1   NIOSH/NPPTL TOTAL INWARD LEAKAGE

2   PUBLIC MEETING

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5   **ORIGINAL**

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8   Tuesday, June 26, 2007

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17   Commencing at 9:00 a.m. at the Embassy

18 Suites Pittsburgh International Airport Hotel,

19 Coraopolis, Pennsylvania.

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1   CONTENTS

1   WELCOME/OPENING REMARKS

2   MR. SZALAJDA: All right, good morning.

3   This is, I think, the first public meeting

4 we have ever had that we have not been begging

5 people to sit down, so it must be a very important

6 topic.

7   My name is Jon Szalajda. I'm the chief of

8 the policy and standards development branch at

9 NPPTL. I would like to welcome you to today's

10 public meeting.

11   As far as the discussions today, we're

12 considering this as part of an open dialogue

13 regarding the development of the performance

14 requirements for Total Inward Leakage for half-mask

15 and filtering facepiece respirators.

16   At this point, we have not begun the

17 formal rulemaking type process to update 42 CFR Part

18 84 to include these requirements. At some point in

19 the future, that process will begin, and the amount

20 of dialogue that we have between the government,

21 NPPTL, and stakeholders will be a little bit more

22 controlled.

1   But at least at this point, this is an

2   informal type dialogue to let you know what we're

3   thinking of with regard to the requirements for

4   inward leakage and to get your feedback.

5   Today we're planning on having a

6   relatively short meeting, but a lot of information

7   is going to be presented. We're going to discuss

8   the development of an anthropometric respirator fit

9   test panel, which will be led by Dr. Ziqing Zhuang.

10   And Bill Newcomb will review for you the half-mask

11   testing and analysis of work that has been done at

12   NPPTL to evaluate and benchmark existing

13   technologies and use that information to help us

14   define what performance requirements should be for

15   half-mask and filtering facepiece respirators.

16   As far as our agenda goes, we're going to

17   be a little loose, I guess, based on the length of

18   the discussion.

19   I think probably after we review the

20   Institute of Medicine's report and analysis of the

21   fit test panel, we'll take a break at that time.

22   But depending on how quickly or slowly the dialogue

1   goes, we may adjust that as appropriate.

2   Regarding the presentations and

3   information provided today, a docket has been opened

4   relative to soliciting and accepting comments from

5   the stakeholders. There's a variety of contact

6   methods to formally submit your input to the docket.

7   At least as far as today's meeting, it is

8   going to be transcribed.

9   After each presentation, there will be an

10   opportunity for questions and answers. At that

11   time, if you have a question, we would like you to

12   come up to the microphone in the middle of the

13   seating, state your name, who you're with, and then

14   ask a question, and we'll do our best to address it

15   at that time.

16   Administratively, at least as far as the

17   operations for today, there is a survey in your

18   packet of information. We would like you to fill

19   that out and drop it off at the box in the back of

20   the room upon the completion of the meeting today.

21   The restrooms are right outside the door

22   at the rear of this room.

1   At least as far as making the

2   presentations available, what we're planning on

3   doing is having them on the website in the near

4   future.

5   What we're planning on doing is sending an

6   email to the attendees as well as to our list serve

7   general mailbox to let you know that the

8   presentations are available on the website, and we

9   expect that to be done within the next few days.

10   And with that, I would like to introduce

11   Mr. Les Boord, the director of NPPTL.

12   MR. BOORD: Thank you, Jon.

13   Good morning, and welcome to everybody

14   participating in the meeting today.

15   I thought before we get into any of the

16   technical discussions and issues, it would be good

17   to kind of look at an overall perspective of what

18   we're doing today and how it fits in -- how our

19   activities today fit into the overall scheme of the

20   NIOSH research program portfolio.

21   And many of you have probably seen this

22   illustration before, but about two years ago, two

1 and a half years ago, NIOSH embarked on a program to

2 organize its research activities into an industry

3 sector-based and sector-based program portfolio.

4   And to do that, the Institute identified

5 eight primary industry sectors that are indicated in

6 the left-hand column of this illustration.

7   So the industry sectors that guide the

8 research activities for the Institute are the

9 Agriculture, forestry, and fishing sector;

10 Construction; Healthcare and social assistance;

11 Mining; Manufacturing; Services; Transportation,

12 warehousing, and utilities; Wholesale and retail

13 trade.

14   So those are the primary industry sectors

15 served by the research activities of the Institute.

16   Now, in addition to that, we have

17 identified 15 different cross-sector programs.

18 Those are illustrated in the second column of the

19 illustration.

20   And as you scan down the list of

21 cross-sector programs for the Institute, you can see

22 about two-thirds of the way down, we have the

1   Personal Protective Technology cross-sector. That's

2   the home of the program that we're talking about

3   today.

4   So our Total Inward Leakage for half-mask

5   and filtering facepiece type respirators is part of

6   the PPT, personal protective technology,

7   cross-sector for the Institute.

8   Continuing on, in the right-hand column of

9   the illustration, you have the other emphasis areas

10   that have been identified for the Institute to

11   govern and direct the programs, the overall programs

12   for NIOSH.

13   Now, speaking a little bit about the

14   Personal Protective Technology cross-sector. The

15   laboratory, the National Personal Protective

16   Technology Laboratory, within the Institute is the

17   responsible area for managing and organizing and

18   strategically directing the PPT cross-sector.

19   In that regard, the vision and the mission

20   statements for the PPT cross-sector are as stated

21   here. The vision is to be the leading provider of

22   quality, relevant, and timely PPT research,

1   training, and evaluation.

2   And the mission of the PPT cross-sector

3   program is to prevent work-related injury and

4   illness by advancing the state of knowledge and

5   application of personal protective technologies.

6   So those are the visions and missions that

7   have been identified for PPT cross-sector within the

8   Institute.

9   Now, I think it's important and

10   interesting to actually look at the strategic goals

11   that have been identified for the PPT cross-sector.

12   And you can see that there are three

13   primary strategic goals followed by a set of

14   intermediate goals that apply to each of the

15   strategic goals.

16   So No. 1, Reduction of inhalation hazards;

17   2, Reduction of dermal hazards; and, 3, Reduction of

18   injury hazards.

19   And I think it's pretty obvious that the

20   program we're talking about today, the Total Inward

21   Leakage for half-mask and filtering facepiece

22   respirators, fits nicely into reduction of

1   inhalation hazards.

2   But I think if you drill down a little bit

3   further and look at the intermediate goals

4   associated with that strategic goal, to develop

5   comprehensive research programs, to work for the

6   development of harmonized PPT standards, to perform

7   evaluation activities, and then the research to

8   practice through communications and outreach and

9   transfer activities, I think you'll see, as the day

10   unfolds, that the Total Inward Leakage Program that

11   we're talking about really hits on each of those

12   areas.

13   So we're going to talk a little bit about

14   the research that's leading the development of the

15   Total Inward Leakage proposed requirement. We're

16   going to talk about the development of that

17   requirement and how we went about establishing the

18   proposed performance levels.

19   The evaluation activities, we're going to

20   spend a good deal of time talking about evaluation

21   in terms of evaluation of programs and projects.

22   Evaluation is a key for the Institute to

1   improve and to instill the quality of the research

2   in other programs that the Institute performs.

3   And then finally, our r2p, our research to

4   practice. The impact and relevance of the research

5   that's undertaken is important.

6   And I think that as the day unfolds,

7   you'll see that the TIL program really hits in each

8   of those four areas.

9   So with that, that will conclude my brief

10 introductory comments. And I think we will turn it

11 over to Mr. Newcomb, who will talk about the program

12 concept for TIL.

13   PROGRAM CONCEPT

14   MR. NEWCOMB: Good morning.

15   Thank you, Les.

16   Most of you have probably seen a lot of

17 this before. This is a review of the total program

18 and the project within that program to look at Total

19 Inward Leakage of half-mask filtering respirators.

20   Back in 1972, when 30 CFR 11 became the

21 law -- or the regulation by which respirators were

22 tested and certified, there was a schedule for

1   particular respirators called Schedule 21C.

2   And prior to this, there was a coal dust

3   test for fitting of filtering respirators. And that

4   was abolished when 30 CFR 11 came along because it

5   was felt that spraying coal dust into people's faces

6   wasn't exactly the best thing to do.

7   But there was an isoamyl acetate test that

8   was instituted. But in order to test filtering

9   facepieces or filtering half-mask or any type of

10   particular filters, you needed to modify the

11   respirator and put an organic vapor removing

12   cartridge on it. So, therefore, the respirators

13   weren't the same mass, weren't the same weight, and

14   didn't fit the same way as they normally would.

15   When 42 CFR Part 84 was instituted in

16   1995, the isoamyl acetate test was eliminated

17   because of the problems in the configuration. Also,

18   the effectiveness of the isoamyl acetate and, at

19   that time, the ANSI and OSHA fit testing methods

20   were contentious.

21   But at that time, OSHA required individual

22   fit testing. So the thought was that the best

1   practices used in qualifying respirators would

2   remove any respirators from the market that did not

3   fit properly.

4   In 2002, there was a study published that

5   was contracted by NIOSH to look at respirator usage

6   in the private sector. And in that study, 53

7   percent of the respondents said they conducted fit

8   tests. And there's a question as to whether that

9   was actually the right figure or whether it should

10   be higher.

11   At the same time or very close after, OSHA

12   published the proposed assigned protection factors.

13   And during the hearings, NIOSH committed to add

14   quantifying fit test methods to respirator

15   certification requirements.

16   So as a continuation of NIOSH's unique

17   approach to modular rulemaking, a program was

18   established to add Total Inward Leakage requirements

19   for half-mask particulate respirators, followed by

20   PAPR and supplied-air respirators -- those are the

21   ones that OSHA gives a 25 or 1,000 to, depending on

22   how they're tested, followed by all other

1   respirators and other PPE -- such as encapsulating

2   suits.

3   In the program for particulate

4   respirators, there were three phases that were

5   established.

6   Phase 1 was the investigative and concept

7   draft stage where the TIL, existing TIL information

8   was gathered.

9   There was a review of the test equipment

10   and the capabilities and the technical

11   specifications of that equipment.

12   We identified a peer review team composed

13   of manufacturers, users, academia, and government;

14   developed an initial TIL concept addressing

15   performance requirements and test protocols;

16   conducted a peer review and a public meeting; and

17   established technical specifications for the test

18   facility.

19   Phase 2 was actual benchmark testing and

20   the establishments of the test facility to do that.

21   We performed benchmark testing to

22   establish state-of-the-art respirator performance,

1 continued development of the concepts, and

2 identified draft implementation plans.

3   Phase 3 would be consistency testing and

4 implementation plan: Conduct a validation testing

5 for the facility, finalize implementation plan, and

6 finalize a concept requirements and protocol.

7   One thing that we set out as a criteria at

8 the beginning of the program was that what we set

9 for a TIL would not be a replacement for

10 OSHA-mandated fit testing because the only way of

11 accessing individual fit is a fit test. You cannot

12 certify a respirator to fit people.

13   To establish the performance criteria, we

14 said that it would be based on actual fit test

15 results and not assigned protection factors.

16   We also felt it was inappropriate to use

17 previously obtained fit test data because of the

18 variety of methods used and the fact that a lot of

19 the data was done on older Part 11 respirators.

20   We would conduct benchmark testing on

21 state-of-the-art respirators within the class, rely

22 on the manufacturer's user instructions. And

1   because there is no criteria established for what

2   size respirators are, we decided to use the entire

3   panel for the evaluation.

4   So for the half-mask project, when we

5   looked at test methods, we looked at the ability to

6   use the TIL in all styles of half-mask,

7   quarter-mask, and filtering facepiece.

8   It should have the required sensitivity

9   for the desired results, the ability to give

10   accurate repeatable results, the ability to do the

11   required test exercises without disturbing the fit

12   due to the test equipment, ease of duplication, cost

13   of equipment, need for a test chamber, and ease of

14   preparation, use, and cleanup.

15   We felt that the best choice of measuring

16   half-mask TIL is the PortaCount Plus with a

17   Companion using a direct reading mode.

18   The most reproducible exercise methods

19   were thought to be those used in the OSHA fit test

20   protocol. One of the reasons for that is that a

21   standardized workplace with standardized movements

22   does not exist.

1   OSHA is wrestling with this at the present

2   time when they're trying to establish what type of

3   tests should be done for different PAPRs and SARs.

4   We decided to use a new test panel called

5   a NIOSH Bivariate test panel that most of you have

6   seen before, and we'll have a lot more elaboration

7   on this in a few minutes. But it's a new panel that

8   replaced the Los Alamos panel, which has more

9   up-to-date sizes.

10   To summarize, the Phase 2 is complete, and

11   we're now in Phase 3.

12   The study was designed to assess the

13   overall capabilities of individual respirators. The

14   benchmark data was derived by testing across a

15   complete panel regardless of the respirator

16   designated size, and, therefore, does not represent

17   actual field use.

18   The data was analyzed in several ways, and

19   conclusions have been reached concerning the

20   proposed requirements for certification. Again,

21   just proposed requirements at this point.

22   Thank you.

1   Are there any questions?

2   We will now hear from Dr. Ziqing Zhuang,

3 who will go over the anthropometrics that we used to

4 create the panel.

5 ANTHROPOMETRICS RESEARCH TO DEVELOP FIT TEST PANELS

6   MR. ZHUANG: Thank you, Bill.

7   Yeah, the title of my presentation is

8 Anthropometrics Research to Develop Respirator Fit

9 Test Panel.

10   And first of all, I would like to

11 acknowledge my, yeah, co-authors on the paper and

12 also the people work on the program.

13   Dr. Ron Shaffer, branch chief. And then

14 Dr. Bruce Bradtmiller of Anthrotech. He is our

15 contractor. And also Dennis Viscusi been working

16 with me on this project for the last few hours.

17   And then lately, we have Dr. Ray Roberge,

18 helping we with the BMI, body mass index paper. And

19 then also Dr. Doug Landsittel also help with the

20 statistical issue lately.

21   And I have a few summer student and a

22 Ph.D. student working on the project as well.

1   So the test panel has been used quite a

2   bit in the past, and then they have been relied upon

3   to provide sizing reference for respirators in many

4   application, and to select representative subject

5   for bivariate testing.

6   As soon as the Los Alamos fit test panel

7   was developed, it was used to collect a lot of fit

8   test data. And then this data was used to establish

9   a APF, assigned protection factor. And also the

10   panel can be used for respirator design and

11   development, and then also Total Inward Leakage

12   testing. And then also they had been used for

13   research purpose.

14   We can use them to recruit subjects.

15   And -- yes. So when the LANL panel was

16   developed back in the earlier '70s, there was no

17   survey of facial dimension of the U.S. civilian

18   workers at that time.

19   So the only data set available was the '67

20   and '68 U.S. Air Force anthropometric survey of the

21   pilot or Air Force personnel. And so the facial

22   anthropometry was assumed to be representative of

1   U.S. adult at that time. They did a pilot study,

2   and they also found some consistency there.

3   And they selected face length, face width,

4   and lip length to develop a panel.

5   And this is the panel for testing

6   full-facepiece respirator. And it is based on face

7   width and face length and the dimension range from

8   93 and a half to 133 and a half millimeter for face

9   length, and 117 and a half to 153 and a half for

10   face width.

11   And based on the percentage of the

12   population of the subject in the Air Force survey

13   data, they divide the population into, yeah, 16

14   cells.

15   But some of the cells here, they have very

16   few people or subject there, so they would delete it

17   and leaving a ten-cells panel. And these are the

18   subjects that they recommend to be sampled from each

19   cell.

20   And for the half-mask panel, they used lip

21   length and face length. And also, yeah, it's a

22   ten-cells panel and 25 subjects.

1   And so lately, when we look at the panel,

2   we thought the demographics of the U.S. population

3   has changed over the last 30 years. And then

4   military data may not fairly represent the diversity

5   of the face size that we see in the civilian

6   workers.

7   So we -- yeah. So we looked at -- closer

8   looked at the data.

9   And if you can see from this figure, that

10   yeah, U.S. Air Force male at that time, most of them

11   are 90, yeah, 7 percent of them were white. And

12   then for female, we have some African-American

13   female in the Air Force at that time.

14   And but if you look at the census data,

15   which is back in 2000, and you have quite diverse

16   population here, about 70 percent of Caucasian. And

17   then African-American or Hispanic, yeah, accounted

18   for about 12 percent each. And then we have about a

19   6 percent others group, like Asian, Pacific

20   Islander, or Native American, or -- yeah.

21   And if you look at the age distribution,

22   we also think that there could be a problem there.

1   As you can see, age 18 and 29 or 30 to 44,

2   and these are the two categories that the pilots,

3   yeah, the Air Force subject were mainly less than

4   45.

5   And if you look it our 2000 census data,

6   it's quite uniformly distributed among the three age

7   groups as, yeah. Like from 45 to 66, we have a good

8   portion of it.

9   And then after the LANL panel was

10   developed, like, yeah, there are a couple of other

11   studies to look at it earlier, yeah, in the 1970s.

12   The first study was conducted by, yes, by

13   Leigh. And, yeah, he measure 1,467 of employees of

14   a big corporation. I think it's called Dow Chemical

15   USA, and it is a division in Colorado.

16   And they also have annual fit test

17   program. They have fit test programs.

18   So they fit test employee and also measure

19   their face length, face width, and lip length. And

20   so what they found was, yeah, more than 12.6 percent

21   of their employee were outside the LANL panel. And

22   so they concluded that adjustment of the LANL panel

1   is needed.

2   And then 1978, Bureau of Mines also did a

3   survey. They only had 48 male mine rescue workers.

4   It's a small survey, but they also found significant

5   differences from their workers than the LANL panel.

6   And so they concluded that a last survey

7   of industrial users are needed.

8   And so lately, back in 2002, there was a

9   project called CAESAR, which is Civilian American

10   and European Surface Anthropometry Resources.

11   So it was a project to measure about --

12   they target 4,000 American and then 4,000 Italian

13   and 4,000 in Netherland.

14   And but the sample sizes are a little bit

15   smaller. They end up getting about 2,500 subjects

16   in the U.S. because the, yeah, the different states,

17   from all the way to over here to like Detroit and

18   Washington DC, so across the country.

19   And so they -- this is a 3D,

20   three-dimensional anthropometry approach. They use

21   a whole body scanner to scan the subject. They also

22   measure 40 traditional measurements. And so we can

1   use face length and face width to look at whether

2   the LANL panel is okay or not.

3   So we find that 16 percent of their

4   subjects were outside the limits.

5   And if we look at the literature, some

6   other, yeah, study, they also said that lip length

7   is one of the dimensions used to define the LANL

8   panel, but did not have good correlation with

9   respirator fit. And they concluded that like, yeah,

10 for this case, it is Dr. Oestenstad in Alabama

11 University.

12   And so since then, we, yeah, initiated a

13 project, yeah, to develop a database detailing the

14 face size of the distribution of respirator user.

15 And we also evaluated the applicability of the LANL

16 panels. And then also, we also had some data, so we

17 look at the correlation between facial dimensions

18 and fit.

19   And then the last step is to develop the

20 new panel.

21   So this is the time line of the whole

22 effort. And so back in 2002, we developed a

1 protocol. We have a panel of five reviewers to

2 review the protocol. We went through NIOSH human

3 subject review board review. They also asked a lot

4 of question, and we need to address their question.

5   And then we also went through OMB review.

6 Since it's a new study and so many subjects

7 involved, the design was to measure over 4,000

8 workers, so we required to go through OMB review.

9   And they also review our statistical

10 design, and we have a few discussion. And so we end

11 up coming -- yeah, getting the way we wanted -- or

12 the way it is right now for the design of the study.

13   And then the data collection was

14 completed, yeah. We started the data collection

15 earlier 2003, but finished by the, yeah, by

16 September.

17   And so we went ahead and did the data

18 analysis like, yeah, some quick summary report. And

19 then also Anthrotech wrote a quick report also. And

20 I just used that report to do a lot of further

21 analysis.

22   So the first proposed NIOSH panel was made

1   back in August of 2004, when we had our first public

2   meeting in Washington DC.

3   And then since then, I presented the new

4   panel, the bivariate panel, and PCA panel at the

5   ISRB meeting in Oklahoma.

6   And then in early 2005, we also went to

7   meet with like 3M representatives and MSA, and then

8   showed them the new panel.

9   And then later in 2005, we initiated the

10   National Academy of Science review. And then they

11   stopped for another effort, and then resumed back in

12   July of 2006. And they finished their review by

13   January of this year.

14   And then meanwhile, we prepared a

15   manuscript and submitted that manuscript to the

16   Journal of Occupational and Environmental Hygiene.

17   And it is also finished by January of this year

18   also.

19   So now it is in press, and, in fact, they

20   have a PDF out. It may be posted soon. I will show

21   you later on.

22   And so, anyway, so the design of the

1   survey was a stratified sampling approach.

2   We look at male, female, and also four

3   race groups, White, African-American, Hispanic, and

4   others. And we also divide the population into

5   three age groups. Just this is arbitrary. And so

6   just to ensure that we have subjects from various

7   groups. And so the final sample was 3,997.

8   A couple of them we did not have complete

9   measurement, and so we end up having about a good

10   data for 3,994.

11   So these are the type of tools we use, a

12   sliding caliper, spreading caliper. And this is the

13   final tally of the database.

14   So we have 2,543 male and 1,454 female.

15   So as soon as we finished the data

16   collection, we tabulate our data into the LANL

17   panel, and quickly we found out that, yeah, only

18   84.7 percent of our subjects are included in the

19   panel.

20   And you can see very few people in cells

21   one and two. They are all less than 1 percent. And

22   you can also they also scatter, like above, below,

1   and to the right of the panel, the subject.

2   And so we used two approach to develop the

3   new test panels. And the first one, we follow the

4   LANL approach, which is bivariate, using two facial

5   dimension. And the other one we came up with is a

6   principal component analysis approach.

7   And for the principal component analysis

8   approach, it is yeah, like PCA defines a new

9   coordinate system using linear combinations of the

10   original variables to describe trends in the data.

11   So we have many dimensions here. So we

12   try to reduce to like key principal components so we

13   can look at the trend.

14   So for our case, it will be like from

15   small to large, short and wide, or long and narrow.

16   So based on this analysis, it will classify the

17   subjects in such a way.

18   And the criteria we used to select the

19   dimension were based on literature review and then

20   also expert opinion.

21   So there are eight studies in the

22   literature that look at respirator fit and facial

1   dimension. And they are all using half-mask. So

2   far, no one has ever look at that using

3   full-facepiece respirator.

4   And so the expert opinion, I talked to

5   Alan Hack, who developed the LANL panel, and then

6   also the ISO committee. So and then also various

7   manufacturers.

8   That's what, yeah, what I call expert

9   opinion, to gather their input and then come up

10   with, yeah, this panel.

11   And then the other criteria we used is the

12   dimension, like excluded, like can be predict by the

13   dimension, including the PCA.

14   Like for this case, it is the PCA panel in

15   the dimension. It can be like, by the other. We

16   think it can be excluded.

17   And then also, we don't want to have too

18   many dimensions, make it manageable. And then some

19   dimensions are very difficult to measure, like with

20   the hair. And if you press a little bit more, you

21   can get a different number or less, yeah, you get a

22   different number. And then those were the variable

1   we try to avoid.

2   So this is the, yeah, NIOSH bivariate

3   panel.

4   So we continued to use ten cell, and then

5   also 25 subjects is what Los Alamos used. So we

6   just copied over here, but number of subjects can be

7   adjusted as needed.

8   And then later on, Dr. Landsittel will

9   explain how you adjust the number of subjects for

10   the panel.

11   And then at least two subjects for each

12   cell will be sampled, and we'll try to match the

13   population, the distribution of the population also.

14   And face length and face width was

15   selected to define the bivariate panel, which can be

16   used for both half-mask and full-facepiece

17   respirator.

18   So this is the new bivariate panel, and

19   the new -- this show the panel. So it a -- we

20   labeled them from one, two, three, four, five, six,

21   seven, eight, nine, ten, and you can see the

22   dimension different from the LANL panel.

1   So it range from 98 and a half to 138 and

2   a half. And then also, yeah, from 120.5 to 158.5

3   millimeter of face width.

4   And so, as you can see, this is the figure

5   to show. LANL panel is the red color, and then our

6   panel right, yeah, pretty much surround the LANL

7   panel and cover like, yeah, in all directions.

8   So if you want to consider like at one

9   size here or there or there, it's not enough. So if

10   you look at the whole panel and use the panel to

11   adjust, then that may be appropriate.

12   And this is the percentage that we

13   estimate of the workers in each of the cells. And

14   we use the 2000 census data to weight our subject,

15   to, yeah, determine -- to estimate these

16   percentages. And they can be used to adjust the

17   panel size if we need to.

18   And so for 25 members -- this is just an

19   example -- basically we sample two persons from each

20   cell. And these are the two cells have more workers

21   in those two cells, so four and five subjects will

22   be sampled.

1   And for the PCA approach, we end up

2 selecting these ten dimension, and this is the

3 loading factors, like item factors for the PCA

4 analysis or panel.

5   And you can see like the first principal

6 component, they are all positive. And these are the

7 coefficient. That can be modified by the original

8 measurement of each of the dimension here, and sum

9 them up to get the first component score.

10   And so if any of the dimension is bigger,

11 the overall score is bigger.

12   But for PCA2, it's different. We have

13 like face length, nose protrusion, and nose length

14 here. They are positive. So the longer these

15 dimension, the larger the component score.

16   And then the other -- for the other

17 dimension, they are negative. So the wider, the

18 smaller the component score. So this is the PCA

19 panel.

20   So we use the ellipse to include more than

21 95 percent of the subjects. And then we also use an

22 inner ellipse to cover about 50 percent of the

1 subjects. And then dividing the subject into --

2 using these two lines, we divide them into eight

3 cells.

4   So it's one, two, three, four, five, six,

5 seven, and eight. And each cell represent about 10,

6 11, or 12 percent of the population, very uniform.

7   And so you can see the scatter -- this is

8 the scatter chart of the NIOSH subject against the

9 new panel. And so the people, yeah, on the left

10 tend to be smaller. Everything is small. And then

11 you go to the medium, and then large. So everything

12 is large.

13   But for the people at the bottom, they

14 are -- have a short face and then wider nose. And

15 then the people up here, they tend to be longer

16 faced and narrow and a high nose protrusion.

17   And these are the percentage that we

18 estimate for each of the cell for male and female.

19 And you can see 95.2 of the male are included in the

20 panel. And then for female, we include more. And

21 then the overall, I told you, is about 96.4 percent

22 of the workers.

1   And then so if -- again, for example, you

2   have a 25-person panel, member, we will recommend,

3   yeah, like four from each of the cells because it's

4   very uniform.

5   And then since like Cell No. 2 has a

6   little bit more people, so you can sample like four

7   people there. But, you know, in our paper, we just

8   say like you can -- as soon as you can find someone

9   from any other cell, it's easier. You can use that

10 subject as well.

11   So two panels, yeah, were developed. And

12 then respirator designed to fit these panels are

13 expected to accommodate more than 95 percent of the

14 current U.S. civilian workforce.

15   And both panels represent an improvement

16 over the LANL panels used today.

17   And then we also prepare a training

18 videotape video. It's a Media -- Windows Media

19 Player file. So you can play on the computer to

20 show how to do the landmarking and measurement.

21   And then we also have a computer program

22 that you can enter the measurement while you are

1   doing the measurement to help you, yeah, correct

2   problem or error. And then it also place the

3   subject into various cells for the PCA or the

4   bivariate panel for you as well.

5   And so these are the references that we

6   have published over the years, and so this is the

7   one that I mentioned earlier.

8   It's just -- the peer review was just

9   completed earlier, January of this year. And now,

10   they gave me this file last week, and they said it

11   will be posted on the internet by the 28th of June,

12   or by the end of this week.

13   So for you, for those of you AIHA member,

14   you can go there and download the file. And you can

15   also contact me for a copy of the paper. We

16   describe how we, yeah, developed the panel, and then

17   also provided some example there.

18   And then, again, this is a list of the

19   presentations that I have made throughout the years

20   to show what we have done in this area and, yeah,

21   while getting input from the area stakeholders.

22   Okay. Thank you very much.