NIOSH/NPPTL Public Meeting to Discuss Escape Respirator Standards Development Efforts for Respiratory Protection Against Chemical, Biological, Radiological, and Nuclear Agents (CBRN)

April 29, 2003
Radisson Hotel Pittsburgh Green Tree
Pittsburgh, Pennsylvania

TRANSCRIPT LEGEND

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P R O C E E D I N G S

ROLAND BERRY ANN: Good morning everyone. Let me start out by saying Rich Metzler, the Director of the National Lab, had planned and hoped to be here this morning, but unfortunately he had to be in D.C. for meetings and was unable to make this, but we want to thank everybody for taking time out of their busy schedules to be here today. We're expecting lively discussions, good exchange of information, and welcome to Pittsburgh. Now John Szalajda will give you details of . . . the . . . what's going to happen today. Thanks

JOHN SZALAJDA: Well obviously I'm not Rich Metzler either, but again, thank you for your attendance on this topic and this continues what we're trying to do at NIOSH in terms of using conceptual discussions to promote ideas and dialogues for chemical, biological, radiological, and nuclear standards to protect workers. In this case, we're addressing the development of CBRN standards for an emergency escape hoods or masks. We have a pretty ambitious agenda for today. What we're going to try to do is to break down the day into a couple of discrete areas. This morning we're going to concentrate on the air purifying aspect of the escape respirator. You're going to hear some discussions regarding the overall strategy as well as some of the conceptual requirements that we're considering at this time for the

respirator. Unfortunately, there'd be one small change, Mr. Mattson from NIST is not here. I'm not sure if he's in route or not. So we're going to skip over that part of the agenda and bring him in later on if the schedule permits.

Some of the topics that we'll be covering through this morning include the gas-life requirements for the respirator as well as special tests that we're considering, in particular, chemical warfare agent testing and laboratory respiratory protection level or LRPL testing that we're also considering. This afternoon we're going to move to another area where we'll be looking at a self-contained escape respirator. In addition, we're also going to be covering work at NIOSH and SBCCOM are collaborating on in terms of developing simulants to assist manufacturers in the design of their equipment. And near the end of the day, Mr. Boord is going to lead us, lead a discussion on some of the other topic areas that NIOSH is addressing, in particular, things that might be of interest to the manufacturing community, are R&D program that we're conducting with SBCCOM to allow testing, chemical warfare agent testing prior to the submittal of an application.

In terms of the actual standards development, we've come a long way with the program that initially NIOSH set out to build partnerships with other Federal agencies to include the

National Institute of Standards and Technology, Soldier Biological Chemical Command, Occupational Safety and Health Administration, National Fire Protection Administration, and we've defined working relationships with these agencies through interagency agreements which allow us to cooperate, provide some linkage and allow us to cooperate in development of the standards.

We've also received funding to develop the CBRN standards from a variety of sources. One that we have received money through the Centers for Disease Control to address CBRN as well as initial funding and continuing funding through NIST from the National Institute for Justice. We also have established a good working relationship with our partners from the Army at the SPCCOM Soldier Biological and Chemical Command to support us and using their expertise on testing with the chemical warfare agents as well as the laboratory protection level testing. I talked . . . I briefly talked on the topics that we're going to be covering this morning earlier.

As far as some of the logistics concerned with the meeting, there were signup sheets in the back. If you didn't . . . If you snuck in without signing in, I encourage you at some point this morning to go back and register that we can record your attendance here at the meeting. Also just wanted to remind you that we are transcribing the meeting in

terms of the actual discussions and comments from the audience, what we'd like you to do at the point where the forum is opened up for your comments and your discussion, to come to the microphone in the center of the aisle and identify yourself and your organization as well as providing your comment. Also if we have an open period at the end of the day to cover any additional presentations if there's anyone in the audience that would like to address the meeting. If you could either let me know or let the ladies in the back know who are coordinating the meeting and we'll get you billed into the agenda. Another, a couple other administrative things that came to my attention, I think when you all came in, you received this packet. In there, there's a survey which we would like you to fill out and leave at the sign-in desk at the end of the day. Also it was brought to my attention that the hotel is offering a buffet lunch at the River's restaurant off the main lobby. I guess the buffet is $9.95 so if you're interested in staying within the confines of the hotel, it sounds like it might be a good opportunity for you to sustain yourself during the course of the meeting. One other thing to bring to your attention before we get into the conduct of the meeting is that NIOSH has created a docket to receive public comment regarding the standards development efforts and in this, we'd like . . . the purpose of the document or the

docket is to solicit information from stakeholders and interested parties that you feel should be considered by NIOSH and this part of the standards development effort and there's several different ways of contacting the docket office either by mail, e-mail, fax, or phone. Those are all provided on this slide. Also I think probably most of you are aware that we try to make extensive use of our web site in promoting the concepts and ideas that we're considered for the standards development and that's our web site right there. And with that, right now we'll move to . . .

ROLAND BERRY ANN: Can we load Phil's?

JOHN SALLOTTO: If you can bear with us for a minute, Mr. Mattson is here and we'll load his presentation and . . .

PHILLIP MATTSON: And we've had the privilege of working with NIOSH and SBCCOM for about, I guess, about 3 years now on this project. And I'm going to talk a little bit about how we got here, how we are managing a program that to this point has been funded by the National Institute of Justice to develop a suite of CBRN protective standards, and kind of where we're going which we really don't know, but that's okay.

Again, the Office of Law Enforcement Standards at NIST, what does the . . . why is there an organization dealing with law enforcement at the National Institute of Standards and Technology which was the organization formerly known as the

National Bureau of Standards? Some of you may remember 1967; some of you may not. In 1967, it was period of great unrest in this country. The crime rate was going up, confidence in public security was going down at that time. A study was done which basically indicated that the law enforcement community was inadequately equipped in that they had a difficult time in order to determine what type of equipment to procure. Basically if you were a sheriff in New Mexico or a police chief in Chicago or something like that, you were basically left with the sales brochures and the salesman and the vendors coming in telling you what they could do for you without a great assurance that even if the equipment did as they as advertised, that it would fill your needs. And this is not a mark against the manufacturing community and in a lot of cases they just didn't know what the requirements were that they needed to meet.

Jurisdictions found themselves shelling out truckloads of money on equipment that may or may perform their job. In 1971, the National Institute of Justice established what was then known as the Law Enforcement Standards Laboratory at the National Bureau of Standards. The NBS at that time was the country's leading forensics lab and had years of experience in developing standards and measurement technologies. So at that time it seemed a reasonable fit. And then later on, we were

changed to . . . the name was changed to the Office of Law Enforcement Standards.

We support the development of performance standards for the National Institute of Justice. One of the major more popular well-known standards that we develop is the standard for body armor which is administered through NIJ and to this point I believe it's approximately 2,600 law enforcement officers' lives have been saved by wearing compliant body armor and no officer has lost their life by wearing the appropriate body armor. We talked a little bit about performance standards. These are the missions of OLES to develop or assist in the development of performance standards, assist in compliance testing programs, develop technical reports, and users' guides. You know, talked about minimum performance standards, we're not talking mil specs. We're talking about a standard that as opposed to a design standard which says how you're specifically going to build it. We're more concerned about performance standards which says it needs to be able to perform in this manner under these conditions.

Now the Office of Law Enforcement Standard is a matrix management organization. This picture was taken on one of our better days and we're basically a group of program managers that identify the needs of the customer, the community, and develop teams and networks of organizations in order to

accomplish the mission. We're organized into six major program areas which are outlined here. The CBRNE standards effort is within the Critical Incident Technologies program area. The senior program manager is Dr. Alf Ataw* and I'm his assistant or backup or whatever. We focus in two main areas: developing a suite of CBRNE standards and also a series of equipment guides which some of you may be familiar. When we talk CBRNE we're talking chemical, biological, radiological, nuclear, conventional explosives and incendiaries. Some people sometimes wonder what's the difference between an RDD, the R and the N, the R generally refers to radiation dispersal devices where you have some sort of radioactive material that is then disseminated either through an explosive device or something like that. The N is the nuclear which is generally associated with a mushroom cloud, and after the mushroom cloud is gone, then you have a very large RDD to clean up.

Also this year we're looking to incorporate into our program communication interfaces with the first responders which is definitely going to be of interest regarding respiratory protection in order to make those interfaces work. For each of the areas, the chem, the bio, the rad/nuke, we're looking at the full suite of protective equipment including respiratory protection, protecting ensembles, the necessary detection equipment standards, decontamination, and then the

supporting guides and testing programs in order to pull the whole thing together.

Now we didn't get there on our own. We work quite closely with an organization called the IAB, the Interagency Board for Equipment Standardization Interoperability. One of the first things that the IAB did was to develop what is referred to as a standardized equipment list or SEL which basically outlines the equipment that is needed to outfit various types of organizations to respond to WMD-type incidents. One of the first things that the IAB noted after they pulled the equipment list together was that they wasn't really certain that . . . the IA . . . the SEL, if you had a chance to take a look at it, is rather generic. It says radiation detection equipment and so on. We're currently working to make it a little more specific, but one of the concerns is that they be interoperable that you're going to be able to respond to a multi-jurisdictional incident and again that the equipment is going to perform as you desire to meet your needs.

So based on the results from the IAB and a number of other areas, a multi-disciplinary organizational team was formed to address the first priority of the IAB which was standards for respiratory protection which includes obviously self-contained breathing apparatus which was the first

standard that was developed by this group. The funding was provided through the National Institute of Justice and two of the main players on this group has been obviously NIOSH and SBCCOM but with participation from a number of other organizations as well.

Now as you can imagine, there's a number of technical challenges associated with this. First of all, there's a lot of information out there on the military aspects of chemical and biological warfare agents, but a lot of that was behind the green door. Our partnership with SBCCOM has helped address that, but also the fact that a lot of the military scenarios and the military equipment don't necessarily pertain to typical first responder incident, whereas in the military environment chemical warfare agent is disseminated is generally going to be outside. The military suits up and goes around it or scoots through it. In the civilian terrorist incident, you're not necessarily going to have that luxury. It could very well be a dissemination of a chemical warfare agent in an enclosed area, you know building, subway, shopping mall, sports arena, and the responders to that don't have the luxury of going around it or avoiding it. The first responders are actually going to have to go into it and so it's going to be a much higher concentration of potentially than the typical military scenario. The civilian equipment

which has been working fine for years against toxic industrial chemicals going against chemical warfare agents is a new untested arena and as many of you have found out doing through the SCBA testing that chemical warfare agents do behave differently.

This is next . . . a little bit . . . kind of explains the methodology for the program. First thing that is done is to do a hazards vulnerability assessment to identify what is the threat, what are the conditions, the operating conditions, and are we looking at exposure limits, protection factors required for protective equipment? Are we looking at key values that we need to ensure that our detection equipment will be able to detect?

Next is the process to develop the standard, examine existing standards and test protocols, determine the required performance doubles for the equipment in question, and then to draft test methods and standards in order to evaluate the equipment. We then procure equipment and test our test methods to make sure that something that was put together by committee is actually something that can be executed reproducibly in a laboratory and modify accordingly and then the standard is revised and issued through the appropriate means whether it's through NIOSH or NFPA or NIJ or ASTM or ANSI as the case may be.

Next and very important is a compliance or certification testing program. You have this wonderful document that says you know what the equipment should do and how you should test it. Then you need to test it to make sure that everything is working. Develop a user guide, these are decision guides which take the technical standard and convert it into a useful English that is going to be understood by the folks in the field that are using it or the procurement officials which outlines the capabilities and limitations of the equipment as a result of the standard.

And then obviously, you need to be able to maintain and update the standard as new technologies come into play, lessons learned through the testing program, maintain a data base of compliant equipment, and so on, but again, this process is not done in a vacuum either. There's procedures built in throughout to solicit public and user comments such as this forum right now.

We've achieved a number of milestones in this program which have directly as a result of the work with NIOSH and SBCCOM to examine the threat agents and concentrations. Modeling was done to do that. The SCBA certification is undergoing. The APR testing or standards and applications are being accepted now for the APR. Now we're here for escape masks.

In other areas, we're working with NFPA and other organizations on protective ensembles and the challenge there is going to be ensure that the interface between the respiratory protection and your ensemble is not going to be a path of entry. And we have published through the National Institute of Justice a series of equipment guides which are basically information in one area for users, procurement officials to see what kind of equipment is out there. We're currently in the process of updating the guide for chemical and biological detection equipment. We hope to produce a guide for radiation detection equipment, explosive detection equipment, and then we will go on and revise the guides for the decontamination and communications in PPE. We eventually, as it stands right now, these guides basically reflect in a gumball chart kind of affair the manufacturer's claims on the performance of the equipment. We hope to be eventually able to provide actual testing results as testing programs ramp up and we're going to have this migrate to a web-based report as opposed to producing hard copy. Because by the time you get a hard copy through all the editors and reviews and so on, it's been a year and a half since we started it. It's already out of date.

Now, what's happening with the program, as I stated, we have been funded to this point from the National Institute of

Justice. Now with the establishment of the Department of Homeland Security, the Department of Homeland Security is going to be picking up the funding for this program and obviously with a new sponsor there's going to be potentially some slight tweaks in priorities and so on. We're in the process of sorting that out with the Department of Homeland Security. There's two main potential sponsors: the Office for Domestic Preparedness which previously was within the Justice Department that handles the training for law enforcement and equipment grants for law enforcement communities. They're in one directorate of Homeland Security. Another organization which is responsible for developing standards within DHS which is in there science and technology directorate is another organization that we're negotiating with and it's been high adventure.

One of the results of all these changes and so on is the Office of Law Enforcement Standards. We are changing our name to something much more simpler, the Technology Office for Public Safety and Security Standards or TOPSSS. We haven't quite . . . You know what . . . one of the things is . . . in order to be a viable organization, you have to have a good acronym. You have to have a good logo and you have to have a budget. Okay, we'll just leave it at that. I guess we're going to be the office formerly known as OLES for awhile.

Bottom line is standards and that's what we're all here about. From our prospective, this is our definition. Actually this comes from Webster's dictionary of standards, conspicuous object such as a banner or flag carried to the top of a pole and used to mark a rallying point especially in battle or to serve as an emblem that is our prospective of standards. One thing that we hope to achieve through the work here is to avoid something like this . . . (background noise occurs) hopefully our standards will be a little more clear and a little more effective than this.

And so for right now anyway, the contact information is still the same, the phone number will still be the same, and I'll be available I guess I don't know if we have a couple of minutes for questions now or later. Thank you.

LES BOORD: Good morning. Phil, unfortunately, I remember 1967. I think I remember it too well. What we'd like to do to kick this session off is talk a little bit about the Standards Development Program and some of you have seen some of this before so maybe it'll be a little bit redundant for you. I think it's worthwhile to go through the whole picture so that we all see where we stand, but where we've been touches a little bit with what Phil mentioned. We have a CBRN SCBA standard which was announced in December 2001. We have a CBRN full-faced piece air purifying respirator or gas

mask standard which was announced in March 2003. We are currently in the certification process for both the SCBA and the gas mask standard and we are in the development stages for the CBRN escape respirator.

To put it all in perspective I think on this timeline, you can see the SCBA, December, the gas masks last month, the escape respirators we're targeting that for October of this year for finalization of the requirements, and from there we'll move on to the powered air-purifying respirators which are currently targeted for March of next year. And then following that, we'll look at other classes and types of respirators, particularly the combination-type respirators.

The program that we're following, the CBRN concept development program, we do have a program management system in place where we identify milestones and timelines associated with the programs and I think as most of you can recognize in good program management, you need to do that in order to keep the programs moving and to achieve the endpoints. Part of the process includes . . . a very valuable part of the process I may add includes the stakeholders' meetings and discussions that we have including public meetings such as this. The dialogue that we can conduct with the experts in the field from all perspectives from the users, from the academia, from manufacturing are very valuable in constructing the standards.

The process that we use to do that is what we call concept development so I think most of you being here in this room today to listen to these presentations are familiar with the concept papers that we use to identify concept requirements. The concepts as they are matured and become refined and become more clearly visible that input and content is reflected into the concept requirements. What we try to do is address performance and design requirements, okay, primarily the interest is to go for performance requirements so the preference is to identify performance requirements for the respirator. However, I think as we all know from our experiences with respirators or standards in general, it's not always entirely possible to achieve the endpoint that you want just by a performance standard. In many cases, there are requirements to specify design requirements. So I think the more in a philosophical way, I think the more defined the user segment becomes in the user group for the type of respirator that we're defining, the more likely there is to be design-type requirements because typically the user will have very strong interests on certain requirements. So design requirements do work their way into the standards where we need to ensure technical integrity of the requirements and technical integrity of the product that's tested against them

and where we have strong user demand, but clearly the preference is for performance-based requirements.

Following our concept program of concept development, we try to maintain and it may not seem this to all who are viewing it, but we try to maintain a logical and consistent rationale following sound engineering and scientific principles when we identify both performance and design requirements. The consequence of this is that we certainly find ourselves in positions where perhaps we're stretching the technology, the technology that's traditionally or routinely used for respirator performance and design. The result of that is that existing respirators may not comply with the standards that we're developing as we move forward, but with that in mind, we always try to make sure that even when we stretch that technology that the requirements are still within reach of state-of-the-art available, state-of-the-art technology for design and performance.

With all that in mind, the topic that we're here to talk about today is the CBRN escape respirator and as many of you who have heard me say before I think you really need to have a goal when you launch a project and you want to achieve an endpoint. The goal for this particular effort is to develop a standard for an escape-only respirator that address CBRN inhalation hazards for use in terrorist events by the general

working population. So you may ask well what is the general working population and we envision that as the people perhaps in this room, office workers, perhaps emergency responders to some degree, but basically the standard and the most important point is the standard that we are working on and developing is intended for the general work force.

When you look at the problems or the challenge of designing an escape respirator standard, it certainly begins with hazard analysis and I think for escape hazard analysis is a very complex problem. And the reason is you need to have some idea of what the intentions are for escape from where and from what. Traditionally within the discussions of terrorism response and terrorism incidents and events, we talk about hot zones where we have high concentrations, potentially high concentrations, warm zones where you have perhaps the support activities that may result from a terrorist event or develop over a period of time. So there just inherently are a wide variation in the hazards, the possible hazards, and threats that an individual may need to escape from. So we have multiple, in addition to that, we have multiple escape activities. Okay, we talk about hazard and threat analysis and hazard and threat analysis can very much be site specific. I think when you think about it, the hazard or threat situation for . . . may differ from metropolitan area to

metropolitan area. The threat for perhaps Washington, D.C., is different than the threat that may exist in Houston, Texas, or in Chicago or Los Angeles. So I think depending upon proximity to industrial facilities and what the basic threat for that area is so I think site specific is one of the primary factors.

I addition to that there are different escape strategies. Most people think escape, put it on, and run till you get out and that is, that's an escape strategy, but that may not be the only types of activities that you need to perform in an escape scenario. Okay, you may need to, you may intend to put it on and run till you get out, but you may get out to that stairwell and find out geez*, this crowd isn't going down those steps so easily or up the steps. So you may actually find yourself very rapidly progressing to an area and then having to wait. In addition to that, there may be escape strategies, appropriate escape strategies that say shelter in place. You don't necessarily exit the area, but you go to perhaps a designated area and stay there. So escape strategy has a multitude of variations and possibilities associated with it. Now the key to all of this or the significance to all this is that I think in designing and developing a standard for escape CBRN escape respirators the standard needs

to be able to address respirators that in turn address the multiple variety of hazards and escape strategies.

The escape strategy concept that we actually introduced I think at the . . . right around September 1st last year appeared in our first concept for this type of device defines the overall range of escape respirators into three categories. And the three categories are a high category, specific category, and a low category. In a high category, we envision a requirement for high protection. We're talking about areas where we just have no idea what the hazard may be or we have a really strong feeling that we're in the target area that could experience extremely high concentrations basically hot zone type concentrations or we have situations where we can envision an oxygen-deficient environment that we need to escape from. For the high category, the universal solution for this type of protection is really a self-contained escape respirator. From a high category, we go down to what we call, what I want to do is skip down to the low category. And the low category is where we're looking at a possibility for a multi-hazard protection similar to the hazards and the protections that we defined for our CBRN gas mask respirator so we're talking about wide range of protections but from a relatively low concentration point so these would be low category type applications where you perhaps you're not in a

real high threat area or you're removed from some distance away from what is thought to be a high threat area. So you have the requirement for a low protection or a low level of escape.

In between the high and the low, we envision a specific category. Now the specific category is where we do envision multi-hazard protection capability certainly with the chemical warfare agent theme. Okay, one of the primary threats when we talk about terrorism is certainly chemical warfare hazards, but we all know that's not the only type of threat that we need to be concerned about so with the specific category we see a range of respirators that are providing perhaps a higher level of protection against the hazards because there's more refinement, more known relative to the requirements of the types of hazards that need to be dealt with. And within this category, there would be an opportunity to focus in on what those toxic industrial protections might be as opposed to the low category which gives an overall broad range of coverage.

So looking at the three categories and for those of you who have looked at the concept paper this should be familiar to you. This little table or tabulation really summarizes the categories as I've just explained them. We have the high category, the specific category, the low category. High, we're looking at protections that would involve certainly CWA

protection, chemical warfare agent, toxic industrial material hazards, high concentrations, oxygen deficiency, and the respirator performance that you need if that is the hazard, the type of hazard that you're dealing with is again a self-contained respirator.

At the low category and we're talking about levels that would be more comparable to warm zone and chemical warfare and toxic industrial material hazards relatively low concentrations, but oxygen deficiency is not necessarily a protection consideration and here we're talking about an air-purifying type of an escape respirator.

Then for the specific category, again, we're looking at chemical warfare agents, but perhaps a greater focus on toxic industrial on certain or select toxic industrial material hazards, perhaps higher concentrations but still adequate oxygen. So again, we're looking at a type of air-purifying escape respirator.

Now with the categories defined and sort of setting that as the framework, the objective is to develop a respirator, an escape respirator standard and identify a concept for the escape respirator standard that addresses both protection needs and yet still achieves a balance between performance and use. You might say well what do we mean by that . . . performance and use and when we look at performance, we talked

about performance requirements a little bit earlier. So performance, we're looking at respiratory protection from hazards. We're talking about performance to meet physiological demands or physiological requirements of the user, performance in the way of ruggedness of the device or its ability to withstand environmental extremes that it may be exposed to during its everyday existence, and then finally, performance, I think focuses on materials and when we talk about . . . start talking about CBRN and materials, we need to talk about the hazards, the hazards that we're dealing with, and the effects those hazards may have on the materials because chemical warfare agents are destructive by nature, but we also need to be concerned about storage and what happens to the materials when they're stored. Escape respirators hopefully you never need to use them so they remain in their package for a period of time and the materials need to be able to withstand the storage conditions and yet be operable when you need it -- so performance issues.

Use on the other hand, we're looking at the human interface. When you don it, how does it don? What are the steps in the procedures, the mechanical adjustments, the fixtures, and the accessories that you need to function and operate in order to use the unit. So the human interface becomes a consideration. Donning, obviously, an escape

respirator you need to be able to open it up and get it on pretty quick. So donning is an issue. I think also with escape we can't, we can't ignore the training aspects. Again, we're talking about a piece of equipment that hopefully we never need to use. Typically we don't have the opportunity to open it up every other day and try it on and practice with it. So the training concept needs to be an important part of it I think. And then finally, size and weight, because we're talking about an escape respirator, an escape respirator that is likely to be stored in a desk drawer or perhaps carried on a belt or carried somewhere on a person's being. Size and weight become factors that need to be considered.

At the meeting today, we're going to focus our discussions and our discussions on the performance and the use issues relative to the CBRN escape respirators and we're going to focus on the April 15th concept. And I think for most of you, you've probably pulled it off the internet, and if you haven't, there are copies at the back of the room. That version of the escape concept is divided into two sections. Part 1 is where we addressed the CBRN air-purifying escape respirator concept requirements and Part 2 is where we address the CBRN self-contained concept requirements. And within those parts of the concepts and through the discussions today, I think we hope to illustrate to you that the efforts are

really aimed at addressing the protection and the use needs and to achieve a good balance between those. Okay, and at the same time, we want to stretch the technology, but we want to be able to be within the reach of the technology because if we have a standard that nobody can . . . that is impossible to meet, we haven't protected anybody. So we need to make sure that we achieve that balance and we stretch it the right amounts and in addition to stretching it, make sure that there's room for growth within the requirements.

I would like to also stress that the escape respirator standard is in the development process so the April 15th concept paper is indeed a draft of concept requirements. Those concept requirements are not necessarily at a high maturity level at this point through presentations and discussions and further development work. We will refine those requirements to the point that they do become clearer. As we do that, those concept revisions will be entered into the concept paper and posted on the web site. So as clarity is provided, requirements will be adjusted and concepts identified in the concept paper, but we'll try to limit that to, as we've had in the past for other standard developments, we'll try to limit to that to twice a month so that you're not forced into a position where you have to go look at it everyday. So typically if there are changes that are going to

be entered, it will be done at the middle of the month and at the end of the month. And with that, I'd like to turn it over to Mr. Szalajda.

JOHN SZALAJDA: I see that this is always dangerous when you're out of town the day before a presentation like this and we just never quite know what we're going to get when you put the charts up on the system. What we'd like to do is spend maybe about the next hour talking about some of the requirements that we're considering for the air-purifying respirator. We're going to focus on initially is to discuss the gas capacity of the system and some of the results from the benchmark testing that our Mike Monahan from NPPTL has been managing and then also to address some of the breathing gas control issues and requirements associated with the respirator.

Bear with me for a second please. Let's try that again. There we go. Thanks for bearing with me on that. I guess with the just kind of get everybody back on the same frame of reference and those who've been involved with the CBRN standards development program can probably see this as a refresher, but for those of you who are new to the process that you know with any effort that part of the . . . critical part of the program is to conduct a hazards analysis as far as what we need to design the respirator to protect against.

Back in the beginning of the CBRN program, NIOSH worked along with SBCCOM, reviewed multitude of different lists that presented potential chemicals which could be used as a terrorist weapon. And from those various lists, we developed a vulnerability assessment which identified chemicals or toxic industrial materials that could present a respiratory hazard to a responder or to an individual that would require protection. And that list covered both chemical warfare, or a multitude of things that covered chemical warfare agents and covered toxic industrial chemicals and also covered toxic industrial materials and in trying to come up and design the system, we felt that in order to have . . . establish a manageable certification program, we felt there was a need to break down the identified hazards in a way that we pursued in doing that was to take the chemicals and put them into what we called a test represented the families or families of similar chemicals and we broke these down into different classes. There was an organic vapor, hydrocarbon class, an acid gas class, a base class, special families chemicals like formaldehyde that didn't necessarily fit into one category or another and also unknowns which are chemicals that we identified to present a hazard but we're going to require more research on our part before we can incorporate them into the standard. We also spent a great deal of time looking at what

would be required in terms of particulate protection and the results of the work that we did and evaluations of existing data indicated that for biological and radiological particles a P100 filter media would be sufficient.

Now the toxic industrial chemicals presented a unique challenge in looking at the . . . trying to classify the chemicals we decided to use after evaluating a lot of physical property data associated with the chemicals we broke down and classified and identified test representative agents for each of the families based on vapor pressure considerations. In that way we felt that this was really the single best indicator of the ability of being able to absorb a chemical onto the filter, the filter media and these are the . . . on the chart identifies the materials that we are addressing as part of the standard. I think if you are familiar with the CBRN APR standard, I think that this list will look very familiar in terms of the gases and other materials that we're attempting to protect against.

Along with that, this is a list of the biological agents that the P100 media will provide protection for and likewise with the particulate matter associated with radiological or nuclear agents that particulate matter will be absorbed by the P100 as well.

What we're going to cover here in the next few minutes are . . . let's try to go over and review some of the benchmark testing that we've been conducting over the last few months where we've gone out and taken commercially available products then used to determine what the state-of-the-art is in terms of respiratory protection and how well that is related to the concepts that we're exploring. We're going to spend a few minutes now talking about gas capacity. Live agent testing we're going to cover a little later this morning and immediately following gas capacity, we're going to talk about the breathing gas control.

For the low category in addressing the air-purifying respirator, these are the 10 representative . . . the test representative agents are indicated on the left and the test challenge is based in part on considerations of ideal age factors. We initially looked at what we had established as part of the air-purifying fine respirator program and the consideration in trying to come up with the proper balance of breakthrough versus concentration in looking at the use scenarios for the different chemicals that you know we don't necessarily believe that the higher concentrations that were identified with the APR would be necessary as a test challenge for this escape-type of device. The breakthroughs also are an interesting topic that initially in starting and using the APR

718 as a basis that primarily we had considered the permissible
719 ratio of 50 percent of the permissible exposure level of the
720 REL level and as a result of our research, we identified and
721 we found that there are some other potential concentration
722 values that we could consider and these are called ERPG's
723 which are Emergency Response Planning Guidelines. And these
724 things were developed by the American Institute of American
725 Industrial Hygiene Association and they recently came out in
726 2002. The way the ERPG's are set up and why we found that a
727 tract of that in the selection of this number for the
728 breakthrough is that it's the maximum concentration in air for
729 which an individual could be exposed to for up to 1 hour
730 without suffering irreversible or other serious health
731 effects. And we thought for an escape respirator with the
732 intent of being to remove yourself from a situation that this
733 may be an appropriate value to consider and that's what's
734 reflected . . . the ERPG values are reflected in the concept
735 paper, but after some additional deliberation, you'll see
736 there's some values up there that are indicated in white
737 primarily the cyanogen chloride, the phosgene, and the sulfur
738 dioxide where there are some questions as far as how the ERPG
739 value was determined and what we've done is we've indicated
740 there what the APR value was and what we had originally
741 considered and the concept papers as far as a potential

742 breakthrough and again you know I think the point that to keep
743 in mind here in trying to develop and determine the capacity
744 that's needed for the filters with these devices is to try to
745 come up with the right balance between identifying the
746 protections that the device can afford.
747 A couple of other things of note on this chart, one of
748 the things that we were concerned about with the, in the APR
749 work was potential byproducts that could be seen by -- could
750 be seen in the breathing gas as a result of the
751 chemicals . . . exposure to the chemicals in the filtration
752 process and the one thing of note with the nitrogen dioxide is
753 that in looking at the APR requirements initially that we
754 sampled for both nitrogen dioxide and nitrogen oxide or NO is
755 part of the breakthrough concentrations. And right now we're
756 getting the impression from looking at the toxicology
757 associated with NO and NO2 and the use scenarios with the
758 respirator that sampling for NO may not be necessary as part
759 of the standard that the wearer may not receive enough of a
760 dosage of NO to present a respiratory risk.
761 In moving along as Les said, had mentioned earlier we
762 were . . . the second category in looking at specific threats
763 and trying to provide a means for a manufacturer and user
764 community to still get the chemical warfare agent protection
765 as well as addressing other toxic industrial chemical threat

766 and to give some leeway between the user and the manufacturer,
767 the manufacturing community the capability to tailor a product
768 to meet a specific user requirement. I think one example that
769 always comes up is that you know if you live, if you live in
770 proximity of a chemical plant that you may not necessarily be
771 concerned about everything on the list but you may have a
772 particular concern about ammonia or you may have a particular
773 concern about sulfur dioxide and with the intent of
774 establishing the challenges, the challenge and the
775 breakthrough concentrations the endpoint on the specific
776 category was to provide the basic protection against the
777 chemical warfare agents as well as providing especially
778 protection based on a user need or a manufacturer preference
779 to address a particular chemical.
780 But what we found, we'll throw the summary chart up at
781 you first in case you can't read the detail. But what we
782 found with the benchmark testing that we've conducted to date
783 is that the commercial products perform fairly well for 8 of
784 the 10 test representative agents. The two chemicals of
785 concern are ammonia and nitrogen dioxide. Nitrogen dioxide in
786 the long term may not be an issue at least as far as how the
787 concepts are currently being stated. Because with the
788 benchmarking that we did originally, we're sampling for both
789 NO2 and NO and the failure . . .I shouldn't say the failures

but the shorter gas life's that we saw for nitrogen dioxide we're based on the NO breakthrough, the filter. With only sampling the NO2, that issue may dissipate.

What I'm going to do is get down on the floor so I can use the pointer a little bit. If you can . . . Where we were with the benchmarking is that we looked at four commercially available escape products and in this column you see the challenge chemicals with the original -- challenge concentrations identified using, using the rail over two values that we had explored with the APR. And I think you see that, and in considering this is a 15- or 30-minute respirator that this product performed fairly well at being considered as a 15-minute respirator that cyclohexane, sulfur dioxide, ammonia, and formaldehyde all had a variety of readings before the endpoint was reached. With some of the other gases, hydrogen sulfide, cyanogen chloride, phosphine, phosgene and hydrogen cyanide, overall the systems performed pretty well.

(Unidentified Speaker): (Inaudible)

JONATHAN SZALAJDA: Yeah these are . . . yeah, thanks Rich. These are over here are minutes to the endpoint okay in this category. At the top the 64 reflects the flow rate, 64 liters per minute at 25 percent relative humidity. This was 64 liters per minute at 80 percent relative humidity and then this was 100 liters per minute at 50 percent relative

humidity. Okay, this was for type A and for type B, again, you get similar type results with varying degrees with cyclohexane, ammonia, also nitrogen dioxide. This one actually did slightly better than the other one. With type C, we didn't get this part of the matrix filled in yet, but I think you'll see that continue the same . . . the same trends continue in addressing these four chemicals.

Last category, I think it . . . it still reflects that for some of the acid gases it performs fairly well. You know ammonia continues to be a problem. Nitrogen dioxide values are marginal, but again, that's primarily due to the NO endpoint. And what we also did in terms of expanding our knowledge bases, we took a look at some of the chemicals that were more stressed as part of the testing, cyclohexane, sulfur dioxide, and formaldehyde. And we ran these tests at a higher concentration than what was currently established for the low category that these were the 2600 parts per million for cyclohexane instead of 1300 and the SO2 value was doubled and the formaldehyde was doubled and this is roughly how they performed. Again, they did fairly well and as for product B . . . okay, then that's B, now let's have C . . . and then product C. That again you know it shows that you still . . . probably with some modifications and work that you

know it should be achievable to get the required service time associated with the products.

And likewise with one of the considerations that we explored in great detail as part of the APR standard development was the flow rates associated with the gas life testing and the concern that some of the traditional numbers used for certification testing may not be truly representative of what actually occurs in the real world and part of the APR process as we attempted to address that concern in terms of adding additional category for the gas life testing which was to address what we call a panic demand associated with the use of the respirator or you may have a higher physiological load on the device and a higher breathing flow rates to stress the system. And the research that we conducted with the air-purifying respirator indicated that 100 liters per minute was probably a good challenge for addressing this type of concern in addition to the considerations of the lower flow rate.

And has Les had mentioned earlier one of the things that we're considering and my colleague, Frank Palya, will discuss later in detail this morning is the environmental and other rough handling type tests that are going to be associated with this product. And in looking at the concerns, you know granted with an escape respirator, you know, it should ideally stay in its package forever, but there are other

considerations that we've heard in terms from the user community . . . in terms of how long the product should last, how it may be stored, where it may be stored, and we felt that there is a need to conduct a certain amount of environmental and rough handling testing to verify the integrity of the product and again, Frank will discuss those requirements in later detail.

I guess what I'd like to do before Les discusses the breathing gas if anybody has any specific questions about the breakthroughs or the endpoints, we can address those now or else we'll let Les go one with the breathing gas control. I think we need a lightning rod in here.

LES BOORD: Thanks John. One of the things that I would like to comment on. I think throughout the morning anyway the term balance you've heard it quite a few times and I think when we look at the benchmark testing that's been performed and we look at what we're trying to do and that is to develop performance requirements, I think that the benchmark testing is really significant because what it does show us is that when we tested the commercially available product today it's showing us that the requirements are pretty much on track for achieving performance in a package that's relatively the size of the commercially available products. And I think you can all pretty much envision what those products and their sizes

are so I think that is a positive indicator coming out of the results of the benchmark study. So I think that benchmark testing for gas capacity is very important to the development process.

The next thing we'd like to talk about is the topic we call breathing gas control and what that really means is oxygen concentrations and carbon dioxide concentrations within the breathing zone or that are the result of the performance of the respirator. In the concept paper, actually in the concept since the early editions of it back in August and October of last year, we have identified a requirement, a test requirement for carbon dioxide control. The requirement performance wise is as illustrated on the screen there that we have a carbon dioxide maximum inhalation concentration of 2½ percent and we have an oxygen minimum requirement of 19½ percent.

The April 15th concept paper identifies the mechanism for establishing conformance to that requirement being performed by a machine that we call the automatic breathing metabolic simulator so this device for those of you who are not familiar with it simulates the physiology of breathing so it has oxygen . . . simulates oxygen consumption and CO2 elimination at varying work rates, oxygen consumption rates which are then tied to tidal volumes and specific breathing performance

requirements. The concept that we've identified is to actually perform that test at six different loads, six different work rates defined by the oxygen consumption rate in liters per minute and those are as illustrated there and it varies from a relatively low work load activity to a fairly demanding load which is 3.0 liter per minute oxygen consumption.

As with the breathing gas capacity and the panic demand and continuing to discuss into the chemical warfare agent testing, one of the key aspects in the development process is to benchmark where we are with state-of-the-art. Again, we've used commercially available escape sets tested against the breathing simulator requirements identified on the previous slide. The way the benchmark testing was performed is we did multiple tests with each respirator according to the requirements on the previous page. The results of this benchmark testing from the machine tests indicated that we've observed carbon dioxide levels within the breathing zone greater than the 2½ percent and we've also observed oxygen concentrations less than the 19½ percent and this testing is continuing on as we speak. So the benchmark testing using the simulator is continuing, but when we look at the results and I would think probably most of you who are seeing this requestor saying well that's the breathing machine, what can we really

conclude from it. And at this point, we're not in the position to say. We feel that those results were kind of . . . non-conclusive. So what we've done in addition to the breathing machine part of the study, we've identified what we call a human subject testing that is also being factored into our benchmark testing and evaluation for the standards development process. The testing using human test subjects is in process. That testing to sort of bracket what we're looking at there, we're looking at testing the escape respirators on multiple test subjects at three different levels of activity as identified on the screen. One is a standing condition, secondly walking on a treadmill at 2½ miles per hour, then thirdly walking on the treadmill at 3½ miles per hour. Another parameter that we're looking at in doing the human subject testing is the body weight, the size of the individual. And in a broad perspective what we're trying to do there is have subjects who are representative of greater than 80 kilograms and subjects that are representative of less than 60 kilograms. That testing as I say is in process. What these preliminary results or preliminary indications from the benchmark testing is sort of leaning us in the direction of for our concept requirement for breathing gas control is that we can envision and this is not currently stated this way in the April 15th concept paper because our

benchmark data is developing as we go. The concept that we envision is perhaps a two-part breathing gas requirement. The first part being using the machine, the automated breathing metabolic simulator, and then secondly a human subjects test. If we conceptualize about that a little bit, we would say that the metabolic simulator component of that requirement would be envisioned to establish the acceptable functioning and operation of the respirator. We would look at conceptually performing the machine test at six different work rates as identified in the earlier chart ranging from oxygen consumption rates of about .5 up to 3.0 liters per minute and what we are conceptualizing is the carbon dioxide requirement on the machine part of the test would be at some threshold value that's perhaps greater than 2½ not focused exactly on what that number would be at this time. We need to continue the development effort, but we're thinking of a screening number that perhaps a little higher and that will depend on how we . . . on the results that we achieve from our human subjects testing. We've done the machine tests for most of the respirators. It continues on some additional so we have the machine component. We will be finalizing the human test subject component and we'll marry the two of those together to try to define what these threshold requirements would be, but we would envision CO2 on the machine leg of the test to be a

little bit higher than 2½ and an oxygen requirement that would probably find a little bit of leeway or little bit of relaxation on the 19½ percent. But then, when we look at the human subjects tests, we would be looking at a requirement where we again do that human subjects test at the same types of work loads that we are currently doing and performing for our benchmark test which is basically the three loads of standing and the treadmill speeds of 2½ and 3½ miles per hour. At each of those activities and on the benchmark test as well, I can't recall if I mentioned it, but what we would do is perform that particular level of activity for a 10-minute period. So you would have the respirator in a standing mode for 10 minutes, increase it to 2½ miles per hour for 10 minutes, and then 3½ miles per hour for 10 minutes. And again the requirement would focus on test subjects, categorized or defined by their weight and with the two categories being greater than 80 and less than or equal to 60 kilograms. Any questions? Yes, Rich, announce who you are and who you're with.

RICH STEIN: My name is Rich Stein from QPS. Two questions, does this include all three categories when you make a submittal or are you just talking about for oxygen systems or self contained?

LES BOORD: No, this is applicable to the air-purifying respirators as well as the self contained and the benchmark testing . . . by the way, the benchmark testing that we've reported on here is with the commercially available air-purifying type escape respirators.

RICH STEIN: And then I think what I just heard you say is you went around at least conceptually 10 minutes, 10 minutes, 10 minutes?

LES BOORD: Correct.

RICH STEIN: And that's even for a 15-minute unit?

LES BOORD: That's a valid question okay that would need to be balanced so typically we were thinking of a 30-minute unit so that would be need to be factored into the requirement so that you have roughly 30 percent at each load. Jay?

JAY PARKER: Jay Parker with the Bullard Company, on the cartridges I was just wondering if, well on the respirators, do you have to have inhalation and exhalation valves or will it be allowable to have the ability to breathe back through the cartridge?

LES BOORD: That's a good question. Right now, the requirements for the concept, they do not specify the requirement to include the inhalation/exhalation valves. I think the experience, again, this gets to the issue or the sort of down the road performance versus design requirements

so we're not specifying that you need those types of systems in the breathing control, but here's the performance requirement that needs to be met.

RICH STEIN: Rich Stein again from QPS, I'm not sure if this is a question or more of a comment. This is the first time I really thought about using an ABMS for simple testing and normally what happens is as the manufacturer you want to set up the system to be equivalent and ABMS systems are very complicated and very expensive for what is being used for what I call a very extremely simple task and so I'd like to bring to your attention that there are other ways to do it for units which are not self contained which would be easier for the community to run the equivalent kinds of tests.

LES BOORD: Yes, thank you. That's also a good comment and certainly will be taken into consideration. I think again being in the stage of developing the requirements collecting the data and then really analyzing it to focus on what those requirements will be that is a consideration. But that is one of the areas where we're still in the process of developing our data base. Yes, that's also the comment that Roland just made. While the meeting is being transcribed and recorded, certainly we would like to have those comments submitted to the docket as well so we can officially address it.

BODO HEINS: My name is Bodo Heins from Draeger Safety, Lubeck. Concerning your benchmark tests, the 2.5 percent of CO2 and the oxygen content which has to be more than 19.5, you should realize that these data are very important for the size and the weight of the unit that the manufacturer has to develop especially all the breathing resistances. My impression is that you took most of your values from standards for working rates of a whole day, but if you only have to perform a 15 minutes service than you do not need discomfort which means for the unit it is much bigger than necessary and you have to differ if the unit is stalled or . . . if a man . . . the whole day if the man has to wear a unit which is very heavy to have the comfort for 15 minutes it's perhaps better to have a lightweight unit and a little more breathing resistance a little bit more CO2 content. For example, if you have 4 percent CO2 to use or not realize it if it he has more than 2.5 and you know also that in Europe for example, oxygen content is much lower than yours here in the states and it works.

LES BOORD: Thank you Bodo, again if you could it is being recorded, we'll have it in the minutes, but if you could submit that as a docket as well. And I would clarify that the requirements that we have specified at 2.5 percent and 19.5 percent are the currently defined requirements pulled out

of as you mentioned the existing standards 42 CFR. I think Bodo also hit on one of the central themes that we've been talking about this morning and that is the ability to achieve that balance and that balance between performance, design, size, weight, and the entire system let's say which I think is really an important consideration in terms of an escape respirator. Yes.

ZANE FRUND: Zane Frund, MSA. I guess a question, two questions, one on the ABMS what were you using or what do you plan to use as your VCO2? You outlined some criteria for CO2 concentration, but you didn't state your VCO2.

LES BOORD: I'm going to ask Eddie. I think the R . . . is Eddy available? What was the RQ?

EDDIE SINKULE: (inaudible)

LES BOORD: Did we use a factor of one or did we use a point -- They are identified in the concept paper. We tabulated the overall performance. So and I'll give you the two extremes at the .5 VO2, the VCO2 is .4, and at the 3 it's 3.15. They are identified.

ZANE FRUND: Also regarding the acceptance criteria on the ABMS, you said you would permit . . . you were sort of looking for a function so the CO2 concentration would be permitted to go above 2 percent, the oxygen below 19.5 percent. What would be the acceptance criteria? You're

looking at something like an inhalation/exhalation breathing resistance?

LES BOORD: Actually the concept would be to have performance requirements for both CO2 and O2. When we do the machine component of the test, those may be different values than the 2½. So that would be . . .

ZANE FRUND: They will be established values?

LES BOORD: Yes. Yes. And that's the part of the program that we're in . . . trying to resolve now. Going through that development process in . . . so, yeah, those would be identified, CO2 and O2 requirements, machine and they would probably be different than the human version.

ZANE FRUND: Thank you.

LES BOORD: If I come back up a little bit too, I think Rich that sort of touches on the comment that you made that from a technical point of view using the metabolic simulator on a air-purifying respirator that is sort of a different approach. Okay, so that's why we foresee that there may be two levels or two, I don't want to say levels, but two thresholds. One based on the machine and then finally the real test is when you use a human test subject.

BODO HEINS: It's Bodo Heins again from Draeger Safety. One important note for the breathing simulator is the way how you are taking out the CO2. If you allow it to let CO2 which

goes through the respirator and it's still in the breathing circuit to stay in the system then you will have different results as if you take it completely out.

LES BOORD: Thank you. Okay, if there are no other questions.

SAM SHEARER: Sam Shearer from CSE Corporation, I believe the one table said that the CO2 concentration is an average. Do you mean average with time as in EN 401?

LES BOORD: I would request Eddie to perhaps clarify that.

EDDIE SINKULE: Can I see the slide that you're talking about?

SAM SHEARER: Average.

EDDIE SINKULE: Okay, that maximum average inhaled is the low adjusted inhaled, average inhaled CO2, and we're not quite sure if we're still satisfied with the 2.5 percent. (Inaudible.) Oh I'm sorry. It's the average over the breath. There's the (inaudible) average between (inaudible).

SAM SHEARER: Basically any instance of time then you're saying? That's awfully tight.

EDDIE SINKULE: Well there's two ways of looking at it. One way is to look at the maximum or excuse me that should read in fact that should read minimum average inhaled CO2 and maximum inhaled concentration of 19.5(inaudible). We're also

looking at just minimum inhaled CO2 in comparison for (inaudible). Well the maximum O2, I guess what I'm trying to say is the oxygen would be a low high and the CO2 would be a high low. That's where metabolic simulator machine has (inaudible) for thinking of having only minimal inhaled CO2 is also averaged inhaled CO2. Average inhaled would be a flow adjusted CO2 during inhalation.

SAM SHEARER: I'm not sure I'm with you, but if you're saying that the CO2 concentration has to be the 2.5 percent and you're not averaging it with time. Remember when you have people wearing this thing, they breathe differently and . . .

EDDIE SINKULE: (inaudible)

SAM SHEARER: Alright we'll think about that one.

LES BOORD: Again, I think that is a good comment and I think that's the type of information we really need to have and to let's say focus on and bring light to in these types of presentations and discussions because as we refine the requirement, then that needs to be clear. Thank you.

MICHAEL KAY: Mike Kay from Ocenco, I'd just like to clarify the 2.5 percent on the ABMS. Eddie Sinkule is correct. That is a flow-weighted average over that inspired wave form so it's integrating underneath the curve in that it's not looking at a peak. It's looking at that average maximum over that expired breath.

EDDIE SINKULE: One single breath?

MICHAEL KAY: Correct. It's doing it . . . It's a breath-by-breath analysis. Correct.

EDDIE SINKULE: Okay. That's putting a lot of burden (inaudible). I can see (inaudible).

LES BOORD: Okay, yeah, if we can . . .

BODO HEINS: Bodo Heins again from Draeger Safety. If it's only for one breath, you will need a very fast measuring equipment and as this measuring equipment is very important thing, you have to fix it every time to come every time to the same results. And for one breath, it is very difficult to measure the CO2 or O2 concentration in that short time.

LES BOORD: Thank you.

SAM PITTS: Good morning Les. Sam Pitts, United States Marine Core, Chem Bio Incidence Response Force. Les, I see ambulatory escapees well represented. Are we going to consider unconscious non-ambulatory escapees at all?

LES BOORD: Perhaps clarify the question a little bit. Are we going to include . . .

(inaudible)

SAM PITTS: We've noticed that . . . Like several escape mask manufacturers like some might have a bite valve to orally respirate and that's great if you're conscious, but for some unconscious people we may want to go with a nose cup type

affair so that they can either orally or nasally respirate. Are you going to look at the unconscious non-ambulatory?

LES BOORD: At this point in time, the concept does not focus on that. Basically, we're looking at the ability to be to don the respirator and use it, so not to put it on someone else. So that's not a part of the concept at this time. Thank you. Any other questions? I think we're about 10 minutes into our break and we had a 45 minute break or a 15 minute break scheduled so why don't we resume at 5 till 11, 10:55. Thank you.

(BREAK)

JONATHAN SZALAJDA: Yeah. The requirements for air-purifying escape respirator. At this time what we're going to do is cover some of the special tests associated with the project chemical warfare agent testing, the LRPL test, and then the environmental and rough handling and human factors type evaluation. The next presenter is going to be Mr. Wayne Davis who used to be my boss in a previous life and at one time he was the Director of Respiratory Protection for SBCCOM and with the reorganizations that they're undergoing I don't know if that's his current title but I still know he's Wayne Davis so.

WAYNE DAVIS: Thanks John. Can everybody hear me okay? I don't know what my current job is either but I'm here

representing SBCCOM and I want to go over some of the testing that we've done on commercially available hood type systems just to show you what the baseline looks like. We've been in the hood business for quite some time at ECBC or SBCCOM. We started hood testing basically back in the 1985 timeframe where we made some hoods for some special application purposes. We've also been working with the technical support working group who has some hood requirements that they developed for the State Department. We done hood testing there. We also have an Army program that you see there, the joint service chemical environment survivability mask which is an ongoing program looking for a hood system generally for escape purposes for military applications.

What I'm going to talk about today is a NIOSH baseline testing that we've accomplished with some of the commercially available hoods. Now the way we do the chemical warfare agent testing is we use what's called the SMARTMAN system and looking around the room I imagine almost everybody knows what that is. Basically it's a head form with a breathing pump or you can put an agent concentration around the system and monitor the penetration and the permeation through the materials that go into the breathing zones. I want to point out also that with the SMARTMAN we're not looking for the fit of the respirator on the head form. We're looking for the

functionality of the system; therefore, we try to get a perfect fit before we go into any type of agent testing.

The SMARTMAN equipment is shown here. Basically we have syringe pumps and air controllers and mixing chambers so that we can get the proper concentration going into the test chamber. We also have a breather pump which uses a sinusoidal wave form and we have various detectors to detect the chemical agents. The chemical agents we use normally are sarin or GB, mustard which is HD, and we also cyanogen chloride on occasion.

This shows the setup. This is one of the older pictures when we had equipment all over the place. Our labs have cleaned up and simplified to some extent, but you can see that it's a fairly complicated test. We have the detection devices, the Dynatherm's gas chromatographs and what not located near the hood assembly. The SMARTMAN system, itself, the head form's in the chamber along with some of the detector equipment. If you need details on any of this equipment, Ray Lins from our laboratory is here and he can go into excruciating detail on every component associated with it.

Here's another picture where we've cleaned it up a little bit. Show the TDA99 in the front of the hood assembly. Every respirator is tested with a TDA99, which is an aerosol leak detector before we can go into the agent test. What we found

if we can't pass the TDA99 test, normally the hood system or respirator system doesn't do well in the agent testing. So that's a preliminary test to make sure that we have a good fit when we start a test. And the test method has been developed. It's been validated. It's been approved for the SCBA and APR respirators under the NIOSH certification standard. We've been using it for about 5 years now in the Center. We're very comfortable with the test. There is one difference in the escape hood portion of the test from other testing that we've done. Basically because we have a bladder system that seals around most of the APR systems to form a perfect fit around the face piece. We don't have that same type system around the neck of the SMARTMAN head form so what we do is we tape the neck seal to the head form to get a good seal. I'm showing gray on gray there so I'm not sure you can see it from the back of the room, but that is tape along the neck seal of that particular hood system.

We also do the TDA99 on the actual agent head form with the escape hoods and the reason for that is we . . . since escape hoods are generally one-time use products, we only want to put it on the head form once before we test it and because of that we test in the agent chamber itself. With APRs we do it in a separate chamber before we go into the agent chamber because once it goes into the agent chamber, the item is

toast. We're not going to re-use it. It's not going to come out from the contaminated waste stockpile.

When we started the baseline testing, we were trying to figure out what to test to. We decided to test to the SCBA standard which is the most rigorous standard that we test to essentially. That calls for a GB challenge of 2000 milligrams per cubic meter for 30 minutes, a very high challenge rate. We have various break points for that. We have a . . . it cannot exceed 2.1 ct or the dosage cannot exceed 2.1 milligram minutes per cubic meter and also no instantaneous concentration can exceed .087 milligrams per liter. For the mustard, we challenged at 300 milligrams per cubic meter for 30 minutes. Now we put on, look good on at the same time as we do the mustard test to roughly 10 grams per square meter or .86 milliliters of agent is what it turns out to be. We have a break point there of 6 ct for the dosage and the break point of .6 as an instantaneous challenge concentration that we don't want to exceed. That's the same as in the SCBA standard. Breather flow rate is 40 liters per minute and we consider this a worse case scenario as I mentioned.

Now I'm going to put up some eye charts. Can people read that from the back of the room? Is that a yes? Okay. All my charts are set up the same way. Essentially the chart on the top left is the cumulative dose or ct in milligram minutes per

cubic meters with time and the bottom chart shows the concentration versus time in milligrams per cubic meter. This shows one hood system that we tested. You can see essentially that it went about 28 minutes and continued to climb. We probably turned off the test then so we wouldn't saturate our detectors, but we also exceeded the concentration in about 24 minutes also in that particular test.

I'm going to run through these fast and I don't want to dwell on some of these. Here's another hood system. You can see that this went the full 2 hours. It didn't exceed our criteria of 2.1 ct and also the concentration stayed below our cutoff concentration. So this test was considered a good test. Here's another set of data. We do tests with both the oral and nasal area and the eye area in some cases just to see where the differences lie, but you can see here this had very little penetration into the system during the entire test and we had two samples that just stayed at baseline. So you can see the hood technology seems to indicate we can very high protection with the basic systems themselves in terms of their functionality. This shows some HD data. You can see in this HD is normally a difficult test to pass largely because of the liquid challenge concentration. We find when we apply the liquid, we apply it to the most critical parts of the system that it can cause significant problems in terms of passing

this test in terms of permeation as well as also damage to components. The test here shows that it lasted about 54 minutes, but it was up way high at the 20 ct level. Remember our cutoff is 6 so it really passed that point at about 24 minutes. You can also see that we exceeded our cutoff point of . . . well it ran up to the cutoff point of .6 milligrams per cubic meter.

Here's another set of data. Again this one ran the full 2 hours. It stayed below the ct criteria and it also stayed below our instantaneous concentration criteria. You can see that we put on the agent for at 30 minutes so it looks like this probably has some permeation based on residual contamination on the system that comes through with time.

And we had three samples that showed baseline concentrations. So you can see the data indicates that there are hood systems that do provide excellent protection. Some of the lessons we learned not from this particular testing but over the years in terms of testing, these samples I gave you hadn't gone through high-temperature storage. They hadn't gone through package vibration as some of the other testing that we normally do prior to the agent testing. These two areas have been shown to be problems with other mask systems that we tested so in the design process, the contractor should look hard at these two areas. The high-temperature storage

tends to cause the seams to disbond, causes the material to blot so it tears when you open it, and things like that. The rough handling if it's not packaged adequately, it tends to break things. The materials of construction are also a concern. Mustard, we've tested some systems and actually pieces have fallen apart when you put the mustard on it. You have to make sure that the materials are compatibility with the chemical agents and are durable.

A real brief summary of results, I think escape hoods are capable of very high levels of CWA protection certainly in concert with what's been presented today. Are there any questions?

BODO HEINS: It's Bodo Heins from Draeger Safety. Is it right that your SMARTMAN was being constructed to test a full face mask? Because I could see that you have only a rubber part which was sealed as the outside of a full face mask but for hoods which are using for example a half mask or a nose cap there's no possibility to seal this area which increases the fit factor for a good portion.

WAYNE DAVIS: That's true. It wasn't designed specifically for nose cup sealing or neck sealing. It is a . . . physiologically it does match the human face fairly well but there is a chance that you could have some bypass in those areas in the nose cup or in the neck seal. Since we do

seal it, I think we have a very good seal in that area. One thing that we have found is that the quality of the neck seal can influence it. There's some neck seals we consider good quality and others that are not so good quality and that's shown in the PF testing later on also.

(inaudible)

Correct, right, Roland pointed out we are looking not the fit test for this but just for permeation, but I think your point is still that permeation or penetration can be impacted by the way it fits the test head itself. Are there any other questions? Thank you.

JONATHAN SZALAJDA: The point has just been made about this being . . . geared to be a penetration and permeation effect or a test and not necessarily a fit test. I did want to bring up at least for a minute some of the methodology that went into the development of the test criteria that is part of the SCBA program and then is part of the APR program. We build on modeling that Phil Mattson had discussed this morning that was developed in concert between SBCCOM and NIOSH to come up with credible events that we try to envision where a terrorist could deploy a CWA agent and various scenarios were identified and evaluated and challenge concentrations were set up based upon on those scenarios and what we did as part of the interim process was in looking at the SCBA evaluation

criteria that we selected at the time we called the most credible event which we thought would be a probable situation or responder would go into an event and this would probably be the challenge concentration that he would see. With the APR we're looking at a completely different scenario with as far as an operational requirement that the challenge is known and quantified and if you're in a less than ideal H scenario which I believe most hygienists call the warm zone and along with building on that knowledge that we established with the air-purifying respirator with the gas mask we looked at transitioning those warm zone requirements from the gas mask to the air-purifying escape respirator and, therefore, we came up with these values for the chemical warfare agent testing. As far as the vapor challenge of 210 milligrams per meter cubed or for GB which is reflective of what we tested with the or testing for the air-purifying respirator for the gas mask. As far as the test time we're anticipating doing is that for if you have a 15-minute device for example that we would expose the respirator to this concentration of sarin for 15 minutes and then there would be a 15-minute decay period where the agent challenge would be shut off and we would continue to monitor for penetration or permeation through the respirator.

And likewise for HD for sulfur mustard, the result or the challenges are reflective of what was developed as part of the gas mask program and again the same parameters for exposure and total test time are based on the time that the manufacturer identifies for his respirator whether its 15, 30, 45, or 60 minutes.

The other part of the special test that we're conducting with SBCCOM and I guess the one point that we would like to make as part of this discussion is that for NIOSH this is an evolutionary step in our organization as far as using another agency such as SBCCOM as our test agent and as Wayne had stated in his presentation that you know we have gone through a rigorous process and ensuring that the criteria are met and repeated for all the testing. But the second part of Wayne's presentation is going to be discussing the other aspects of the special test for which SBCCOM is our test agent and that's the laboratory respiratory protection level or the LRPL testing and again Wayne will discuss how SBCCOM does the testing in their approach and what they seen with testing the escape hooded devices and Les will discuss the requirements as we currently envision them for the testing.

WAYNE DAVIS: John said we'll talk about the laboratory respirator protection level testing. The purpose of the LRPL is shown here basically to evaluate the respirator protective

equipment for military and civilian applications requiring protection against NBC warfare agents. We have various test standards. We've been doing this test since 1992. We developed a test method with Los Alamos. It's been approved for the joint services. It's been approved also with NIOSH for the SCBA testing as well as for the APR testing that we're doing so it has quite a history behind it. This shows our LRPL test chamber. It's about 10 by 10 by 30 feet roughly. We have enough room in there for 16 subjects at a time, but normally test no more than 12 at a time. We use a real light scattering photometers to detect the aerosol and we can measure protection factors up to about 100,000 using this instrumentation and it's a real time measurement. This shows actually what a test looks like. Essentially we have our test chamber. We fill it up with corn oil aerosol, monitor the people inside. We have test monitors that watch the test subjects to make sure that they're performing the tasks as they've been taught to do. Also to notice . . . any problems associated with conducting the test itself.

The aerosol challenge is corn oil. The concentration you can see there. The particle size is about .4 to .6 microns measured regularly to make sure we maintain that kind of standard. The temperature control inside the chamber is actually 70 to 90 °F. Humidity we keep it around 20 to

25 percent. A lot of people ask why do you test at this particle size you test at and the reason is the threat size for generally biologicals runs into the 1 or 7 to 8 micron range. There's various reasons for that. That's the best lung retention. That's what generally you would find among the various countries in the world. Viruses run smaller than that, but generally it's very difficult to disperse a virus as a single particle in the size range as shown. Also if you remember how HEPA paper works, the most penetrating size particle is somewhere between .1 and .2 microns. Efficiency increases both above and below that point so you're getting about 99.97 percent efficiency at about .3 microns. That's a very conservative test we feel and does demonstrate that you get adequate biological and particulate protection.

The protection level itself is an expression of the outside concentration over the inside concentration. It's a . . . as you can see in the example, you have 1,000 ppm outside and 1 ppm inside, you would have a protection level of 1,000. When I report the data, we'll be going over some of that. For the exercise routine, it varies depending on the agency that comes in and asks for the testing. Basically these are the normal type exercises that are done inside the chamber. We've also done lots of different type exercises to simulate specific military conditions or civilian conditions.

Generally we would run these exercises for 1 minute duration. Well we also have done different tests such as sweat testing we call it where we actually run some fairly hard exercises over a duration of about 30 minutes just to see what happens under different conditions, but we found that generally just going through the standard head motions shows the same type of information that we get by going through some other rigorous type physical activities.

Now I'm going to go into some actual data that we generated on some of the commercially available hoods. The charts are all basically the same although the format looks a little bit different. On the left, you'll see the protection factor in terms of specific bands that we try to report it in. The frequency just tells how many people out of the total number of subjects fell into what band. The cumulative percent that shows a percentage of people that were in that particular band and the past percent shows a percentage that were higher than that particular band. Generally we look for a 95 percent point. That's what we'd like to see for a protection level requirement. You can see in the one test 500 pf was roughly what 95 percent of the people received. I might point out that all the data that I'm going to show you here is for a hood with a one-size-fits-all type neck dam. The other test on the right-hand side you can see I've

highlighted a 93 percent so somewhere between 500 and 1,000 is what the pf would be on that particular hood system. You can see the total number of people. The first one had 48 subjects; the second one had 96 subjects. That often depends on how much somebody is willing to pay to do the test and how many subjects we have.

Here's some other; here's two other samples. This particular one shows that the one on the left anyway we didn't have very good protection factors. You can see that only 83 percent of the people got above a pf of 10. Nobody got above a pf of 1,000. On the one on the right-hand side, you can see that 95 percent got a pf greater than 2,000 and this all has to do with the design basically of the neck dam in most cases but there also can be other leakage points within the system that we found during testing.

We also test. This is one mask shown with a hood sample as well as an oral and nasal sample. Generally there are some small differences between the two. You can see with the hood sample on this particular one 93 percent of the people got over 5,000 and on the oral and nasal sample, 97 percent of the people got over 5,000. So this shows an example of one hood system that provides a very high LRPL sample.

Summary results though are basically escape hoods are capable of fairly high LRPL levels values of 500 that look

like they're readily met and greater utilizing the one-size-fits-all neck dam. So I think the baseline data shows that we're in the ballpark in terms of what kind of protection factor we can expect with hood systems. Are there any questions? Okay, thank you.

JONATHAN SZALAJDA: Again, you know we're translating and building the requirements and building on the experiences that we gained as part of the other programs and I think that this chart basically covers the topics that Wayne addressed in terms of actual aerosol and the particle size. In addressing the escape respirator, it's a unique concept in terms of how we ensure a proper fit for between the respirator and the individual wearing it and in looking at the population and trying to consider the audience the user community that would be using this to try and come up with a mechanism to ensure that we can fit the population that would potentially require the use of a respirator and to that end, we fall back on addressing anthropometrics. And with a traditional gas mask type of approach, there's a lot of data, Los Alamos data that approach that we've addressed to try to come up with different cells and anthropometrics and fit of the respirator to the face. But with the concerns as far as having an untrained population trying to use this type of device whether or not you know trying to design the parameters for the system around

the traditional methodology there, we had some concerns about how to accomplish that and in looking at a hood type of device and the physical parameters between the head, the neck, and the face length seem to pretty well identify and break down along the traditional small, medium, and large sizes that could potentially be used to fit an individual to a respirator.

And to that extent, we fell back and found a fairly amount of good data that was used by the Air Force in terms of developing a data base for the anthropometrics associated with the hooded type of device. And we built a test matrix based upon those requirements that were identified in that anthropometric data base to encompass small, medium, and large sizes with really the critical dimension being the neck circumference and with a lot of the issues associated with wearing a hood and providing a good seal between the wearer and the respirator that there may be some potential benefit to having a size a tariff-type matrix to address the potential needs of the user community. Again in terms of actually conducting the tests, we conceptually view or envision right now is to conduct samples at least five samples per each cell and use that as the basis for the conduct of the test. Does anybody have any questions?

JAY PARKER: Jay Parker with the Bullard Company, I have a question getting back to the requirements of the test. I see that in Wayne's paper he was using the 5th percentile what I normally call the 5th percentile or the 95th percentile; however, the draft does not state that it just states the measure LRPL shall be 2,000. And that also brings another question to mind and that is that Wayne's paper stated that the hoods are capable of 500, but these standards requiring 2,000 so I was wondering why NIOSH has gone with 2,000 whereas the baseline data indicated lower results.

LES BOORD: Concerning the 2,000, we'll do it in reverse order. I think some of it and this is one of the areas that we need to stress that we still are developing and refining the requirement. Some of the data that Wayne had mentioned did show values I think as high as 5,000 so while the predominance of the data on a one-size-fits-all would indicate the 500. There is data that supports a higher level as well. So that sort of goes down the line in the direction of 2,000. The other area and the other aspect that we're still under review and considering is the concept of the one-size-fits-all, right now the concept is noncommittal in that regard. So there may be actually some advantages that can be realized by not employing a one-size-fits-all type of a hooded respirator

so that's relative to the order of magnitude. And what was the second question?

JAY PARKER: About the 5th percentile versus the average or --

LES BOORD: Again, this is part of the development process, okay. As we investigate this area more, we will define what that percentile is. Any others?

IRA GURVITCH: Ira Gurvitch from I.B.N. Protection Products. Why does the standard have to be a hood if you have a one-size-fits-all mask?

LES BOORD: One of the requirements and I think that stated in the concept or one of the concept principles is that it needs to be a head covering so that you are providing both eye protection and head covering from the chemical warfare agents.

IRA GURVITCH: Why the head covering? I mean, I've heard that the layer of the skin on the head is thinner than on different parts of the body, but right now you have the general gas mask, you don't have a head covering?

LES BOORD: Yes, the concept is we are talking about an escape respirator that you're putting it on. The person really doesn't have any other personal protective equipment to use in this type of environment. The escape respirator is the unit that's carrying him out or carrying him to the safe zone.

So it's the feeling conceptually that the need for a head covering is there for head protection.

IRA GURVITCH: But I'll go back to the APR's, there's no head covering there and today policemen are walking around with gas masks on their side and they put it on. They don't have an MBC suit or something to cover their head.

LES BOORD: Again, good comment, but again, people who are working with an APR in a work environment, they're typically . . . they have the ability to use additional personal protective equipment at the time so it's . . .

IRA GURVITCH: Policemen out in the street or civilian in an office . . .?

LES BOORD: Good point. I would suggest that you can document these and send it into the docket because it may be something we need to consider.

IRA GURVITCH: Thank you. I have.

(Unidentified Speaker): If you're talking about the CBRN APR, one of the conditions of use, excuse me.

IRA GURVITCH: What are those initials? I am not familiar with those.

(Unidentified Speaker): Are you talking about a regular gas mask?

IRA GURVITCH: I'm just . . . I'm comparing it to that. Why does it have to be more stringent here than it does for a conventional gas mask for a head covering?

(Unidentified Speaker): Our standard is addressing the chemical warfare agents, blistering agents, and you know we're doing the permeation and penetration so on the CBRN air-purifying respirator gas mask, there's a condition of use which says use appropriate dermal protection before entering the area. With the escape mask . . .

IRA GURVITCH: But that's not the real world, what's going on. I mean take a look at the New York City police. They're walking around with a gas mask on their side and they have no head covering and the same thing, forgive me, but Les, you're original concept was for inhalation hazards. I remember your original concept on there. So I'm saying what does that have to do with the head and if you're talking about a low concentration for 15 or 30 minutes and you have a one-size-fits-all mask, to me that's a lot more . . .

LES BOORD: Again, the concept is and the concept requirement is to provide the protection to the eyes and to the head. That is the concept requirement. I think your point is a good point and I think, I mean we can't really debate it in this forum.

IRA GURVITCH: I understand. I'm just trying to bring it up so I was . . .

LES BOORD: That's good. I think what I would suggest is, as with everybody else, the comments that are being made here are being transcribed and recorded, but I would encourage you to submit that to the docket as well so it can be part of the decision process in constructing our final requirements.

IRA GURVITCH: Okay, because also within a mask versus a hood, at least I know with my mask, it's a lot easier to put on than a hood and a lot quicker and a lot smaller and a lot lighter in weight. I'm just saying those are all important factors that have to be weighed in this type of thing.

LES BOORD: Sure, sure. Thank you.

RANDY SAKOWITZ: My name is Randy Sakowitz. I'm from TeleScience International. When you talk about one-size-fits-all, is that in terms of adult or is that children or is that both?

LES BOORD: Primarily we're talking about escape respirators that are for the general working population so I think by that definition, you would be looking at an adult population.

RANDY SAKOWITZ: So these standards aren't in regards to children.

LES BOORD: No. Again, it's for the general working population.

RANDY SAKOWITZ: Okay, thank you.

LES BOORD: Any other questions? I think we are running a little behind, but would really like to try and finish the morning segment of the presentation. So . . .

JONATHAN SZALAJDA: Okay, to that extent, we're going to move ahead and discuss some of the human factors and the environmental conditioning aspects as well as some of the engineering design parameters that we're considering for this type of device. The next presenter is going to be Frank Palya from Policy and Standards Group within NPPTL.

FRANK PALYA: Thank you John and good morning, barely. I am going to present the concept for the human factor requirements for the escape respirator. As you can see, it's the field of view, fogging, and communications.

The first one that I'm going to discuss is the field of view requirement. In order for the escape respirator to pass the field of view requirement, it must obtain a visual field score of greater than or equal to 70. An apertometer that meets the requirements of the EN 136 or equivalent will be used to perform the field of view test. And the respirator size that anatomically best fits the head form will be used. Again, we're talking about the concept of one-size-fits-all

and that will be the official visual field score will be the average of three different fittings too. This 70 points was derived from the AMA guidelines, the functional impact which basically translates to a mild visual impact when you obtain a score of 70 which basically means they require scanning for some of the obstacles. This is the same test that we use to test a full face piece gas mask respirator. It was set at 75. This one is set at 70.

On the left part of the slide illustrates is an illustration of the apertometer that will be used for the field of view test. On the right side is the field of vision plotting chart. Both of these, if you look at it, has the same skill and the grid on the right here assigns a 110 points to a field of view within the radius of 70. 50 points are assigned to this same area up to 10 degrees fixation.

There are 36 meridians . . . this thing has a hair trigger . . . I was trying to point on there but it wasn't working . . . place at the top. If you look at the different meridians, there's 36 of them basically at the 10-, 20-, 30-, 40-degree mark and so on around the entire circle there and the radius's are, again as I said, at the 70-degree mark radius and the 10-degree mark at the . . . there are 50 points assigned to the central area and basically what this does is that it assigns a high priority to the center area as opposed

to the outer periphery. As you can see on the hemisphere there, the apertometer hemisphere, it's a dome shape and again, the center has a higher priority and the points are assigned there at 25, 55, 120 as you can see all around. And how this works is when you put the respirator on the head form and you illuminate the lights, the lights will shine through the lenses of the respirator and it will illuminate around the area. It'll create a lighted area and then what you basically do is count the points inside the lit area and that'll be your score. Go ahead Les. This is an example of such. As you can see in the upper right quadrant, this area has a value of 22 points. The left upper 22 again, lower left is 27, and lower right 25. This particular fit, this is fit 1 of respirator 1, you got a score of 96.

This slide illustrates the field of view scores for some of the escape respirators. As you can see, there's different fits and then to average at the end and that will be the official field of view score.

The next human factor requirement that I'm going to discuss is the fogging resistance. The fogging resistance will be tested in two environmental conditions. The low-temperature one will be at 13 °F. It was based on the normal daily mean temperature of Minneapolis, Minnesota, in January. January was selected because it was the coldest month of the

year on record for the past 30 years. The data was obtained from the National Oceanic and Atmosphere Administration (NOAA). The next environmental condition is the hot humid condition. It will be set at 90 °F at a 60-percent relative humidity. Miami, Florida, was used as the base city because it's one of the hottest and most humid cities in the United States. The data was also obtained from NOAA and the month of July was used.

There will be three visual acuity tests administered. The human subject will don the mask in atmospheric conditions. A visual acuity test will be administered and will then be administered as soon as they enter into one of the environmental chambers whether it be the hot or be the cold. The Snellen chart will be used to test for visual acuity. Then there'll be a 5-minute exercise period and then during a 2-minute rest period another visual acuity test will be administered. The procedures . . . you're probably wondering why well geez* why are they going and donning an ambient and then going into an environmental chamber? And what this is suppose to replicate is if an office worker or somebody indoors in ambient condition dons the respirator and runs out into the outdoor conditions, we want to make sure that this doesn't . . . they'll fog up when they go from ambient to extreme cold or ambient to very hot humid conditions. I think

that would create another hazard if they would go ahead there inside the mat, respirator where they cannot remove it and then it would create a physical hazard by not being able to see.

There will be two different human subjects tested for an environmental condition; however, the same human subject will be used for hot and then also for cold. For each individual, an average of visual acuity score chamber will be calculated and that's basically the first reading plus the second reading divided by two. And then to get the performance rating, what you basically do is to take the average visual acuity in the chamber and divide it by the ambient and multiply it by 100. In order for the escape respirator to pass the fogging requirement, all four performance ratings must be greater than or equal to 70.

This slide illustrates some of the models that were tested for fogging. As you can see -- I'm sorry this one right here is for the cold chamber. The average ambient temperature test was 75.8 degrees. It was a little bit higher than what we wanted, but it successfully passed. All the models passed the requirement for the cold chamber. Next was the hot humid. As you can see, model P did not pass for this particular test. If you look at the ambient, again it was in the afternoon when we started testing and we didn't have

the . . . the air conditioner wasn't functioning so it got a little bit higher. The data may have been worse, it may have been worse, if it was a little closer to 72 degrees.

The final human factor requirement that I'm going to discuss is the communications requirement. The communications speech and intelligence capability of an escape respirator is an optional feature. We look at it as a market-driven feature. The communications conveyance is not a mandatory requirement like I said so it'll be up to the manufacturers. The manufacturer wants the respirator to be NIOSH qualified for communication. They'll request NIOSH to do the testing for it and they'll be denoted on the NIOSH approval if it passes the requirement. Again, the requirement should be greater than or equal to 70 percent.

The test method that will be used to test the communication performance requirement of the escape respirator will be the Modified Rhyme Test. This is the same test and test requirement as the CBRN gas mask. The background will be set at 60 decibels consisting of a broadband pink noise with a frequency range of 20 hertz to 50 kilohertz. The distance between the speaker and the listener will be 10 feet. There shall be 10 MRT's trials conducted yielding 15 MRT scores per listener with respirator and without respirator, 15 without. Enclosed are some of the MRT test results of the three

respirators that NIOSH obtained. As you can see, none successfully passed the requirement. And also I may note that none of the respirators has any voice conveyance mechanism incorporated into the design.

In summary, enclosed are the requirements for NIOSH escape respirator requirement for the human factors. At this time, I'll answer any questions.

If not, I'd like to move on to the environmental durability challenge test. I'd like to go . . . briefly go over the overview. I want to discuss the purpose of the test, the goal, the general assumptions, type of durability tests, assumptions for the test, and the rationale. The purpose of the test is to ensure that integrity is integral to design and packaging of the escape respirator. Basically because it's almost a one-time use situation that's in a self-contained packaging, the packaging would be inspected but think about it, the respirator really can't go through its inspection such as a full-face air-purifying respirator. The goal is to ensure that the escape respirators provide adequate respiratory protection after being subject to potential environmental and normal transportation storage conditions induced by the user. Again we're not testing the manufacturers' over pack or trying to replicate any kind of shipping, but this is from the point of issue.

General assumption is that again it's from the point of issue by the user. The CBRN escape respirator will be subjected to the durability test and the ready-to-use configuration to individual unit pack. The assumption is that it will remain sealed. And also it's for a non-industrial use scenario for CBRN emergency use only. First the escape respirator will be subjected to high temperature at 71 °C constant temperature in accordance with MIL-STD-810F. The duration will be for 5 weeks. The reason for this testing is to simulate solar loading conditions representative of climates in the southwest U.S. Again, the rationale is that we went ahead and looked at the meteorology data from Phoenix, Arizona, from the Arizona State University and from NOAA. We also factored in an inducement factor from MIL-STD-810F. This also takes into account induced temperature and aging testing of the respirator. After the high-temperature test, the respirator will be subject to the low temperature of -31 °C. Again, this will be constant in accordance with MIL-STD-810F. The duration will be for 3 days. It simulates the outdoor storage temperature in the basic cold regions. The 3 days was chosen because it's representative of minimum temperature in the U.S. intermediate zones and also the duration is what MIL-STD-810 recommends.

The third and last environmental test condition is the humidity storage test. The escape respirator will be subject to a natural diurnal humidity cycle which varies from 31 °C to 41 °C. Also the relative humidity is 88 percent to 59 percent and that's also in accordance with MIL-STD-810F. It's for a 5-day quick look and it's representative of again humid regions, also, again, such as Miami, Florida, and also again the rationale for the 5-day quick look is what MIL-STD-810 recommends.

The next test for durability is the transportation shock test which consists of vibrating the escape respirator in accordance with MIL-STD-810F. Again, this is similar to the CBRN gas mask, full-face gas mask. The respirator will be vibrated on three axes for 12 hours per axis. This vibration test is the same, again, it's the same vibration test as the gas mask. This replicates conditions over the U.S. highways in a vehicle and we're doing this test to determine if there's any initial life-cycle failures. This chart illustrates the three axes of vibration.

And the last durability test is the drop test. The intent is to drop the escape respirator from a height of 3 feet onto each of the three different axes. There'll be one drop per axis totaling three drops. One impact surface per axis and this is to replicate several falls from a table or an

automobile over the life time of the respirator. Again, this is incorporated into the requirement as to ensure that there's integrity built into design factoring of the respirator. This is the axis of the drop, again, I'm just emphasizing that it's just only one . . . it will be dropped on one surface of the axes totaling three.

In summary, this is all the durability test requirements for the escape respirator. The very first one will be hot, cold, humidity, and on down to drop. At this time, I'll answer any of your questions.

JOE DUNLAP: Joe Dunlap with ILC Dover, what is going to be the acceptance criteria after these conditioning tests are run? Are you going to use the laboratory respiratory protection level as your acceptance criteria? Are you going to be using SMARTMAN or some other standard?

FRANK PALYA: Well, as it was with the CBRN APR, we went ahead there and . . . I mean . . . We would look at the packaging and it would be denoted in the test report but then it would go through a series of gas life testing, pressure drop testing, all the usual tests that NIOSH conducts, filtration testing. For the LRPL test, I believe that probably would be a different batch of respirators for that similar to the CBRN APR gas masks. There's a flow chart on the web site. Now that's just for the gas mask, illustrates

the flow of the respirator that is brought in and what respirators are used for what testing. I would imagine this escape-type respirator will be pretty similar. Thank you.

JONATHAN SZALAJDA: In an effort to get us pretty much on schedule or close to schedule, Les is going to wrap up this morning's session with some of the other design parameters that we're considering as far as concepts for the requirement.

LES BOORD: Okay, this last section will be a little bit of a hodgepodge because we're in . . . run through the requirements for donning, flammability, the definition of the hood device, and breathing resistance. In the first slide is the requirement . . . flammability requirement or concept and again this is principally for the respirators and the hoods that would be used let's say in a fire-type environment so what we did was we actually looked to an existing standard, a draft standard which is the ANSI ICA air-purifying protective smoke escape hood device and also EN 136 test equipment where the respirator is exposed to an array of burners. The requirement there is that after the flame exposure, there is no after flame after 5 seconds and that no drip, melt, or other damage is visible to the respirator and primarily the hood. And again, understanding that again, this is in the concept stage and how we actually fit this requirement into the overall requirement still needs to be determined whether

it is applicable to 100 percent of the devices or whether it's applicable to only those that achieve certain protections. So that's still an area that would need to be further developed.

The next requirement and as it's defined in the concept paper we're looking at a donning time requirement and the donning time of 30 seconds which I think is again consistent with some of the other escape masks, escape respirators standards that are in existence or being worked on. And the donning time of 30 seconds from a ready-to-use configuration where ready-to-use is considered to be the operational package, the package that the user would be confronted with if he needs to employ the respirator. Again, as stated in the concept, the requirements would be for escape respirators rated at 15, 30, 45, or 60 minutes depending on how the manufacturers specifies it and again rated according to the gas capacity for the particular respirator so the gas life at the appropriate interval of time.

And then, finally, to touch back on the head covering again that the concept currently is that the escape respirator is for a head covering shall be designed as a hooded device and the hood shall include an area for field of vision and compatible with wearing glasses. And again, I would encourage any comments relative to other alternatives to be provided to the docket so that they can be reviewed.

Then the final requirement that I'd just like to mention is the breathing resistance which is again borrowed directly 42 CFR and that requirement is stated at 85 liters per minute the inhalation resistance is less than 70, 70 mm of water and exhalation resistance is less than 20. And with that if there's any questions, any questions relative to those? So we managed --

LARS RONNER: Lars Ronner from Sundstrom Safety coming back to flammability, did we talk about six-burner test or one-burner test?

LES BOORD: I believe it's the six-burner test. That's the array of burners.

LARS RONNER: Of course talking about 800 °C according to EN 136, then it's a one-flame burner test.

LES BOORD: Okay, thank you.

ERIK JOHNSON: Erik Johnson, 3M, you're comment that the flammability was definitely in the concept phase it might be only applied to some of the submissions. Was that for the submissions that would have the CO approval?

LES BOORD: That would be the possibility, yes.

ERIK JOHNSON: Okay.

LES BOORD: So it may be you could actually segment these types of escape respirators by their protection.

ERIK JOHNSON: Thank you.

JAY PARKER: Jay Parker with Bullard, I would just add to this last statement here that it should also be compatible with beards as well as glasses.

LES BOORD: Good point. Yeah, I think that's a very good point. When we think about a hooded respirator, a lot of times we sort of think that that bypasses some of the normal considerations that we need to address when using a face piece and that's not necessarily the case facial hair, glasses, and so forth still enter that equation. Any other questions or comments? Notice how quick that was. So with that, I think we'd like to adjourn for lunch. We have allowed 1 hour and I think we can stick to that. So . . .

(BREAK)

JONATHAN SZALAJDA: The chemical warfare agent simulant project as well as introducing concepts for the self-contained escape respirator and then we have some additional CBRN standards development topics which will be covered at the end of the day plus also any comments or information that you would like to share either with the standards development team or with the community as a whole. With the standards of development program, one of the things that we heard in responding to our stakeholders and the whole development process was a need for tools for the manufacturing community to allow pre-certification testing of their equipment against

the chemical warfare agents that . . . You know, there aren't that many facilities available for evaluation of materials that could be used in the development and construction of the respirator to be tested against the penetration and permeation effects of the chemical warfare agents. So following the request from the manufacturers for us to look into the identification of potential simulants, NIOSH and SBCCOM sent out in collaboration to conduct a project to identify simulants for use by the manufacturing community and others to evaluate the materials for effects of penetration and permeation from different agents and what we're going to cover here for the next half hour or so is the current status of that work. Frank Palya is the NIOSH project officer who is managing the work. Dr. Rivin from SBCCOM at Natick or at least for today is the principal investigator who's conducting this effort. And what I would encourage you to do if you have some specific technical questions regarding the work if it's going to be getting to too much of a technical detail that Dr. Rivin will be making himself available to your questions and I would suggest if it's not something of a general nature, but if you wanted to get into more specific technical type discussion if you could catch him during the break or following the presentations at the end of the day. So with that Frank Palya will introduce the project.

FRANK PALYA: Thank you John. As John had mentioned before that I am the project coordinator for the chemical warfare agent's simulant project and Dr. Rivin is the principal investigator. I'm going to discuss the need for the project and some of the administrative details. This project was funded by NIOSH and SBCCOM conducted the research and experiments at the Natick, Massachusetts, locations and at the Edgewood, Maryland, locations. For this project I want to make it clear to everyone that when we're talking about simulants we're talking about chemical compounds that have the same permeation and penetration effect on personal protection equipment varying materials as chemical warfare agents namely sarin GB and sulfur mustard HD.

I would like to emphasize that actual chemical warfare agents will also be used during the testing for NIOSH certification of respirators. This project is to provide personal protection equipment manufacturers with information so they can select simulants to perform development at work or for doing some of the pre-testing before submitting their applications to NIOSH. For the overview, we'll present some background, the purpose and the objective, the permeation of the chemical warfare agent simulants, the goal or approach. Dr. Rivin will be talking about the technical details,

potential benefits, accomplishments and current status of our research, and the summary and conclusions.

The purpose is to identify through research and testing chemical compounds to simulate the permeation and penetration effects of GB and HD through barrier materials. The objective is to identify simulants and laboratory procedures that can be used by manufacturers for estimating breakthrough or permeation breakthrough times of the actual chemical warfare agents through materials used by the manufacturers for their personal protection equipment. In general, the breakthrough time is the time for a chemical to seep through the surface of a barrier material of the personal protective equipment such as in respirators or protective suits that are worn by the first-responder community.

Our goal was to develop a low-cost, rapid simulant screening method for determining agent permeation through barrier materials. Again, the approach was to develop an inexpensive permeation test that can deploy a new test cell design that can accommodate both hard and soft barrier materials up to at least 1-cm thick. The manufacturers can use at their own convenience in their own research labs making it a lot available . . . availability to them would certainly reduce the cost. Selects relatively non-toxic simulants for GB and HD based on solubility of the standard polymers. Tests

the performance of certain barrier materials by comparing their breakthrough times when exposed to the actual chemical warfare agents in other words just compare the agents for . . . the permeation times of the actual chemical warfare agents versus simulants.

At this point, I'd like to call upon Dr. Rivin to discuss the technical details.

DONALD RIVIN: Thank you Frank. Before I start, let me just add that as Frank mentioned, this work was done both in Natick and Edgewood and there were co-investigators at Edgewood, Wendel Shuely and Bob Lindsy, and Wendel is here in the audience and sure you'll be willing to talk to everyone afterwards also.

On this, we see the basic permeation system. I'll go into more detail of the cells shortly, but it's quite a simple system. The basic detector we've been using is a flame ionization detector. We tried other detectors too and any detector that is sensitive enough for the vapor concentrations that we experienced would be okay. And we're dealing with high vapor concentrations and the reason for that is that we have chosen to use a fully wetted specimen rather than drops. There are theoretical reasons to do this. There is a direct relationship between how the materials perform with the drop challenge and a fully wetted surface challenge, but you get

much higher permeation rates. It's much faster permeation. It's much simpler test when you run it with the fully wetted surface. I won't go into more detail about the system. You can ask questions later. It's as I say relatively simple.

The cell is composed of two major parts: the bottom section which has the gas flow below the specimen. The specimen sits on a little platform in that specimen . . . in that cell. There is where the air fluent is swept into the detector. The top part is the section which screws into the bottom section and it creates the liquid well. We can see that much better in the next slide. Here are two views of the cell. The first are the two major components, the top and bottom of the cell. Upper left-hand corner is the top of the cell and we have a quick connect gas connection on there; that's on the left-hand side. Relatively simple, it has grooved sides and the top section which is directly below it has a screw on it and it just screws in. However, you first put the specimen in. The specimen is a 1½-inch diameter disk. The actual size is not critical. It has to be large enough to cover that hole and this is about three-quarters of the available surface at the bottom of the base of the cell. You put the specimen in and the Teflon O-ring or gasket which is shown on the right sits on top of that specimen. The Teflon is there so that when one screws in the top part, there's no

movement of the sample which is underneath. And on the right-hand side, you see the arrangement that's the bottom of the cell with the specimen in there, the Teflon O-ring, and the top part screws in. Sitting on top of this is a loose fitting cap that's just to limit the evaporation of the liquid. You don't want it to be very tight because you don't want to create a vacuum up there as liquid permeates through. We find that there is very little evaporation of liquid through the top of the cell.

Now, using the cell, we now have to find what are the best simulants to use with the agents. And to do that we first selected test materials and we decided to use representatives of a series of well-characterized elastomer samples which covered a range of barrier properties. We did initially emergent testing with these samples to determine relative rates of uptake and solubilities and from this we selected four samples, four rubbers. Three of them we did permeation testing with both agents and simulants as well as emergent testing. One of them which is nitrile rubber we did simulant work and emergent testing. We had not yet done agent testing on that. So when I show you the results later, most of what you will see would be these three elastomers with different agents and simulants and there'll be some results with the nitrile also. As far as the simulant, before we get

to that, the question, what we're really after is how good of a barrier material do we have so this is a permeability question. Permeability is the product of the diffusion coefficient or diffusivity, the solubility and it's inversely proportional to the thickness. Diffusion coefficient is mainly a function of the molecular cross section or volume so a molecule which is much larger than another molecule will diffuse more slowly. Solubility, however, is controlled by factors which are much more complex than just the size of the molecule. They have to do with the specific chemical interaction which shows up in the solubility. So here you want to be able to pick a simulant which has similar chemical interaction to the agents in a variety of different materials. If you don't do that, you end up showing an excellent correlation in one particular barrier material and a completely different relationship in another. So that's why we did our preliminary evaluation doing emergent testing which allowed us to both get a measure of the diffusion coefficient and also the solubility.

I don't want to leave thickness out because that's critical. If you are using permeation, let's say the steady-state permeation as a criterion, then your permeation is inversely proportional to thickness. If you're using break time or other time characteristics which I will talk about a

little more in the future and later on, then it's proportional to the square inverse square of the thickness. So thickness is a very, very important parameter here and you have to correct for that in order to compare materials.

Now we looked at a relatively large number of simulant candidates, actually more than I have on this table here, but we did the most work with the ones that you see here. And those four which have an asterisk are the ones that we decided to go ahead with the more intensive permeation studies with. So what you will see from this point on are data with these four simulants. I have them broken down here as HD simulants and GB simulants because everyone always talks about simulants particular agents. When I go farther on, you're going to see that there's a fallacy here. Now this is a permeation curves. One of the things we did was we chose the thickness of the elastomer to compensate the differences in barrier properties. We didn't want to do these experiments with one elastomer, let's say silicon rubber, which is a relatively poor barrier so that we would get an experiment which took place in 2 hours with the particular thickness and then ran with butyl rubber and got it, took place in 4 days. So what we did was knowing what the properties of these materials were, based on the emergent results, we could select thicknesses of these polymers so that we would get results within let's say a

factor of two or three in terms of overall time of the experiment. This doesn't in anyway affect the overall result. It just makes it a more convenient experiment. So here we have results with three different polymers and three different simulants. You get an idea of what the curve shape looks like. Now we use these curve shapes to determine characteristic parameters and that's as we see here. Now there are three of these characteristic parameters that really define the permeation curve.

First is this T_b which is the time at initial break. Now you will often see break time of values and very often what's meant by that is the time at which people first detect some air fluent coming through. This is of course very sensitive to the method of detection. The T_b value here is one based more closely to theoretical . . . on theoretical grounds and it's the intercept of the linear portion of the curve. If you notice this "S" shaped curve the lower portion of it is linear. And you take the intercept on the background time axis and see there's a slight positive background in this you take that intercept that's T_b. For the agent work we measured both the first detection of penetration and T_b and, in fact for most of the cases, they were the same or within few percent. In the case of silicone there was some detection of small amounts of material before you came to T_b, but it did

not affect the overall results. T 1/2 is the time at which you reach one-half of a total permeation. This again is related on theoretical grounds with the fusion coefficient. So both T_b and T 1/2 you can calculate the fusion coefficient from these which are completely independent of solubility of the chemical interaction. That's very important because in order to check the validity of our results it's nice to have some independent methods of comparison. And what we did was we compared the diffusion coefficients that we obtained from T_b and T 1/2. Which again, are independent of solubility, or any of these factors, to the diffusion coefficient that we obtained at the third characteristic parameter, that is the steady-state permeation value. And that requires, as you saw from the equation previously, knowledge of solubility, as well as the thickness. So if one can obtain a diffusion coefficient at steady-state, which is not too different from what you obtain at T 1/2 and T_b then you have an internal check that you have meaningful data here. We also included a diffusion coefficient obtained from the emergent work, which again is a completely different experiment. That checked out pretty well with these results. I have one other parameter here the T_s, this has no theoretical significance, and it's simply there, as an indication of how long the experiment is. We now have a final report on this. We list T_s data so one

has an idea of how long it takes to reach a steady-state. So you have some idea what the total experiment time is. T_b and T 1/2 are fundamental and what I'm showing on this graph is the normalized T_b and T 1/2. Mentioned earlier that you can calculate diffusion coefficient but the diffusion coefficient is related to these times and the square -- inverse square of the thickness. What this is is we've taken these times, T_b and T ½, and divided by the square of the specimen thickness. What we see on the bottom, I hope you can see it all, are three polymers, starting with Silicon, we show the 2 agents, HD and GB and the four simulants. The left-hand block is T_b and next to it is T 1/2. First thing I'd like you to see is the general fingerprint that you get. There are some differences in these polymers and they are not terribly different. The biggest change we have, the biggest range we have is in the case of butyl, which is the middle set of the graph and that has about a factor of 8 between the highest and lowest normalized diffusion parameter, characteristic time. In the case of Silicon and EPDM it's much smaller. Also notice, the relationship of HD and GB, they're not very different. In the most extreme case is about a factor of 2 difference, in many cases they're much closer than that. Also as I inferred before the question of what is a HD simulant or a GB simulant. Well the first two simulants, DCH and CEPS are

presumably HD simulants and the next two are DIMP and DEMP are GB simulants or D agent simulants and you can see that there isn't much of a difference. So bottom line here is that you could chose any of these simulants and get a pretty good value for the data for most of the -- particularly in Silicon and EPDM. In the case of butyl, you can bracket the data you get with the agents with DCH and CEPS or DCH and DIMP. Again, within a factor of 2, you can do better if you develop a more extensive data base, you can do much better than that but it's not very hard to get that kind of agreement. Now there are other ways we can take this data and other criteria we could use for looking at the barrier properties. So this is one this is actually measured break time or half-time, let's limit it for simplicity to break time. Another method that's been used is the permeability. Permeability is simply the permeation divided by the thickness. As I mentioned earlier since thickness comes into it you can compare a 50 mil material with a 2 mil material and you don't know what their real characteristics are unless you correct for thickness. I've just said that, but I will go into the next exhibit and I will negate that. Right now looking at this, what we see on the left-hand side are the four polymers and the simulants and the agents. And you can see that silicone is such a . . . is such a poor barrier relative to the others that you can't tell

very much about the other polymers if you put them on this scale because silicone dominates. But looking at the silicone results, what you see is that no matter what we're using as the permeable we're getting results which are pretty close. Again, this goes along with those kinetic parameters T_b and T 1/2. Permeability, of course, takes in both, the kinetic, the diffusion coefficient as well as, I believe, not much difference in the case of silicone. Now on the right-hand side I've eliminated silicone the same data that we see on the left with the scale now is expanded we've left out the silicone. Here you begin to see more of a difference between these polymers. On the right-hand side of that is the HD and GB and you can see again that you can pretty well bracket the HD and GB results with CEPS and DCH. As I mentioned earlier we have not run nitrile with the agents so I don't have a nitrile curve there. So you'll have to limit the comparison to EPDM and butyl on the right-hand side. Again, you can easily bracket them with these agents, or if you have again, a data base and in our report we have the data for these materials but if one has a more extensive data base one can easily develop pretty good correlations there. Finally, I said I'd negate my comments about thickness. Let's say you have an unknown material of whatever thickness and you wanted to say, well how does this compare as a barrier material to

2362 something else that we're using which we know is a good
2363 barrier. Now we know for example the butyl rubber is a good
2364 barrier, 12 mil butyl will pass the drop test, easily enough.
2365 And we could simply say let's take . . . this is our standard
2366 material and we run it with a particular simulant, let's say
2367 we ran it with dichlorohexane, DCH, which is the top line. If
2368 our unknown material, of whatever thickness gives us a
2369 permeation curve which is equal to or below this then that's
2370 as good a barrier as butyl, based on this kind of criteria.
2371 If we took DCH as the value, that's the line right near the
2372 bottom, the dark -- I'm colorblind I think that's blue -- line
2373 near the bottom. Then you would then relate that, if you had
2374 an unknown material that was much greater then it would not be
2375 as good a barrier. If it were equal to or less than this then
2376 you have a good barrier material. So this would be a way of
2377 using the test method and a simulant with an unknown material
2378 if you want to relate it to a standard material. So I've
2379 described three methods, I have not said use one or the other
2380 of these because I think there are considerations for both.
2381 There is a fourth method that could be used. You could say
2382 well we want to get a certain amount of permeation now in the
2383 drop methods they listed a certain permeation level which
2384 would be a pass or fail. You could do the same thing with
2385 this test. So again, the question of how to use it and what

will be the easiest and most effective for you is something which you can be thinking about and we can talk about afterwards also.

Just to summarize this, where we are now we have developed a permeation test method that we feel is quite reproducible and reliable. And as I mentioned it uses a fully flooded permeation cell, which gives you a maximum air fluent, which is again relatable to the smaller permeation you get with the drop loadings but allows you to use a variety of different kinds of detection equipment. I mentioned the flame ionization detector, in fact, we used a few of these, one of them was actually a gas chromatograph. We just bypassed the columns and just used the detector in the cell. I've given you a few different ways that you could use this data and we've shown some simulants, which we feel are pretty good ways of predicting how these materials will respond to an agent. We've written a paper on this and a test method, and this has been submitted to NIOSH. I'll leave it up to them to decide how they want to discuss that aspect of it. Now this is a method which was developed for correlating relatively nontoxic chemicals with agents, but as you can see the cell doesn't care and the detectors don't care what the toxicity of the material is. So this method is just as useful for TIM's and TIC's and whatever other chemicals you want. The only

requirements that you would have on this is that the simulant you use doesn't dissolve the material. The test doesn't work, if it dissolves, and it doesn't attack the cell. The cell is . . . materials we used were stainless steel and aluminum alloy which we knew were stable and useable with agents and we've had no problem with them. How one uses this well as Frank mentioned it can be used as a preliminary test this is not part of a specification. This is not the final test you use but you can, I think, really characterize materials and determine whether something is likely to pass the agent testing by running a test like this. I've basically, summarized most of what we have here. At this stage we have, I think, a good method and we have statistical data over a range of materials which indicates the reliability of the method. There are additional things that we feel should be done; for example, we only have a limited range of polymers. Two of them are basically hydrocarbon polymers they were carbon black filled butyl and EPDM. One of them was a peroxide cured silicone which is more polymer -- more polar, excuse me, but we would like to extend this to a few more polymers to make sure that the relationships that we're seeing are durable. The test procedures are described in the draft we have given to NIOSH and the disclaimer is I guess you've seen that before. Thank you, that's it if there are any

questions I'd be glad to answer them. Oh yes, if any of you would like to go into greater detail about specific aspects of this, more technical aspects and what have you Wendell and I are available to meet with you this afternoon.

BODO HIENS: You said that these tests could be easily done by the manufacturer but we can't buy these warfare agents.

DONALD RIVIN: Well that's the whole point. You don't have to use the warfare agents. What this is showing you is that you can use a nontoxic or relatively nontoxic liquid, some other simulant and get results which will predict what you should be getting with the warfare agent, within relatively close they're not exact but they are pretty close. Depending on how good a data base you've developed, you can get closer. If you want to run a range of liquids and compare it to a known material which has good properties with the warfare agent, you can actually get a very close correlation. (inaudible) Oh yes they're all, I got them from normal laboratory supply houses.

ZANE FRUND: Zane Frund, MSA. Have you identified the fundamental -- you've showed empirical, you've shown data, fundamental reason why silicone is so much poorer than the butyl? Is it something related to solubility cross-linked density or glass transition temperature?

DONALD RIVIN: Vaguely to the third it is due to the so-called free volume in the polymer.

ZANE FRUND: Molecular free-volume, Okay.

DONALD RIVIN: The packing in silicone it's pretty wide-packing and butyl is very tight.

ZANE FRUND: Okay, thank you.

LES BOORD: Okay what we'd like to do now is focus our attention on the self-contained escape respirator concept. I'll talk a little bit about the strategy for what the concept requirement is and then John will elaborate a little more on some of those . . . the details of some of those concept requirements. Basically, for the self-contained escape respirator we envision a requirement or a concept that's very similar to the concept that we use for our self-contained breathing apparatus, which basically is a three-tier requirement. The first tier being 42 CFR Part 84 approval. So recognizing that there are requirements for this type of device in place 42 CFR does identify those. Then the second tier being enhanced performance requirements and then finally the requirements or the concept requirements that we see for the CBRN applications. To talk a little further about the first tier of that requirement 42 CFR Part 84 approval the rated duration or the rated service of the time for the escape respirator as defined by 42 CFR would be 15, 30, 45 or

60 minutes. And then another requirement that one of the enhanced requirements that we'll see as John does his discussion, and we talked about it a little earlier this morning, was the requirement for a fogging performance or a fogging test. In that test we actually have a low temperature requirement of 10.5 °C. So for the self-contained escape respirator it needs to be operable and approved at at least that low temperature requirement. So concept one for the escape respirator is 42 CFR Part 84 approval, service time 15, 30, 45, or 60 minutes as determined by 42 CFR and then a low temperature use approved for at least 10.5 °C. With that I'd like to turn it over to John, who will talk about tiers -- tier 2 and tier 3.

JONATHAN SZALDJDA: I think, and if nothing else I think we're trying to be consistent with the approach that we've taken with CBRN standards as far as having the tiers of requirements. To go along with that, we've identified these areas as potential requirements that we would like to explore as part of the concept. I think a couple things and we've . . . I guess basically you've heard this morning as part of the discussion the technical details as explained by Frank Palya as far as the actual conduct of the test. I did want to make one point that just to clear up I guess any confusion as a result of one of the questions from this

morning was that what we envision on doing along like what we've done with the gas mask standard is to do the environmental . . . environmental conditioning of the product prior and to proceeding into the last tier of testing. I think from this morning with the gas life testing in particular with the, I believe one of the questions came up as far as the equipment and how the equipment would be tested against those requirements. And they were going to try and maintain that consistency throughout the effort. Again, we are looking at the self-contained device being a hooded type system. At least conceptually that's what we envision right now. I think we heard several good comments this morning with regard to considerations of facial hair, the potential for wearing glasses, people that have long hair that this could be a concern as well, but again these are all factors that will be considered as part of the evaluation criteria.

Donning time again, donning we envision being an important characteristic as far as going from the packaging to on the user and ready to be used within 30 seconds. Likewise the types of environmental conditioning we're envisioning are pretty consistent with what we explored in detail this morning with regard to the temperature and humidity challenges as well as the transportation parameters. Again, in looking at the type of environment with this type of system, we are

anticipating having the flammability concept, we will do some additional explorations, as far as whether it's the one burner versus six burner type test but the parameters of the evaluation will stay pretty consistent. With the human factors type testing, again we're looking at field a view, fogging and communications, with the communications being an optional type of requirement with the actual numerical values fairly consistent with what we discussed this morning. I think we've heard that no fogging given the potential use of this system and the donning and ambient condition in moving into a potentially different temperature environment will be very important. Breathing gas is less explained we're looking this morning with the air-purifying respirator; we're looking at using the metabolic simulator as the tool for the self-contained system. Again, these are all conceptual but we're trying to base along the lines of what's currently captured in existing standards. The third tier after . . . in line with our standard is the special CBRN requirements, and in this case obviously with a self-contained system there isn't going to be a filtration requirement so we will just be solely addressing the LRPL testing and the chemical warfare agent testing. With the LRPL again, the parameters of the test are the same. Conceptually we are looking at the same fit factor requirement that was identified with the air-purifying escape

respirator. Understand that this is a concept at this point and as we move further along with the definition of requirement that you may see some variability with the LRPL value. Again, going back to looking with the hood system tying into the anthropometrics associated with the data base that we identified from the air force and measurements of head circumference, neck circumference and face length. Again going into filling these cells in terms of conducting the actual certification test, I think one of the sidebar discussions that we addressed earlier is that even with this type of matrix it doesn't preclude a one-size-fits-all characteristic but just that conceptually as far as conducting the certification testing that we would be filling a panel with each of those associated cells and evaluating the respirator as appropriate. Along with the other special test, or the other CBRN unique test is the chemical warfare agent challenge. In looking at the requirement for the self-contained unit in comparison to our earlier work that we anticipate that the self-contained unit would be used in areas of unknown and unquantified types of concentrations and as such we're looking back at the parameters that we establish for the SCBA program where a responder would be going into a unquantified, unknown environment. And we're using the CWA parameters that were established as part of a hot zone type

operation for the SCBA. Again the test time would be dependant on the manufacturers indicated service life as part of the application whether it's a 15-minute device would mean a 15-minute exposure and then a total test time of 30 minutes for any penetration or permeation through the respirator would be required. Likewise, we're following the same methodology for the sulfur mustard test with the application of not just the vapor challenge but also the liquid challenge to the respirator system. And with that these are I guess the general . . . the general concepts that we've anticipated for the self-contained unit but it seemed originally with our concept development process we weren't planning on addressing the self-contained aspect initially but as we got into the identification of the requirements and the evaluation of potential concepts for the air-purifying respirator it just seemed it was a convenient and naturally evolving process to take the information that we've accumulated and then roll it into the self-contained concept as well. I think you'll see over the next several months the evolution of our thinking with the self-contained concept. Any questions?

STEVEN BERNING: My name is Steven Berning, I'm with Ocenco Incorporated. I'd like to make three recommendations related to duration. First, there's hundreds of thousands of NIOSH approved devices in use in the United States for escape

less than 15 minutes. So my recommendation is that you include the durations that are in Part 84, that is the 3, 5, and 10minute ratings. In fact, you are not showing the full range of durations from Part 84. My second point is small changes in self-contained devices have dramatic changes in the size of the self-contained device and for that reason Part 84 also includes a clause that says that intermediate durations are acceptable. I recommend that you also adopt that approach.

My third recommendation is that you, consistent with Part 84, you look at the possibility of long duration, self-contained CBRN devices and let the market determine if 60 minutes is long enough and Part 84 would have 2 hours, 3 hours, 4 hours ratings.

JONATHAN SZALAJDA: Thank you very much, appreciate it.

JAY PARKER: Yes Jay Parker with Bullard. I was struck by having the same laboratory respirator protection level requirement for a negative pressure device and a positive pressure device; I think that's somewhat questionable. You know, in other words a positive pressure device should be capable of providing a higher fit factor or protection factor so you may want to look into that a little bit. The other comment I have is on the flammability test you're referencing EN 136 which is full-face masks as something you looked at for

guidance but how about EN 270, which is airline hoods, which does have a flammability test also with a single burner. So you might want to look at that flammability test because that's hoods rather than full-face masks.

JONATHAN SZALAJDA: Thank you for that comment. I guess on the one comment on the LRPL value, I think that one of the things that we're considering while we acknowledge the difference between the positive and the negative pressure that in the event that the positive pressure aspect of the respirator fails, for whatever reason, then you can still have a degree of protection from wearing the respirator in a negative pressure mode and as Rowland said, that's the way it's tested.

WILLIAM NEWCOMB: Bill Newcomb with North Safety. As I read the concept paper originally it sounded as if this was going to be full body and take into consideration all sorts of dermal protection. Was I wrong in reading it that way or is it changed?

LES BOORD: One of the concepts that is mentioned in there is the possibility of additional dermal protection. Again, it's a concept I think, the evolution or development of that concept we need to mature further. At this point, it's identified as a concept, dermal protection will be required.

WILLIAM NEWCOMB: One other issue that comes from this morning's discussion. In the concept paper it indicated that the liquid mustard was going to be 60 minutes, rather than being the same as the vapor and the gas and your overhead showed them being the same. I wanted to just confirm that the concept paper is not correct in that aspect.

LES BOORD: The intention for the liquid application would be the same as the vapor.

WILLIAM NEWCOMB: Thank you.

LES BOORD: That's correct. Another comment that I would . . . thanks . . . another comment that I would like to make is the . . . we talked about bench testing quite a bit for the air-purifying type respirators for the self-contained respirators, we do intend to do bench testing as well, particularly in the agent environment. So we do plan to continue our bench testing program to evaluate self-contained equipment on the SMARTMAN. Additionally, there was a element of bench testing reported this morning, which I think is applicable and that is some of the CWA testing that Wayne spoke about. Where we tested hoods from some of the commercially available escape respirators, air-purifying respirators but we tested those systems at the high challenge rates. We tested them at basically the GB, HD challenges that we're mentioning for the self-contained unit. We saw very

positive results in that area. So in that respect, that bench testing tells us that the hood technology is certainly there to meet the types of requirements that we're looking at for the self-contained. So as we go forward, further bench-testing will be done on the self-contained systems on the SMARTMAN configuration. Any other questions?

I think what we'll do is, we're . . . miraculously, we're a little bit ahead of schedule. I think what we'll do is we'll take a break now and let's convene at 2:30 and then resume with the last segment of the program.

(BREAK)

JONATHAN SZALDJDA: A couple . . . before we have the last presentation and the open period of the program for additional public comments, there are a couple . . . couple things I just wanted to re-bring into everybody's attention. The yellow . . . yellow form that was in the pamphlet that you received, if you can fill that out and give that to the receptionist at the end of the day, we'd appreciate that. The other thing, is that the attendees list is for who is at the meeting today is available and it's on the back table with the other standards as well as some of the other concept papers and letters to manufacturers and interested parties that we've released in the last few months. To conclude, or at least as far as our formal presentations today, there is some general

topics of interest that we would like to cover related to the CBRN program, as well as some other programs that the National Personal Protective Lab is conducting that may be of interest to both the stakeholders, as well as potential users of these products, so with that let's talk about some of the CBRN related topics.

Actually, we're going to jump ahead a little bit and I wanted to at least spend a couple minutes talking about an effort that I'm the project officer on for the NPPTL. As a result of the events of September 11 and the collapse of the World Trade Center, NIOSH has undertaken a program to develop health and safety guidelines for emergency workers, who may be working in a post-structural collapse hazard. And the intent of the guidelines is to address the first 24 to 48 hours of an event where responders would come on site and what they would need to do to protect themselves against hazards that would be present in the environment just solely from the aspect of the building itself collapsing. We're working this project in conjunction with . . . under an interagency agreement with the National Science Foundation and the RAND Science and Technology Policy Institute. What we're doing in terms of this project is using a three-part approach to develop these guidelines. The first part was to characterize the response mission and the hazard associated with the emergency responder

going to a collapse site. Simply put we broke it down into physical, chemical, and biological type hazards that a responder may be faced with in moving into one of these types of environments. Along with that we spent a good deal of time researching the hazards associated with the collapse, primarily based on looking at the timeframe . . . looking at tall buildings around the country that were using, primarily, a 20-meter type building as the baseline. Developing, looking at the data and construction trends based on the last century of building within the United States to try to identify and develop as a tool, a model of what a responder may expect to see in the event of responding to one of these types of events. I guess for example, just to go on a tangent for a minute, when you look at the building trends in the country especially for developing tall structures, there are some distinct periods which pretty well track along the times of good economic prosperity, where tall structures were built across the country and along with . . . following those trends there are also distinct trends in the types of building materials that went into . . . went into the structures. Earlier parts of the century was very concrete based, latter parts of the century, a lot more steel, a lot more glass. And part of what we're . . . what the effort was, was to identify in the event of a building collapse knowing the construction

parameters of the buildings. How to take that and translate that into the hazards that a responder may see in the first 24 to 48 hours of being on site and to that extent we've gone ahead and identified the . . . conducted a hazards . . . identified the hazards, conducted a hazards analysis and we're at the point where we've identified traditional industrial hygiene practices that in a real . . . in a perfect world that could be applied or should be applied for the responder and working in one of these types of environment. I think the interesting aspect of this program is that for us we're trying to take a step beyond the traditional industrial hygiene guidance. The traditional things that you may look up in a manual or HAZWOPER training or whatever but to provide guidance to the responder based on questions that he may have with regard to the hazards and his equipment. Really Rich Metzler likes to say that this program began about 2:00 in the morning on September 12, when he got the first call from New York City about what type of respirator do I need to wear for asbestos. Not knowing anything about concentration levels or the amount of hazard, the duration of hazard, you know, it's flying by the seat of your pants type of industrial hygiene. The intent of this effort that in the event we have another incident whether it's caused by a terrorist incident or caused by natural disaster (earthquake, flood, or whatever) but to

develop the guidelines associated to answer questions that the responder may have regarding the hazards that he could be facing as well as questions regarding his personal protective equipment. Where we are in this project, we're planning on having a final document available by the end of the summer and we're doing coordination between different federal agencies, with OSHA, with FEMA, with the Environmental Protection Agency, as well as working with the ISEA with the International Safety Equipment Association and responders and trying to develop these guidelines. What I would encourage you to do, if you're interested in more information or potentially would like to be part of this effort, you can see me after the meeting or give me a call or send me an e-mail over the upcoming weeks and I can give you some more information regarding the project and the potential for your involvement. And with that I'm going to stop talking and let Les finish with the other R&D -- or the other CBRN related topics.

LES BOORD: What we'd like to do now is go over a few topic areas and programs or projects that we've identified that are pertinent to the CBRN standards development activities and some additional ideas and visions that we see for the program and perhaps some of the impact on certification costs and fees and so forth.

The first one I'd like to talk about is what we are labeling as our inhalation flow investigation. This has been initiated due to information provided to the docket concerning high physiological demand or high work rates, high breathing rates and respirator use at those high rates. Some of the data provided or submitted to the docket indicates that peak inhalation flows can range from 700 to 900 liters per minute. Other more recently submitted data would tend to suggest that that flow rate . . . peak flow rates are more in-line with 400 to 500 liters per minute. In addition to the high flow rates the data also suggests that there are increases in the peak inhalation flow that are the result of speaking type exercises. I think if you look at the data that's been submitted that would suggest that you can have perhaps a 10-percent increase in what the peak inhalation flow rate is. And then finally, the submitted data suggests that the result of such high flows may indeed affect the overall performance of the respirator. In addition to all that, I think there is independent data available that would sort of indicate and support the flow rates in the range of 400-500 liters, may indeed be the high end of what the human response is. So to address the information that has been provided to the docket NIOSH is conducting an investigation to address the concerns of the high physiological demand. The investigation basically

has three parts or three components to it. The first is what we've labeled as a literature search or a research into what's been published. Secondly, is the testing respirator testing and data analysis to . . . that may be required, and then finally is a protection analysis. With the literature research we intend to look at what's been published and perhaps look at some ongoing research to actually zero in on what the maximum ventilation rates that we should expect to experience when using a respirator. In addition to that, we'd like to see what the research says relative to the wave shape or the shape of that breathing response as we increase the work flow . . . or the work rate. And then finally to see what research says relative to influencing factors, speech, and so forth. The first part of the investigation is the literature search or literature research, then secondly, the respirator testing and data analysis, we look at the . . . what we're looking at there is perhaps filling in some of the gaps that we identify in looking through the research. We anticipate that there is testing that will be required on different types of respirators, self-contained, particulate, gas and vapor respirators. We also can envision that the second part of the program will not necessarily be totally in series with the first. We may actually . . . I think there are some suspect areas now where testing can actually parallel

the research investigation. The testing and data analysis is the second part. Then finally I think once we focus and have data and information in these areas, I think we need to finally then put the whole picture together and see what is the impact -- what we're calling the protection analysis. If we do experience the effects of the high, extremely high inhalation flows and the different types of respirators, and what is the real impact on that respirator system and the protection it is intended to provide. The final phase then is the protection analysis and any resulting impact that may come from that. With this investigation we hope to be able to address some of the information that has been submitted to the docket as part of our standards development process.

The next program I'd like to talk a little bit about and this is probably very apropos to the discussions we've had today. That is a program that we refer to as our CBRN R&D program and this program was announced in a letter to all manufacturers on March 4. Basically, what it does is outline a program where we . . . where a applicant (the manufacturer) can do CBRN agent testing on the SMARTMAN test apparatus through NIOSH. It provides an access to applicants and manufacturers to actually do chemical agent testing on respirator designs that they have . . . that they want to evaluate. There is a qualification on it in that we limit the

participation in the R&D program to applicants or manufacturers that have a quality control plan evaluated as acceptable by NIOSH. Basically, it comes down to as part of a certification program you have a quality control plan that basically needs to be in place in order to participate in this R&D . . . CBRN R&D effort. The part of the program is that it will provide three days of testing to the applicant. Three days of agent testing at the SBCCOM Chem. Lab. The vehicle that the manufacturer would use to initiate this testing is a letter application to NIOSH. The form and the format of that letter application is provided as an attachment to the March 4 letter. So it's a pretty simple format that's used by means of the letter then and that is an attachment to the March 4 letter.

A qualification and information that's I think very important to it is that one of the restrictions is that the R&D testing, any of the testing cannot and should not be counted as certification testing eventually. Basically, the testing is independent from certification. The applicant certainly can be in the laboratories to witness the test. I think there are criteria and guidelines relative to who can access into the Chem. Lab. I think it's a maximum of three individuals and with also requirement relative to citizenship and so forth and that still needs to be adhered to. And then

finally the data, any data that's generated by means of the R&D program belongs to the applicant or the manufacturer. Basically, what this does it gives an opportunity to do what I like to refer to as trial and error testing. Trial and error testing on respirator designs that the applicant the manufacturer then can make decisions relative to the performance of their equipment. Within the constraints of that program then there are a maximum of four . . . within a three day period there are a maximum of four live agent tests that can be performed. That would be two sarin tests and two mustard tests. In addition to that within the three day turnaround time there's up to 10 agents, material swatch test that can be performed. These tests with the March 4 letter, there is a menu that identifies the testing fees as well as the test possibilities. You can see that the SMARTMAN sarin test is $4,500 per test, the HD test is $4,500 and then material swatch tests are $50 per swatch. Just working out a little example, you don't have to do all of the tests. In other words, in the letter of application to perform the R&D testing you may only want to do two GB tests or you may want to do two HD or one HD, two GB. That's up to the individual; you use the test menu fees then to determine what the cost would be. So for the example that we've illustrated there if you did two GB tests, 1 HD test and then 10 material swatch

tests the total fee would be $14,000. Again, that's in a 3-day turnaround time. The only restriction relative to access to it is that the applicant needs to have a NIOSH acceptable quality control plan. Before I go off that any questions on that . . . On the R&D program?

BODO HEINS: Bodo Heins, Draeger Safety. When you're speaking of the turnaround time, then you mean once the test is starting but what about the time until the test will start? Second question is, are we allowed to take the data from this testing here as pre-submission data?

LES BOORD: That start time to testing once you make the application depends purely on the backlog for testing at that particular time. The R&D testing does take a second priority to certification testing. So if we have certification testing in queue . . . okay . . . that is being performed then that has a priority over the R&D. I think what typically happens is that there are sort of gaps in the certification testing where the R&D testing can be inserted. That's the first part, the second part is can . . . yeah the pre-approval test data or data that's generated during the R&D program can be provided as pre-approval test data but it can not count as certification data.

WILLIAM NEWCOMB: Bill Newcomb from North. Has NIOSH considered having an R&D program for the metabolic simulator?

LES BOORD: As of about 2 seconds ago, that's a good concept, good idea. And as the requirements for the breathing gas control continue to develop further that may indeed be a direction that we need to go. Again, the whole motivation behind identifying a CBRN R&D program is as I'm sure everybody recognizes there is extreme or there is limited access to using chemical warfare agents. With this program, we see a way to actually facilitate the ability to do research and development type testing.

Concerning the estimate of certification fees for an escape . . . CBRN escape respirator we would, at this point in time, just using a gross gauge we would say that it's probably going to be in the $90,000 area. I think those of you who have been following the program, and involved in the program, pretty much know where that number comes from because it's very . . . it's comparable to the certification fees that we have for our CBRN gas mask. The scope of the testing is relatively the same so I think that is a good gauging number at this point. Now as the program develops as requirements become more defined there will be more definition behind that number. Then the processing time, the 120-days, again is patterned after and estimated after the CBRN gas mask, where we know that we have 80 days of pure test time involved. So 120-days would seem to be a reasonable number there. And

again, both based on the CBRN air purifying respirator. Very rough numbers at this point.

Finally, what I'd like to do is the development process for the escape respirator obviously will continue. At the beginning of the program we announced that our timeline for completion of the standard in our overall CBRN program calls for the escape respirator to be completed in October of this year, so October 2003. But as I'm sure everybody in this room realizes the escape respirator is a topic of intense interest. So while that is our goal and our timeline, we're not sure what the pressures . . . how outside pressures or other pressures may affect that. Right now our defined time is October of this year. In anticipation of continued development efforts we are scheduling another public meeting that we'll discuss the CBRN escape respirators the end of June. That target is actually is being even more focused, it's like June 25 is the date we're trying to nail down. And we will need to make that official or finalize that June 25th is the target. The target would be, again in Pittsburgh probably at one of the Pittsburgh locations, perhaps where we had our October 2002 meeting in Cannonsburg but it will be local in Pittsburgh. With that I would like to ask if there's any questions?

JAY PARKER: Jan Parker with Bullard. I would just like to say that I think NIOSH should consider a similar program for this standard as they did in the gas mask standard in which the live agent testing would be performed up front on two samples to sort of weed out any . . . or to prevent the wasting of resources both money and time on respirators that aren't going to pass the test. You know, I think that would be the smart thing to do.

LES BOORD: Thank you, I think that's an excellent suggestion. Any other comments?

SAM SHEARER: Sam Shearer, CSE Corporation. I have a couple of comments I'd like to make in general . . . part of the program . . . future thoughts. Have you considered different applications, permit different standards for the apparatus? For example, people working in offices should not require an apparatus that can withstand abuse you may find in the industrial market. What I'm saying is, if somebody has a unit in an office, it's not going to be exposed to all the atmospheric conditions that it would be in a commercial industrial plant. Training, has there been any thought regarding training potential users of these types of apparatus? Can we expect users to put on apparatus in 30 seconds? If their unit is stored in their desk does it need to pass the long duration temperature test and etc.?

LES BOORD: Thank you, both of those I think are certainly good comments. To answer the first question, at this point I need to say that we hadn't considered a . . . let's say a tiered type of a performance requirement where you may have light use units versus heavy duty use units. So we hadn't considered that but that is a good idea. The second thing, concerning training, I think, again, a very good point, I think when we talk about escape respirator the training element can not be over emphasized. When you . . . for those of us who are familiar with respirators and using respirators, I think it's quite evident that you can't expect a person to have an escape respirator, train them on it in July of 2002 and expect them to be able to use it in February 2003 without ever having looked at it again and without a proper type of a training program. I think that the training aspect is certainly something that needs to be factored in to our CBRN standard. I do envision that the concept will address that, the training, and the training module for these types of units. I think it is an important aspect. Any other comments, questions?

ERIK JOHNSON: Erik Johnson, 3M. I must say, I don't envy having to rationalize all these enduring comments. You made quite a distinction between the full-face standard, where you're required to wear other types of PPE on their body.

This one scope is for office workers who are clothed as we are today. I guess the question would be why are we even testing them for liquid agent resistants, possibly flammability, if our scope really is office workers who do not have this extra type of PPE to protect the rest of their body?

LES BOORD: First, the question relative to the flammability, we do see that the requirement for flammability, may in fact, be something that can be directed towards only escape respirators providing certain types of protection, CO protection and so forth where you may have the high heat or the flame hazard. So I think that's a possibility as we develop that requirement. Secondly, concerning the liquid agent I don't know, and I don't think that we've seen or perhaps rationalized our way through to the point where we can say that there would never be a liquid agent potential. I think even in an escape scenario, if we're talking about escape from CBRN type environments, then you always have that potential that you could have a liquid present. So I think it is . . . I don't think we can preclude it from being one of the hazards. I think also when you take that aspect and you marry it to the benchmark testing that we've done that demonstrates the ability to provide liquid agent protection is within state-of-the-art technology. I think that also

supports the idea that it shouldn't . . . shouldn't just eliminate it, that we shouldn't preclude it.

IRA GURVITCH: Ira Gurvitch, I.B.N. One of the areas that we didn't go over that much has to do with the size and the weight. Is it possible as previously mentioned, there could be a two-tier structure where let's say the smaller it is, let's say from the low level, the 15, 30 minutes versus the specific area where you're talking 45, 60 minutes? Generally speaking the smaller, naturally is not going to last as long but it's important for people that are taking subways or around a bus or a train.

LES BOORD: Correct. I think relative to the size and the weight right now the concept is silent relative to those. We don't come out and specify a particular size requirement or a weight requirement. In fact, I think we've sort of taken a different approach and the approach we're trying to develop through the concept is, again, coming back to the idea of balance. Balance between what the performance requirements are, what the user requirements are, and the technology. To let those minimize the packages that result. I think our benchmark testing is very useful in helping us to do that. So when we talk about size and weight, I think that becomes one of the areas where we sort of verge on the line between performance requirements and design requirements. Right now,

so far, our approach has been to try and build it through the performance requirements. But there will be . . . we do expect there's a distinct difference between the short duration unit and the longer duration unit. Okay, if there are no other comments, I think we can rap up today's program. Again, the next meeting is targeted for June 25th in the Pittsburgh area. Look for a federal register notice to that affect and a letter to manufacturers as well. Thank you for your participation, the input has been valuable to us and don't forget comments supplied to us, both verbally and written, to the docket, I think, are very meaningful. Thank you.

(END)