central undercut pillar that you can see there in dark gray.

Those instruments also gave us some good information about the symmetry of the displacements and deflection of that backfill sill. And I'll get into that in just a minute.

This slide shows that in a little bit more detail. So, if you look at the legs that we're measuring on those extensometers, we were trying to pick up what is the vertical displacement in the backfill, what is the vertical displacement in the mine roof, and what is the separation or deflection of that backfill beam from the mine roof.

And what we found is that really very little happened in the backfill itself or in the mine roof. But that beam acted just like a steel plate, and it separated from the mine roof. And that's what's shown in the dashed red lines there for beam deflection.

So that's, that Section B on the chart there shows that most of the large measurements, which were about two-tenths of an inch, were due to deflection of that backfill beam.

And what this showed us was that the readings from those six extensometers showed us that that plate really behaved symmetrically. So you could take a plate deflection calculation from a mechanical engineering textbook, enter in these displacements, and come up with a pretty good answer for what was happening with the backfill itself.

And this means that it was moving as a monolithic beam or plate rather than segmented sections of those drifts that you see on the upper level.

CHAIRPERSON NELSON: What do you think was the strain on the bottom of that beam intention?

MR. SEYMOUR: I couldn't tell you that, Priscilla. I'd have to go back and take a look at the data. That's something we didn't really calculate. It didn't come close to failure, so we didn't really analyze that.

I'll show you some slides coming up here where we looked at a flexural analysis of it. And the safety factor was pretty high.

So, by looking at the points of where we, the locations where we put these extensometers in, you could see that the behavior of this thing was very symmetrical. The instruments in the center of this, of the undercut entry displaced more than the ones that were closer to the ribs, the rock ribs on the bottom.

So it really moved symmetrically, which surprised us, because you've got three vertical cold joints right here in the mine roof that are totally exposed along that 100-foot span. And so we thought we'd see some movement on those cold joints. But just the friction and the sheer strength along those cold joints was sufficient to keep the material intact.

And here's the photos from the completion of the undercut. And you can see the cold joints here in the mine roof. Let's see if I can do this. There's one there. Here's another one. There's one here.

So these cold joints remained pretty tight. We didn't see any opening on them at all. The rubble that you're seeing here, this was a waste rock area. So they did not try and muck this out after they had mined it. They just blasted it and left it in place, tried to cast it off to the sides as you can see in the center photo there.

Okay. Now, here's some of the results of our latest set of measurements that we've gotten from it. Remarkably, these instruments are still working after more than 16 years.

And so you can see from the graph on the right-hand side there, very little movement has happened, has occurred in the mine roof in the last ten years. So the readings in the ribs and in the mine roof have basically stabilized.

And that means that the backfill, the mine roof is not coming down and loading the backfill itself. There was no additional loading that we picked up in the backfill. In fact, the readings from the backfill tended to decrease. So everything seems to be very stable.

We couldn't get into the undercut entry to get a visual observation on this, again, because they have that entry blocked. But our measurements indicated that that backfill span is still intact.

Now, along with the instrumentation work that we did here, we also collected some in stope backfill samples in 6 by 12-inch cylinders. This is a photo of their underground batch plant with a backfill truck that's being loaded. And you can see the backfill cylinders there to the right of the slide.

And we brought those samples back to our lab in Spokane. And we tested them. We did unconfined compressive strength tests and tensile strength tests after 2 years and after 16 years of curing.

And so what I told them at ARMA was everybody has a concern about the government moving slowly. Well, in this case, it worked to our advantage because we were able to do these 16-year tests, and we were able to come up with this nice strength gain curve for CRF. And lo and behold, it's very similar to concrete.

So this is something that wasn't readily available for the industry before we had done this work.

And we compared our 2-year and 16-year samples, I'm sorry, with 7 to 28-day tests that Placer Dome had done at the mine site. And that's how we developed that curve.

Now, in addition to the unconfined compressive strength tests, we also did some splitting tensile tests. And again, backfill has been used for a long time, but there's very little information about the tensile strength backfill, particular CRF.

So what we did is we used a test that's done on concrete, the splitting tensile strength test, which is similar to a Brazilian test, to come up with our tensile strength values.

And we found that the tensile strength of the CRF material was actually about one-sixth rather than one-tenth, which is the value that they typically would use for mine design purposes. So that's, I mean, that's good information. That shows that their design calculations are conservative and they're on the safe side.

So here's the graph I was talking about, Priscilla. This is a -- here's we're looking at the unconfined compressive strength of the initial tests that were done by the mine in 2001 and then our 16-year tests that were done last year in 2017.

And we're comparing that with Mitchell's limit equilibrium equations and some historical work that Rimas Pakalnis had done to come up with these empirical design curves for different spans.

So we're looking at a 45-foot span here. And when the study was first done, that lower red dot is about a safety factor of 1.4. And that actually increases to 1.9 if the material cures the same as it did in our fog room, which it's not going to. But at least it shows them that that's the trend. It's trending in that direction rather than getting weaker.

So the conclusions, the good part about this study is we were working with Turquoise Ridge. And they were able to use this information then to justify putting long-term mine infrastructure in their entries beneath CRF.

And I've got some photos coming up that will show you that. And as I mentioned, this information was published at a recent ARMA paper.

Okay. Now, in addition to the performance monitoring of CRF, we also looked at the strength of the in place material. We didn't take samples from in the stope. But what we were trying to do with this study is look at a size effect for different size samples of CRF.

So we did some tests with standard 6 by 12-inch samples. But we also took 12 by 24-inch samples and 18 by 36-inch samples of the same batch, same material. And we brought those back to our office, cured them underground, brought them back to our office and tested them.

And as you can see from these curves, depending upon the mine site and the specific mix that you're using, there's a very significant strength reduction in the samples that's dependent upon the size of the sample.

And there's a number of factors that influence this. One is that, you know, the ASTM standard for casting a standard concrete sample is the diameter of the sample should be three times larger than the largest particle size of the material. So, when you're casting a 6 by 12-inch cylinder, you're screening out plus two-inch material.

Now, when you do that, depending upon the batch design that you're dealing with, you're taking out that oversized aggregate that's changing your size gradation curve. Usually, it's causing your material to be more dense because you've got more fines in it. It's increasing your cement content. And it's increasing your water-cement ratio.

So you've changed the mix design, and that's why the difference in strength between these different sized samples.

And here's a curve that illustrates this in a little better manner. The scale factor here would be the correction factor based on these large 18-inch samples compared to the 6 by 12-inch diameter samples.

And so you can see for the green triangle that's the Stillwater mine there using a plus four aggregate size. And so their strength reduction there, their 18-inch samples are about 22 percent of the strength that they get from their 6 by 12-inch cylinders. And you can see that there's a nice curve that comes out depending upon the size of the aggregate.

So, once again, the mines that we were dealing with, Turquoise Ridge, Cortez Hills, and Stillwater, they are all, in turn use this information for their future mine design for their calculations of what their realistic in place strengths would be.

And we've got a number of publications recently that have come out on this work. Sean Warren presented a paper at SME in 2018 and another paper at a recent rock mechanics conference, ARMA conference in June also.

Okay. The final thing I'm going to talk about now is cemented paste backfill at the Lucky Friday mine in northern Idaho.

This is a schematic that shows the vertical vein system and some of their development entries. And the photo on the right shows you more of the, goes into more detail on the type of mining method that they're using.

As I mentioned, it's an underhand cut and fill mining method. So they're mining, backfilling, and then mining underneath the backfill.

Their vein is accessed by this spinal ramp system. They'll drive a slot drift typically off of that ramp access. And then they'll mine on either side of that slot drift about 600 to 700 feet in the vein itself. And they'll mine typically five cuts from one slot drift.

And this is at, you know, extreme depths. The depths that we were at were about 7,500 feet beneath the ground surface. They've recently put a number 4 shaft in at the mine. And that goes down to a depth of about 9,700 feet. So it's a deep underground mine, high ground stresses.

Okay. So here's a photo of an underground backfill stope that's being prepped prior to backfilling. And you can see that they've placed broken muck on the mine floor. This is prepped muck. Usually that's a layer of about a foot to a foot and a half of material.

And then in that they'll stand up these number 7 DYWIDAG bolts and put nuts and plates on them. They'll wire them in place. And those are serving to reinforce the backfill when they come under it and they do a subsequent cut beneath the backfill.

You can see the timber barricade in the back of the slide. That's what's used to retain the backfill. So they'll usually have a lateral extent of their backfill core of about 150 to 200 feet. And that's to have better control of the quality of the fill that's being pumped into that area.

The schematic on the right-hand side there shows in kind of a --- cartoon characteristics of what's happening to the stope as they mine underneath it. So you can see that there's quite a bit of closure that's measured in the stope. And that causes, in turn, causes the backfill to crush and to break up so you get the sustensional fracturing at the top and bottom surface of the backfill.

But it's, it remains in place. It's intact. And it serves as a good mine roof for the miners to work under.

And this is backfill overhead in the slide here on the left. So you can see the bolts and mesh that are placed on -- they've got this bolt in the muck here so when they mine underneath it the broken material falls off and you're able to put mesh on those bolts and plate it.

And then they'll also put friction bolts into the backfill to help support the mesh. And you can see the mesh and plates that are used to reinforce the side walls of the sill.

Okay. So, to monitor again the geomechanical behavior and stability of these backfill stopes, we designed a heavy duty closure meter that we bolt on the walls of the stope.

So we've got, let's see if I can get this to work, telescoping sections of pipe and tubing here. And they're bolted to these end plates that are in turn bolted to the ribs of the opening.

And then we've got linear potentiometers that run down the inside of this instrument that are monitoring that closure.

On each one of these plates, we've got an earth pressure cell for monitoring horizontal stress change within the fill. So there's a center plate here that you can't see very well. There's a pressure cell on it and also another end plate here.

So we're trying to pick up what is that closure of the stope and what is the horizontal stress that's placed on that material. This material acts like a uniaxial compression test that's turned sideways so those stope balls are coming in and loading the fill.

It's not confined on the top or the bottom. So it tends to break up on the outer surfaces that I showed.

Now, from what these estimates showed us is that there's -- sorry. In this graph right here, the black line gives the closure meters, the closure measurements that we're reading. So each step in that curve represents a subsequent undercut beneath the location of those instruments. And what you can see from that is there's about two to three inches of closure consistently with each undercut.

The pressure cell readings are seen better in this lower slide. Typically, what we see is that that backfill will fail in compression during the first undercut. And that's the peak that you're seeing on the blue curve there. That's the pressure cell that's in the center of the stope.

And then depending upon the location and the reinforcement that we have around those pressure cells, you'll see that there's either a step response where the load is decreasing on those pressure cells as you're mining, you know, successive cuts beneath it or it gradually decreases.

But the thing that's important is we're ending up with a one to two megapascal residual stress within the fill itself. So it's still able to withstand some loading, still able to support itself. And it's got the mesh underneath it that helps hold it in place.

Okay. So, in addition to the instrument measurements, then we look at also what is the in situ stress and strain within the backfill itself. And that's what this curve here is showing you.

So you can see, here's the peak strength that occurs typically at about .5 to 1 percent strain. And then there's typically this strain softening response afterwards until you get out to about 13 to 15 percent strain in this case. And then there's a strain hardening effect.

And that's important to the mine, because when that material is confined enough and you've reduced that void gap above and below the fill, then it's able to carry load from the face. So this is indicating that if you come up with direct material design for this material, then you can take the load away from the face and possibly reduce rock bursts by the design of your fill.

And here's some of the tension and compression tests that we've done on it down below.

So, once again, Hecla used this information in their mine design. They're using it to quantify the ground support provided by the fill. It aids them in making decisions on when to close or reopen stopes due to rock burst events.

They'll look at the magnitude of the readings from the closure meters and say, well, you know, we've seen a lot of movement lately. We're going to close this stope down. And then they'll open it back up when the readings level off.

They're also able to revise their undercut and fill mine designs. And we're, hopefully, we're going to do some more tests with Lucky Friday to come up with a more ductile backfill so you won't see this huge peak in failure at the start.

And then here's some of the publications that we've had from this. We've had a Mine Fill paper that gets into more detail on the instrumentation. And then we've had a couple papers that were presented at ARMA also.

Okay. Future research, so we're going to continue to work with Lucky Friday. They're on strike right now. So we've had a break from installing more instruments. And it gives us a chance to look at the response of the instruments in more detail, particularly in regard to the seismic events.

And then as I mentioned, we're going to conduct some tests to come up with a better mix design in collaboration with Hecla engineers. And then we're going to conduct another set of large scale tests, hopefully with Barrick Gold's strike operation here in the spring.

We've got -- one of the things that we'd like to do is come up with a method for sampling the in stope material.

So what we're thinking about doing, you know, based on six inch in situ stress overcoring work, we're thinking about taking some large samples from a minus two-inch aggregate fill, probably at Cortez or someplace where they've got the smaller aggregate.

And then we're going to take some in stope samples and try and come up with some information on the density of that material, the porosity of that material, and also its strength characteristics, and relate that back to the 6 by 12-inch cylinders, and then come up with a better idea of what's happening between the in stope sample, the in stope characteristics and the characteristics of those smaller size samples.

And then we hope to get into Turquoise Ridge and open up that lower access entry and read those lower extensometers and see what would happen to those instruments over time.

And then one of the areas that one of our researchers would like to get into more depth on is to come up with an automated way for casting and preparing and testing these CRF cylinders at the mine site.

Right now there's a wide disparity in the strengths that you get from those based on the person that's casting the material and testing it.

So typically what the mine consultants will tell the mines to do is you need to record the crew number and the operator that's casting those samples so that you can go back to the individual that's not doing a very good job of that and train them better. You get them to do the job properly.

And then here's a list of some of the publications that we've got coming up this year. I've co-authored a paper with Gabe Stone that's going to be presented at SME.

And we've got two papers from the ARMA conference that were selected as best papers. And they're going through a blind peer review right now. And hopefully they'll be published in Rock Mechanics and Rock Engineering later on in 2019.

Okay. That's it. This diagram off to the right shows you what those cuts in the slot drift look like. So that would be one, two, three cuts that you can see in that slide there with the fill fence.

CHAIRPERSON NELSON: So thank you.

MR. SEYMOUR: Yes.

CHAIRPERSON NELSON: Can you explain to me those failures that you were referring to earlier in your talk -- and I wish you would put numbers on slides so that we can refer to them here and elsewhere.

MR. SEYMOUR: Sorry, I can go back here.

CHAIRPERSON NELSON: So what failure mechanisms were causing those problems?

MR. SEYMOUR: I'm not sure --

CHAIRPERSON NELSON: You were talking about failures associated with backfill and undercut I guess. What was going on? What was the failure?

MR. SEYMOUR: Well, typically what you see when -- are you talking about the fatality that happened at Lee Smith?

CHAIRPERSON NELSON: I'm just talking about what you said. So I'm not talking about anything specific.

MR. SEYMOUR: Okay. Let me see if I can get to the specific -- you're not talking about this one.

CHAIRPERSON NELSON: Backfill fatalities.

MR. SEYMOUR: Oh, okay.

CHAIRPERSON NELSON: How did the failures develop now?

MR. SEYMOUR: Okay. This one right here was at the Lucky Friday mine. And that was a peculiar incident where they typically don't mine one vein. But if they have an adjacent vein -- they've got a series of silver veins. And so they were mining their main number 30 vein, but they also mined a vein that was close to it.

And they had a situation where the mining span was wider than it typically is. And they had a rock above that had backfill on the inner side of it.

And so when they mined underneath that, it stood for a while. But when the miner went into wet down the muck pile and start bolting that entry, it collapsed on him. And it was, you know, a major fatality of huge --

CHAIRPERSON NELSON: Okay, okay. So what I -- I think there's few enough of these that each one is distinct.

MR. SEYMOUR: It is, yes.

CHAIRPERSON NELSON: But I think from the standpoint of -- for me, you have a lot of focus on compressive strength.

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: And a lot of times it's not compression that is the mode of failure.

MR. SEYMOUR: Yeah. And --

CHAIRPERSON NELSON: And --

MR. SEYMOUR: And the reason why I'm mentioning that, Priscilla, is because that is the only test that is done at the mine site.

CHAIRPERSON NELSON: Yeah, I understand that. But from the -- I mean, people in rock mechanics anywhere --

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: -- and rock engineering still correlate everything to compressive strength even though almost none of --

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: -- the failures are compressive.

MR. SEYMOUR: Yeah. So --

CHAIRPERSON NELSON: It's just an index test that people end up doing.

MR. SEYMOUR: Exactly. So, for most of those undercut spans, typically for like the Lucky Friday, and that's a good example, it's -- you know, you're looking at a span that's maybe 10 to 12-feet wide. If it gets to 15 feet or more, then they've got issues with it.

You know, but there's a Mitchell limit equilibrium analysis where they look at different failure mechanisms. The main one for undercut and fill for most applications is a flexural failure in tension, getting back to that tensile strength on the bottom of the beam, right?

CHAIRPERSON NELSON: Right. And a flexural failure in tension is a continuum failure. You've also got discrete fracture propagation and cold joint mobilization --

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: -- that can happen.

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: So all I'm saying is while you're addressing what the mining companies are doing, I think there's an obligation to carry a wish to do maybe something that would tell you more fundamentally --

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: -- about what's going on along with it, rather than --

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: -- feel constrained by what the mining company is doing.

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: But, so I would also wish two things. One is these are really interesting case histories. But, I mean, and your approach -- they're very thorough. I'm sure they're fine.

I would love to have academe involved in every single one of these cases where people could come in, maybe with alternative theories as to what happened --

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: -- or do additional analyses that maybe you're not doing.

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: Let's use them, each one of these as precious learning activities.

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: So there could be on the back of any kind of a case maybe a piggyback grant to academes so that they could actually work with your staff on following up on some of these.

MR. SEYMOUR: Well, that's more important than you realize. I mean, a lot of the --

CHAIRPERSON NELSON: Yeah.

MR. SEYMOUR: A lot of my early backfill work was done with Doug Tesarik who was, his main strength was modeling.

CHAIRPERSON NELSON: Yeah.

MR. SEYMOUR: And so, for this Turquoise Ridge example that I showed you, he modeled that with a FLAC 3D model. I just didn't show it to you.

CHAIRPERSON NELSON: Yeah.

MR. SEYMOUR: So he went back and looked at that beam. And then he came up with, you know, a likely load that would be placed on it, getting back to Donovan's top hat theory. So we looked at what would be the maximum amount of material that could fall out of the mine roof and load this beam.

CHAIRPERSON NELSON: No, I understand.

MR. SEYMOUR: And he looked at that, those tensile failures and --

CHAIRPERSON NELSON: Yeah. I would just like -- I think there's a partnership here --

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: -- that would result in more richness.

I also think that when you work with both Shaw Creek and with backfill there is whole lot of people who have been doing cementitious materials research over in the concrete world.

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: And to try to recreate that coming from the rock mechanics world, there's sort of, there's time to hire somebody who knows about concrete materials --

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: -- because they'll save you a lot of time --

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: -- so a lot of stuff that's already been known.

And the final comment that I would like to make here is that one of the outstanding questions as far as I'm concerned about using backfill, whether it's rock fill or piece backfill, is long-term chemical stability as well.

MR. SEYMOUR: Yes.

CHAIRPERSON NELSON: And when the water, ground water table gets reestablished, stuff can happen.

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: And we're not really monitoring that. So like good mining civil engineers we try to understand things on the physics of the problem, but there's also the chemistry of the problem --

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: -- that I think we have to start paying attention to.

MR. SEYMOUR: Yeah, there could be some acid ground water issues that could --

CHAIRPERSON NELSON: There can be all sorts of things.

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: I mean, you're putting in cementitious material. But you've got minerals that are weathering much faster than we might think and other stuff happening. So --

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: -- just to carry that kind of thing along in your thinking, because, I mean, it's not a safety issue. But perhaps it's not a safety issue, but --

MR. SEYMOUR: If they're putting a long-term infrastructure underneath those --

CHAIRPERSON NELSON: There's an impact that we ought to evaluate.

MR. SEYMOUR: -- entries, yeah, there could be.

CHAIRPERSON NELSON: Yeah.

MR. SEYMOUR: Yeah.

CHAIRPERSON NELSON: Okay. So I dumped myself on there. Anyone else want to say anything? Okay.

MR. SEYMOUR: Well, thanks for your attention. Sorry to give you so much information.

CHAIRPERSON NELSON: Well, it's always nice to see somebody who's passionate about what their subject matter is --

MR. SEYMOUR: All right.

CHAIRPERSON NELSON: -- which it's clear you are. Good. Okay. So thank you very much.

Public Comments

We will now invite public comment. Is there anyone here from the public that would like to make a comment?

CHAIRPERSON NELSON: Oh, okay, Ed.

MR. GREEN: Tom, do you want to go say anything or --

CHAIRPERSON NELSON: Tom?

PARTICIPANT: Oh, I'm sorry. I don't have anything to add.

CHAIRPERSON NELSON: That's okay. All right. So, Ed, the floor is yours.

MR. GREEN: I just have very few things to say. First of all, I wanted to congratulate Bruce on his long years of service --

(Laughter.)

MR. WATZMAN: You know what, I think I'm going to stay.

(Laughter.)

MR. GREEN: All kidding aside, Bruce has done a really fabulous job for mining history and deserves a huge amount of credit for remaining in the industry, along with him, the leading from behind so very carefully, and great job, Bruce. I wish you many years of happiness. And you'll probably be a rich consultant, so do that.

MR. WATZMAN: Thank you.

MR. GREEN: And, number two, congratulations to the committee for another excellent meeting. I'm so pleased to see the committee active.

I know you all take time from your own schedules to do this. It's not easy to pull away from your regular jobs. But congratulations to all of you, Priscilla, in particular. Keeping the cast moving in the same direction is not easy to do.

I want to give a plug for the January 23 diesel technology workshop that is a product of the NIOSH MSHA Diesel Health Effects Technology Partnership. It'll be at the Department of Labor auditorium beginning at 8:00 in the morning on January 23 going through the entire day. We should have a full schedule. I think Jessica has some time in the next week or two to get it out to everybody. It should be --

DR. KOGEL: Yes.

MR. GREEN: -- worthwhile.

DR. KOGEL: I believe the agenda was going to be finalized this week.

MR. WELSH: Yes, it should be pretty much together.

DR. KOGEL: Yeah, so it should be showing up in people's -- if you're on the mailing list for the Diesel Health Effects Partnership, you should be getting the final agenda either by the end of this week or early next week.

And I think perhaps there are many people on this committee that may be interested in receiving it that are not on the list. So maybe we can add you all to the list as well.

MR. WELSH: It will be on the NIOSH mining website, too.

MR. GREEN: Right. Thank you, Jeff. And almost last, but I wanted to hope that NIOSH is going to be submitting comments on the MSHA RFI on mobile machinery and conveyor belt systems. Thank you.

And, well, one last thing with regards to the self-contained risk group, IAM's (phonetic) extension, thanking, thank NIOSH for putting that out as a proposed rule. And the only thing I would ask is that ambition to extending the deadline indefinitely, which is a great idea, and I think it's important for NIOSH to talk to the vendors of the subpart H crew devices to make sure they continue to be produced and what the price is going to be. And so it's an important issue.

So thank you. And I can't tell you how much I appreciate you guys giving me the opportunity to talk in the limited time we have. You're all doing a great job. And, Jeff, thank you for all the --

MR. WELSH: Thank you, Ed.

MR. GREEN: -- work that you do. And I hope to even in semi-retirement continue to pester you.

(Laughter.)

MR. GREEN: Thanks a lot.

CHAIRPERSON NELSON: Great, thank you, Ed. Thank you. And welcome to your new sidekick.

(Off-microphone comments.)

CHAIRPERSON NELSON: Is there anybody on the phone?

MR. WELSH: Anybody on the phone that would like to make a public comment?

CHAIRPERSON NELSON: If so, you have to unmute yourself to be heard. Well, thank you very much. I guess not.

Wrap-up and committee discussion on future agenda topics and dates - Dr. Priscilla Nelson

All right. So we are on schedule amazingly so. We are here for the wrap-up and thinking about the future agenda and dates.

I've been -- everybody, sort of the pulling together the ideas. But one question I wanted to ask you, some of you otherwise might have also been contacted by Sibanye South Africa. They want to form a special advisory group and get universities to sign up regarding safety in mining. Have you heard anything about it? Have you heard anything about it?

DR. KOGEL: I don't think so.

CHAIRPERSON NELSON: Okay. I will send out to people so that you can see what it is. I don't know anything more than just having received an invitation to join. And it seemed like it was something that, I should have sent it to you immediately, but I didn't think of it.

Okay. So, good. I think that what we have carrying on and the ideas that came up to me were, first of all, we'd like to hear more I suspect on the progress on the hybrid matrix evolution and also on stakeholder engagement in that regard.

We'd like, I'd like to hear more on webinar assessments, because we really I think want to put out quality webinars but, and to know why something is a good one would be important.

There was discussion here predominantly, with Todd out of the Spokane center focus on the future of deeper and hotter mines. And I guess that rather than having a bunch of individual projects, the idea of them in an anticipatory sense, if that's going to happen, what should be done before the problems start arising as we get deeper and hotter mines, higher stress situations, et cetera.

We're going to have the mine automation report that's going to be out. And so we want to have an opportunity to think about what do we do beyond that. So everybody needs to be reviewing it, think about whether we want to have some of the panel come in and talk with us or what is the path forward after that.

We would ask to have Cecile's report and the video links distributed so that everybody has it, along with your response, NIOSH's drafty response so that the committee can consider in the near future.

And this should be something that we would have on the agenda for the next meeting, although there may be some activity identified before then. But we would want that on the agenda.

DR. KOGEL: Just a clarification, first of all, Cecile's report being the one she presented here?

CHAIRPERSON NELSON: Yeah.

DR. KOGEL: Okay.

CHAIRPERSON NELSON: Sorry. That's the one I meant.

DR. ROSE: You can get it also as a hard copy, which is maybe a little easier.

CHAIRPERSON NELSON: Yeah, I think it would be good to have those distributed.

I would personally like to at some point have -- I'm going to be thinking about the artisanal small scale mining. And I would ask that Spokane think about going beyond Utah, maybe coming to Colorado School of Mines at some point or Arizona or some of these other places out here. That would be good.

So those are the things I pulled out. I would personally also like to hear more on corrosion and ductility in ground support systems, particularly the Shaw Creek.

But how does everyone else feel? What were the issues that you saw that we ought to be spending more time on?

DR. LUXBACHER: I'm very interested to see how the worker health program develops that Jerry's working on.

PARTICIPANT: Me too.

CHAIRPERSON NELSON: Right. And I think that's got a very broad interest. So, as you form the committee and there's probably going to be more than two people from the MSHRAC that would be interested in tracking this and maybe being there at workshops.

DR. BURGESS: So, Priscilla, we were hoping that before the end of the meeting that we could ask for the individuals that would be interested in joining the group.

CHAIRPERSON NELSON: Sure.

DR. BURGESS: So I don't have -- at a point that works for you in the discussion --

CHAIRPERSON NELSON: Okay. Well, since it's been brought up, the issue on worker health, who would like, in particular, know they want to make a commitment to actually work the workshop, Kyle?

MR. ZIMMER: Okay.

CHAIRPERSON NELSON: Okay. And if we can keep everybody informed, though, because things may change and other people may -- sorry, yes, okay, Marifran.

DR. BURGESS: Cool, thanks.

MS. MATTSON: You talked me into it.

CHAIRPERSON NELSON: And you might be thinking about who you know in your network who should also be invited to whatever the workshops are, if there's more than one whatever.

DR. MILLER: So, Jeff, who all do we have?

DR. BURGESS: Well, I saw Kyle, Craig, Marifran. Ed did raise his hand. Is it okay to have people that aren't -- okay.

CHAIRPERSON NELSON: Yeah.

DR. BURGESS: Ron, is it okay to have people that are, they don't all have to be specific MSHRAC members?

CHAIRPERSON NELSON: No.

DR. BURGESS: They could be other individuals as well, too. Yeah, I just want to make sure. Okay.

CHAIRPERSON NELSON: You can add special technical experts to your working group.

DR. BURGESS: And, again, Ron had raised his hand. Okay. And then was there anyone else? And Aubrey? Okay. And if anyone else decides that they want to join afterwards, please just send Kyle and I, Kyle and me I guess, an email.

CHAIRPERSON NELSON: Well, we might have an MSHRAC meeting.

DR. BURGESS: No, we got --

CHAIRPERSON NELSON: We have a quorum here.

DR. BURGESS: Okay. We're doing one actually on the automation, too. I mean, you had like seven or eight.

PARTICIPANT: We had seven, yeah.

DR. BURGESS: Yeah. So it's similar. Thank you, everybody. I appreciate that.

CHAIRPERSON NELSON: Good. Thank you.

DR. BURGESS: Thank you, Priscilla.

CHAIRPERSON NELSON: Any other issues coming up or comments about what you'd like to hear more about in the future?

All right. I have a comment that I think that occasionally we should take a photo of ourselves so that -- you will find a use for it. Marifran.

MS. MATTSON: One of the things I thought we could maybe hear more about was just kind of talent and, you know, attracting talent to NIOSH in these research areas and also retention of the folks that you have.

CHAIRPERSON NELSON: Well, this also gets into the time required to hire, which is something we've been griping about for a long time.

While I think -- I mean, it was interesting, George, to hear your, just thinking about the capacity building projects. And the focus has been on ground control and ventilation. And I've been looking for faculty. And I'm not looking for ground control and ventilation people. I want other people. And we're sort of skewing the PhD population to those areas. And that's who's coming out.

(Off-microphone comments.)

CHAIRPERSON NELSON: Yeah, so you did it. So I'm glad you're maybe modifying it a little bit so that we might be able to get some students coming out who are interested in developing expertise in other areas.

Along that line though, it would be interesting, because not all of us go to the workshop in West Virginia, when you hear about these capacity building projects that are in ground control or in ventilation. Can we have maybe a little bit more about what's going on with the extramural projects?

I think about two years ago, maybe two and a half, we had some more presentations about those, the university-driven projects. And it would be interesting to maybe at every meeting or every other meeting we have at least a couple of the projects or a couple of the focuses discussed and covered. That would be helpful, because we don't know necessarily what all those projects are.

Yeah. Aubrey.

DR. MILLER: I would be interested in an elongate mineral particle update some day in the future.

DR. KOGEL: It's going to be a long agenda. We've got 11-12 things now.

PARTICIPANT: Or I could do it online.

DR. KOGEL: Yeah.

DR. BURGESS: This gets back to this issue of do you want more in-depth discussion on certain topics --

DR. KOGEL: It does.

DR. BURGESS: -- as we -- then I think you're going to have to prioritize, because there will be future meetings as well, too, for some of these items that are updates as well.

DR. KOGEL: And I guess that was one of the questions I was going to bring up to the committee.

We've fallen into this two meetings a year pattern. And I was going to ask if that was what we wanted to continue to do. Now that we've got this list of topics that we would like to hear reported back on, I'm thinking maybe we do need to continue two meetings per year, because if we're going 12 months between, really it, a long time before we can cycle through these things.

CHAIRPERSON NELSON: Well, if you want us to do something and be a little proactive, I think we have to meet --

DR. KOGEL: I think that's true, too.

CHAIRPERSON NELSON: -- twice a year.

DR. KOGEL: Yeah.

CHAIRPERSON NELSON: If we only meet once a year, we're going to be --

DR. KOGEL: We'll lose the momentum.

CHAIRPERSON NELSON: Yeah, and I mean, as we become more active then your attitude towards the MSHRAC is probably going to change. And you think about how can I use the MSHRAC --

DR. KOGEL: Well, that's exactly --

CHAIRPERSON NELSON: -- differently.

DR. KOGEL: -- what I think is happening.

CHAIRPERSON NELSON: Yeah.

DR. KOGEL: So, okay. Good. I just wanted to make sure the committee felt that it was worth their time to be -- you know, because I recognize the time all of you spend traveling and attending these meeting is, you know, significant. And I think it is a much more engaged sort of interaction that we're having now that's very, very useful to us. So --

CHAIRPERSON NELSON: Yeah. And some of these things that I came up with can just simply be points of information.

DR. KOGEL: Yeah, just --

CHAIRPERSON NELSON: We don't have to have presentations on them.

DR. KOGEL: Yeah, and typically, I think we've tried to incorporate some of that into one of the director's presentations --

CHAIRPERSON NELSON: Yeah.

DR. KOGEL: -- just to kind of give you a one-slide update on it. So --

CHAIRPERSON NELSON: Right, right.

DR. KOGEL: -- yeah, we can certainly do that.

CHAIRPERSON NELSON: Okay. Any other comments? In which case, the only thing left on the agenda is to figure out maybe when we're going to meet and where.

DR. KOGEL: So we've been doing May and November. So I would suggest we target some dates in May if that works for people.

CHAIRPERSON NELSON: I don't know any big conflicts. It's just the second week in May is usually exams and graduation at academic institutions.

DR. KOGEL: So later May?

MR. ZIMMER: We did the third week last time, right?

DR. KOGEL: I can't recall actually. It's probably on the minutes.

CHAIRPERSON NELSON: I think either the first or the third works better for academe.

DR. KOGEL: Yes, May 22nd to 23rd was what we did last May and that -- so we'll look at the last two weeks of May.

CHAIRPERSON NELSON: Okay.

PARTICIPANT: Oh, Memorial Day, yeah.

DR. KOGEL: Oh, that's right, Memorial Day.

CHAIRPERSON NELSON: Well, it depends on -- it moves around.

(Simultaneous speaking.)

CHAIRPERSON NELSON: I'm all screwed up now because Thanksgiving was so early.

DR. KOGEL: I know. Yeah, okay. So that would --

CHAIRPERSON NELSON: Do you know when Memorial Day is?

DR. BURGESS: The 27th.

CHAIRPERSON NELSON: Oh, that's okay then --

DR. BURGESS: It's that Monday.

DR. KOGEL: Okay. So, if we went to that week, we would look towards the end of that week.

MR. ZIMMER: Or the week of the 13th you're looking at possibly?

CHAIRPERSON NELSON: The end of the week of the 13th. I don't --

DR. KOGEL: Maybe --

CHAIRPERSON NELSON: Let's find out when graduation is, because I know it's scheduled. I just don't know when it is.

DR. KOGEL: And maybe find out when graduation and other things like that are happening in May, and then we can avoid that.

DR. LUXBACHER: Ours is the weekend of the 18th. So, you know, any time -- again, Monday the 20th would be --

MS. CHOVANCE: Excuse me, Jessica, this is Marie.

DR. KOGEL: Hey, Marie.

MS. CHOVANCE: So we're kind of holding the end of the week of May 13th for the mining program review panel meeting. So that's going to happen sometime in May 2019.

DR. KOGEL: Are we holding the whole month? I can't recall.

MS. CHOVANCE: Yes, right now we're holding the full month. I don't know exactly when that's going to be. So --

DR. KOGEL: Okay.

DR. LUXBACHER: Maybe late April.

(Simultaneous speaking.)

CHAIRPERSON NELSON: We did that once.

DR. KOGEL: I think we might have.

CHAIRPERSON NELSON: Or that first week in May. But, I mean, your attention is going to be on that big panel meeting, though, isn't it, preparing for it and --

DR. KOGEL: That's what I'm thinking --

CHAIRPERSON NELSON: Yeah.

DR. KOGEL: -- from April, end of April may not be ideal from that perspective because, yes, we would be focused on that. We're holding the month of May. But I don't think that means that if we stake out two days for the MSHRAC that, I don't think that's going to be an issue.

So let's continue with those, that last week of, what was it, the --

DR. LUXBACHER: The week of the 20th?

DR. KOGEL: 20th and --

MR. WELSH: It's the week of the 27th and --

CHAIRPERSON NELSON: Because you said your graduation is the 18th? So week of the --

DR. KOGEL: So we'll get -- yeah. So we'll think of that. And then I'll have some discussions internally about whether or not that's going to be an issue with the panel review.

How about location? We've kind of done --

DR. KOGEL: So we've been typically meeting in the east for the spring meeting and in the west for the fall meeting. So we would be going back east in May.

MR. WELSH: But the last two, D.C. and then before that Morgantown.

DR. KOGEL: Yeah, and then Pittsburgh. So maybe it's time to cycle back to Pittsburgh, because we haven't been to Pittsburgh for a while. And there's no reason --

CHAIRPERSON NELSON: Sure. I might -- I'm always hesitant about Pittsburgh because I never know how I'm going to get lost. I just know I'm going to get lost.

DR. KOGEL: Dale just said what about Elysburg (phonetic), and I said we'd be happy to host if people wanted to go there.

(Off-microphone comments.)

DR. LUXBACHER: Yeah, I like doing it in Pittsburgh because that means more people on site --

DR. KOGEL: Yeah, we can see what's going on.

DR. LUXBACHER: Yeah.

CHAIRPERSON NELSON: Fine with me. Okay. Did you have enough budget to budget for any number of workshops that they may want? Yeah?

DR. KOGEL: I think so.

CHAIRPERSON NELSON: I just --

DR. KOGEL: I mean, we can go --

CHAIRPERSON NELSON: At some point you kick in with a --

DR. KOGEL: Yeah, no, I think --

CHAIRPERSON NELSON: -- budget constraints. I don't know what they are.

DR. KOGEL: I think they're fairly inexpensive really.

(Off-microphone comments.)

CHAIRPERSON NELSON: Okay. Any final comments from anyone?

MR. WELSH: Okay. Well, the mine tour outside, right outside the Marriott at 1:00. It takes 30 minutes to get there.

(Whereupon, the above-entitled matter went off the record at 11:48 a.m.)

Adjourn