

Critical Issues Conference On In-Facepiece Sampling

PART 4

International Society For Respiratory Protection and National Institute For Occupational Safety and Health

- PROCEEDINGS -

Parts 1,2 and 3 of the Critical Issues Conference have appeared in previous issues of the JISRP. Part 4 completes the proceedings of the Critical Conference Issues.

Mr. Wilmes: Will the Panel on discussing the future research come forward? Okay, this portion of the Panel discussion is going to focus on future research needs in this area. The last day of a half we have heard a great deal already concerning the needs but, hopefully, we can focus and narrow down some of the specifics.

The Panel members are Larry Reed, from NIOSH; Frank Lotito again, from MSA; Jim Johnson we heard yesterday; David Swift, from Johns Hopkins; and Tom Nelson.

I would now like to begin with Larry Reed.

Mr. Reed: Thank you, Don. I think we all accept the premise that we need the best possible measurement of in-facepiece sampling to effectively perform quantitative fit testing, and also to perform workplace protection factor studies for field evaluations of respirators.

To this end, NIOSH began a

vigorous research activity two years ago with Warren's work to test the fundamental hypotheses of in mask sampling techniques

I think this research effort has been corroborated by three of the four studies that were presented yesterday, which corroborate the high variability found in current in mask sampling techniques.

As a result of that, NIOSH will continue to vigorously pursue research in this area and the end objective is to refine the in mask sampling technique to best determine the measurement of in mask environment for people who wear respirators.

Of the current research that is being performed within NIOSH, there are 13 respirator research, ongoing this fiscal year, being performed within the Division of Safety Research. Four of those directly involve the development of in mask sampling techniques. Warren's work was detailed yesterday. Steve Lenhart has a project, Steve Lenhart in the Field Investigation Section, which involves the development of sampling methodology for organic vapor respirators. Don Campbell has two studies, one of which is effect of lung deposition on the measurements of protection factors and, finally, Don is also involved in a study of characterization of

respirator face fit as a function of facepiece pressure and leakage rate. We also have several other studies that indirectly involve the application of these sampling technique, particularly a study with Gary Noonan, where we are actually applying in the field the revised sampling techniques for evaluation of respirators in the field. And that is ongoing within NIOSH research study and also assistance outside in performing respirator evaluations.

Future research -- I think it is clear that we must take current data that we have and, through mathematical and whatever statistical mean, identify the optimal set of parameters that will give us the best evaluation of the in mask environment. And that is not only NIOSH data, but all other sources of data that we have been here yesterday and in the future.

And I think a suggestion was made this morning that a good forum for that would be the upcoming ISRP meeting in York. Perhaps an additional session might be devoted particularly to this topic.

Future NIOSH research will also involve the identification of other factors which may be appropriate and lead to the high variability that we are seeing. Some of those have already been mentioned - probe configuration and shape; probe placements; leakage site geometry; different flowrates, including leak

rates; breathing rates; sample flow-rates; possibly also looking at challenge aerosol, the challenge media.

This year we will also begin work in a parameter study with full face respirators, continue our work with the air purifying respirators, and possibly also do work in the powered air purifying areas, as mentioned this morning.

We will also begin work in future years with air supplied respirators, including self-contained breathing apparatuses, suits, air hoods and helmets.

Once we have identified the optimal set of parameters, I think that it is also important then that we do apply these to actual field use conditions and we have on hand several projects which will incorporate that on an ongoing basis.

I think finally I would just like to reiterate the purpose of this meeting. As Nancy and John Moran mentioned this morning, we felt that this was a proper forum for the presentation of the state of the art research going on in this area and we welcome any kind of feedback that you can give us to help refine our technique and approach and ideas.

Obviously we don't have all the answers but our ultimate objective is just to develop a refined in mask sampling technique. Thank you.

Mr. Wilmes: Thank you, Larry. Frank Lotito, please.

Mr. Lotito: I have been trying to decide as to how we can best say something as to what is needed in the future, either from what can be expected from the manufacturers or maybe what the scientific community might be investigating or the Standards Committee might be trying to address.

I think we realize that when we talk about the manufacturer, the development and marketing of

respiratory protective devices, we are talking about an industry that is quite diverse, using multidisciplines. There are a few companies that only make respiratory products. Many of the companies make a lot of products, different types of products. And the introduction of a new product in any marketplace is a very expensive undertaking.

Rules are changing. Market demands are changing. And we try to address these needs. As far as basic, fundamental research from manufacturers that might address some of the questions that have been raised, I would like to think that we can see some answers from the manufacturers. but I think the bulk of the research effort is going to have to come from a specialized and dedicated scientific community, which itself has to be very multidisciplined.

I am really not familiar with the background of most of the principal investigators to date, but these people are going to have to know a lot about a lot of things in order to address all the concerns that I have mentioned before that might affect what we detect inside of the mask.

I think we have to be careful how we invest money in the near future in field type studies or continued laboratory studies on the performance of respirator protective devices. We should not turn off these investigations but we are going to have to use the best available technique and information, and be prepared to address the challenge that our conclusions or numbers may not be 100 percent correct. That is totally obscure, whatever is done in the future, until a lot of basic questions are answered.

The bulk of the work is going to have to be done in the laboratory, using very qualified people that are

multidisciplined, using very expensive equipment.

The standards group are going to have a heck of a time trying to standardize, I think, on QFT type procedures. The procedure involves, not only the instrumentation and the probing of the respiratory protective devices, some of the procedures would have recommendations on what the subject is supposed to be doing during the course of this test. We have strong evidence that sedentary type tests really aren't representative of anything.

So from my point of view, I think it is going to be a while before we see some sort of ANSI or ASTM type documents come out.

What do we do in the interim to convince the worker that he has the best protection? Well, we are addressing his particular problems in the best way that we can. I guess we have to continue in the best way that we know how and it would be foolish for us to set up some sort of panic and say that you must now all use air-supplied devices, or something. I think it is ridiculous to do that. We have more than enough evidence that seems to indicate that what we are currently doing is probably pretty good.

I don't see that in the near future we are going to have all of these topics addressed. But we must have continued dedication by the investigators, by the sponsoring organizations, to keep this momentum going. We have finally bridged, let's say, into a new phase of the technology. We are no longer talking static, constant flow, bench test type evaluations. We have finally made the transition into the dynamics of the total system. And I think the investigators should be applauded for their efforts.

Mr. Wilmes: thank you. Jim

Johnson?

Mr. Johnson: Well, I think for the present, short-term future R&D needs - after listening to everybody and pondering what we tried to do in my group, to me the key question in discussing with a lot of people in the audience and thinking myself, is that I haven't convinced myself completely, nor you people, that we really know what the flow patterns are in the facepieces. Because, you see, that is a very basic understanding that we can draw a lot on.

I really thought Ed Baier's position to let's go back to basics, let's look at a ventilation system -- because we know how air flows in a ventilation system; there is all kinds of data to tell you how to sample in a ventilation system. One of the key questions you have to answer though is do you have good mixing? Is it turbulent flow, which is what we kicked out initially to look at in the full face mask? And I think that still needs to be looked at further.

We can fine-tune probe lengths, we can chase all kinds of ideas, start machining specially kind of flat leaks versus square leaks versus eye socket leaks, and what are we doing if we don't really know if when it gets into the facepiece is it well mixed? And that is a function of the flow patterns and whether it is turbulent or not.

So to me the thing that jumped out that I am going to spend some time on over the next 6 months is looking at the flow patterns in the respirator and finding out whether they truly are turbulent, as our initial work shows. Because I think we can draw from the basics then a lot of reasonable conclusions and then test them on the facepiece.

Just so everybody kind of understands a little bit about the Lawrence Livermore National Laboratory that I work in, not to be confused with the Los Alamos

National Laboratory that my counterpart, Jim Jackson -- Jim and I trade names and introductions from time to time so there is a little confusion. We are two separate entities. The group that I am in is doing some respirator research right now, in conjunction with federal OSHA funding, in the areas of closed circuit breathing apparatus with the State of California. CAL-OSHA is also in the process of providing some funds to look at closed circuit breathing apparatus and their performance problems as used in the fire fighting business.

We are also looking at contact lens use in full face respirators and hope to have that study finished so that we can end an old wives tale on contact lenses.

Many years ago, like about 8, we developed our own powered air purifier. We called it the Daisy pack. And there was an AIHA article on that. It was used for an activity that worked very nicely: It is not one that we are going to talk much about but we know that it was very acceptable. To me, that is the most innovative piece of respiratory equipment that has hit the market in the past 20 yrs, as far as providing the worker with something, from an industrial hygiene standpoint, that I think he will wear.

So we are going to take a look at powered air purifiers and see how they perform and what kind of protection factors come out there.

We are also interested in the effect beard growth on self-contained positive pressure breathing apparatus performance, and hope to provide some insights and close the book, I hope, on beards and respirators so that we can get on to more important things.

Now, what do I see in the future? As I noted before, if we can't

demonstrate consistency, how can the layman on the outside believe anything we say? So I think that to me is a very important overriding goal that needs to come in.

Now, the nuclear business showed that you really can't go test every physicist's idea with a 2 to 5 million dollar shot at the Nevada Test Site. So what they did to try and screen these things out, they developed theories. And that is why we have some of the biggest computers in the world right now, to save money and test hypotheses before you go to the laboratory, in that case, the Nevada Test Site, for testing.

I see that as what we are going to have to do in the respirator business in the long-run. And I am talking 10, 20 yrs. We need to get some science into this understanding of how respirators work, and not some black magic or whatever we tend to call it. So I see the need to develop theories.

And just to finish up on a crystal ball discussion that I had a few weeks ago on total encapsulating suit representative, he said, well, how are we going to deal with chemical permeation and the performance of total encapsulating suits? What do you think? I said, ideally, what I would like to see is some kind of model, that you take some basic permeation data, some specific suit characteristics, and you can then deal with the multitude of chemicals and calculate protection factors that a total encapsulating suit would provide somebody at a dump or waste cleanup area, and then monitor this with some type of internal device. But the key decision-making process for the industrial hygienist, the safety person involved, is that he has to either charter a small computer, take the parameters that are developed, and he has a good model to go.

Now, that is where I see respirators fitting into the subset, ten years from now, 15, that we get some good theoretical bases to go on. It is going to take a lot of work. but if we are going to look into the future, that is where I see we have to go. We can't deal with individual chemicals and some of these little nitpicking problems and not forget, as was noted many times, that we are interested in the user of the respirator. I will finish there.

Mr. Wilmes: Okay, thank you. Next will be David Swift, from Johns Hopkins.

Mr. Swift: I have a number of items that I listed which I think are important research needs. A couple of these have already been covered by speakers and, certainly, many of them have been mentioned but I think I would like to reiterate them to stimulate response and thought with respect to needs.

Again, agreeing with what several of the others have said, I think the question of cavity geometry, the effect of cavity geometry and flow and the description of flow, the nature of mixing within the facepiece, is a critical issue and, certainly, the demonstrations both in person and in videotape that we have seen I think indicate that we need not only to look at wear and under what conditions laminar flow or turbulent flow occur, but I would add, in looking at Jim Johnson's pictures, that we need to look at stratified flow as well. To me, in looking at his pictures, part of the area appeared to be well-mixed but it was confined to one section of the respirator, at least under certain conditions it was. So stratification, it seems to me, is another feature that ought to be looked at.

I asked Warren yesterday about the temperature and humidity conditions in the mask cavity and the head form and, of course, that is one

obvious difference and, to the extent that skin temperature might set up natural convective currents within the facepiece, I think this is an area for investigation and how it is in the real facepiece situation on a human subject, how that influences mixing, distribution.

I was pleased to hear that there is a project underway at NIOSH on lung retention. I think this is a long neglected field. As has already been mentioned, the material that has been presented here has made various assumptions about lung retention, either complete or complete lack of lung retention. Clearly, depending on whether you are inhaling vapors or aerosols and what particle size aerosols you are dealing with, and whether they are hygroscopic or not, determines to a large extent what factor lung retention will play in the measurement of the concentration for the fit factor determination. And I think that is an important consideration.

It seems to me lung retention might be, in fact, turned around and used as a way of looking at the mixing characteristics, particularly if we choose particulates which have significantly different lung retention, we might be able to look in a controlled fashion at the effect, particularly the effect of sampling throughout the entire cycle and sampling during only inhalation.

Charlie Billings alluded to this. But in the early experiments at Harvard it was deemed desirable only to sample during inhalation. Again the tests that were described and the papers that were presented here, one or both modes were used. I think the question of when sampling should be done is still an open question. I don't think it is a resolved issue as to which is the

appropriate way to do sampling to make a best estimate of the exposure. So I think the question of the period of sampling, if we choose sampling.

Now, another issue that I think we ought to continue to look at is the issue of whether we need to actually draw a sample out of the facepiece or whether there are some other alternative methods to estimate the exposure situation, other than literally putting a probe in and pulling a sample. This, obviously, is a disturbing factor in the situation and we have done a little bit of thinking about this, as well as other people, about how to measure concentration within the facepiece of an aerosol or vapor in what one might call a non-intrusive fashion, either from without or some kind of probe which did not involve literally pulling a sample to an analyzing instrument -- an in-place device. I think that would be a useful way because if this probe device were small enough it could be placed in different locations and again give some idea of the concentration distribution within the facepiece.

Some mention has already been made, but I think again, we don't have enough information at present on the effect of leak geometry. All of the studies that are reported at this conference had to do with capillary leaks. Certainly other kinds of geometries have been considered, at least in theory, but as far as I know little has been done experimentally to look at this and I think this is an important area to consider.

One of the areas that we have been concerned with in trying to do some simultaneous measurements has been the issue of gases and particulates. This issue was raised here. In other words, if the respirator is intended to protect against a gas or vapor exposure and you are using

particulates as a way of measuring the leak, is this an appropriate surrogate? And what particle size do you choose?

Again if we look historically, I think we find that particle size was chosen on the basis of the use in-filter penetration measurements and the light scattering was adopted, at least as one of the methods, for use because it was sensitive. Yet we know that if the particle distribution is polydispersed and if there is selective removal, the light scattering measurement may, in fact, not be a true reflection of, let's say, the biological dose. So I think there are some issues there about what particle size is used and whether penetration is significantly a factor of the size. And we notice that the data that was presented here from the 3M group involved a particle size which was significantly larger than I think has been used historically and one would wonder what effect using that larger particle would have on the results.

One of the issues that we have been very interested in also at Hopkins has been the issue of the mode of breathing, whether we breathe by mouth or by nose, and I think that is an important area to look at, the effect of the mode, on the flow in the cavity, whether we are breathing strictly nasally or by mouth and nose and what the proportion is, and how this influences the distribution of air within the facepiece.

I think that it would be very useful to have some physiological type studies done on the switch-over under working conditions from strictly nasal breathing to mouth breathing with the added resistance of a respirator.

The other area that I think is important again goes back to an issue that has been mentioned here I think, that is, there are many different ways in which quantitative fit test

measurements are made, different kinds of aerosol, different vapors, methods of analysis, light scattering, flame emission, going back to the original work at Harvard, chemical analysis of a fluorescent material.

One of the things that stands out to me, perhaps when you are looking at something with a half face respirator that has a fairly low fit factor this may not be too critical, but in other issues, when you are looking at higher factors of fit, we really don't have an absolute standard for quantitative fit testing. We have these measurement devices which are supposedly linear or have some characteristic response and my impression is that the situation is getting more complex as time goes on. For instance, there has now been introduced into the business the use of a condensation nucleus counter for doing quantitative fit testing for the military. This simply increases the number of instruments and methods that are used. And we don't have any kind of a good idea about how these compare to one another, nor do we have an absolute standard against which to measure them. So I think there is a real need there to have some kind of a standard method.

Finally, I would go back again to saying that we need to do some tests to compare the quantitative fit testing answers to the biological uptake issues, in other words, can we do simultaneous experiments where we measure penetration by standard method and also get a biological indicator at the same time? There are a number of ways we might do this bioassay method and I think that is an important issue in answer to the question of whether quantitative fit testing methods really do estimate the dose that the

worker receives.

Mr. Wilmes: Thank you. Tom Nelson?

Mr. Nelson: I would like to talk, I guess, from a practical basis of being someone who has the responsibility of helping select and telling someone to use a respirator, and what do we need to do from the standpoint of research to get those kinds of questions answered.

I think in very general terms you can look at what we know about in-facepiece sampling and we can, one, attempt to eliminate the variability and, the other way we can go, I think, is try to understand or maybe measure the variability.

If we attempt to eliminate it, what would be the effect? Well, if we eliminate the variability just from in-facepiece sampling, then we still have to deal with other variability involved in this kind of testing. You have variability of the test equipment; you have variability testing person to person. And these sources of variability might be larger, smaller -- we have no idea. They are still going to be present and we will still have to deal with those. But if we can eliminate some source of variability it will give us a chance to maybe separate some of those out and we will have a better handle on what is going on.

The second way of just trying to understand the variability and being able to measure it gives us the opportunity then to use statistical treatment. I can make an off-hand comment I guess, the only group of people that I know that get picked on worse than lawyers are statisticians.

But we can use science to take care of that variability. If we can measure it and we understand it, we can deal with it.

And just two examples, I guess, talk about. Let's talk about using quantitative fit testing to assign a

person to a respirator. I think we can take a look at it -- what I am interested in being able to do that is, take an example, someone has a true fit factor. Its truth is 100. If the variability goes from 800 to 400, that really doesn't bother me a whole lot if the true is 100. And I can say, you know, if I see ten I reject them but if true is 100 I am not concerned if I can find him another respirator.

What I am concerned though is if truth is eight and I see 600 to 400, I have to know enough about that variability to say that you have to be better than 500 to be able to use that. That is, I think, one of the key issues we have to start to understand.

I think the second way of looking at it is in the use. If we understand the variability we can use statistical treatment then as a basis for making decisions on use limits based on in-plant workplace protection factor studies. I have mentioned this before, I think variability is the key. With the work we are doing we do have some conservative estimates. We don't have exact estimates. We have some conservative estimates, we have some qualitative guesses. I think we do need to go out and be able to understand a little better so we can make better estimates though.

Mr. Wilmes: Thank you very much. Are there any comments or questions from the audience?

Mr. Freeman: Jim Freeman, with Allied. In one of our workplace protection factor studies, as we were trying to resolve all the differences, it turned out that we were working with uranium dust and one of the large sources of air was played out (phonetic). That tended to give us a large variability and one of the problems, as you think about this sort of research, is something that needs to be inputted, just one of the factors.

Mr. Lotito: Can I ask you a question

about that?

Mr. Freeman: Sure.

Mr. Lotito: No doubt, played out was particle size dependent.

Mr. Freeman: Oh absolutely

Mr. Lotito: Was it concentration dependent?

Mr. Freeman: Probably, although we did it over a long period of time and we felt that perhaps relative humidity and a lot of other factors may have been equally important. And we just noted that it was a problem and have not yet taken the time to define it.

Mr. Wilmes: Any other comments?

Mr. McNeil: Barry McNeil, with Reynold Electro-engineering. On looking into the future what do we do with the data from the past? Ed Hyatt's studies at Los Alamos, plus other previous research, and the Harvard research, where do we fit that into perspective for the future?

Mr. Nelson: I guess that is why I made my comment about trying to understand the variability. You can go back and treat data and have some better understanding. I know you are really faced with the problem because you have Z88.10.

Mr. Johnson: Well, Barry, I would say that one of the purposes when we looked at the full facepiece and identified that we normally sampled in the nasal-mouth area, which is what a lot of the past - most of the past data was on, we need to get a feel for how bad or how good that estimated the performance of the respirator. Now, it is not going to be 100 percent. But I think there is some good conclusions and there is a lot of good data there that we can use as a basis for some conclusions.

Mr. Wilmes: I think your question probably is important and is the prime reason that continuing variability studies must be made. We

have a wealth of data base that we have operated on up to this point. If we can really understand the nature of the variability, maybe we can apply the appropriate decisions on past data and still understand it under future uses. For example, if the error of the mean is not significant we can talk about mean protection factors or mean fit factors. If we look at the variation, some people call it the 95th percentile, if you look at the range of data and we understand the variation and what may have caused that data, we can make judgements on it. But this is the importance of continuing to study the variation so we really get a handle on it.

Mr. Lotito: I think that we may have some problem doing that. If we can resurrect, let's say, the original Hyatt data when the Hyatt panel was put together of a dozen, two dozen or 500 panel members which we used to investigate one or more different kinds of respirator classes or a number of classes, we have the individual responses of the subject. However, those responses were all dependent upon the specific system that was used at the time. So we know the variation of data based on that particular or those particular systems that were in effect at the time. So can we ascertain from that, if he had placed a probe in a different place, the variability would have been...? I don't think we can do that yet.

We did have some evidence, although Warren Myers didn't present in detail distributions, just gave maximum and minimum and average maybe with the geometrical, or arithmetical average, that the distributions, indeed, do change. I mean, they change some of these features. So we may have some trouble in looking that old data and coming to some conclusions as to

what may have caused it and how can we correct it in light of today's knowledge or lack of knowledge.

Mr. Reed: I think NIOSH's stance is that we will continue to accept that data as the current best data available but we will refine it, upgraded it, whatever you will, based upon these refined sampling techniques that are being developed.

Mr. Brennan: Bob Brennan again. There is something that is bothering me a little bit, that is the primary purpose when you design a respirator is to provide respiratory protection. The things that are done have been done traditionally to increase tactile comfort on the face, to increase security on the face, to minimize CO₂ rebreath, and on the full facepieces with the lenses to minimize lens piece fogging minimize water collection in the facepiece.

Those things are necessary for user comfort and for the device to work as a device, as respirator. Now, it may be that you get turbulent flow automatically as a result of achieving your primary goals and maybe you don't. And it may be that for a respirator to work properly you cannot have turbulent flow completely inside the facepiece of you will get lens piece fogging, for instance, on a regular basis.

So the problem, as I see it, is not to determine whether the flow is turbulent because if you show that the flow is turbulent what you are saying is, oh well, I can use my old data and don't worry about it. The problem I think is address the fundamental issue, what is facepiece sampling? In-facepiece sampling is a means to determine whether the respirator works. It is not the job of the respirator. The job of the respirator is to work. What we are struggling with is what objective techniques can I have to show that the respirator works and it is

a measure of the amount of goodness the respirator is performing.

All right, now, that is not a primary task in the designing of a facepiece, if you follow what I mean. So that it is very, very possible that it may be in some models or styles or types of devices that the technique that we have been using is completely valid or in another similar appearing, but designed to do a slightly different function, the technique may be invalid. So it may not be possible to say, oh well, we will run a study and we will define proper facepiece or probe location and for all things that are black in front of you and have straps, that is what you do.

So that is where we get to where we are again. So the comment that in the long-term the research really has to be addressed to, hey, on a fundamental level how do I measure the performance of this device, other than go out and deliberately expose my workers to something I can measure in their blood? You know, that is one way but it is losing favor. People don't like that. So what we have to address is a measurement technique. And it may be withdrawing samples and it may be something completely different. That is where the fundamental thinking has to go in my opinion.

All right, for the short-term though, I would like to make this comment for the short-term, in our present state of knowledge if you qualify a test technique, that test technique is valid only for the particular device that you examine until we really understand all of the mechanics going on. What I sense as a possible outcome of this is that we will check some facepieces and we think we will solve the problem. And I think that is not the goal of the research. Thank you.

Mr. Clarke: Jay Parker, Pulmosan Safety Equipment Corporation. We have spent about a day and a half now talking about quantitative fit testing and the problems associated

with it. I would just like to comment, I don't know if everybody in the room really realizes that as far as NIOSH is concerned, when they test and certify respirators there is no quantitative fit testing required in 30 CRF 11. So when manufacturers design respirators they don't have to do quantitative fit testing. Instead they have an isoamy¹ acetate test that is used to test and certify respirators.

So we are certifying respirators without running any quantitative fit testing. And I think, you know, we maybe want to look at that too and I think we want to get that into the regulations as soon as we can to try and get some more consistency there because it is a strange situation when it is not required in testing certification but it is required or had been required by OSHA in some cases. So I think that, that should be looked at also.

Another comment I would like to make is that all the tests that we have seen involve the best selling type of dual cartridge respirators but there are a lot of these kinds of respirators, for example, single cartridge respirators which probably behave much differently and it is very difficult to get a probe into the area that you are talking about, between the nose and the mouth. If you have your cartridge located in that area there is no place to probe the respirator there.

Mr. Wilmes: Thank you. That is a good point.

Mr. Moran: With regard to certification, NIOSH, as most of you are aware, proposed and transmitted to MSHA some three years ago, three and a half years ago, proposed revisions to Part 11. The fundamental basis behind those proposed revisions was and remains that certification by NIOSH and MSHA of such devices should be more reflective of what the purchaser and the user can expect in the workplace. That is the fundamental basis behind the research programs we are running, one of which you have

heard about in the last day and a half.

Within the proposed revisions to Part 11, if and when, after 15 months, we get formal comments from MSHA, is, in fact, requirements for quantitative fit testing and requirements for achievement of protection factors and requirements for field testing.

Mr. McCreadie: John McCreadie, Parmelee Industries. I think I would like to throw in a note of some caution here that we don't go, I think the term was, bird walking all over this problem. We need to find some kind of solution whereby we can do some degree of accuracy in quantitative fit testing.

This information on laminar flow and turbulent flow and stratified flow inside a facepiece is very interesting but we don't know, in the workplace whether it is going to be one or the other or a mixture, whether it is going to change from day to day, from person to person, from device. We are probably going to have to look at all of them and find a technique for dealing with them all.

The same with probe placement. Somebody said to me earlier this morning, don't give me a respirator with 14 probes in it, I can't use it on my work force to do quantitative fit testing.

I think possibly we have a solution, a temporary solution, which might give us some degree of reliability and repeatability, that is, to measure from the exhalation valve. It will deal with the mixing inside the facepiece or non-mixing. It will deal with whether you have the probe in the right place or not. Maybe we should look at that. It may not give us protection factors with ten decimal points behind it. Maybe it is only going to give us 200 or 225 or 250. But it gives us that reliably, that is a lot better than where we are now.

So I guess that while we are thinking about all these complicated things that are going on inside a facepiece, we also think about some simple way of producing some reliable, repeatable numbers. Thank

you.

Mr. Sustello: Rick Sustello, from Wilson Safety Products. In regards to requiring quantitative fit testing for NIOSH certification, I think that we should be reminded that quantitative fit testing is a method to relate the fit factor for a particular person with a particular respirator at a particular time. Trying to quantify a respirator in general for a style of respirator and trying to say that it will provide a particular respirator protection factor is misleading in that one particular respirator could fit one person on this side of the room and may not provide any protection for a person on the other side of the room. So quantitative fit testing should be used in the workplace for the people that are going to be using the respirator.

The quantitative fit testing procedure that is used right now gives a general idea that a particular respirator will provide some protection for a particular person or a respirator has the capability of providing protection for the worker and that the quantitative fit testing should be used for the workers in the workplace that are going to be using it for protection.

Mr. Wilmes: Thank you.

Mr. Wolfred: Rod Wolfred. I was thinking it might be nice for the future to see the use of a clear half mask and do some work with smoke modeling that is being done and use the smoke modeling then to try to develop a flow pattern using a computer to develop a projection of the way in which the flow curves in the face into various facepiece sizes in such a fashion as to create the greatest possible turbulence in the face mask, and then to return to sampling methods that depend upon turbulence and mixing for the measurement. It would seem that would be nice for the future in some sense.

Mr. Wilmes: That sounds good. I would just like to make a comment to

get back to something Jim Johnson said, how he could never get two aerosol physicists to agree on anything. I have had the same experience with fluid dynamics experts. We hear that some flow is laminar or turbulent or stratified, or whatever -- the fluid dynamics people have left me totally up in the air in that they say it is not a case of laminar or turbulent; you can have laminar and turbulent and stratified, and I can't remember the other types of flow, all in the same respirator at the same time, and they are all theoretical. It is not as simple as it sounds -- all you need to do is determine whether it is laminar or turbulent. There are far more complex issues involved than that. Any other comments?

Mr. Moon: Mike Moon, with HSC Corporation. I would like to see one of the academic groups do a study of a probe which takes Warren Myer's contention to a logical extreme. He said the deeper the probe goes into the facepiece, essentially the better results he obtains, better correlation between that type of sampling and the so-called true concentration inside the facepiece. The logical extension of that would be a probe which is closed on the end, open on the sides, and extends all the way to contact the face, possibly between the nose and mouth. I think that such a probe would possibly eliminate a lot of the variability that we have seen from probe locations.

Mr. Wilmes: Any other comments?

Mr. Swift: Could Warren respond to that?

Mr. Myers: I think it is a good idea.

Mr. Wilmes: Warren said it was a good idea and he will make a note of it. If there are no other comments, I would like to thank you very much for coming to this conference. I feel that the issue is - I felt that it was, and is, critical and I appreciate everyone's participation. Thank you.

(Whereupon, at 11:50 a.m., the Conference adjourned)