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EPA/NARSTO PM MEASUREMENT RESEARCH WORKSHOP

"Welcome and Overview"

July 22, 1998

MR. GREENBAUM: Good morning to all of you. I'm hoping that, given the different time zones you all came from, that you're all equally awake or, if not, that you'll catch up some time during the day or by about the time we finish tomorrow, your time zone will be just right for our... For those of you who don't know me, my name is Dan Greenbaum. I'm the President of the Health Effects Institute, and I have the pleasure, with Dan Albritton, to co-chair this session over the next couple of days. As you can tell, we have a few last minute arrangements that are arriving as we speak, but we're looking forward to a couple of productive days here. I think people will be coming in as we get started, but we wanted to keep pretty much on time with this meeting. I want to say that we're pleased to be able to bring this meeting together and want to thank EPA for asking us to do this and their support and the support of a number of people as we move forward with this meeting. We have in front of us, I think, an

enormous opportunity. Major investments over the next several years in the level of air quality monitoring is, in some respects, unprecedented. An opportunity to design that air quality monitoring system, not just as it must do to measure whether an area is in attainment of a new standard or not, but also to dramatically expand our knowledge of a much broader range of pollutants than even just PM10 and PM2.5.

In a moment, Dan Albritton will lay out the context of the charge for our work here today. I wanted to make a couple of general comments as we start. First of all, I think it's important for us to recognize that we have, in some ways, a multi-national audience here, it's a multi-cultural audience, and I don't mean just because we do have some people from Canada here for the meeting and from other countries. In one room we have people from, obviously, from a number of parts of EPA, which probably at times is a multi-cultural experience in and of itself. As well as people from the states and people from different parts of the research community, the health effects, exposure assessment, and atmospheric chemistry parts of the research community, and in each of those groups and between each of those groups, there's plenty to learn from each other. We have not provided for simultaneous translation for this meeting, so I will ask everybody who is engaged and involved to remember that not everyone

in the room will understand what SLAMS or NAMS is or what cytochrome P450 is or other jargon that I could certainly think of, or any one of us could think of along the way.

But, we have asked in these general sessions, and then also very much in the working groups, people to move outside of where they necessarily would ordinarily be. We do have, and we'll get into the details of this a little later, we do have suggested assignments for people into the working groups. You will find that it is not by your disciplines, so that people with a health effects background will find themselves in exposure assessment or in accountability. People with other backgrounds will go into other working groups as well. That is by design. We really do want to get some cross disciplinary discussion going. We want to be able to come out at the end of this, not only with some good ideas, but with some networks and connections built that will serve all of us well as this process moves forward over the next two to five years, as data starts getting collected and as data starts coming in, and I think we have a good opportunity to do that. So, without further ado, and assuming that we're getting set up here, it's my pleasure now to introduce my co-chair, Dan Albritton, who will take us through the context and the purpose of what we're trying to accomplish here.

MR. ALBRITTON: Thanks, Dan. Is this? Check the sound levels out here. Does that pick up okay? Better? Is that better? Good. As Dan mentioned, what I will aim for is to give you a very brief, but broad, overview of why we're here and our procedure for working these two days, and, as Dan mentioned, we're aiming to identify key measurement needs associated with the characterization of ambient PM in a way to aid multiple disciplines. If there's a common point that we hope is going to connect all of the presentations, it's that we are a mix of disciplines here and we have an inherent belief that many of the measurements concern multiple disciplines. We believe we have an opportunity on the issue of PM and health, in the atmospheric side, to take advantage of the communication and the overlap that we hope this workshop will provide.

Now, the way that I'm going to try to do this summary is in five parts. First of all, I'll beg your indulgence for just one overhead context and I apologize to the experts in each of those areas for the brevity of each one and for the fact that you know far more than I do about each of these topics that I'll try to put into context here. Then, secondly, many of us here have been involved in air quality, global climate change, stratospheric ozone depletion. Those issues have taught some of us, perhaps, a few lessons and we

can point to some scar tissue on several aspects of dealing with the science and the effects and the causality aspects of that. I'd like to lay before you just a few personal points of what I think we might have learned from some other issues that would be relevant to us as we plan the measurements and observations of the health PM issue. Thirdly, I begin to converge here to comment where the steering group that organized this, begins to see where the atmospheric observations per se can fit into understanding the complex issue of atmospheric PM health and effects. For example, the types of things that are being talked about from an important compliance standpoint, the things that are being talked about from an important, equally important, understanding standpoint. Then, for the last two overheads, I'd like to summarize for you what the steering committee is proposing, what is our task at this meeting, and that is to examine the draft concept paper structure that we've provided by ELAO and have added additional copies here at this meeting, and to discuss how we hope you're going to help us improve that draft concept paper. Then finally, to outline for you what the next two days are going to look like in terms of sequence and the things that we'll be doing.

So, first of all, in terms of context, let me just very briefly go through that. It will at least put us all at the same starting point of this issue and, as we know,

what originally brought us here, what originally triggered the fact that we're here, is that studies have indicated that if fine particles are elevated, then correlations indicate that aspects of health go down, and that observation, the reporting of that and publishment of that, obviously places before decision makers, who are charged with the responsibility of the public health, think about doing things, and, as this group well knows, this is a U.S. example and there are other such things, as we stated, for Canada and Mexico. But, the U.S. response to this statement and that they've sent and this awareness was the following, namely, earlier, somewhat earlier this year, the PM2.5 standards were issued. We are here and in looking ahead, the plan for this effort calls for periodic review on roughly a five year interval, starting virtually now with the idea of having in place observations that would support and test what these standards state. Then, sometime early in the next decade, have enough information from this and other studies, to begin to consider areas which may not meet those standards. Then to also follow a process of indicating how respondees to the nonattainment are laying their plans and then somewhere out in future decades, the question of compliance to all of that. Classical, regulatory approach to the issue, a time line that is brisk and, while there may be debate, and certainly is debate over

many of the aspects of this, this being on the table led to this example within the U.S.

The third point I wanted to mention is the third part of this triad, and that is if, indeed, there are decisions coming down about what to do about ambient PM because of that, it will be the remainder of the community here that will be turned to for their understanding that links what goes into the atmosphere to the transformations and transport, the direct emission of PM or the formation thereof, and the properties of that. So, from the health, the policy, and the atmospheric aspects, the more integrated this picture can be, the better we, as taxpayers, are getting value for our dollar put into it.

It's that scene that we have before us and there are two elaborations, I think, that are useful from the standpoint of this workshop. Those in the health community could elaborate far better than my simple four bullets that try to illustrate some of the key questions that are sitting in front of the health community. Namely, what's behind this correlation, namely what is the causal constituent or set of constituents, and secondly, how, what are the principal biological mechanisms supported by the body response to any or all and, thirdly, what is it that each of us, as individuals, are exposed to and in particular the susceptible groups that have been identified. Then,

thirdly, trying to characterize the lay out of those susceptible populations. Many, many questions, very intriguing questions, and from the atmospheric standpoint, there's an equally intriguing set of questions. One, what is PM in North America, by abundance, by type, by distribution, by variation? What could be causing those in various places, first pass source attribution, the related characteristics that each source influences, and now, getting a little closer to the bottom line, how smart are we in this community to allow a calculation that would say if we change source I, what would be the responding change in exposure for subject area or population J, which really is now getting to tool making associated with this issue. Then, overarching that are observations that look at what has been happening, what could happen, is it better or worse in the face of actions and, to some extent, the bottom line accountability of this understanding and the actions taken.

The key thing, I think, for this workshop is the question I put at the bottom of the page, and that is what does this overall picture from health and its questions, policy considerations and time tables and atmospheric understanding and tool building, what does this picture imply for research as a whole in the area of health and PM and atmospherics? Yes?

SPEAKER: Dan, we're having

trouble hearing you.

MR. ALBRITTON: The mike is out? I'll speak up until we can do our electronic repair on the fly here. Is there a switch? I don't have a switch. I will speak up until they see how this is going. There are probably five broad points that relate to this picture of PM, health, atmospheric research, and the first one, I think, recognizes the key reason why we're here, namely that this is a joint research problem, associated with the impacts and the understanding needed to ameliorate those impacts. Is this better? Hear better now?

The second point, I believe that everybody understands on PM... What next?

SPEAKER: Try it again.

MR. ALBRITTON: Better, worse, the same? Okay. I will continue, though, I think we all realize that this is going to be a long term issue, not issue du jour, and I think we know the reason for that. That if we were to plot the degree of difficulty in understanding particulate matter and compare to our old friend, ozone, we would need a lot of paper to do that and the key reason is that an ozone is an ozone is an ozone molecule, but very clearly a PM is not a PM is not a PM at all places in all times for all reasons. I believe that those of us that are charged with research planning and policy planning recognize that this point

is a crucial factor for the next couple of decades from the standpoint of doing the research, training students, et cetera, et cetera.

Saying that it's going to be a long term one, we also know full well that there are short term information needs, as it is with any issue that bursts fresh upon the scene. I'll mention two of them. One is, what's out there in North America regarding PM and secondly, if we want to understand trends, an early start on baselines, even though the pay off may be later, an early start is a critical bit of early information and early action. So, to some extent, what you'll be helping us with is setting near term priorities for what clearly will be a long term research issue. Fourth point here, the environmental veterans can point to scars that, and intriguing scars that we can be sure that, for this issue, there are going to be surprises. The reason I can state that with confidence is that I don't know of many counter examples in environmental studies where something has changed the paradigm in the way you've looked at it. The key thing, I think, there is that as an issue as complex as this one, that flexibility in research design, including wild cards that can incorporate a search or an unexpected discovery will be very, very important.

The last point gets you closer to this workshop goal. I'm making a prediction that at least one of those

surprises is going to come from a first of a kind observation, something noted by a new technique, in a new place, that reveals something that we had no idea of. I think the reason for that is that geosciences has classically been an observations limited field and when new break throughs and observations have occurred, our pictures have changed dramatically. One close to home example for many of us here is the unexpected ozone hole over Antarctica, where 15 years of research had not uncovered the quadratic dependence of chlorine and ozone over that particular region. This point, that some of these surprises are going to come from new observations, is another reason that we are here at this workshop.

Now, where do atmospheric observations fit into the scheme of things? Let me go quickly through what many people have been considering in this regard. Overall, research context is challenging and interestingly complex. I've mentioned them graphically before. I'll list the elements of the expertise of this group and I'll point out that already, because of the importance of this issue, several entities, several entities of research planning and evaluation have begun to look at this in a holistic way. The one I wanted to note here is the National Academy study, which has published what is commonly known as the Burning Bush Report. It is the first statement out of

that multidisciplinary group about particulate matter research, and we'll hear a short summary of that Academy activity by my co-chair, Dan Greenbaum, a little bit later.

The issue regarding observations relates to several of these research areas, and let me mention just a pictorial status of how things stand in that regard. If I could call something classic monitoring, I just wanted to put down here some notes on what has already been discussed and presented in several areas. The EPA and the states have underway the mounting of a very large network of reference sites that are aimed largely at evaluating from a compliance standpoint. These are designed and on the way are being put into place as we speak. Secondly, they are considering a smaller number of research sites that do real time speciation of many of these. This is largely a mass oriented measurement network. Then, a key reason that we are here is that they and other organizations foresee the need for special types of observations and monitoring and research sites and the idea of the supersite or highly instrumented site is part of this complex that several entities are looking at.

But, we know full well that the understanding of these items goes far beyond just classic monitoring in an observation sense. Many of us think of these issues with this framework, and what I hope we can do

here at this workshop is not only discuss what we would say as regular monitoring measurements, but how these also fit into field programs in association with this and what kind of connections there are to the other parts of the triad and this.

Related to this picture, we'll have three short summaries this morning about special perspectives of this simple cartoon. Gary Foley will elaborate on EPA's perspective, particularly the approach toward the monitoring and the supersites. Petros Koutrakis will describe the chemical speciation sites, since they very much have a strong research component to them. Then, Peter McMurry will summarize the meeting just held yesterday about the analytical opportunities and challenges associated with the measurements.

Now, okay, so, what do we do here, having converged now from that general discussion? Let me mention just a tiny bit of history that led up to here. Last fall, sponsored by DOE and NARSTO and other organizations, the atmospheric, members of the atmospheric community and the health community met in Georgetown in D.C. and went through much of what I had described and I drew from that meeting severely. Among those conclusions from that meeting, which was hosted by Silva Edgington and Jane Halos, there was a call for us to focus on what we would call supersites or special purpose monitoring. In a way, the path that led

to here started there with that comment. Then, with Russ Weiner assisting from an EPA standpoint, a steering group was put together that had both the atmospheric and the health communities represented. We met here in May of this year and began to talk about what ultimately led to this draft concept paper that each of you now have, and it was written by many members of the steering committee in terms of components and assembled very nicely by Jim Mark into a full write up, and it's this, now, that we want to improve.

Having looked backwards, let me indicate the approach that we'll be taking here. Two questions. First one, what are the measurement needs associated with the science questions or hypotheses regarding, and the steering group put five topics on the table- health, obviously, exposure and source receptors, saying that each of these, if you call it, say, a discipline, each would have their own viewpoint of the health PM issue, and we asked each of these three to write down what are the key science questions or hypotheses from your own personal perspective, what should be measured, where should it be measured and when or what time frequency? Those that had been looking at it in detail see that they have very interesting and valuable answers.

For example, I was particularly fascinated by the listing of the ten components or aspects of PM that

have plausible links to human health degradation. Beautiful starting list from the standpoint of what atmospheric people ought to think about in terms of designing measurements. From the standpoint of exposure, people like myself learned that, obviously, since we can't measure the breathing zone of every individual under all circumstances, we must do that well enough to construct a model, a co-variant model that would allow an overall outdoor exposure values. Outdoor ambient concentrations would be translated into what it means for population X, what it means for location Y, et cetera, et cetera. Very nice write up in terms of the questions and measurement needs for that.

Source receptor, very much an atmospheric question, which is tool building for, related to the solution of things, underscoring very, very much the regional viewpoint, as opposed to a classical fixed point chemical observatory standpoint, linking source and receptor to areas. The steering committee also saw two cross-cutting topics that were very, very important to put on the table here at the outset. One is the issue of accountability and that is, as we start this, are we adequately planning to be able to show progress and, indeed, ultimately show the taxpayers and institutions that solutions are on the way, that solutions are coming. We have comments from a group as to how this relates to measurements.

Then, the fifth point in itself is measurements itself. Namely, PM is a very challenging entity in terms of measurement definition. There are many needs, and three of them are outlined in there, about evaluating various types and developing new types of measurement techniques. For example, they are pointing out the need where the supersites can play a very big role in evaluating the strengths or the shortcomings of the more common federal reference method that is in many, many sites.

The second point that I want to emphasize is really striking to the heart of how this workshop was designed. Where are the overlaps between those five needs? What is common to the different aspects- health, source receptor, exposure? That is, what can be done here at the outset that will simultaneously benefit more than one discipline? An example that was listed in there and we want to try to, in a very large way, flesh that out here. One of the ten hypotheses for a causal agent of health degradation is the organic content of PM. It's an irritant, a mutagen, a carcinogen in terms of some of its aspects. We also know, in reading the methods section, that the type of collection in the FRM loses some of the organic fraction, and so here is a linkage that if the health people want to assess what the role of organics is, we know the shortcomings of one technique and how are we, as a

community, dealing with examples of interconnections between things like health and measurements in this regard?

Finally, now, let me outline for you the course of action at the workshop that we will be aiming at in the next two days. As I mentioned, there will be some short presentations on the various perspectives of this issue, but we get down to business when the five coordinators of those five topics lay out for us the major points that are in that booklet for your consideration. We'll do that here. We'll do it in plenary and that's why this gallery is here. Lunch will occur and there will be seated lunch and they will serve those. That was deemed the most efficient. After lunch, we will meet, we will reconvene, but in this time, in five break out groups, and we'll have posted outside where those groups will be. We've already posted, as Dan Greenbaum said, we've already posted a break out of the attendees here into those groups and, as he indicated, we've tried to do that in a way to give a basic disciplinary core, but to see all the groups with some cross disciplinary input, to move us further along, than purely a one-by-one look through those five topics.

Those break out groups will meet during the afternoon and then briefly, tomorrow, what we would hope is that at the end of the day, the leaders and rapporteurs of those groups will begin to collect

together the major new points raised. They will have a chance for an hour and a-half tomorrow morning to continue that group activity, maybe to present some trial ideas to the group for finalization, because what we are looking for after that is that we will reconvene in plenary about mid-morning, where the group leaders from each of those will summarize for us the key things that those break out groups have come up with. There will be lunch and then in the afternoon, based on what we've heard, several of us will try to pull together the comments we hear from the five groups into what are some of the key new additions at the workshop, what are some of the key commonalities on where, what and when, and to describe some further actions in that regard. This is a fast run through from broad scale to the small scale, and Dan, I'll pass that back to you then.

MR. GREENBAUM: Which of these do I dare try to use? Hello. Right now it's working. Thanks, Dan. By the way, I should have mentioned that if any of you are wondering how it was that we were selected to be the co-chairs, it was clear that you had to have a certain name in order to be a co-chair at this meeting. Maybe we'll make our way through a lion's den somewhere along the way.

It's my pleasure, now, to introduce our next speaker. Gary Foley is the Director of the National

Exposure Research Laboratory for EPA. In most respects, we're here because a number of people in EPA have put together a multi-faceted program for new measurements of particulate matter and its constituents, and Gary's going to lead us off with a summary of EPA's vision for that system to help us, then, do our work over the next couple of days.

"**EPA Vision for PM Measurement Program**"

MR. FOLEY: Can you hear me? Perhaps a little bit closer. Closer? Is this better? Does this work? Everybody in the back can hear? Yes, some waving yes? Okay. I'll try not to move around much because with all the wires here, I could have a catastrophe. We'll see if the microphone holds out for

this talk.

But, I'm here representing all of EPA. This is the presentation that gives the overall EPA perspective and our charge to all of you. First of all, we're here, both in our own right and as a principal sponsor of NARSTO, an important public/private partnership that we really think is doing outstanding work and is now moving into the PM area, after having work in progress on ozone that will continue. We're also the coordinating organization for federal PM health research and so we're here in that capacity.

We owe thanks to quite a number of people for this workshop. First of all, let me thank the panel, Dan Greenbaum and Dan Albritton, for all the work they have done to get us ready for this workshop. Let me thank the Academy committee for their work and their report and their guidance to us, which has been very useful to us in thinking about where we are going to be going with this program and laying out some of the important things that need to be discussed in this workshop. Let me thank all of you for taking the time to come here and to work with us on this. Most of you belong to one of the two communities, either the atmospheric sciences and measurements community or to the health and exposure research communities, and we wanted you all to come together here at this workshop to give us the benefit of your thinking, as we design the supersite

portion of the EPA State Particulate Matter Monitoring Program. Dan has done, I think, a good job of laying out some of the things that need to be thought about and I'm going to try to reiterate some of them from EPA's perspective.

We feel that the considerations in this workshop and the deliberations should extend to all PM research measurements that must be made to meet the needs of the PM research community. Included will be measurements that can be made in and around specific locations, things that we are calling the supersites, and also tiered sets of measurements that can be best made by combining the work at the supersites with the web of chemical speciation sites that will be run by the states under an EPA program with the states, and you'll hear more about that. These considerations that come out of this workshop will guide EPA as it builds its supersites program. We are very dependent upon what we will hear from you to do that. We also hope that this, the results from this workshop, will guide other sponsoring organizations that are planning to do similar measurements in similar sites, and we hope we're setting the stage here for a measurements partnership that will come out of this.

Dan mentioned the draft concept paper on PM measurement research and gave you a little bit of background as to how it was put together. We think this

gives us all an excellent start. We've provided you the companion piece that EPA wrote, called Objectives of the PM Supersites Monitoring Program. As you look at that, you'll see that many of our views are the same as in the piece that Dan Albritton talked about. The two pieces clearly complement one another. The purpose of our objectives piece is to share with you our thinking on why the Supersites Program is needed, the purpose we now see it serving, and describing it in relationship to the rest of the U.S. regulatory or compliance network that EPA and the states are putting into place.

Here at this workshop, we are seeking your thoughts on where, when and how to do this Supersites Program. Our current view comes out of two considerations. First of all, we have a desire to make multiple use of the measurements that are coming out of these supersites. Now, these were originally planned to be sites primarily for a NAAQS attainment, attainment planning, quantitation, accountability purposes, but everybody has strongly advised us to think more broadly and now we really want to know how to make multiple use out of these.

Also, the second consideration is a desire to provide ambient air information that are needed by the researchers that do health effects research, exposure research and atmospheric processes research. We expect this research will test hypotheses on the

relationship of exposure to dose, to health response, on the relationship of ambient to personal exposures and on the relationships of source receptor relationships.

I'm not going to spend a lot of time on this, but I wanted to put up here the time line for the U.S. standard of review and implementation. At the bottom you can see our rough time table for installing supersites and doing the data collection, and we have it as a dotted line because there are still uncertainties as to how long we need to run the data collection in order to satisfy the needs that will come out. We have, also, the NAAQS being reviewed and the implementation program leading to SIP preparation and things like that, where the results of the data collection efforts here, combined with the monitoring data from the other sites that EPA is working with the states on, will be producing. You can see that there are a number of places in the NAAQS review and in the SIP preparation and in the next NAAQS review where the results of this work can have an impact, so we want you all to see that in perspective.

We see our supersites serving three objectives. Certainly it's supporting the state implementation plans through improved understanding of the source receptor relationships, which will lead to improved design, implementation and tracking of control strategy effectiveness of the overall PM control

program. Second, we see the supersites providing monitoring data and samples that will support health and exposure studies, that will lead to a reduction in the scientific uncertainty and hopefully will lead to a better formulation of future national ambient air quality standards, based upon improved understanding of the health risk. Third, we see the supersites serving as a platform for the comparison of emerging sampling methods, comparing them with the current methods and ensuring that we can do a smooth transition from the current methods to new methods.

At the outset, in designing these objectives, we know that the air quality information needed by all of the scientists will call for measurements of multiple components, aerosols in the particulate phase, the gaseous forms that the aerosols interact with. We'll need to know the different chemical and biological species that make up the particulate matter, along with all the co-pollutants and the meteorological variables, and Dan had already covered a bit of that.

Similarly, echoing what Dan talked about, we will need measurements made in different scales, spatially, temporally, of different durations. Some measurements need to be continuous. Some will need to be intermittent and staged over prescribed periods. Different domains. In some cases, the research may need to focus on urban centers and other cases, rural

background areas, sometimes both. Certainly, at times, coming up with different areas representative of different regional aerosol compositions and gradients. To provide this information, the design will probably require multiple layers of measurements, run by multiple participants, and we're here to hear your thoughts on how to do that.

We certainly can take advantage of measurements that are already being made, and this is described in more detail in the EPA report, but I put it up here sort of as a backdrop for you to look at as I talk about the different things. We have the PM10 and PM2.5 regulatory networks, using the federal reference method. We have the Special Purpose Monitoring Program. We have the Regional Haze Monitoring Program, using the improved protocol. We have the Chemical Speciation Program, which personally I think will be most relevant to the supersites. In addition, not on this chart, we have a number of centers which will be conducting intensive regional field campaigns and other measurement work, and these centers are funded by EPA and include the Southern Center for Integrated Studies of Secondary Air Pollutants at Georgia Tech; the Research Consortium on Ozone and Fine Particle Formation in California and the Northeast U.S., under Cal Tech; the Investigations of Factors for Determining the Occurrence of Ozone in Fine Particulates in

Northeastern U.S. under Penn State University. Then we have five Airborne Particulate Matter PM Centers that have been, I guess, the solicitation, has it gone out, Jack, for that or almost?

SPEAKER: It's been out over a month.

MR. FOLEY: Out over a month, okay, and those five centers will be determined, and so we see that those are also important places that will be making measurements that we need to take into account as we design these programs.

So, we're looking for from this workshop advice on what is the crucial missing information that's going to be needed by all of your researchers. First, by having you advise us on what measurements are needed to test the prevalent hypotheses. Second, by considering which of these measurements can be met by the existing and already planned monitoring programs, and third, by looking at the gaps between what's needed and what's available and identifying what can be met by a new set of measurements that could be circumscribed at a supersite.

Let me talk a little bit about how we imagine that this might play out. We're hoping that the workshop will identify the components, scales, duration, domains for future measurements. Commonalities or intersections in measurements which meet our three

objectives will need to be highlighted. This set of needs will need to be compared to existing plans for routine special purpose and speciation monitoring sites and have the gaps, then, identified. We need to look, then, at the ability for the supersites, alone or in combination with others, to fill these gaps. As we get all of this information out of the workshop, EPA then will come up with a proposal for a supersites program and we'll draw that up and present that to our advisory committee, the Clean Air Science Advisory Committee for scientific peer review before being implemented. Agency considerations within this plan could include a supersite monitoring program, beginning in the field as early as the summer of 1999, starting with one or two prototypes or some pilot studies, sites located in typical problem areas, and I'm giving just some examples, there may be others that you can think of. But, areas such as Southern California with its nitrate and carbon dominated aerosol, the northeast with its dominance by wood smoke, the sulfate and acid aerosol dominated northeast, the southeast with its significant biogenic organic carbon and the upper midwest with its heavy influence by industrial sources. In addition, the plan could include supersites designed as platforms in combination with an array of speciation sites; some sites operating for the short term, a year or a couple of years study, some sites being moved from location to

location, some sites operating in whole or in part for a longer term, maybe five to 10 years, if the budget people are willing to let us do that.

Some sites are oriented, might be oriented primarily toward health and exposure information needs. Others may be oriented toward atmospheric process needs, but where we can do both, all the better. We're looking to optimize at these sites the ability to meet the needs of all research groups, and for the health study sites, we envision that there may be a match up to indoor and personal exposure measurements that might be funded out of other research programs.

A few further thoughts to leave you with. First of all, this is not a stand alone regulatory monitoring program. We're planning, at the outset, to tie this wherever we can to the research programs that I've been talking about. The Supersites Program will be an integral part of the array of North American PM research measurements under the NARSTO Program. Timely adoption of new measurements through testing under the Supersites Program is also an important feature. We're interested in using a state of art technology, especially to fill the gaps from information, where we have a lack of suitable methods.

Let me put one last backdrop up here, sort of to give you some thoughts that, some last thoughts, and

say we certainly appreciate your work here and we hope it goes beyond helping us in the design of the supersites and helps us move to building a partnership that I talked about for the Measurement Program. You are playing a very important role. You are identifying the measurements needed by the PM research community at large to be filled by the PM monitoring community at large.

I'd like to take questions now and I'd like to invite Bill Hunt from the Office of Air and Radiation to come up here and join me on the podium to take these questions.

MR. HUNT: Any comments on what Gary said or any comments on the design of the national network? I'd be happy to answer those. Or anything anybody doesn't understand about... It looks like you did a good job, Gary. Okay, thank you.

MR. GREENBAUM: Thank you, Gary. I would like to think that everybody has already read everything that you've provided and that it was so well written and understood that we all have all the answers. But, actually, what I think was really valuable for us, your talk was entitled A Vision, and I think it was. I think that some of the things you described at the end of what we'd like and where we'd like to be, is a shared vision for everybody and we all appreciate that as a way to get started on this work. As I said in introducing

you, I think the fact that EPA has put the thought that it has into thinking about this system, puts us in the position to have this kind of discussion.

<u>"Overview of NAS Report-Research Priorities for Airborne Particulate Matter"</u>

MR. GREENBAUM: I'm now going to

shift gears from being the emcee for a moment to briefly describe the results of the work of the panel of the National Research Council, which most of you know is an arm of the National Academy of Sciences. Jon Samet, who is a member of our Steering Committee and the Chairman of the NRC panel, was unable to attend today. There are a number of members of the panel in the audience, so I assume that they will keep me honest when I say the wrong things, but we thought it was useful to get some background.

The panel issued its first report earlier this year and it was entitled Research Priorities for Airborne Particulate Matter. As I said, this is a panel called the Committee on Research Priorities. It was part of the Board of Environmental Studies and Toxicology, which is part of the larger National Research Council, and published under the auspices of the National Academy Press. This is the list of the panel members who were involved in the first study. As I said, a number of these people are actually here in the room and have been involved in this and participating in this discussion.

Next. This panel was established by the Council at the request of EPA, who was providing the funds, and that was done in response to language in the federal fiscal year 1998 budget, which was approved by the Congress last October, and the panel was organized

quickly and convened in January of 1998. As required in the legislation, it issued its first report, the Burning Bush Report, that Dan Albritton held up, in March of 1998, setting a new land speed record for any report by the National Research Council or a number of other groups I can think of as well. I will pause to note that I think the choice of the Burning Bush was appropriate, given that it probably is the only source we could think of, combustion source that does not put off a fine particulate.

At the core of the panel's work is a paradigm that I think is not unfamiliar to most of you and that is a paradigm that takes you from understanding the sources of airborne particulate matter through ultimately to human health response. We start with understanding those sources and then have to begin to understand in research needs the mechanisms that determine how different sources of particulate matter contribute and then through atmospheric transformation result in certain levels of outdoor ambient air measured in, at monitors. The second piece of that is we have to understand the connections between the outdoor ambient air as measured in mass concentration or in other ways at the monitors, and actual personal exposure and to understand those relationships in more detail. Third, even if we understand what people are actually exposed to, there are a number of questions in

terms of how, once that's at the breathing zone, it actually is inhaled, how much actually is received in different parts of the body and different target tissues in the lung and elsewhere. Finally, but by no means least important, once they are at some target tissue, what are the mechanisms by which such pollutants may cause effects and what are those effects and how severe are they?

Now, for each of these areas, and I will not go over every one of these, the panel identified key uncertainties, a list of 10 all told, areas where the panel thought high priority research needed to be done. Those priorities and those questions in one sense are noncommunal. I think that they are questions that EPA had identified in its research need documents and others had. The panel felt that these were of the highest priority, and if you'll show the next slide.

Probably the most important, the panel added to just a list of needs, what we considered a portfolio of investments. That is, a portfolio in which one invests over time and sets priorities amongst these items, not by saying this is top priority and this is lower priority, but rather by saying, how much should we invest in each of these things in each of the coming years? We laid that out over a 12 to 13 year period and, in an initial cut at this, put some thought into how one stages some of that.

Let me give you an example. I don't expect people in the back of the room to be able to read this. We can get you the full report. But, the top item is outdoor versus human exposure. This question of, in general, when we measure something in an ambient monitor, how does it relate to actual human exposure, and there are certain measurements that the panel thought very much needed to be made and needed to be done right away, that could, in fact, help inform the next review of the standards and that work is underway now in a number of areas.

The second item, however, was taking that to the next level. Once we start identifying, several years out, are there parts of the particulate mass that are more toxic or of more concern? Can we then further understand how people are exposed to those components of PM? So there you see it starting in 2001 in the panel’s portfolio, a staged investment in those items. This was two months worth of work, an effort by people who know these research areas in general to try to come up with estimates. As you'll see in a moment, the panel is now, in preparing its second report, going back into more depth in these areas and trying to identify how to refine and improve upon it. Next slide.

Now, within this, the panel did take a look at some of the early documents that were presented to it by their agency about its monitoring system and it had

some questions and concerns. There's also been some, shall I say, hype about what those concerns were and I thought it would be useful to try and lay out exactly what the panel said about this and how it helped shape the needs for this workshop. The committee recognized that substantial resources must be applied to ambient monitoring to ascertain attainment of standards of various geographic areas. But, it did have some concerns about whether the full scientific value of that data can be accomplished if all of the monitoring and all of the system is fully planned and implemented before some of the research moves forward, and particularly it was concerned that any monitoring program needed to be designed to support the relevant health effects, exposure, and atmospheric modeling research efforts.

Actually, before you go to the next slide, I just wanted to say here that that's, in many respects, the genesis of this workshop, but to be fair to EPA, those of us who got involved in the steering committee got calls before the panel even issued its report, so some of this work was underway before the panel came out with those results. The panel clearly was saying and reemphasizing the important elements. Next slide.

The panel had a number of specific comments. I've put some of them up there. One is that we thought that the current plans, as outlined, were inadequate to

provide all the useful data you need for improving research or risk assessments for PM. That there appeared to be a need for greater use of continuous and hourly monitors, so we could better characterize exposures for people in a variety of times of day and activities, and that more chemical characterization of particulate matter was extremely important to enable testing of specific indicators that were better than just looking at the PM2.5 alone, and that involved both frequent characterization, as well as more detailed characterization. So, overall, the committee recommended that EPA reevaluate its current plans for the monitoring network in light of this report and consider more fully the possibility that future research results might indicate, and this goes back to Dan Albritton's comment about our all being surprised during this process, that the monitoring program may not initially, that indeed, the monitoring program may not in the long term be where we end up as saying it's the most important thing to measure. What we've seen over a number of years is the transitional process in which we've gone from measuring things like TSP to measuring PM10 and now moving to PM2.5, and really all of our hopes is that at the end of these efforts and of workshops like this, that we will be better able to focus and target it over the long term. Last slide, please.

Unlike some committees, this committee doesn't go away with its report. It is continuing. That was the original intent. It has added some expertise in the monitoring atmospheric area. Dr. Fred Anson of Cal Tech, Glen Cass from Cal Tech, Warren White from Washington University and Bart Crows from Karb, some of these people are here today as well. It is in the process of reviewing the monitoring program and current EPA and other research in more detail in order to understand what's underway and how our portfolio intersects with that. In fact, had a very productive meeting about a month ago here in RTP with a variety of people from the EPA, as well as people from NIEHS, and is preparing to issue a second report later this year. The panel is convened for five years and will meet regularly to monitor how the program is going forward and will issue additional reports in 2000 and 2002.

So, with that, I will stop and see if there are any brief questions about the Academy report. Copies are available from the National Academy Press of the full report if you need them, and I think it sets the stage well for what we're trying to do. Any questions?

Okay. Moving on, then, as Dan Albritton suggested, we have two more specific presentations about recent efforts to bring together experts to look at pieces of this overall monitoring network, which we thought it would be valuable to share with the whole

group, so we were all operating on the same basis. The first of those is the results of a workshop that was held several months ago now in Seattle, that looked at the routine speciation network or the speciation network more largely, that is being implemented as part of this, and tried to put together guidance on how that should be put together. Petros Koutrakis of Harvard University, who was one of the Chairs of that workshop, is going to present the results of it.

“The EPA PM Chemical Speciation Network”

MR. KOUTRAKIS: As you know, after the previous speakers, they mentioned about the speciation network, it’s an initiative put together by EPA, but it's a network that's going to be, is going to run... Can you hear now? Now? You want me to scream? So, it's a network which will be run by the states and EPA's going to provide seed funding, but I think it later on will be supported by the states.

Anyway, the main objective of the speciation network is to evaluate, develop and evaluate control technologies. In other words, after five years, we want to know if there is any improvement of air quality. How to do that? You can do it by measuring the trends of the particle mass in each component. It's going to be about 50 sites. The core sites will be located

throughout the United States and these sites will be used for trend analysis. Also, it's going to be 250 sites that they are not going to be run continuously, and they will be used by the states to establish spatial variability of particulate concentrations and mainly they will be used for SIPS. Now, the trends and the SIPS... I'm sorry?

SPEAKER: Jargon.

MR. KOUTRAKIS: Oh, jargon. State implementation plants. These two, the trends and the spatial variability is the main objectives of the speciation network. There is two other objectives, which is to provide data for health studies and other air pollution studies, visibility studies or source apportionment studies. But these are secondary objectives, and the network will be designed to optimize the first objectives. We think that it's going to be a lot of data from even the 50 sites that can be used for epidemiological studies for cross section analysis. There is some issues here, but I will bring them up later on.

EPA has put together a working group that consists of state employees and EPA staff. They have done a lot of work over the last year. They have prepared, they have several meetings, and they've prepared, in collaboration with DRI, a guidance document that describes the different methods available

for measurements, describes analytical methods, sampling methods, procedures, QA procedures, data analysis, et cetera. This document was reviewed by an expert panel, which was elected by EPA, that consists of Dr. Kuger, Kahill, Gandale, Ordo, Stevens and myself, and after there was a meeting in Seattle, where the expert panel and the working group got together for two days to discuss the guidance document and also to make specific recommendations regarding the speciation network.

The major characteristics of this network are flexibility and cost effectiveness. This network is not exactly like a compliance network, where you cannot change anything. Here, there is a lot of flexibility. If the states want to select method A over method B, they can do that. If they want to select the types of analyte, they can do that. Of course there is a minimum requirement, which is... I'm trying to figure out. Yeah, for the 50 core sites there is not much flexibility. The methods would be more or less the same, but for the 250 sites, the states can make decisions regarding the types of analytes and the types of methods. Also, we know that the methods which are available right now might not be accurate and it's a question, of course, which is under investigation and if there is new methods in the future, these methods will be implemented and be used. Also, if there is any continuous instrument that

would be developed in the future that can be used to reduce the cost of the existing integrated receptors, these also would be used by the states. Also, as we discussed today here, it is possible that the health studies that will provide more evidence about which physical, chemical or biological property of aerosols is associated with the observed health effects and probably in one year or two years, we would like to measure europium or cerium or anything that we don't have in our list, so we really have to be flexible to adjust these protocols.

Now, we had to discuss a lot about the monitoring strategy. I think a major issue here is that it is the episodic character of particulate matter and the regional character of particulate matter and for areas like northeastern United States, when we have high levels in New York, we have high levels in Boston and Philadelphia. The composition of aerosols is more or less the same. These areas are impacted by similar types of sources, cars, plants, industry, and so basically there is a lot of similarities among the different environments and also there is not only in composition, but in temporal variability. So it is very important to understand these issues in order to be able to develop a network which is cost effective. This network is not about put a map of hundreds of sites around the United States and have a nice spatial

variability. I think this network, it's already expensive, and will be, it should be cost effective. The selection of the sites should be done in such a way that we address, we understand the big picture. We understand categories of sources, as compared to power plant A versus power plant B.

So, basically, if we consider that, there is very, of course, similarities with ozone. Ozone is to a large extent like that, but C0 is not or N02 is not. So we really have to communicate to the states that this is not about chasing hot spots and this is not about fixing a problem overnight. Lots of particles, if they show up in one state, probably are formed in another state, or are emitted in another state. Some of these particles are primary or secondary, and that has to be understood and that's the reason I think we really have to focus on understanding sources, as compared to go after specific sources.

So besides these, we also commented on the subject frequency. The original proposal was for the 50 core sites to measure every six days, and of course they did that because it was very expensive to run 50 sites and do all the speciation on a more regular basis. However, and I apologize for my slight, we don't believe that you can examine trends on the order of 1 percent or 2 percent for the next 10 years if you have measurements which are not accurate. Measuring every

six days probably will give you a measurement of plus or minus 10 percent for high mass and probably for different species, that variability can go up to 30 percent. It would be ideal, of course, to measure every day because that error would become 0, but I think a compromise was made that we can, probably, every third day collect data and that assessment probably would become, you know, a factor of two.

So, where we stand right now is that the network is going to operate every third day. That also would make it comparable to the improve in the regulatory monitoring and so I think that really is a serious improvement. Also, when you need to do a source apportionment studies and understand relationships between meteorology and emissions and concentrations. If you have only 50 measurements per year, probably it might not be enough. If you have 100 or 150, that gets better. The same for health effects studies. If you wanted to do time series analysis, 50 measurements a year is not enough. Probably 100 per year or maybe 200 for two years would be appropriate. I really believe that these network will provide a lot of data to the health community. 50 sites is a lot. We expect to see variability in composition, and I think this variability might be very useful for cross section or even time series analysis or health effects studies. I think I already discussed this issue, so let's move to...

Thank you.

So the next issue was what kind of chemicals are analyzed. I guess it's a question we should address here today and in order to be able to select the analytes, you have to know what is the use of the data. We thought at first we would say why we need this data and how we will use this data and that will decide which analytes to use. First of all, this data will be used under scan, which are the major components of fine particulate matter that make up the fine particles. We know it's sulfate, carbon, is another organic, nitrate, ammonium and elements in the form of oxides or sulfate nitrate source. So basically we want to analyze these major components. Also, we'll use the data or will be able to use the data, but I guess the scientific community will give access to this also, for quality assurance purposes. If you add the particulates and you find that the composite mass is three times more than what you measured in the field, therefore is it fine mass or one third, that tells you that there is something wrong with the analysis. So I think that has been used in the past from an improved network as a quality control and I think that will be very helpful here.

Finally, this data will be used for qualitative source apportionment studies and I say qualitative because I think, over the last 20 years we have developed methods of source apportionment and we

have relied on them, but I don't really think that these methods are very accurate. We developed methods 20 years ago when we had tracers. We had tracers for lead, for cars it was lead. Now, we don't have those tracers anymore. We find that we did a good job with the primary emissions, so most of the particles in the atmosphere we have are secondary. It is very difficult to do source apportionment secondary particles. Also, we find every day that meteorology drives concentrations and everything goes up and down. We have co-linearities among the different species, so it's very difficult using the existing methods we have to do source apportionment and I hope this new, the supersites and the NARSTO community will be able to develop more sophisticated source receptor relationships.

So, basically here, we want to make sure that people don't understand that we would be able to use this data and say power plant A versus power plant B. This data will be used to understand which are the major components in a very qualitative way and, as such, I don't think we need to do much besides measure some base analytes, which include elements. These elements would be used to determine soil attribution and do some source tracing. Also, these elements, of course, can be used by health studies to understand the relationships between health effects and particles and

metals. The second group includes iron, sulfate, nitrate and ammonia and finally, elemental and organic carbon. We also included an optional analysis that different states might select to analyze species, depending upon the...well, I don't know how this will work. An experimental science. So, basically, the states now, they use a number of analytes, but, they can do, like I think, for northeastern United States, where they use a lot of ammonia. There is aerosols are very acidic, especially during the summer, so it might be more for some of the states, northeastern United States, to measure hydrogen. Hydrogen is more expensive and tricky, but I think for a limited number of sites, would provide very useful information in terms of understanding the acidity of the atmosphere and the availability of ammonia. It's very important information for the NARSTO chemical studies.

Some other states might choose to do organic type of speciation. There is some methods right now, they are expensive, for organic carbon, but organic carbon represents a large fraction of particulate matter. It might be worth, even, for a subset of samples to do organic speciation. Regarding other methods, such as microscopic methods, we have now started electron microscopy because visually electron microscopy and other methods, they provide some information, important, but they are very expensive and it's very

difficult to use them on a routine basis. So I predict that their use will be limited.

Regarding particle size distribution in number, in mass, in size, the panel felt that, although it's a very important barometer for air pollution studies, for this network, the size depends on humidity, the particle number depends upon the flows, the border is to a source of ultra high... So, basically it might not be that useful in terms of the objectives of this network to establish a trends analysis.

Finally, continuous methods will emerge and will appear, probably will be cost effective and the states might decide to use this, as I mentioned before. Regarding the sampling technique, EPA has worked a lot already. They have procured three monitors, samplers that are under development right now and these samplers will be used, they will be our candidate samplers, from which they will select one for the 50 sites, but for the 250 sites, people can use any of these three samplers. The panel did not get enough information to evaluate these samplers. There was only a concept presented in the document. We did not have any data and we were not able to say which sampler is appropriate. I think what we did is probably more reasonable. We provided EPA with guidance, how to select those samplers and once they have the data, they can make the selection themselves.

Some of the states representatives, they felt that since their user rate had improved, they establish familiarity with improved network, we should probably give it a chance to improve a monitor, a sampler. Along with this three candidates, improved now is also a candidate, which will be tested and probably EPA might chose improve over the other three or not. We felt that EPA has to set up a semi-rigorous testing procedure for these samplers. We thought that if you want to use this data for closure or mass closure, it better be that the speciation sampler collects the same amount that the FRM collects and we might not be as picky and put in our square of 95, but probably in our square of 90 and a slope of 1 plus or minus ten percent might be appropriate. But, it would be a crime that we go out and use speciation networks and collect 50 percent of the mass, as compared to FRM. I think the whole network probably would not survive.

For the irons, we felt that there is denuder technologies already out, described by the EPA compendiums, that they can be used to more or less provide accurate measurements for nitrate, so these future speciation samplers should be in good agreement with the denuder systems. Finally, there was a lot of question, what to use for measuring carbon and how to sample carbon. The consensus was that it would be nice to use denuders to at least scrub the gaseous

phase of organics, so what stays on the board's filter is really particulates, but the panel felt that at this stage the denuders are not fully evaluated and field tested and probably, until this happens, which make take six months or one year, the networks should proceed and collect carbon without denuders.

Now, I know some of you use two filters, two quartz filters to measure organic carbon, but the panel felt that we really don't know what that second filter means. Should we add it or subtract it or multiply it? We have no idea, so we felt, in the meantime, until we solve this, we better just measure only the front filter. It's cheaper and probably more reasonable.

Finally, the supersites are very related to this speciation network. I think there is benefits for both networks in the coordinate. First of all, the supersites can be used as testing platforms to evaluate the speciation samplers and also the speciation network can be used as a satellite monitoring to assist the supersites. So I think there is a lot of commonalities here. Finally, the last recommendation from the panel was that there is a lot of good ideas and a lot of enthusiasm about this speciation network, but if we don't want things to collapse in a few years, we have to make sure that EPA assigns a group of scientists that they will oversee and coordinate and work with the states. Otherwise, these things will not be successful.

So the panel really strongly recommends an ongoing and continuous effort here to coordinate things, not only just for the speciation, but also with the other networks that would provide data. Thank you. If you have any questions, I would be happy to answer them. Peter?

MR. McMURRY: You may have to repeat it. I have two questions. Did the panel consider, instead of every third day sampling, just sampling every day in the seasonal month and has the panel done statistics, demonstrating the difference, in order to get an annual and seasonal fixture?

MR. KOUTRAKIS: Yeah.

MR. McMURRY: The second question is how come there's no meteorology there to help with the source attribution? I think that your report reflects too much chemists' influence. If we're sitting on the ground, you can't tell, you know, where the stuff's coming from if you don't understand the atmospheric dynamics.

MR. KOUTRAKIS: Okay. Two very good points.

SPEAKER: Could you repeat the question?

MR. KOUTRAKIS: Yeah, the question is three-fold. If the panel considered to go every day for the summer months or winter months...

SPEAKER: Seasonal.

MR. KOUTRAKIS: Seasonal. That was the first question. The second was if the panel did some statistics to see to what extent every six day versus one day, how you... If the every six measurement days is accurate and every third day. The third question is how come we did not include meteorology here and this speciation network is oriented too much toward chemistry.

Well, to answer the first question. I think something like that would probably hurt the final budget if we had a choice to do every day, so it's a question of resources. The EPA staff and the states, they felt that if we put all the money into the 50 core sites, probably would destroy their 250, but I agree with you and that would be a good idea for a few days. We did not think about that, we were thinking about a whole year, and the reason is that if you do a trends analysis, the question now is how you weigh those days, weeks, where you have everyday measurement versus the other ones. But, I think that's a good suggestion, probably it's possible.

Now, regarding the analysis. I did some analysis myself and Dr. Wilson from EPA did some analysis. Things get ugly if you start doing every six days and things get a little bit better if you get every three days and ideally it would be good to have every

other day at least. But, again, resources is an issue. Every third day was a compromise. I think, for fine particulate matter would probably be okay. I think for aerosol acidity, for some exotic elements, I think the air's going to be too high to make trends.

Finally, considering meteorology, I think this data meant to study trends and that's the basic objective of this study. Now, if meteorologists...let me finish...that does not preclude scientists in EPA to take the meteorological data and try to find relationships between source and receptors based on this data, so we did not really, and Rich wants to add some thinking down there.

SPEAKER: Yeah, Peter, there are people doing meteorology at all the mass speciation sites.

SPEAKER: Only 10 meter meteorology, right?

SPEAKER: Well, in many areas, especially when we are looking at sites where we have the ability to do a radar profile, and things like that.

MR. McMURRY: That's really important, and the other part, it didn’t come out in the workshop report just now, and the other part, what I really meant is if you sample one seasonal month every day, you only measure one-quarter of the entire year in terms of resource and I think we've done a lot of

analysis. A lot of data are out there to analyze the point of once every third day versus once every day for just the seasonal month, assess the seasonal month over time in order to get trends, and also to catch episodes, and it depends on the local regional meteorology as to which one will work. In the western United States, we analyzed that kind of information and we found every third day in the inter-mountain west, it's about right because the episodes seem to go in three day segments, but in the eastern half or the northeastern half of the United States, it doesn't happen that way at all and there's plenty of data around to demonstrate that you get, represent the entire year much better by sampling every day for 30 days in a seasonal month and there will be the same resource requirement.

MR. GREENBAUM: I think Rick Barnett has a quick comment.

SPEAKER: It could be discussed in the workshops, I guess.

MR. BARNETT: Just to follow up on the daily sampling, one of the things in health studies we find is that air pollution has a distributive, time restricted effect on health, holding over for several days, so even if you sample one out of every three days, you know, you're going to underestimate the effect considerably. So I really try to encourage for

human health studies that you get some measurements every day because you're really going to lose a lot of the health signal, one every six or one every three days.

MR. GREENBAUM: That's the kind of thing we need to talk about. We can certainly talk about it in the work groups. Bill?

MR. HUNT: Just a clarification. I think Peter's comment and your previous comment were very interesting, but when you look at the 50 trend sites, which are the national monitoring sites, your trend sites, we're trying to see the impact of the control programs as well over time. When you sample once every third day or once every other day, which is something that we could also do, you're basically lowering the variability you need for the core. The way that annual mean statistic is put together, all four quarters are weighted equally. If you sample in an imbalanced way, you focus your sampling on any one particular quarter, it complicates the calculation of the variance and may not draw down the uncertainties. The other thing, from the standpoint of trying to see progress over time, you're trying to get the best estimate of measurable statistics, which moves you more in the direction of sampling every third day or every other day. Point of clarification, I think it is very important to do this.

MR. WILSON: I wonder if the speciation group considered the possibility of collecting integrated samples. Run a sampler at a lower rate for a week or a month and use that to give seasonal or annual averages.

MR. KOUTRAKIS: I forgot to say that the report, that whoever wants a report, a copy, Jim Homolya has it, and also it will be on the web site, so inside the report we wrote that we considered that. We found a lot of reasons not to accept. Of course, if you have weekly data, probably might not be very useful to the health effects studies. Also, we found that this is not comparable to the rest of the networks, so it would be very difficult to make comparisons. Also, some people, they were concerned about the integrity of the sample if you leave it for a week and you worry about semi-volatiles. I know you had some data that showed it was okay if the acidity was good. But, yes, we did consider it, but we wrote several reasons in the report why we don't think that was a viable solution.

MR. GREENBAUM: Let's go over here.

MR. WESTERDAHL: Just a very quick question.

MR. GREENBAUM: Would you stand up so people can...

MR. WESTERDAHL: You're speaking

primarily about 2.5 size effects, but are you also in the speciation network, considering other size factors like PM10, or at least to get some measure of the coarse fraction?

MR. KOUTRAKIS: That's up to the states if they want to enhance it with other size fractions, but basically this document was put together for PM2.5 speciation.

MR. GREENBAUM: One more over here.

SPEAKER: Just a quick comment. I think that one a month might work if you could retrospectively choose the month you want. In other words, collect all the samples every day and go back home and analyze it. But, if you don't, if you choose a month, you may choose the wrong month. A few years ago in Maryland, we had a Provisiado system sitting off the coast and we had winds from the east, 29 out of 30 days, and normally we get winds from the west. When we get winds from the east, we don't get the sulfate. So it just won't work if you pick the wrong month.

MR. GREENBAUM: You had something?

MR. KOUTRAKIS: Yeah, John Ondov, who was part of the sulfur panel said that if you choose one month in the year and tested every day measurements, you might choose the wrong month, so I

think that's a very good point.

MR. GREENBAUM: Thank you very much. Few of us knew, Petros, that you have a future as a nightclub crooner, the way you held this microphone and wrestled it to the ground. I do want to, as we go forward... First of all, I think some of the discussion that's just going on, there’s going to be room for that to continue and we're going to want more thoughts on that. But, I think it's important for us to step back and think about a couple of important things. We seem to have some dynamic vibration going on with this podium that we asked for.

The two things that I think are important to think about as we go forward into this discussion, and draw from that what we just had. One is to recognize the central importance of building stronger and stronger links, not only between the research community and EPA, but obviously with the states. There are, obviously, many cases where researchers are working closely with their state agencies and we have a number of people from state agencies in the room, but I think that's going to be an important element as we move forward in thinking about how to do that and how to make the most out of these networks.

The second thing I'll say. This last discussion was useful and I'm sure we could all come up with better ways or more detailed ways to monitor and there

are going to be choices along the way. But, for anybody in this room who is familiar, for example, with the challenge, until such a system has been in place, of getting reasonably routine sulfate data, for example, the efforts that were made to get the sulfate data that went into the American Cancer Society's study that was one of the epidemiology studies that happened, that contributed to the debate last year. This system implemented in just the way it was just described, with no added things and without supersites, would be a dramatic improvement over anything we've ever had in those areas, and I think we all need to recognize that. It's not saying it couldn't get better, and it can be, and I think the supersites give us an added ability to just augment that dramatically, but I think for those of us who are familiar, for example, with the scramble to get decent, even basic ambient monitoring data for some of these components, for epidemiology purposes, we are making some major steps forward and I think hopefully we can make even more forward out of this.

All right. With that, there was a workshop that concluded just yesterday here, that looked at different issues around PM measurement and Peter McMurry is going to present to us the results of that workshop, and I'm going to try to suggest that you...

“PM Measurement Workshop Report”

MR. McMURRY: Maybe it would work better if I sing. The SCISSAP Program is the daughter of the Southern Oxygen Study. The Southern Oxygen Study focused primarily on the formation of the secondary gas phase products, especially ozone and

other oxidants. The SCISSAP Program has extended that focus to include secondary particulate matter. The program involves a collaboration among universities, government laboratories and private industry, and it's headquartered at Georgia Tech. The meeting that we held yesterday focused narrowly on the aerosol measurements that will be done as a part of the SCISSAP Program and those measurements are summarized on the first slide. The discussion was to follow the order shown on this slide, and it went in order from sort of the bread and butter measurements that would be done on a routine basis toward more specialized and finding more experimental sorts of measurements.

MR. GREENBAUM: Peter, we have to, we're going to try and do... Okay, thank you.

MR. McMURRY: What I plan to do in my comments this morning is rather than go down these measurements one by one, I thought I'd give somewhat more of an overview discussion of aerosol measurements and incorporate in that discussion some of the comments made yesterday in the workshop discussion.

This slide perhaps provides some general sense of how you might ideally like to carry out aerosol measurements. The ideal, if you had the perfect instrument that provided complete information on the

composition of individual particles, continuously as a function of time, and provided very detailed information with respect to size. Now, one could extend this conceptual diagram to include other dimensions. For example, it may not be adequate in order to answer some hypotheses that we have about particular health effects, simply to know the composition of individual particles. We might, for example, need to know the surface composition of particles because, after all, it's the surface that first makes contact with cells upon deposition in the lungs. So one could add additional dimensions to this and that might then define the perfect aerosol instrument.

We're a long way from having that instrument. Instead, what we're really faced with in terms of current state of the art is that we have some instruments to measure aerosol composition and some instruments to measure sizes or size distributions of particles, and other instruments that measure some integral properties, some total measure in the aerosol, perhaps the amount of light that it scatters or the total number of particles present. But, if I stand over here, Peter, I can't see the slides.

Now, in the color code here, the red corresponds to the type of instrument that we're dealing with and the green indicates the property, the particle property, upon which that measurement depends. So for

example, if we look at sizes, all measurements of aerosol composition, the most common sort of instrument that's used is a cascade impactor. Cascade impactors separate particles according to their aerodynamic size. Aerodynamic size depends on the geometric size, which is what you would measure with a ruler, but it also depends on the density of the particles. It's an inertial effect. It may be that that's exactly what you want for, to calculate deposition in the lungs, for example, but if you're interested in evaluating the scattering, the light scattering by that particle, then you would like to be able to convert that aerodynamic size to effective light scattering size. So we need to have additional information on particle properties, such as the density of the particle or perhaps the shape, which also affects the aerodynamic size, refractive index, which determines the particle's optical size and the amount of water that the particle contains.

Now, another issue that came up in yesterday's discussion was the issue of accuracy. Of course, how true is a measurement to the true value of that aerosol property in the atmosphere and that's a very difficult, in many ways, an intractable question. My personal view is that the best way to move toward more accurate measurements is to attempt to reconcile related measurements made by very different

techniques. So if, for example, you can measure size distribution and measure the density and from those data, determine the particle mass concentration, one can then compare that with the mass concentration obtained with an FRM technique. If they disagree, one or the other or both techniques are wrong. If they agree, there's a possibility they might be right. If you then take another technique, for example, look at speciation, chemical speciation, and try to reconstruct the mass to try to find out if you can reproduce these values. I think this ultimately is the bootstrapping technique that we're going to need to follow to really understand the quality of these various measurement methodologies.

Now the state of the art for aerosol physical measurement is that we have some techniques that do a very good job of providing very fast time resolution of certain so called integral properties, total qualities, the total number of concentration particles, the total amount of light that they scatter and so on. Whereas, there are other techniques, for example, impactors, that provide some sizing information that the integral techniques typically do not, but impactors can provide some sizing resolution, but at the cost of time resolution, the time resolution is, at best, hours typically on the order of a day. One can, there's also instrumentation that can be used to measure size

distributions, and quite a bit of progress has been made in this area in the last several decades. The time resolution is not so good typically as the integral techniques, but it's better than what you can get with an impactor. Typically on the order of minutes.

I think an interesting historical note here is that, oh, for many years, progress in aerosol science primarily was made by the physicists and engineers, and it's only in fairly recent years that chemists have taken an increasing interest in this area, and so I would say that this technology is mature, relative to our ability to measure chemical properties of particles. There's still more to be done, but we've made progress here.

Go on to the next one. So, in summary, the sorts of progress we've made in aerosol physical measurements, we now have fairly good techniques to produce calibration aerosols, all the way from about 3 nanometers up to perhaps 50 microns or so. These calibration techniques enable us to produce particles of known concentration and of known size, and frequently precisely known size. We can typically select the composition of our calibration aerosols and, in some cases, with some of these instruments, we can actually use them to produce size selected atmospheric particles for calibrating instruments. So there's been quite a bit of progress made in that regard.

We also have made quite a bit of progress in our ability to measure size distributions. We can measure them accurately and I've put a question mark after that because we do have this one nagging problem of what are the properties, such as density, refractive index, shape and so on, that make it difficult for us to transform measurements from, for example, optical equivalent size to an aerodynamic equivalent size, and this is an area where I believe more work needs to be done.

To provide you with a perspective on some of the issues that have come up. One integral measurement that one frequently makes is the mass concentration. This is the measurement that is made with the FRM sampler. We've made, these results were put together by Pradeep Saxena and Betsy Andrews at EPRI and they involved summaries of a number of different studies that were made in different places around the country in an effort to reconstruct the measured mass distributions from the measured chemical speciation. You'll notice that, in some places, you can do quite a good job, but in other places, for example in SEAVS, which was done in Tennessee, and Mepier [phonetic], which was done in Arizona, we were unable to account for all of the measured mass, and we really don't know exactly why that is.

We have some hypotheses, of course. One of

the hypotheses is that the mass measurement might have been in error. Another one is that some of these speciation mass concentrations may have been in error, but there are also some other problems. You'll notice that in order to get to the organic carbon particulate mass, we multiply the amount of carbon that's measured with the organic fraction by 1.4 to account for the hydrogen and oxygen and so on in those organic compounds. Some recent work has shown that that number might not be right. It may depend on location and it certainly will depend on the composition of the particles. Many of our uncertainties, in fact, have to do with organics, and I'd like just to show you some examples, not that these are necessarily the most important results, but they provide an example of the sort of uncertainty that we're dealing with. This again, was work down at EPRI by Betsy Andrews and Pradeep Saxena, showing the dependence of that unknown mass fraction on organics and what you see is that the percent of the organic matter in the fine particle fraction was in some way related to the percent of the mass that was unidentified, and there were both positive and negative deviations between the percent of mass and, in other words, in some cases you could account for more than the amount of mass to be measured, in some cases less, and in all cases this appeared to be somehow correlated with organics.

So, a hypothesis this raises, then, is whether or not this is a real result and can we explain why. Another recent result is that frequently we have thermodynamic models that enable us to calculate the amount of water that's associated with the inorganic ion mixture that makes up these particles. But, what we've found is that frequently the amount of water in particles exceeds the amount that can be predicted by these thermodynamic models. Some of the work that was done in our laboratory, we found that there was a correlation between this excess, the difference between the amount of water that's measured in the particles and the amount that you can account for by the thermodynamic model and, again, the organic mass fraction. As the organic mass fraction increased, the excess water increased, suggesting that perhaps some of this water is associated with the organic fraction.

I don't present these last two results as data completed in any regard. I present them as suggestive that perhaps there's an awful lot that we don't understand about the organic fraction that we need to understand to understand fine particle matter.

In terms of some of the major achievements that we've made in aerosol chemical composition, I think a very important achievement since 1980 was the development of the fusion denuder samplers. These samplers enable us to measure the gas phase

composition of semi-volatile compounds that undergo exchange with particulate matter. Indeed, a significant fraction of the fine particle mass is exchangeable, and to a large extent, that's part of what makes fine particle mass measurements in the atmosphere so difficult. I think this was a very, very significant achievement and we've really understood a great deal more about fine particle fraction now than we did in the past. However, it became very apparent from yesterday's discussion that there is no standard accepted technique for measuring even the inorganic species such as nitrate and ammonium compounds. There was a great deal of debate about the appropriate compounds to be used for gas phase denuding. There was a great deal of discussion about the appropriate filter media to be used in filter pack samplers. I think it's fair to say that these systems have improved our ability to measure the fine particle fraction and to measure the semi-volatile compounds but that, even now, after about 15 years of routine use of these techniques, we do not have the perfect solution here.

There was also quite a bit of discussion about applying denuder samplers to semi-volatile organic compounds. We do believe that quite a significant fraction of the atmospheric aerosol is semi-volatile organics, which can exchange and be lost during sampling, and I think it was concluded yesterday that

while in the fairly near future we can expect significant developments in this area, at this time there is no accepted methodology available for measuring both the condensed and gas phase compounds of semi-volatiles, of organics.

We had quite a bit of discussion of single particle mass spectrometry yesterday. There will be a single particle mass spectrometer used by Ann Melbourne during the SCISSAP Program. I think it's felt that these instruments can provide wonderful insights into aerosol sources and behavior in the atmosphere that had not been accessible to us in the past. I believe that another important development, not very recently, but perhaps within the last 10 years or so was impactors that enable us to size segregate samples for chemical speciation down to about 50 nanometers.

There remain some major challenges in terms of characterizing atmospheric chemical properties. I think there's a need for a lot more work, for real time measurements of aerosol composition. Indeed, when I was a graduate student, starting around 1971 or so, this was part of the Holy Grail, we have to develop techniques for continuous measurements and, indeed, some progress has been made since that time, but it's not so easy to go out and buy a commercial instrument to set up at a sampling site to measure sulfate continuously as a function of time. I believe that such

instruments need to be developed. I believe they will be developed with the renewed excitement in this area, and I think it will reduce cost and improve our understanding of atmospheric aerosol behavior.

There is a need for better techniques to measure water in particles. Keep in mind that above 80 percent RH water is the major fine particle species. At this point, we have some indirect techniques for measuring water. There's no direct chemical technique. We have no way of measuring bound water in particles, and I think this is something that we need to improve our methodologies for.

Organic aerosols are, in my view, by far the biggest frontier in aerosol measurement. We don't even have a good way of measuring total organic carbon, as Petros Koutrakis mentioned earlier. We don't know if we should add, subtract or multiply the after filter. Typically when you measure organic carbon by different samplers and different sampling techniques, it's not unusual to find discrepancies of a factor of 2 or more, and keep in mind that in many locations, organic carbon constitutes half the fine particle mass. So this is really an enormous hole in our ability. One of the problems, of course, is that organic carbon is not a species. What we really need to do is develop better techniques for routinely monitoring speciation of the organic fraction.

Finally, this issue of hygroscopicity of the organics, is it real? What are the thermodynamic properties of these hygroscopic property, of what organic compounds? If so, can we calculate the amount of water that they take up as a function of relative humidity? Another area of particular interest to me, we talked the dimension, that impactors can incise particles down to 15 nanometers. Typically, the masses below 100 nanometers are quite small. It's often difficult to get accurate speciation and yet we've heard that one of the hypotheses, one of the 10 hypotheses for health effects in particulate matter is that it might be due to deposition of ultra-fine particles. So there is a need for improved techniques for measuring speciation of the ultra-fine fraction and, indeed, for other reasons there's a need to measure composition of particles even smaller than that, perhaps down smaller than 10 nanometers or so.

It may be important to understand surface composition. The surface is the door through which some high volatile particles exchange in the particles. It's the point that comes into contact with the lungs. We may need to know that. Finally, the gas particle interactions may play an important role in determining mass concentrations of fine particles in the atmosphere and we'll have to develop chemical techniques for both of those sort of interactions.

I have several summary slides to present. The first has to do with measurement accuracy. I think we need to put more effort into establishing accuracy and, as I indicated, I believe that one way to do that, this, is to make related measurements with independent techniques and to attempt to reconcile measurements made by different techniques. Frequently, even a technique that is very carefully calibrated in the laboratory under controlled conditions will not produce accurate results in the atmosphere because the properties of atmospheric aerosols are different from those used in laboratory calibrations.

I think there's a very real need for real time measurements of aerosol composition and I think the community needs to improve on our ability to make such measurements and ultimately to make such techniques available. I think eventually such techniques will replace the filter and impactor techniques and this, of course, is a dream for the future, but I think it will really improve our ability to understand and test hypotheses.

From my view, the individual particle mass spectrometers that have been developed since 1990 are the most significant advance in aerosol measurement in the past two decades or so. I think this is a very exciting development and we read new results from these techniques almost on a monthly basis. They've

already provided important insights into aerosol behavior and it will be a while before they're available for routine monitoring and it's not clear how they would most be effectively used, if at all, on a routine basis, but this is a very exciting development in my view.

I think we need to put more thought into the aerosol water. It's a major component of fine particle species. Organics may be hygroscopic. We should have a better technique to measure water, including ground water. Preferably, a chemical technique. Finally, particulate organic matter is a major contributor to submicron particle mass concentration. The compounds that comprise that particular organic matter have an enormous range of properties. There are hundreds of compounds that vapopressures vary widely. They have a wide range of water solubilities and our understanding of the properties and the sources, both primary and secondary, and the measurement of these compounds is primitive relative to our ability to measure inorganic compounds, and I think we need to do much more work in this area.

I guess I have one more slide and that is that, in my view, the state of the art in aerosol measurement is inadequate to test many of the hypotheses that we might like to test in terms of health effects research and that we need to continue to develop measurement methodologies in concert with hypotheses that might be

raised. I think we can do better than we have done, and I think that we will be doing better because there are a lot, there's a new community of people involved in this work and it's really a very exciting time for aerosol measurement science. I'd be happy to try to answer questions. William?

MR. WILSON: Peter, I agree with your comments that a lot of the advances have come from engineers and physicists, but in terms of the chemistry, I just want to remind people that we do have techniques coming from physics that allow us to measure the elemental content of atmospheric particles on, say, a half hour time interval or with impactors, divided up into size distributions on slightly longer techniques. These are the pixie-Pisa and nuclear generated x-ray techniques, some of which were in use in the late ‘70s, but which have advanced and are available for measuring elements.

MR. McMURRY: Good point. I think those measurements have provided us with some very valuable insights.

SPEAKER: Pete, just as a quick explanation point, could you put that slide up that had percentage of organics versus the aerosol content? I think it was about the fifth slide.

MR. McMURRY: This one?

SPEAKER: Okay, yeah, what's the

difference between a negative percent and a positive percent as identified on the F6?

MR. McMURRY: Is Pradeep here? Do you want to address that question since you were more closely involved?

MR. SAXENA: What that could mean is the difference between chemical mass and what is the critical mass, percent mass. What other means is he using for identifying organic. What means are they using here when they take the sample?

SPEAKER: Okay, so in one case the sum of the parts is more than the whole and in the other case...

MR. SAXENA: Yeah, I can explain, give you a good explanation of why. In fact, the more area there is, the more likely you are to see...

SPEAKER: I have an organizational question, if I might. I just wondered how this workshop was publicized?

MR. McMURRY: The workshop addressed narrowly the needs of the SCISSAP Program and so it was not meant to be an overview workshop of atmospheric particulate matter measurement, and it was organized yesterday because we thought that we might be able to draw in a number of people who would otherwise be coming to this meeting anyway. So it was really, we took advantage of an opportunity that we had

and we invited a number of experts to comment on the proposed measurement methodologies that were used. But, it was not, by any means, meant to be a general workshop on the area of fine particle measurement.

MR. KIANG: I would like to ask a question about the 50 sites, like the speciation, chemical speciation. In the workshop yesterday, you know, scientific community is still debating about some of the chemical species and that how are they going to get the whole 50 sites or all the states or a national policy or standard and how do we get some kind of result and data base, which is reliable and not have a dispute?

MR. McMURRY: Well, I'll just give a quick answer and then maybe I'll let Petros comment as well. My view is that it'll be some time before we can make perfect measurements that are perfectly reliable. I see this as a bootstrapping operation and you do the best that you can do and you find out where the holes are and then you try to fill up those holes, and I think that's what we've been doing. I think that you'll find different holes at different sites, depending on the character of the aerosols and I think that would be very informative, but I don't think that those 50 sites are going to produce perfect results. That's my view.

MR. GREENBAUM: Okay, well, thanks very much. We've come to the end of this first

set of presentations. I think we've gotten a good basis to understand some of both what we do know and some areas we don't know. We're going to take a short break now, let you out of this room, but ask you to get back here by 11:00, after which we will speak to the specific work groups. Now, before people leave, I want to make sure people understand that there is, there are available on the walls outside, and we have copies as well, of the assignments for the work groups. So, during your break, if you could check those out or get a copy, we'd appreciate it. We'll see you back here at 11:00.

(**WHEREUPON**, a break was taken at 10:44 am.)

"Panel Discussion-Research Monitoring Objectives-Charge to Breakout Groups"

MR. ALBRITTON: As I indicated this morning, we are now beginning to look at the five topics, the five topics that are in the draft concept paper, and up here in the front are the group leaders that actually prepared that draft, made it the very nice quality chart that it is. As you can see, our idea is before lunch, is to ask them to comment briefly for any of the five topics, what they believe are the major points, the key science questions, some key measurement needs. They will basically be summarizing for you each of their sections that's in the concept paper, and we can invite, and each of them

invites comments from you about the broader aspects of that. I think from my, at least from my personal perspective, the booklet based on their work and their insight and writing in a very brief, straightforward style, one can almost see in reading through the five parts, commonalities already emerging for what we would hope at the end of this meeting would be moving toward actually a plan, a synthesis or a plan, but things that can accomplish several things at the same time. In fact, Gary Foley, at the end of his summary, briefly walked us through some of those synthesis highlights and they were distinctly pulled from the different parts of the report and it painted a very nice emerging picture.

What we will do is to ask each of them to give a short summary, we'll raise questions, they will lead the breakout groups in the afternoon, and before we break for lunch at 12:30, the hotel will have gotten us the assignments of those breakout groups, and I'll go through that before we leave. Let me, then, ask Joe to start things off from his and colleagues' write up on the health studies.

“Health Effects”

MR. MAUDERLY: Thanks, Dan. I want to go through two or three things just very briefly. One is to sort of give an outline to the present perspective of the health research community on the health effects of particles as a foundation for discussion. Now I want to caution you about several things and I hope to dispel a couple of myths while I'm up here and I'll sort of point those out as we go through. But, I would caution you not to take what's written in that section now as a consensus view of the health community. This was a consensus view of a few people from that community, and it is also not inclusive. I have heard words this morning which suggested to me that there may be an attitude in some quarters that God came down and gave 10 hypotheses, and the true answer to the riddle of particles in health must lie in one of those hypotheses. My friends, I want to warn

you that the truth my not lie in any of those hypotheses. Those just happen to be the things that us health people are talking about most frequently over the last year or so and so let's not overrate the precision of those ideas.

But, first, I want to get at an issue. This is a tutorial. I can't avoid the temptation. Let's put up the first slide. We've got a grossly over qualified projectionist here, but he will do a good job. Now, if you look at picture 1, don't do this right now, just watch what I'm doing, you know. If you look at figure 1 on Page 1 of the introduction in this booklet, there's a figure by a Wilson, et al. Now I know this fellow, Wilson, and I know that he knows that that figure that was developed over 20 years ago would be modified a bit if we looked at it today. But those of you that aren't familiar with these issues need to understand something. It isn't just the ultra-fines that get to the lung. Now there are many models for this and all of them have a lot of truth in them, but this happens to be my favorite one, and I'll just point out that if we look at particle size, assuming unit density, spheres and all that sort of thing, and deposition fraction, the different regions of the respiratory tract, this red is the pulmonary or deep lung deposition and it isn't all down here in the nano particle range and so don't be misled by thinking that there are only certain particle sizes,

any more than you should be misled by thinking that PM10 only includes particles smaller than 10 microns. I mean, we know better than that.

If you look at the tracheal/bronchial deposition, there is a large peak down here in the fine particle range or ultra-fine or almost hesitate to use a descriptor at this point, but there is tracheal/bronchial deposition all along. It is true that big rocks land mostly in the nose, if you happen to be breathing through your nose when you inhale. It is also true that the very fine nano particles have a very high deposition in the nose because of diffusion. It is also true, I can't help but remarking on the cleverness of God, who created fire and then created people and knew sooner or later people would start playing around with fire and then breathe smoke and a lot of the combustion stuff would be in the half micron range, and we have a total deposition minimum right there, and that's pretty clever engineering. But my point is that the particle sampling community should not be thinking that there is this clear distinction between particle size and location of deposition.

Well, now, that was the sermon. Let's go on to the next slide and get more to the point before Dan pulls me off the stand here. Research priorities. This is Mauderly's list of PM research priorities and we could've simplified a lot of committees and discussion if

we just adopted this to start with and that is, the health people are asking these questions. First of all, do they really do it? I mean, it's not at all assured that particles alone are causal in many of these effects. In fact, it's almost virtually assured that particles alone are not causal in many of these effects. Do they do it alone? Which ones do it? Well, that's interesting. Who do they do it to? How much does it take and how do they do it? Now, if we answered those questions, we'd have the riddle solved and then your research agenda, you can set up a target, and if your study will directly answer one of those questions, you get 10 points. If you write a grant and mention particles in the title... So you've had that experience.

So those are the kinds of questions and we're still dealing with very fundamental questions here. We don't know much. Next, Jim, you're on a roll here. What are the research assumptions of the health community in? These are assumptions. We have to make assumptions to do studies. We, in the health community, don't ordinarily just collect data and hope that the truth falls out, although probably more often than we care to admit. But the assumptions, none of which are absolutely proven, are these. First of all, increases in particulate are causally related to the health effects that they're associated with. There is a presumption of causality in order to do the experiments.

The culprit is a subclass. That is, not all particles are equally toxic. Increases occur against a continuous background, and that's very important because we're talking about fluctuations. We're not talking about particles today and no particles tomorrow. The response is manifested in compromised subjects, not everyone is equally susceptible. Death results from a sequence of events. It could be a very complex sequence of events, and particles contribute to that in some way. It may be an indirect way, and the contribution of particles begins with contact with the individual. Now that's a pretty Brady one, but a critical event might not occur at that site. There are cascade effects that can be initiated by the deposition of particles.

So then let's move to the next one. If we take that, then what does the health community speculate about particle characteristics? Again, these are, I think, the 10 hypotheses. They have not yet been carved in stone. In fact, we may totally rearrange these over the course of the next day. Who knows? But these are a list of the things that health people talk about most frequently lately and that's about all they are. We can't forget that, after all, the health data we have come from associations between particle mass, changes in the mass of material in the air, and health. I mean, that's what we know. Mostly, the rest of this is

intelligent speculation. Ultra-fines we know very little about. We're speculating about them because they're there. We're talking about them more and more. We know very little about their actual health importance and virtually nothing about the ultra-fine organic aerosol. Metals, there are very good reasons to be suspicious that, in some cases, metals are important, transition metals, and there are studies that may be further along in this area than in some other areas, showing that, in some cases, metals have evidently been very important in health effects.

Acids. Varied opinions on this. Atmospheric acid and acid aerosols have been a topic for a long time. It's not one we're prepared to dismiss, although when we get down to low concentrations and think about neutralization, you can argue the case either way. But we're not ready to dismiss that. Organic compounds, a huge trunk, which is perhaps a Pandora's box of potential health effects associated with organic compounds. Everything from allergies to cancer and irritation and everything in between. We don't know much about that. There is a lot of speculation, but there has been very little work on the biological origin material in the atmospheric aerosol. Plant, animal origin and what not. Bacteria endotoxins, a whole range of things, that we know could be problems. We don't have very much information about. But, we're not

ready to dismiss that.

Sulfates and nitrates, of course. There have been a lot of studies on those over the years and we know that in some cases they can be toxic and it's logical to think that they may be playing a role. Elemental carbon is primarily a marker for soot and we're concerned about soot. There aren't too many pure carbon particles out there that we're worried about. But, it is a marker for soot and so we're very interested in atmospheric sampling of elemental carbon to tell us something about that material. Oxidant injury is a mechanistic pathway for injury to cells. That is, oxygen radicals being created on the surface of particles or by the interaction of particle borne materials with cells, and so that's a mechanistic pathway we're very interested in. Of course, co-pollutants, which is the overarching hypothesis that there's something out there and it's associated with health and if it's not solely caused by one constituent, then it's the gamish and we need to be doing gamish studies and we don't know much about gamish because we’ve regulated research pollutants one at a time and that's what's been incentivized. But I think most health people believe that the health effects that we see are most likely contributed to by a variety of things, among which are particles, and so my purpose here is to list those, but also to warn you that there are other

possible hypotheses, and we don't really know which of these might be most important and, in fact, you have a range of things here, from mechanisms to mass, and that's not a very coherent list of hypotheses. So I'll stop with that.

MR. ALBRITTON: Any questions or comments? Joe, thank you. Okay, next from the standpoint of exposure. Paul?

"Exposure Assessment"

MR. LIOY: Good morning, everyone. It's a pleasure to be here, and it's a pleasure to have an opportunity to look beyond the initial discussions we had in May and start looking at the idea, what are we going to do about taking measurements that are new and improved and help us understand some of the

serious questions that Joe brought out to us a couple seconds ago.

I think the issue on exposure, I can start out very simply, is through contact, and contact, as Joe made the point, that do people come in contact through chemicals or do they come into contact with the mass itself? So, therefore, if you're going to deal with the issue of exposure, how do we determine, using the measurements that we can make at supersites, whether or not we are able to derive from those data opportunities for determining whether or not people are actually exposed to those chemicals in their daily lives? For personal monitoring studies or for indoor studies, to infer personal monitoring data. It's clear that if we're going to get closer to establishing cause and effect relationships, as well as associations, we need to get closer to where the people who are at risk are, with respect to certain chemical species. That means we have to understand the nature of some of those hypotheses that were stated by Joe in terms of the chemical composition of importance. Obviously, the underserved organic aerosol is a major concern. The relationship between acidity and ammonia neutralization. Do you have acidity in the outdoor air and have no acidity in the indoor air, or do you have it in both places? Clearly these are questions that one needs to have to deal with, but I think importantly from

the standpoint of the supersites, these are questions that we have to consider in terms of what kind of measurements can we make at these supersites or supermeasurement sites that can assist people doing exposure studies and A. redefining the chemicals they're going to be looking at, the aerosol fractions they're looking at, the time scheme of their measurements, and whether or not we can deal with hourly data, or 12 hour data, 24 hour data, to truly come up with an assumption or at least some conclusion about whether or not people are exposed to ambient aerosol and how they were exposed to it over time and in space.

Just taking directly from our summary, one of the things that we really need to do is look at the diurnal profiles of PM. Clearly, it's a complex mixture, specific in size distributions and I think it's important to recognize that we have day time and night time features to the aerosol. There's no question about that. The more closely we can come to what I call real time measurements, the better off we will be in terms of understanding how sources may impact an individual locale. That may not be the best sort of measure for an exposure study. We may not go down to real time measurements of exposure to an organic aerosol. But at least we know what the chemicals of concern are. We can redefine our monitoring strategy better to try to

see if we can look at the chemicals of concern at some longer time interval. Needed for exposure modeling because, clearly, we cannot measure every individual, every subclass of a population that have been exposed to particulate matter. It's just not physically possible. We're dealing with hundreds and hundreds of potential subjects. They're difficult to get and many times they modify their behavior based upon the current status of the type of personal monitor you use. If we can come up with smaller, more effective ways of doing personal monitoring, well, maybe we can find more data. But then we lose the sensitivity in terms of what chemicals we can measure.

We need it for source receptor relationships. One way to look at receptors at this point is, basically, make a subpopulation of a city. Can we establish, using techniques that are currently available and new techniques for source apportionment, to try and understand the impact of particular sources in a neighborhood? This becomes a difficult problem when we deal with a day like today. I flew down this morning at about 6:45 a.m., and flew down from New Jersey down to RTP, North Carolina, and it was a NARSTO day. Everyone who works at NARSTO should be out there drooling. I mean, we have photochemical smog outside that, from my standpoint, when I first started in the field, I would just be enjoying the day, taking

measurements. My wife says I'm a carpetbagger. But, in any case, that means in this type of day, it's a regionality problem and it may not be one particular source. It may be every automobile that you and I drive in the northeast corridor, as well as down through South Carolina and Alabama. That's a concern. So, therefore, coming up with strategies for supersites may not necessarily be individual sites in a city. It may be a combination of sites and measurements because we have broader distributions of populations affected, at least in the eastern part of the country, by this aerosol that's out there today in combination, obviously, with gaseous precursors and secondary products like ozone. So, establishing source receptor relationships. The human exposure question I think is a very important issue.

They should employ state of the art measurements at the supersites because that's how people who are doing exposure research will, in fact, be able to derive new techniques that focus on particular parts of the aerosol that may be of concern. Because right now, our techniques are basically functioning in such a way that we're able to measure mass and maybe a few inorganic chemical constituents like sulfate and maybe organic carbon. But if we’re going to become more sophisticated in terms of understanding what's in the outdoor air to try to determine how much that

penetrates indoors, penetrates into your personal life, we do, in fact, need to know chemical composition better, so we can focus attention on better measurements for monitoring.

We'll talk about the report for five seconds where we had the ten, it seemed like we had a Burning Bush described as our report for NRC by John Bachmann. But one of the things, most important part of our report was that we want to see flexibility. We want to see flexibility in measurements because over time, as we learn more information, we may want to reconstruct what we measure. This comes from the standpoint of exposure studies, as well as from the standpoint of monitoring studies because, in the long run, if we're going to do major trials of epidemiologic studies, I want to see the epidemiologist have the best measure to exposure possible to work with. Whether or not it's from an ambient measuring site or whether it's from personal exposure measurements. To try to reduce the uncertainty in how we can understand the problem. So we need continuous mass measurements and speciation personal continuous monitoring. Obviously, this is going to take a lot of work. It's going to be difficult.

Again, going from the reverse. If we look at, if we take these supersites or supermeasurements, we will get back to understanding better what is out there,

which will provide a focus for toxicological studies, so that they, in fact, can maybe pare away at that list of all these compounds that we say are necessary to test hypotheses on now, to ones where we may, in fact, not have a gamish, but maybe have a bronze bullet or a brass bullet or something closer to a silver bullet that we want to have measured in a toxicologic study, or maybe a series of bullets. But, clearly this is what supersite measurements will help us do. It may be, in fact, we may just end up with the mass, that being the silver bullet. The whole thing. In fact, it has a surface. It has chemicals on the surface, but the inherent fact that you have a mass with an active surface may, in fact, as Peter said, be one of the most important things we have to measure. What is the surface of the particle? What's the surface reactivity? We don't know that. We can't quantify it because frankly we really haven't done that much measurements. That point that Peter brought out I think is very, very important to keep in the back of your minds because it's something we have to worry about because the aerosol is an active dynamic material. It is not just a singular point in space and time.

Well, the group can now go meet where we meet this afternoon. I mean, basically the questions are the questions that were posed. What are the major science questions necessary to, for the supersites to

address to help us understand personal exposure of populations at risk and just the normal population that walks around on days like today in the outdoor air? What needs to be measured? Again, what kind of new and innovative techniques can you come up with for measuring these sites that can push the science forward so we can understand whether or not there are particular components of the ambient air that we truly, in fact, should be measuring in personal monitoring studies. At this point it's an open book. It's an open question. We don't know what it is. The more information we have, the better off we'll be.

Where should the measurements be made? I think they should be made in as many places as possible. Philadelphia. People talk about, well, Philadelphia is just downwind of New Jersey, but I'm telling you that Philadelphia and where I live in New Jersey is not the same. It is not the same as Birmingham, Alabama. It's not the same as Raleigh-Durham, North Carolina area. We have to take these measurements in a variety of locations, in a variety of seasons of the year because even though there is some consistency among aerosol, there may be differences that are important to consider.

When should they be made? As soon as possible. Yesterday. We have a clock that's ticking. Gary’s already put the clock up on the board that's

ticking real fast. But, when should they be made? They should be made basically in a variety of seasons of the year in a situation where you have maybe diurnal sampling, where you have continuous monitoring at some points, but these are questions I think we should bring out in the discussion this afternoon so we can fill in some information, so we can fill some gaps. My feeling is that these supersites and supermeasurements should go forward in such a way as to provide the best possible information to support the research being done, both in epidemiology and exposure and in air quality fields. Thank you.

SPEAKER: Important question. Dan's presentation this morning and your presentation just now has underlying a working hypothesis, which I'm questioning whether it's even worth testing. That you can simulate the exposure that we get, spending most of our time indoors, in malls and in hotels like this and in our homes, from measurements outdoors and it seems to me there's already a lot of information out there that says you can't do it, so why do we have that working hypothesis?

MR. LIOY: My hypothesis is not that. My hypothesis is what contribution does the outdoor air play in terms of personal exposure? So it's not, it's not saying that it does. What is the contribution? Is it 5 percent, 50 percent, 90 percent?

We really don't know because we haven't done enough studies, and so therefore the hypothesis is what is the contribution out there in outdoor air to personal exposure? Thus, the supersite measurements will allow me to focus on chemical composition that will, in fact, be maybe indicative of an outdoor air contribution and to basically push that against information that we will be gathering over the course of the next three to five years or so, on what the composition and the sources of indoor particles are. So it's a different hypothesis. What is the contribution? It could be a 0. It could be 100 percent. Does that help you? Okay.

MR. ALBRITTON: Any others? If not, our third topic was source receptor relationships. We have two people that will speak to different parts of that. Paul, Pradeep, who is going to start off? Pradeep. Okay, thanks. Pradeep.

"Source/Receptor Relationships"

MR. SAXENA: Thank you, Dan. Our assignment today for this agenda was to highlight the major points that were written down in the document. I read the document, I don't have to go through this talk. I give this every year, give it a different twist. What I will do is I will give you the generalized, the major points of the essay that Glen and I wrote and then Glen will give some real life examples on how to implement.

The first point which Dan made this morning is in terms of designing Supersites, we usually do this by designing experiments and not single locations developed to measure these. The exercises were executed for PM and ozone in the past have been done on regional quarter, and in scales we've been thinking in terms of designing regional or urban studies in which Supersites could be a central location, with heavy instrumented experiments and then there could be satellite sites, we set as the number six to eight times in a single location, which would be less as an instrument.

Another point I want to emphasize is to the PM experiment should be synchronized with the other experiments, namely haze, ozone, and relation mass experiments. A lot of our knowledge for PM actually, we know today comes from visibility studies. In fact, the criteria document relies very heavily on accrued

data from other experiments. There's a lot of value there. If we could synchronize special experiments, what Bill Martin does and Edward Voggs with these candescent segments here, then people like Ed Russell who are doing the modeling will have more data at more locations than they otherwise would.

The same is true for regulated installations. There are a lot of data and a lot of experiments that our committee didn't know about and I'll show you an example. So, another point I want to emphasize is we should look at the pure pedicel, not the particle base components only, speciation, that was brought up this morning, generally. The thinking has been about the ions, the OC & C and the elements, and I think for source distribution, for understanding what's out there, as well as what's caused them, we should look at some of the gaseous components and particle components as well.

One thing that could be done is to think about the year round and the episodic measurements, and the idea here is the models that are developed by me and others are more suited for episodic applications with time and technology probably that would be applied for year round applications. However the standard that's limiting right now to versus the annual average trend. So, the question is, how do you deal with this mismatch? One, of course, we could think about is to

have a basis in measurement so these models can be applied at the basic level for year round applications and the more intensive measurement being as it is.

The point of what I did is about, I want to emphasize again, I'll show you a slide, is to not focus on two dimensions. The PM committee so far has been very two dimensional in terms of looking at concentrations at ground level only, and a lot has been learned, in fact, very, as Dan talked about this morning about changing our paradigms, finding out things we didn't know about to achieve understanding. In the Acoli community, for instance, looking at concentration above ground level. Another point is, we shouldn't just think in terms of the mechanistic models as satisfying all our needs, but also the observation based models. Again, Glen has done a lot of work, which I will show a sample, using chemical traces, and again I have done that work using organic chemical traces to perfect those resolutions. So we should think, keep that in mind, when we've done these studies.

The major science questions are very basic as to what is the size and chemical composition of particles and how do they invade time and space, what is the error associated with it, what is the reliability of the models in relating ambient emission to these constellations. Again, we are interested in the PM haze element together, so it seems like we've tried to design

this to look at these things together.

What are the spatial scales of influence? There is some presumption about some parts of aerosols being regional scale, but I think that needs to be tested. What fraction of the part of the dead people who are exposed in the city come from within 50 km and 100 km and 10,000 km. Someone tells me then that out west in Grand Canyon should be lots of spatial scales, but wouldn't apply, for instance, to permeators in the East.

Another thing is how do we think about relationships and innovations in air quality more equally? Again, the presumption is that we can allocate a certain amount of air concentration just because of sources, but what we know from past experience in mass deposition and what's been done in PM and ozone is that these relationships are maybe more meaningful relationships are the changes in asthma concentration, as much as changes in emission. For instance, changes in NAAQS may lead to changes in process concentrations. The sulfate in SO2, damage in SO2 would actually reduce hydro-concentration. Some work has been done in showing that production of VOCs might be also connected in this PM puzzle, so all that has to be looked at through these models.

And another thing is that you, how as best to check into the lab regulating these matters, is how do

they deal with these radical changes? Actually what are the sort of the changes in emission and how do they relate to air quality. In the forest deposition what happens in the South Coast overlaps with the East. And whether you can see a signal, part of the signal reproduced by our assimilations.

Another thing is how receptive are these when checking into the liability of these methods is how do they compare to the sites and then what's happened in the Southern California over the last 15 years, and whether we can see a signal and then how do the signals reproduce by our simulations. Some of the basic concepts of the primary design we proposed for the discussion today is to have what we call Supersites and, as I said, six to eight satellite sites or Supersites and I gave a description of them in the essay, so that the supersites will not have the instrumentations and the other sites are or have less implementation, some methodogically, for the purpose of our essay. Again, as I mentioned, which is again information that they get for the measurement, as well as the information on the surface measurements and allotments. Again, I won't go into details here, but we have come up with a matrix continuous, which we means that we have technicians for 10 minute resolution or less, one hour, four hour and 24 hour measurements that could be used in these. And if we use that study of that point, as a part of the

time point. Another thing we proposed was in the measurement so that we can identify it. Again, if you look at your handout, there is a summary of that in two dimension or one dimension in terms of gases, here's a list of things that we think should be measured both parts of the information and for testing models, and for the breakers and so on. So I won't go into details here, and there is the nitric acid, peroxide, and there are the three items there, which is important for nitric oxide, peroxide, ammonia, nitrate, and chloride, which is important, and the second one is especially. For fine particles, nothings different than what Petros talked about during lunch, I looked at the acidity, organic carbon and organic composition, which is important from a health standpoint, as well as from a mobility standpoint. We also had that and talked about the compounds. We talked about this morning, is having the physical properties of the aerosol, the distributions and all of the properties would be helpful if we were going to be looking at these. Again, as well as the methodology and lastly, the particle formation processes assume for example, for as well as those processes and there going back again to get the run data and the trial transition and the chemistry. How much water have we got? For the example, it would be helpful? In terms of locations, this is what we came up with, the Los Angeles is country by itself. Okay, it's

chemically individualized and unique in terms of equal amount of the gas and sulfate and that's why this has been sited before. For similar reasons, very individual in the quantity and in the sources. Denver where there has been a) lot of work has been done in the past, if we could test for further testing and models. In the Eastern U.S., we thought about this as a regulatory. Four or five regions. The first one is based upon what the modeling shows New York and then the hot spots for high concentrations. And there in the valley, and the upper mid-west, as Dan talked about this morning, again there is some sort of that. Southeast, as you know, is under vast budget, working for the chemistry and then in the Gulf Coast. This is the last slide that I've shown. This is the work done, talked about the creation study, which we are really unaware of and this is 96 July, here at regulatory matter, and what they had done was two aircrafts out of Virginia, and looked at the particle composition as a function of that, and what you see there is the fraction of particles, dry mass that's organic. It goes up as you are higher into the atmosphere. Again, this is one experiment, but the point I want to make is it is something we should consider. Thank you.

MR. CASS: Pradeep and I were asked to consider how the Supersites Program might be used to advance the ability to conduct source

apportionment studies to determine the responsibility for the creation of fine particle concentrations, which would, in turn, assist the long arm control program. In order to support source apportionment work, it's necessary to be able to verify the accuracy of the Arcoli models that are going to be used for source apportionment. So what we did was, we tried to determine how could these Supersites best be used as a basis for model evaluation, particularly the evaluation models that we use for source apportionment work? What we did was, we adopted the construct that the Southern California Air Quality Study had been particularly successful in providing the kind of data needed to evaluate advanced models for conducting assessments with inertia body relationships for fine particulate matter and we tried to determine what sort of extension of that paradigm to the rest of the country might fit within the confines of the Supersite Program.

Basically, what we came up with was first an assessment of where the large scale modeling grid sees us in the country and then a determination of how Supersites might be placed within those grids to act as the basis for cumulative data on the size and composition and distribution of the aerosol, for checking the models that were to be run over those grids. Then I thought I'd show you, perhaps, a few illustrations of what comparisons between models and

measurements might look like from Supersite like measurements.

The first draft that I'm going to show you is a hand drawn sketch that I made up in the last 10 minutes, illustrating the major modeling domains that are in current use in the United States. The modeling domains around Southern California include a box that contains the Los Angeles area from about Point Concepcion down to the Mexican border, mouth of the Pacific Ocean and into the Mojave Desert. Just above that, is another big modeling domain that's used to map the area from Point Concepcion all the way to about the northern boundary of the state of California, principally for use in studying air quality problems that exist in the San Fernando Valley, which for particulate matter, is about serious as the one in Southern California, but it also contains the major coastal cities like San Francisco.

Now, in the Eastern United States, those of you who are familiar with things like the 0 tag modeling process, and those of you who have looked at the wide particle models that Ted Russell is running, or the one's that EPA's research and development people are running, would find that the modeling domain being used for the Eastern United States is basically the entire eastern half of the U.S. That's just a hand drawn sketch. It's not correct in detail, but the general idea

is particle models are going to be run over the entire eastern half of the United States and that if you want to do an extension of the SCAQS like protocol for model evaluation in the Eastern United States, this is the model domain, that entire green area covering the entire eastern half of the United States. So, what we did was, we looked at what would happen if you were to place perhaps five or maybe even six, if you wish, of the Supersites at locations like the ones indicated here with the big red stars, which are in areas that are thought to have either hot spots or major regional importance, and then to scatter around those about six or eight satellite sites each, making more limited measurements, which, nevertheless, could be a boost to the high time resolution, based on sequential filter base sampling over intensive periods of observation needed to get the kind of data for modeling evaluation. But, basically what we're talking about is trying to use Supersite plus intensive speciation modeling sites together, model evaluation data for episodic aerosol processes models over this large region of the country. We're also proposing that year long, or longer series of experiments, based largely on filter based sampling, possibly neurological measurements, be conducted for the purposes of permitting models for any average concentrations to be tested over these domains and also to permit tracer based models, based on receptor

modeling techniques to be exercised over this large domain. The report that we've written contains tables that specify the kinds of measurements to be used. I thought I would show you how models are compared to those sorts of measurements. Essentially, from sequential polar based samples, taken over short periods of time, for example four hour averages. These are SCAQS data from the experiment suggested that we model our efforts on. We're looking at comparisons between aerosol processes and airshed models in which the particle size distributions have added up over the PM 2 to 2.5 size range, over consecutive time periods and compare it against sequential filter samples are taken over four hour periods. Likewise, comparisons can be made for a chemical sub species like black carbon against the model outputs for PM2.5 sulfate, against the model outputs, or, for that matter, sulfates, nitrates, chlorides, ammonium, iron, trace metals are all of the species that are predicted as interval parameters in the particle size distribution. And then we track against sequential samples at each of the monitoring sites during intensive time periods. Comparisons like this could also be made over longer averaging times.

From cascading factor measurements, it is possible to compare the predictions of the air quality models for the size distributed chemical composition in

the aerosol. For example, that runs model predictions of elemental carbons by size and concentration at a particular time against cascade empactor measurements and then the data at that time at Clairmont. So we can check out the size distribution prediction for these models by species. Next slide. From the electronic particle size distribution monitors, it's possible to make comparisons between the measured particle size distributions, particle size against volume concentration, compared to model predictions of the particle size distributions. You can see the measurements are failing us up here, the optical part. The counters are failing to adjust the particle that exist in larger sizes, but the point is general data besides this could be both measured and modeled are not too far wrong. At least we can track to see how close they might agree. You can also note that, no... The actual underlying predictions of the advanced aerosol processes models really look like this. They give you the size distribution and the chemical composition of the airborne particles with fairly high science resolution and it is these model predictions that can be taken apart and aggregated to match the parameters being measured by different sorts of instrumentation at these intensive monitoring sites. Next slide. Now we're interested here. The purpose of this discussion is really to discuss source apportionment. These

models are capable of tracking the sources from which the particles would admit it, and looking at how much diesel soot or whatever happens to be in the atmosphere, how much paved road dust is present from paved road dust sources or sources other than from paved road dust, tracking some of the meat cooking affluent in the atmosphere and so forth, and then looking at the accumulation of secondary aerosol on top of these primary particles. That's the kind of source apportionment information you can get if you can verify the accuracy of the models that you're using and you need high resolution atmospheric data in order to check the model's performance, which is why we wanted to formulate the problem the way I just discussed.

Next slide. Finally, the data that we are proposing to take would permit both trace metals and organic chemical species to be measured from the collective samples in such a way that receptor based models, based on chemical tracer techniques, could be used to support source apportionment work by a variety of techniques. So basically the notion here is define the areas over which source apportionment models are likely to be run, try to adapt a SCAQC like protocol to making intense monitoring efforts at the Supersites that have been discussed, at six or eight locations within the Eastern U.S. or at one or two locations in some of the other modeling domains. Then, to supplement those

measurements with high time resolution with the use of speciation monitors at six or eight times as many intervening sites in order to gather the kind of air quality data that are needed to evaluate model performance and enhance to support source apportionment work. Thank you. It's also, by the way, interesting to note that the measurement program that we've proposed looks very similar to the epidemiologic measurements program that's being conducted in Germany and therefore we believe that the measurements that we're taking, or proposing that be taken, overlap the kinds of measurements that will be chosen by the people in the health effects community as well. Thank you.

MR. ALBRITTON: Thank you, Glen. Questions either for Glen or Pradeep?

SPEAKER: Pradeep, in your multi-phase components, you didn't include organics. Would you care to explain why?

MR. SAXENA: Within that measurement, I was using the VOC as a central gas and the organic for PM, so I think what you're talking about is that program, but I think that is what you mean.

SPEAKER: I noticed in your recommendations for sites, you only had really two northern ones, Chicago and Cincinnati. Did you take into consideration about grand boundaries that stop the

main flow up into Canada or from Canada to the U.S. I'll be generous here. I'm wondering because I think one of the important things that we need to look at is the seamless boundary and the sites that, if we're going to be doing measurements in Canada, which we are, and in the U.S., we have a lot of comparability between the networks being developed.

MR. CASS: I think the key issue here is really funds available to do this work. The six to eight supersites that we're talking about using in the proposed experiment are going to be, when added to the high intense use of speciation monitors during the episodes that will be studied, are going to be spectacularly expensive, possibly exceeding EPA's currently available funds for this purpose. There's not enough money, that I can pull up in any way, that will allow us to add more sites, but I'm certain that the U.S. government would more than appreciate a Canadian sponsored site or two or three on the other side of the border. But, we're talking about the cost issue here. I haven't tried to put a price tag yet on what it would mean because we were simply asked to describe how the intensive monitoring sites or the Supersites could be used in a scientific research program to address source apportionment issues. But I think money is going to become an issue real quick here.

SPEAKER: But I would just like to

supplement that if you do it from a scientific view, that I think it's important to consider the northern climate and what it is, so if you're just looking at that scientific, I don't see it as too many in the northern regions, I agree with you though that finances may be the limiting factor.

MR. CASS: The question we were asked to address was, given the premise of six or seven Supersites, how could they best be used to address source apportionment issues. We were not given a blank check and I, personally, if I had my choice, would like to add a few more stations to this system and one more for the border, certainly, or two more for the border certainly are appropriate from a scientific point of view.

MR. ALBRITTON: Thanks, Don. Certainly, Don, from a scientific perspective, the trans border information content of having such measurements in Canada, we'd really welcome the input here into this, to improve this write up. Peter?

SPEAKER: In Glen's analogue, of course the SCAQC, the site and the sources was very good except for the secondary equipment material, they said was sulfate, nitrate and ammonia. What really is important is finding out where it's coming from and in order to be able to do that, you definitely need diurnal or sub hourly resolution, as well as both ground level

and outside air meteorologists at the Supersites. Now, for these presentation measurements, you see that, but the SCAQC office did not. So, you know, what of the things we have to solve is how do we source attribution to material like sulfate, nitrate and ammonia.

MR. ALBRITTON: I guess that probably the answer is yes.

MR. CASS: Yes. The mechanistic aerosol processes models can be evaluated in terms of their performance against the ability to predict the size and time resolved sulfate, let's say, or nitrate concentrations. Although those models don't reveal directly the source from which the sulfates and nitrates came, that can be learned through simulation of proposed emission control apparatus, by using the models once you've found that they're working well. So you can study sulfate and nitrate control through models evaluated on this basis. It's just that the field experiment doesn't tell you the source attribution directly. In terms of the aircraft type measurements and so forth, those are included in our proposal and they were also included within SCAQC. Perhaps the data have not been used to the extent that they could've been.

MR. ALBRITTON: They have the data available.

SPEAKER: Can I just beg to differ

on one point?

MR. ALBRITTON: Sure.

SPEAKER: Very quickly. What I also wanted to mention is that if you looked at the web page for the University, you could get the report for the Northern Front Air Quality Studies and there we actually were able to make an attempt at observationally doing the secondary allocation. We're not totally dependent on this assimilation.

MR. ALBRITTON: We have two other topics, I mentioned this morning and they cross cut the three that we have just heard. First of those is the concept of accountability, tracking progress, evaluating success and Ken Demerjian will summarize his group's remarks on that.

<u>"Accountability"</u>

MR. DEMERJIAN: Actually, this accountability activity was stimulated back in the early 90's as part of the Academy activity of rethinking the ozone problem and, at the time, I raised the issue of the fact that I felt that the SIP process had not been that effective. It didn't have an accountability process built into it. So, as an extension of that, I've had the opportunity to develop it further for EPA in 1995 with

Phil Rothman and Charley Blanchard and then recently, in this ozone assessment that's being prepared for the ANASCO program, it's going to be further compliant. What I want to do is talk about it in the context of PM2.5 and it's relevance to this Supersite deployment because I think there are aspects of this accountability that will have to be considered if we are going to be responsive to the public need and the public good. So I want to discuss four aspects of this. What does it mean? Why is it important? How is it achieved? What is needed? Then I'll go through what I think should be charged to the workgroup after that. This accountability proposition, say, it actually should work across management problems for all environmental activities, not necessarily just for air, but it could work for water and all types of media and the process is one of which has new components to it, the pathway components of how you actually march through this accountability and then there's a responsibility aspect that someone has to oversee this process. There's actually nothing magic in this. Anyone that balances their checkbook, realize has an obligation to make sure that funds go in and they're managed properly. Presumably, they're responsive to how you use them. That's basically what this process is as well. To give you an idea of what are the pieces that are involved, I'd like to show the next slide. Well, first of all, before we

go into the process. Why is it important? It's important because on any problem, we're spending money and the question is, the public would like to know why we are spending it and is it being spent responsibly, and so in the case of the PM problem, we need to assure the public trust and scientific credibility, that these dollars are being expended in a way at this point to address the problem and, in doing that, there basically is a requirement that the measurements that we make are going to demonstrate that the reaction to the control or the result that we're expecting in the net. In just about any management system, you are responsible to put analytical procedures in place to monitor the progress of the particular actions you're taking and there should be no difference in terms of air quality management as well. Next slide.

The principle steps in the process of this accountability is that when an action is taken in terms of a control requirement, not only there is a process that has to be put into place to demonstrate that, that control is being achieved. So, for example, when the admission control programs in automobiles was put in place, it was a compliance program that requires automobile manufacturers to demonstrate that the vehicle was capable of maintaining or operating with a certain amount of control or whatever the particular component is and they have to demonstrate that at the

factory before the car is released. What we don't have is a process in place that is fool proof to demonstrate that, that compliance continues throughout the life of the car. It's one of the things that should be built into the process. So, if we took, for an example, the PM2.5 issue, one of the questions will be is what will be some of the control actions that will be put in place? For example, if we were to have a reduction in point particulate from diesel exhaust and put in a control program, I would think that what we would have to have in place is a demonstration, not only in terms of at the factory on the engine, but ultimately when we go out and monitor, we want to be able to demonstrate percentage control that is anticipated for the particular vehicle that is being reflected in the air quality. So we have to have a program that will allow us to verify an emissions action taken are really achieved. The next step, of course, is to show that those actions can be monitored in the environment in terms of air quality. That is, that we see over time with the introduction of these reduced particles, producing vehicles, that we see a reduction in a particular component of that material in air quality measurement. The purpose of, one of the purposes I see of the current network that's being put in place, the PM network being put in place, will be its responsibility to demonstrate these types of responses to emissions control. Then ultimately that

process feeds back down to the final result, which is does the reduction in particle air quality demonstrate itself in terms of response to the health effect indicated. So, if, for example, in introducing the PM standard and introducing controls to mitigate and reduce PM air quality in urban centers, the expectation is, for example, one of the expectations is that we will see a reduction in asthma admissions potentially in terms of hospital stays and we need a process built into the system to allow us to demonstrate that and build that into it. So it basically means it demonstrates the ability to show that the emission controls have occurred, that they are, the atmosphere responds in the way we expected, in terms of those emissions controls, and that the environmental indicators that we claim are to be mitigated or to be improved have occurred and the whole method needs to be put together to basically do that. Next slide.

Okay, what is needed? We need successful deployment and commitment to long term measurement programs. We need to be able to measure the components that are most critical in terms of identification to the particular strategies that are going to be embarked on in terms of PM2.5. So that the systems must be coupled in with a health maintenance system. That is, one in which we're going to be able to see the response in terms of health data as a result of

the changes in air quality improvements and then we need a mechanism that's built into the management process that allows us to both track the reductions, as well as look at the various tools that we use to implement these strategies. For example, using the air quality model coupled with the diagnostic model. That those two systems can be used in a continuous mode as we introduce controls and feedbacks are available to support the accountability system in terms of the management process.

What I see as the charge to the workshop is that we need to identify what are the most likely emission controls that it would take, in terms of mitigating the PM2.5 problem. Then we need to ask ourselves, do we have the measurement techniques in place in the current baseline network, regulatory monitoring program and will that be capable of seeing the effects of the emission control. If they're not, how do we need to augment it and help the Supersites be augmented in such a way that they will provide supporting data to help us identify the ability to look at the responsiveness to control of PM. Obviously, for primary particulate a lot easier than for secondary particulate. So we're going to think through, in detail, what will have to be done in terms of monitoring to get at the secondary production choices of the first emissions that relate to those. What measurements

should be added to the network to track the air quality changes in the anticipated PM issues and the varying issues. Okay, next slide.

What are the most likely health indicator measurements to be tracked and to monitor response to the changes in the PM2.5 air quality? There are studies that are ongoing right now. There's an asthma study that's starting up in New York City. The question is, is there a way that we can start introducing the concept of continuous monitoring of health indicators so that they can be coupled into the air quality management system and basically providing this accountability process. What is the most likely ecosystem indicators? For example, the acid rain program has attempted to stop and look at various response functions within the ecosystems. Some of that is related to particle loading. Are there other indicators that we could be tracking that could be used in terms of this closure process? Then, finally, what are the appropriate key fact mechanisms that should be considered within the atmospheric environmental management process to ensure accountability and responsibility in the process? That question leads to the last question, which is what's the role of modern diagnostic tools? How should they be tied into the process? What is going to be the SIP process by which this whole program is going to be implemented? Is it

going to be the same SIP process where everyone goes to the back room and basically comes up with the appropriate emission control, runs it into a bottle, says this is going to get us the results and then 10 years later or five years later, we don't get the result and we ask the question, why? The point is that one needs to tie in touch points within this process in order to assure that the progress is being made in the way that you expected in terms of controls being implemented. We should have measurements to confirm that. I'm going to stop there.

MR. ALBRITTON: Comments? Questions?

SPEAKER: It's a little confusing to me to understand how this accountability process is going to apply when exclusive control factors aren't going to be in cars in the next 10 years. It certainly doesn't fit within the concept of Supersites. Maybe you can explain a little bit.

MR. DEMERJIAN: Here's an example. I think EPA would claim that control is already under way. Well, just to give you an idea of the effects of Title IV on S02 reductions in the northeast and these are total self committees that are over a period from 1980 to 1996. One might argue, and I have this for PM10, as well as and this will actually benefit you. One might argue that at least this gives you some

indication that you're on the right track, there are some interesting results right here that need to be verified, in terms of what's happened to the emissions in '97. The only reason this success is occurring is because under the Title IV Act, we have emission training and actually these numbers are measured numbers. The emission numbers are measured numbers and it's going to be very interesting to see, because they've over, in essence, they've over controlled on the Title IV because there's some reason to believe that actually '97 emissions did go up and when they roll into phase 2, the expectation is that this will come back down. So this is the first step of the process of demonstrating accountability. It says, we made an emissions reduction and the atmosphere has responded in the following way. The first question is, did it respond in the way you expected it? Is it linear, non-linear and if it's non-linear, why is it non-linear, etc. The next step in this, of course, is from a Title IV perspective, has this resulted in a reduction in mitigation in terms of depositions and the impact on the environment. It's actually, I didn't bring it, but the NAPP data would show that there's also been a reduction in wet deposition in this region as a result of this. Then, of course, finally is has the ecosystem responded in the way you expected? So that kind of a process from an acid rain perspective is a much more difficult program when

you're talking about a health effect, but I can not conceive of us continuing to spend the kind of dollars that we do, without giving the public some idea that they're getting something in return for it. The only way you can do that is to demonstrate that you're getting the results that you claim, because that's the whole reason you went into it.

MR. ALBRITTON: Also, cross cutting virtually everything that was said is, as several of them pointed out, innovative and accurate measurements of critical components and Susanne is going to give a summary of their write up and describe the major points that they believe lie on the table in front of us on that particular topic.

“PM Measurement Methods”

MS. HERING: First, I'd like to recognize my cooperatives, Jim Mahr and Philippe Facana. Since I was out of town this was done by the discussion leaders. The previous speakers have really looked at and focused on the measurement needs and hypotheses of modeling needs that are needed in the immediate future here. What do we need in terms of looking at the health effects of particles? What do we need to do in terms of better understanding the sources and the origins of particles, including secondary particles? What do we need to do to better understand the relationship between outdoor air quality and personal exposure, what people actually breathe. What I'm going to, and what our panel is looking at is a slightly different question and that is how do we use the opportunity that is presented to us through these Supersites to build our measurement capabilities for the future? One can certainly believe that it will not be possible to continue for many, many years into the future with the kinds of an intensive monitoring that, and measurements, that have been discussed today. How do we best build our capabilities to gain the information we need in the future at costs that are reasonable to expect?

First of all, I think, in looking at the measurement of particles, we have to go back and

realize, of course, as has been said here is that PM2.5 is not one thing. PM2.5 is many things. We have many different particle sizes. We have many different chemical constituents with many different particle morphology. We also have variable single particle composition. Is it overall particle acidity that matters or maybe is it just having a handful of rather very acidic particles that matter? We also have the question that airborne particles are not really defined apart from their environment. Airborne particles are an aerosol. That means both a gas phase and the solid/liquid phase. There's always this constant interchange, back and forth, with the gas environment for change relative to humidity, affecting water uptake and particle sites. The exchange with vapor constituents, ammonia, nitric acid, organic semi-volatile, that have a very important effect on the particles.

When we look at measurements, there are three broad categories of measurements that are identified in the document. The first one being doing ambient measurements. Also, mentioned is measurements of personal exposure, although that's not the directive of the Supersites. When it comes to measurement methods, it is something that needs to be of concern. Also, the question of compliance monitoring. Just how well or how accurately does the FRM or what does the FRM measure relative to what is

in the ambient air? I think it's also important to recognize that there are different types of monitoring. You could have intensive measurements for, tailored for specific studies, and then there's a different set of issues when one looks at routine monitoring. So, let's go back to our question here, which is how do we build our measurement capability to meet our future needs for health assessment, exposure assessment, source resolution and accountability? I think what needs to be done here and what I'm sort of throwing out a list of questions to you and I'm hoping that in our discussion sessions we get many responses to this, but I see them as somewhat of a three step process. First of all, identifying the need. What parameters? Number of concentrations? What species? So what parameters need to be characterized? Again, parameters with respect to ambient monitoring or personal exposure or compliance monitoring. Some obvious questions that were raised in the document are what types of organic characterization are needed? This is a big unknown right now. Time resolution? What time resolution do we need? How immediately should the data be available? What are the feasibility constraints in terms of taking methods and making them, which are now research methods, and making them into long term monitoring methods? With respect to that, what are the validation requirements? How are we going to field

validate these methods? So these are our needs. Then, we need to look at and identify processing approaches for meeting these measurement needs.

Then, finally, I believe what we're looking at here is the opportunity to compare methods in the field and we listed in the document examining the FRM requirements. We listed taking new methods and comparing, for instance, automated measurement methods with traditional filter based methods. The other issue is comparing different approaches for speciating the organic aerosols or for characterizing the organic aerosol in a meaningful way. Questions on what are the losses of semi-volatile constituents and questions with regard to monitoring is whether or not the performance of these instruments depends on the maintenance schedule and how, you know, how they're operated. Operator dependence is always an issue. Well, I wanted to also show this...Actually, there are things that we know. There have been, in the past, many field method comparisons. I'm sort of treading on ground here, showing data again from the Southern California Air Quality Study, which is now 10 years old, but what we have here is a comparison of two very different measurements and I'm putting this forth as an example of how one, through a field comparison, by comparing methods that one from first principle may suspect that will have opposite kinds of systematic bias

that when you do find an agreement there is some reason to believe that this is an accurate measurement. We have here a comparison of particle nitrate measured by an impacter from that measured with a denuded filter and you can see this is unedited data because there's an outliner. But, the line that's drawn is a one-to-one line and the data are from four cities in the Southern California area. The bottom is the same comparison for sulfate with the same outliner. But we also have comparisons for the physical science of aerosols and here we take the same impacter data, actually impacter measurements made with one type of impacter, the burner impacter for the ions, and for the organic aerosol and the audible aerosol with the medium impacter. I just summed all the size distributions from these two measurement techniques and it's compared with a composite physical science distribution made with, by electrical aerosol measurement and with an audible counter that was calibrated with electrical mobility collected ambient aerosols. I think It's quite interesting to note that similarity in the size distribution. Here we have for wintertime size distribution in Long Beach a union module accumulation known as aerosol, both sides distributions showing similar characteristics. For the summer time in Clairmont, also in the Los Angeles area, we find both sets of measurements, giving us a bi-

model accumulation mode aerosol. In other words, we have a droplet which is a micron and what's called condensation model aerosols. So this is kind of a positive note that I'm trying to show that we can find comparability among measurement methods in the field when performed in a research mode. I think a challenge in the future is going to be taking these kinds of measurements and getting this type of comparison for measurements done in a monitor mode.

MR. ALBRITTON: Thank you, Susanne. Comments? Questions?

SPEAKER: Susanne, in comparing these different kinds of instruments, you really have to take into account the data conversion testing. It seems to me when looking into that area...

MS. HERING: Yes, all of these data, the impacter data were in grids. The physical science distributions were not. They used, in this case, similar techniques for both impacts.

MR. ALBRITTON: Thanks for the summaries. I think that outlines for us the items placed on the table to be discussed this afternoon in smaller groups. Let me say a few words about those and then ask for a few housekeeping questions or comments from our host. The hotel will, after we vacate this, mysteriously divide it into three rooms and they will be theater A, theater B and Russell's, so those in these

groups can return to this area after lunch. The Zurich Room is off to the right as you go out the door, a separate room and the Kings Club is on the third floor up. There's an elevator and a stairwell that go directly up there and this is where the source receptor group will meet. As I mentioned earlier this morning, we had posted breakouts by names of the attendees. We obviously missed some. There were also late registrants. Take your call as to which one you would like to be with, bearing in mind the 6/70/30 split of disciplinary and interdisciplinary, so factor that into your choices. The lunch today will be just outside the door. You saw the tables. They are setting them up. There will be table service. It won't be buffet. That was thought to be quicker. That will be immediately after we break here and then the breakout groups start at 2:00 p.m. this afternoon. I believe that there is a logistical procedural point that EPA wanted to raise.

MR. WIENER: I'm Russell Wiener. I'm representing the chair of the organization. I just need to say a few things. I want to thank everybody for coming and especially wanted to thank ATI and EPRI for donating the support so that we could have the lunches. I also need to ask that all the EPA personnel contribute to the basket at the registration stand. Thank you all. Have a good lunch.

(**WHEREUPON**, a luncheon break was taken followed by

Breakout Groups convening separately.)

C A P T I O N

The Session of the Workshop in the matter, on the date, and at the time and place set out on the title page hereof.

It was requested that the Workshop be taken by the reporter and that same be reduced to typewritten form.

EPA/NARSTO PM MEASUREMENT RESEARCH WORKSHOP

"Breakout Groups Reconvene to Finalize Reports"

July 23, 1998

MR. GREENBAUM: Thank you very much for joining us again. We are going to spend a while now hearing from the workout groups...the workout groups...breakout. We have Jane Fonda and...

SPEAKER: Are you going to start us off with pushups?

SPEAKER: Right.

MR. GREENBAUM: Well, there is something about aerobics and ozone, but...anyway, two items I would like to mention. One is we have had a slight amendment to the agenda, a very important one. Our goal today is to hear from the groups this morning, break for lunch, and then right after lunch, Dan and I are going to try and summarize as best we can, with Jim Morrow's help, what we think came out of the different groups, some of the commonalities and some of the challenges ahead.

We have added a very important piece of that. Rich Scheffe who has the lead responsibility within EPA for implementing this system is going to get up and talk about next steps at the end of that, and I have heard that question from a lot of people, so, where do we go from here. We are both going to talk a little bit about

that and get your ideas on how to proceed from here.

So, we are looking forward to wrapping this up. We may end up actually being able to wrap up a little earlier than we had originally planned which I am sure nobody would mind, but we are looking forward to a productive day.

The second thing I will mention is that if people are interested in getting one of the shuttles back to the airport which I am sure you won't be interested in until after 3:00 o'clock this afternoon, the shuttle company requires some advance notice. So, at the lunch break, you probably need to make sure that you have contacted...if you talk to the contract support staff right at the desk here, they can...they are doing interface with the shuttle company, and you can arrange a ride back with them.

So, we started yesterday and set the context. We had work groups. The steering committee had laid out some initial ideas, and then each of the work groups took those ideas, probably threw them in the trash, and started over again, but we are looking forward to hearing what their comments were.

We are going to start with Joe Mauderly who led the Health Effects group and hear what they have to say.

<u>"Health Effects"</u>

MR. MAUDERLY: Is this working? Well, it seems to be.

The Health Effects group is somewhat of a misnomer. We did have some health people in there. It was quite interesting, because I anticipated coming to

the meeting, when asked to head up that group, that here would be a bunch of health people who would be speaking more or less the same language, and we would wrestle with some issues and give advice and then worry about definitional issues later some time.

In fact, we did have some health people in the session. We spent a lot of time doing something which, although it was a bit frustrating at the time, I think, in the final analysis, was probably very useful, and that is we got hung up in a lot of definitional discussions. Occasionally, after some heated exchanges, we found out that we were really talking about the same thing. We were just using different language.

And that goes along with an idea that I and a number of people have had for some time at these communities, that is, that the health community and the atmospheric measurements community do not interact enough and ought to, and I think we both saw plenty of evidence of that and also perhaps made some headway on some small basis of helping that to happen.

So, with that prelude, let me sort of synthesize what we did do. We dealt with four issues which, actually, we laid out ahead of time. It just happens that Dan and Dan had the same things in mind, and we worked our way through a bit of whether or not the portrayal of the health-based hypotheses about important particle characteristics that are in the draft

document are reasonable.

That was not intended to include everything that people could think of that might be a potential mechanism, but are the major current arguments among the health community of what are likely to be important particle characteristics, is that still reasonable, is our summary reasonable.

Is there any way...and I think this is more of a question than an agenda...is there any way that we can focus on a limited number of characteristics? Because, basically, we want to know everything there is to know about what is in the air.

Is there any advice we can give regarding siting of measurements, and what advice can we give in terms of measurement frequency? Well, having said that, let me just summarize quickly what happened.

There were, again, some definitions that were unclear. We had talked about particle size in the hypotheses. That wasn't very clear. We'll clarify that to make certain people understand we are interested in particle size and particle surface which hadn't been emphasized. When health people think of particle size, usually, they are thinking about that either because of where and how it deposits in the respiratory tract and its surface, but that wasn't explicitly stated.

We had talked about elemental carbon, but we are really interested in that primarily because of its

signal for soot. So, we'll say soot.

There are lots of cofactors. Some of them are co-pollutants and some of them are not, and we'll tune that up a bit. And, again, we'll emphasize more strongly in the text that these are sort of the major hypotheses that are out there among the health community today.

And there are a number...some were mentioned in the discussion, others can be mentioned...that may be an idea that someone is working on about how particles might pester the body in one way or another but are not sort of major hypotheses at this point.

Well, what characteristics should you measure? Can you people just give us a kind of a simple list, preferably a short one? And we'll go about our business.

And, of course, we can't do that, and we worked on this quite a long time from different aspects. It became clear that no, we can't take 20 parameters and really prioritize them very much. The best we can do is say that, for most studies, you are going to want certain key parameters to be measured, and beyond that, it really depends on the study and the arrangements that can be made between the health experimentalist and the people collecting the samples.

But, certainly, we want size fractionated mass

and particle counts. One point that was brought up is that we do have a PM_{10} standard as well as a $PM_{2.5}$ standard. The health community does not feel that the coarse fraction that is between 2.5 and 10 is a throwaway at this point. In fact, there are some strong arguments that, in some cases, that may be driving some health effects. So, we would say don't forget that fraction, and we would hope that supersites aren't just $PM_{2.5}$ supersites but that they are characterization supersites.

Elemental composition is important. There are several kinds of elements that are of interest, especially the metals.

Co-pollutants are very important. In fact, having that information, in some cases, may be more important than increasing detail about the particles themselves.

Meteorology, of course, is important as not a particle characteristic but as co-factors.

And then, we are very interested in sources just as the rest of the community is. We are interested in associating health effects with sources. So, source apportion variation in composition, what are the markers of different sources.

And then, you can get into sort of a second rank of issues, and you could go third and forth rank, and we didn't. We couldn't get that far, but I think that

there are a range of things that we can portray that are sort of must dos and them some additional things that are going to frequently be helpful.

And when you get beyond that into the minute details of the particles and other constituents, then you are really talking about a particular study...no pun intended...a special study that a health person might want to do to address a specific hypothesis, and the next health person that comes along might not be interested in that constituent at all.

So, that is how we would address those issues in the text.

Measurement frequency, it really has to do with the type of study. There are many different kinds of health studies that one would do, and we are talking about studies that one would do in association with a measurement site, whatever that site might be. We are not talking here about studies that are done with materials that are captured from the environment and taken to a laboratory.

So, in the epidemiological realm, studying people in the environment around these sites, there are really three general kinds, although there are subdivisions of each of these: panel studies where you have a group of people with particular characteristics, an old folks home, kids with asthma, people with red hair, whatever, people who have a certain

characteristic that you are interested in because of a hypothesis.

In those cases, almost invariably, you are wanting as much detail as you can get, and even a 24-hour integrated sample may not be sufficient for the study. To the extent that there are continuous monitoring data that people can look at in one to two-hour averages or, at a minimum, 12-hour day/night kinds of averages are really required for those kinds of studies. And you are talking about studies that last on the order of days to weeks. You are not talking about studies that are going to last, in most cases, for years.

And, of course, I am generalizing here grossly.

Time series studies, looking at temporal associations between changes in air quality and changes in health through time. Here, in almost all cases, 24-hour averages are okay, 24-hour data are okay. You don't really need much better resolution than that, and you are talking about studies, though, that do go on, in most cases, for the months to years time frame.

Chronic effects are something else again. It raises a whole different set of questions, and in this case, sampling every third day or there was some discussion about sites that are sampling with certain kinds of samplers that have 2-week integrated samples,

and I guess there is some skepticism from the health side that well, now, gee, we really thought that you couldn't do that. I mean, you lose things off that sample. Right? And it is not a very good sample. But we were assured that, for some parameters, in fact, those are valid samples, but, again, less frequent sampling.

There was not a great deal of comfort that you could take a single 24-hour sample once a week or every six days or something like that and that that would be adequate, but, certainly, you don't need daily samples.

And these studies tend to last for decades. To really understand chronic effects, you are not just doing a cross-sectional study at one point in time. You would have to follow it for decades.

And based on that, it was posited that, for the most part, the, quote, supersites may not be the sites that are really used for those studies, because they may not last for decades.

So, that is what we have to say about timing.

And then the last topic, siting. Several points that were brought out there in a general way. Again, like most of these other topics, this gets to be kind of an endless discussion, depending upon how much detail you want to go into.

One thing that was brought out and then, I

think, reinforced during the session was the fact that in order to contemplate making use of a site for health studies, there is going to have to be a very good degree of coordination. There is going to have to be a commitment that measurements will be done in certain ways, that health studies will be done in certain ways. The bottom line is these things aren't just going to happen.

And there was some discussion as to whether one could really expect the consistency and commitment and so forth, in some cases, flexibility from a contractor operated site. You know, I'd rather not get into the nuances of EPA contracting and funding mechanisms, but the point remains that there needs to be a substantial commitment and advance planning between those forces that are doing the measurements and those forces that are using the data.

Well, having said that, then, what can we say in general? Well, first of all, look for opportunities to take advantage of spatial variations, differences in composition among different sites where if one is using data from the larger number of speciation sites, what the health people would be looking for are differences, because it is those differences we want as an input for our contrast.

Temporal variability. We discussed whether or not temporal variability at a given site is a good

thing or a bad thing, and the consensus was that that is a good thing, that, in fact, if you have variations at site A and variations at site B in addition to differences between those two sites, for most kinds of epidemiological studies, that will prove to be a good thing, not a bad thing.

Movable capability. Now, we got in a discussion which probably could have gone on even longer before we realized that we were talking here on different definitions. The health people sort of came to the meeting charged to say look, we have got to have mobile capability, and then we were told we have got all kinds of mobile capability, but if the tires are rotting in the parking lot, it doesn't work. And we said wait a minute, we didn't know that, and we don't believe that.

Turns out we are not talking mobile. We are talking movable, and that is a big difference, and that is just an example of why we need to be talking more. But the fact is that there are lots of opportunities that we envision for studies in which you would want a, quote, super capability or perhaps an enhanced speciation site in a particular location, not just in a city, but within some component of that airshed to match up with a panel study, a particular population that you are interested in.

So, to the extent that it can be considered within this supersite framework, some capability for

being able to move into an area. Now, I don't care what you call that, and I don't care whether it comes on 18 wheels and you can fire it up every morning and move it which we don't really want to do, trying to chase these people down the street, or whether you have to make five trips to move it and it takes two weeks to set it up. We really don't care. All we want is some reassurance that if we identify a really hot group of people to study, that we might actually get some measurement capability there, and that is what we mean.

Well, coordinated national studies. I mean, one point that came up is the idea that...well, ideas like this, and you have all heard them. Gee, if we just knew where these five particle research centers were going to be, that is where we'll put a supersite. They'll do the work, you know, God is happy, good science occurs.

But there is a lot of skepticism about that, and there is a plea that to the extent possible that a range of sites be taken advantage of, if not all of them, and that studies that are coordinated across not only this country but certain portions of others might be involved in coordinated studies. So, the value of that was mentioned. Much greater value to be derived there in some kinds of studies than what would be possible at any one site.

Then, another point that was brought up is using supersites as platforms for collecting samples to

take into the laboratory, concentrated particles or organics on a track or whatever that might be. It is recognized that it is not likely to be the mission of the supersite itself to be in the business of collecting those samples regularly.

That would be nice. The health people could drive up their SUV and open the back door and load in a 100-pound sack of, you know, last year's particles, preferably for 25 cents a sack, and we'd take them off to the laboratory and do something about health.

But recognizing that that may not be the mission of the site, at least the opportunity, the openness to use that site as a platform for making a collection to capture materials to take to the laboratory and leverage, then, on the other information that is collected at that site.

So, that is about...that is the gentle distillation of what we talked about.

MR. GREENBAUM: Thanks, Joe. Do people have questions for Joe? We'll take one or two questions now.

SPEAKER: You said something about SIP. SIP is not a very good nomenclature for carbon. There are two forms of carbon. There is the condensable carbon, and then there is the black carbon, and the scientists...chemists...who examined, black carbon they called C_{de} which is elemental carbon,

and the soot is a combination of the black carbon and the condensable carbon.

MR. MAUDERLY: Indeed, the health scientists are aware of that, and we do study those things. In fact, that rationale was why we talked about elemental carbon in the initial draft, and that is what got us in trouble, because when it comes right down to it, what the people are interested in knowing was the health effects of the soot which, of course, is a combination of materials.

SPEAKER: So, that is total carbon.

MR. MAUDERLY: Well, that is total carbon on those particles. There is other carbon in the air as well. So, that is exactly why that was put up there, is that distinction, and that points out one of the...the terminology issues. But what people are really interested...there are some people that are interested in the toxicity of the black elemental carbon. Okay? But for the most part, what people are interested in is the combined material as soot.

MR. GREENBAUM: So...is this on the same point?

MR. DEMERJIAN: Yeah, I think it is important, because in the speciation document, EPA defines elemental carbon and organic carbon in a very different way. I don't care what the concessions will be, but we really have...we have two methods, national

methods, and we have to use the same language. So, we either go back and change the speciation or we make, you know...some people worry about this, because it is going to be a big conflict, you know.

MR. GREENBAUM: Well, this is a perfect point that we are going to have to work out in the...in kind of some way and integrate it, but I think what we are hearing here is two different cuts that have been made of this and some different reasons for doing that, and that is fine. We need to sort out how to do that.

Will?

SPEAKER: Could you comment briefly on the biologicals? That didn't make the first cut of your ranking? Is that...could you elaborate on that?

MR. MAUDERLY: Well, biologicals were mentioned among the hypotheses that people frequently talk about. And, in fact, we don't know much about that, but there are reasons to speculate that biologically...materials of biological origin that we inhale in the air, quite often on particles, contribute to allergenic responses and several other kinds of responses, endotoxins and so forth.

But when it comes down to prioritizing studies and prioritizing the kinds of samples to be collected on a routine basis, it was not thought that that would rank

up there among the top few.

Now, you would be very interested in, you know, understanding the composition, the biological composition of particles on a selective basis, but out of our group, we did not come to the point where we thought that, on a routine basis, that was a constituent that we were interested in seeing on a daily or on an integrated basis.

So, that is the difference. I mean, am I being obscure here? In the first case, we are talking about what are the hypotheses people are discussing. Okay? And some of them lots of people are working on; some of them a few people are working on.

And then, over here, we are talking about well, what are the sort of most important things to measure to enable studies to be done? And the studies at the supersites from a health standpoint, the studies associated with the sites are largely epidemiological studies.

And there is interest in the exposure of people to biological materials. That is probably more likely to be examined by panel studies or more specific studies rather than the routine work.

That is the best rationale I can give you for that difference. In other words, we did not go about taking the biological hypotheses, you know, of the year sort of thing and then saying well, each one of those

has to correspond to a measurement to address the hypothesis. We did not take that approach.

MR. GREENBAUM: First of all, I think we appreciate the fact every group came up with a longer list than will possibly be able to be measured on a routine basis. I think what is important to understand is that routine measurements at every supersite, for example, does not preclude that some subset of supersites might do additional measurements because there is somebody designing a health study around it and looking at biologicals, and you would have the benefit of that.

So, I think it is important...but it is useful to do that. I'll be interested to see what the other groups have to say on that.

I have one more comment over here, and then we are going to go on.

SPEAKER: I think the term soot would be very nice if we could use it, but none of us are going to know soot unless you can do it by microscopy. You can only know elemental carbon by doing measurement. You are not going to have a number for soot.

SPEAKER: But even elemental carbon is an operative definition. You can find elemental carbon quite operatively, and it is not a very meaningful number.

MR. GREENBAUM: Can I just suggest that we...I am going to suggest this, at lunch, we can have a soot table, and we can work things out there.

This is great to hear. This is exactly...and I knew that the use of a highly scientific term like soot would bring some reaction, but, on the other hand, I think underlying that...because I know Joe all too well...is some thinking about biologically what might be interesting versus what we are actually measuring, and that is part of the idea of having the health effects and the measurement people together.

So, we don't have to call it the soot table. We could call it the elemental carbon table, but...anyway, thank you very much.

Can we have the microphone back?

MR. MAUDERLY: No.

SPEAKER: It is the only one that works.

MR. GREENBAUM: In the back of the room, you are still hearing most of this? We should do a better job of repeating the questions, and we will do that.

Next, we have the leader of the group that looked at exposure assessment and its needs, Paul Lioy, and he is going to take us through that.

"Exposure Assessment"

MR. LIOY: We had a rather lively group. I think we probably disturbed Joe half the day yesterday, because our room was very interesting. We had no exit to the outside world except in front of his group. So, therefore, you had the lead panelist, Joe Mauderly, and his two rapporteurs being constantly interrupted by a group of people walking out going to the bathroom and getting soda. We apologize for that, Joe.

MR. MAUDERLY: We know you are

truly sorry.

MR. LIOY: But in any case, we did accomplish a few things yesterday. We had a definition problem, and we had some problems with communication, and just like there was a communication problem between health and atmospheric science and health and exposure, we still have those communication problems. There is still a communication problem between exposure and air quality, and it is clear that meetings like this, I think, are very useful in helping us break down some barriers and recognizing that we are truly trying to go in the right, same direction, although we have different methods and different approaches.

Well, we started out with a hypothesis, and we said that supersite measurements can be used to establish the compounds, indicators, and mass fraction of PM that must be measured, and exposure studies to determine the portion of the ambient PM and its chemical constituents that contribute to total particle exposure, sort of a working hypothesis saying that well, gee whiz, we have to start out with something saying that...you are not going to go with the null hypothesis. We are going to say that there is some possibility that PM in the ambient air does, in fact, reach to human being.

And we feel that if the supersites will take certain types of measurements that will be useful to us,

they should provide us with oh, three major goals in terms of the exposure community. One is to provide information on the range and variability of pollutants necessary to address the ten hypotheses, your ten hypotheses, Joe. You didn't give me any details, though. That was a frustration, because you didn't list the chemicals of concern.

That is a problem, and we'll talk about that in a little bit, the issues of the ten hypotheses. There are a whole group of chemicals, and there are going to be maybe 1000 chemicals within that group that one can consider measuring, but I think we have to come to grips with the fact that we can't measure everything.

We need to establish the presence of these pollutants in the ambient air, because if we are going to do exposure studies, we want to be able to invest time, effort, and money on looking at those pollutants which actually have some levels in the ambient air and may, in fact, define a level of concern for that pollutant in the ambient air.

We want to identify key variables for selection of future health and exposure studies. At the end of the day, if these supersites can give us new methods, innovative technology that will allow us to then develop new exposure metrics that can actually be applied to health studies which will look at more detailed characterization of the ambient air, whether it is PM_{10},

$PM_{2.5}$, ultrafine particles, or the chemical constituents thereof.

Second goal we feel that the supersites can help us achieve is to provide information to design the next generation of exposure and microenvironmental monitors. It will help focus personal microenvironmental monitors and measurements on pollutants related to the ten health hypotheses.

Again, specific chemicals within those hypotheses, not the 1000. We are not going to measure 1000 pollutants with a personal monitor. Folks will not strap...have a backpack strapped to his back weighing about 1000 pounds to carry over the pumps and batteries needed to operate it. This won't work.

This is also needed to help determine personal and microenvironmental exposures derived from the ambient PM. So, therefore, we feel those will help us design the next generation of exposure monitors and microenvironmental monitors.

Now, for those of you who want to know what the definition of microenvironmental monitoring is, it is basically monitoring we do in some enclosed space like a person's home or a building. It is not an ambient monitor, because the volume of air...if you suck out too much of the air, basically, you will suck out all the pollutants in the air, and you'll have cleaner air in your building. You have to balance the amount of flow with

making sure you don't disrupt what the internal ventilation rate of the building is. So, a microenvironmental monitor is designed to deal with a specific space.

Goal number 3, I think, is a goal that we feel is very important for future modeling efforts and the current modeling effort. We want to provide information needed to supply the next generation of exposure models for estimation of population exposure to PM as well as current generation of models that are going to be used for the next round of standards evaluation. This will help reduce uncertainties currently associated with estimates of ambient exposures and subsequent dose received for the ten health hypotheses.

Again, if we can get better information on selected chemicals which have some association with the health concerns that are being studied in toxicological studies, this will help us to make estimates of exposure that clearly go beyond what we do now which is basically using default factors and estimates of what chemical constituents of concern based upon, let's say, a sulfate value. You assume a sulfate value, and then you say the sulfate to hydrogen ion ratio. Well, that may not be true for most people. You might want to be able to get better information for a particular urban area to look at...derive the outdoor concentrations of acidity.

That has been done more for organics, but I just wanted to use an example.

We also provide more realistic information on exposure paths for compounds and size mass fractions of concern for ambient air, meaning that if we can get better speciation at these supersites, we'll be in a much better position to understand the variability of outdoor exposures rather than using estimates alone.

We need a monitoring strategy that will allow you to...hopefully, when you link up with the need for source apportionment and link up with the needs for health information, that will be able to provide us with the type of data that will be useful in designing exposure studies. Remember, I am focusing on key information that we need for exposure studies.

It would be very nice to have supersite-specific hypotheses, and I think that goes to the point that Joe was heading toward, is that the mobility factor in these supersites, I think, is very important. You have to take into account the idea that not all urban areas are the same, although for some places, there will be some general characteristics that are the same, but we have to assure ourselves we don't miss opportunities to understand populations at higher risk as well as general segments of the population which may be at moderate risk in the world's large cities.

We want to link with ongoing research in the

air quality and exposure personal indoor studies. This is a desirable thing, but it is not a necessity, but in some cases where you can do this, well, we suggest that you do it, but, again, don't use that as the prime example, because there may be, again, opportunities out there we have not touched. So, I think the idea of having supersites that have more flexibility is very useful.

Looking at spatial and temporal variability, measure contaminants in classes associated with the top ten health effects hypotheses, we feel, is very important, because that will help us in terms of exposure as well as the other groups.

Characteristics for populations near sites should be considered. The duration of certain site activities for fixed sites, not meaning fixed in terms of popping in the building. It could be an 18-wheeler that is plopped in a location for a year to two to three years...as well as having mobile type operations where you can stay in a location for a month and do intensive, provide data in the area that may have characteristically interesting problems, and that will eventually lead to the development of more sophisticated exposure studies and coordination with health studies.

Collect particles for storage and future characterization. Sample bank for physical, chemical,

and toxic materials and, I'd say, good biologicals.

I think that the issue of biologicals should not be understated. I think it should be put into the context of using it as a class of material that we should sample, maybe not every day, although some people in our group suggested every day. I will not ignore that, but the clear thing is we should have a reasonable amount of biological measurement, the measuring of biologicals.

This is an issue, number 8, which we feel is very important, coordination of satellite site monitoring with supersite measurements. Let's say you have a supersite for a year, year and a half, but you have all these speciation sites hanging around. Well, we feel that it is very important that these speciation sites have some flexibility in terms of changing their monitoring strategies based upon the ten hypotheses, biologically built hypotheses, and if we find there are chemicals of concern that should be measured for a long period of time, this should be considered in the satellite sites that are within X number of kilometers of a particular supersite, mainly for long-term continuity.

One of the things that we did find of concern was the idea of having every third day. We know that that is an issue that was presented yesterday through Petros' discussion, but, clearly, the closer we can get to 1-day measurements, the better off we are going to

be, especially for the longitudinal health studies.

And, again, that is helpful for us for exposure, because we can understand variability better and, in some cases, if you have too long a period between samples, you will miss episodic situations.

Balance detailed characterization with time resolution on samples. It is always a question that we have. Even though we feel as though we are developing superior methodology, we are never always able to measure as much as we want for as short a period of time as we want.

Site selection criteria. Oh, upside down and backwards. I cut off something at the bottom that I am going to leave for the end. So, that was...I was told by the group to do that. That is why I am a little confused.

Anyway, site selection criteria. Current and future exposure studies...now, again, this is not in descending order or ranking order. These are just for consideration.

Existing monitoring data for studies to provide basic information on maybe severity of problems in particular areas and maybe existing infrastructure for these supersite. The point is why not the best.

Who is going to do these measurements? Is it going to be a contractor? Is it going to be a university? Is it going to be the local health department? Is it going to be who? Who is going to do these, and who is

going to do it in such a way that we have high quality data for long periods of time?

We feel it is important that this kind of information is necessary to know the existing infrastructures available to help develop siting criteria, not the actual selection of the site, but at least facilitate where the sites can be located.

Provide diverse conditions of sources, meteorology, topography, and primary and secondary aerosol. I think we discussed that a bit.

Geographic location, we should look at different climates, coastal versus interior locations and altitude, and then, the effects that these ideas have on the activities of human beings. Are they indoors more, or are they outdoors more? Clearly, these are issues of concern.

The issue was brought up and Petros volunteered...he wanted to run a background mobile site. He was going around the country to find out exactly what is background. No, he is not. Just kidding.

MR. KOUTRAKIS: The 500 Cities Study.

MR. LIOY: It is the 500 Cities Study, yes, to find out whether the background is 2 or 12 mg/m^3. But, clearly, we feel this is an important issue here, and we don't know how to handle it yet, but

we feel as though it is an important thing to consider, because if we take annual average of 15 ug/m^3, in some locations with high backgrounds, it is clearly an issue of what is the background and do you control it or is this just something you have to live with.

Population considerations, high density population considerations. Obviously, everybody thinks of major cities in terms of PM. People at high end exposure conditions due to specific source categories, and then we also need to consider representative segments of those large popu...representativeness of large segments of the population, meaning that we just can't ignore the people out in the field. We can look at high end situations, we should look at high end situations, but we also should consider the fact that the mean has to be considered at some point.

The next point was very, very controversial. This is not defined in gold; it is defined in gamish or mush and may be a gamish of mush, but in any case, the point is that we had to come up with some things that we could say in terms of time, what we would like.

Based upon what we know now, what can we live with, knowing full well we want to go as far down as possible. Okay? That is in terms of sampling frequency. All right? Can we give, you know, lifetime employment for the aerosol physicists and chemists.

However, joking aside, we are looking at to

help us understand how to design the next generation of exposure studies from the standpoint of physical, chemical, and biological properties. Concentrations, we feel as though if you can get us continuous measurements now, we'll take it. That is for the ultrafine, the fine, and the coarse particles.

For ionic species, mass, and biologicals, if you can get it down to 1-hour samples...and it doesn't have to be every day all day, but, you know, in some cases, if we can do some things all the time and some things on a periodic basis, we'd like to see us get down to 1 hour.

Organics, we know there is going to be a split. Some we can get 4-hour samples; some organic fractions we can get down to 12-hour samples.

Peroxides, it would be fortunate if we could get 24-hour samples for materials like that. So, we feel in terms of this, this is what we are shooting at to see as being core measurements of the supersite.

In terms of episodes, mass and chemical species, we would like to see us get down to continuous, but we'll accept something way up in here at the present time, but we feel as though episodes, if there are high enough concentrations of certain materials, we should be able to get up to the detection limit of some of the equipment that we have today.

For exposure models, it is clear we want to

have continuous mass and, where possible, species measured continuously, like total sulfur, total organic carbon...maybe I shouldn't bring those words up...elemental carbon, soot. Right? But if we can get down to...

SPEAKER: What about...

MR. LIOY: Well, I didn't want to bring that up yet.

SPEAKER: Oh, all right.

SPEAKER: Nobody in the back of the room can see that.

MR. LIOY: Oh, okay. Well, then, we'll do it this way. How about that? Is that a fair compromise?

SPEAKER: That is good. That is a well.

MR. LIOY: There is a well. For exposure models, we will take continuous if we can get it. Otherwise, for the organic and inorganic, for some of our exposure modeling now, 24-hour sampling would be adequate for providing us with that kind of information in current conditions.

For source apportionment, basically, the tracers for the receptor modeling, we feel as though if we can get down to do ultimately with tracers, natural organic tracers, folks. That is not just lead for gasoline. That is organic tracers for gasoline and for

diesel fuel emissions. We will take tracers down to 12 hours if we can. Anything you can give us at this point.

For air quality models, inorganic species down to 1 hour. Organic indicators down to 4 hours if they are available. We will take them also which will help us define the future exposure studies.

These models would be very helpful in terms of not only looking at the receptors and receptor site, the receptor as being basically maybe a sentinel human being in that location at the site, but with that information, can we, in fact, determine that we can do some exposure monitoring on individuals based upon these types of modeling results. It would be very useful for translating the type of work that we do now to locations that may not be able to be serviced by a supersite but may have characteristics similar to what is being measured around supersites.

All of the above is predicated that we have pilot studies that give us outcomes to select what to measure as a coordinated study. We have to be realistic. We are not going to have a fortune to do this, although in terms of air quality studies, we will have a fortune to operate supersites in terms of what we are used to operating with, but the main thing is a core set of measurements that are validated, because if they are not validated, a validated set of measurements, then it is not going to help us in designing exposure studies

and say well, I have this gee whiz technique but, no, I have this large uncertainty in the data, so how can I essentially apply it to developing the next generation of exposure studies.

So, clearly, the monitoring folks have to come up with what I think is the core set of measurements to put in what I would call the mobile van...not mobile van...I would say mobile traveling platform that you move from spot to spot, and then use that as a basis from which to add components, to add new and exciting and creative techniques for measuring various parts of the aerosol.

We went down and looked at research activities that are currently underway or will be coming underway in the future that might be helpful, and we looked at in terms of exposure. These are some of the study areas that are going to be...or that are occurring right now or will be occurring or are finishing up: New York City; Elizabeth, New Jersey...which is a city; Atlanta, Georgia; Seattle; L.A.; Boston; Baltimore; and Houston in terms of exposure studies. Source/receptor studies, some major studies that are occurring are listed in the next column.

But these should be supplemented by whatever you all know about, because we don't know everything, thank God, and in addition to that, it should be added on in the future, because when you finally consider how

to select these supersites, we should have as good an information base on what kind of exposure studies are being done, being considered, or being started so that site selection over the course of time will be based upon the best information possible where supplemental work is going on, and that includes both exposure studies and, actually, exposure and epidemiologic studies.

I was asked to provide this little anecdote at the bottom from Virginia Graham that the asterisked studies are not started yet but require Congressional approval.

SPEAKER: Or Congressional funding.

SPEAKER: Appropriation.

SPEAKER: The report is not complete. So, these asterisks are things to be considered...

MR. LIOY: Well, somebody told me it was approval.

SPEAKER: Proposed sites, and there is a difference between a proposed site and something that is utilized.

MR. LIOY: It is what we might call a disagreement. However, in the final analysis...and we had a little bit of trouble with the wording on this, and I probably still didn't get it right, we need to take

coordination advisory panel for the initial site selections and subsequent relocations, because I think in terms of getting us, the exposure folks and the air quality folks and the health folks and all of these people involved in this, to work together, we need to keep constantly talking to each other.

And that includes within EPA and within the steering committee to ensure that the types of measurements that we feel are absolutely essential to help us design exposure studies, at the minimum, and, obviously, to help better design health studies get to work, and I think this is something that Dan is probably going to work with this afternoon, but it was a consideration of our group, and it was felt that I should end with that.

Thank you.

SPEAKER: Did you have one thing that you were going to go back to?

MR. LIOY: Oh, that was the same thing except better phrased.

MR. GREENBAUM: So, he has covered his bases. Let's see. Do we have any questions? One in the back? Yes, Charles?

SPEAKER: Two sort of comments, I guess, about this satellite issue. You brought up the issue, and I think I heard it mentioned a couple of times that these satellite stations are basically to state on

speciation methods, but it is coordinating those activities with other things that are going on.

Right now, the way we see the primary purpose of that network...and it was defined yesterday...to add some spatial variability to the speciation program and receptor balance. So, I would say that if you are going to add additional objectives to that speciation program, there is going to have to be some mechanism that makes that happen.

Right now, the stage we are looking at is we are going to use this network to get the data we need basically to develop a control program, not looking at...

MR. LIOY: Well...

MR. GREENBAUM: Before you answer, let's, so the people in the back of the room know, the issue raised by one of the State officials here is that the speciation network is being designed in each State for purposes other than the kinds of purposes that Paul was talking about and how are we going to get toward some kind of coordination of those joint or multiple interests.

MR. LIOY: I think that is a good point, and I think what I would worry about is already that people are considering that the speciation sites are going to become cast in concrete. We don't know, Charlie, yet what it is we are going to have to control.

So, if you are going to develop SIPs based

upon what we are going to be measuring at these speciation sites now, you may be targeting the wrong answer to an important question, and I worry about that. I really do, because I think we mentioned in our meeting in North Carolina last month that these speciation sites are going to give us semi-qualitative information on possible sources.

Those speciation sites are not going to be able to, I feel, define what is coming from automobiles which is going to be the big regional problem in the eastern United States and a lot of other parts of the country. There is no tracer there. Unless I am wrong, I don't think they are going to have...they are working on it, but that is not the same thing.

SPEAKER: Well, methods exist to take the samples from those speciation monitors and to break out automobiles, diesel trucks, wood smoke, you name it. The question is, is anyone willing to pay for...

MR. LIOY: That is the point.

SPEAKER: ...setting up the process to analyze the filters that will be collected.

MR. LIOY: And no one has said they are willing to do it at this point. I think it is a very important point, as the way they are being set up now, it is not going to be done.

MR. GREENBAUM: Excuse me. First of all, I think this afternoon, between our

conversations and Rich Scheffe's presentation, we are going to talk about this coordination issue which I think is a very real and serious issue that we need to sort out in terms of what mechanisms can be there, how we aim for mechanism. I am tempted to say that since Charlie is from New Jersey and you are from New Jersey, you can sort of work that out, but...

MR. LIOY: And we will.

MR. GREENBAUM: But having said that, that is not universally true. The second issue is this question of what we are expecting this piece of this system to accomplish, and that is something we are going to have to come back to, I think, in this discussion.

There was another hand over here?

SPEAKER: Yeah, I had a question. This is for the previous talk as well. What are biologicals? Are you talking about viable organisms? Are these viable organisms, or are they specific viruses or components, or are they just indications that there is a biological source?

MR. MAUDERLY: Well, all of that. No, seriously, you know, it isn't focused on any one of those. There is a question as to whether or not live organisms are transmitted.

Now, we have very little data that suggests that is the case. It is an open question, but most of

these samples don't have a lot of activity you can grow from them. Okay? That is point one.

Point two is that there is a lot of concern about pollen proteins and plant proteins. Now, proteins specifically. Pollen are very big particles, you know. You are not going to get a lot of those deep into the lung. You will a few.

The problem is that pollens have materials associated with them that can be released from the particles, and those proteins are the allergenic materials, and the extent to which those materials might be contaminating a range of particles that land in the airways and lungs is a very important issue with respect to the virtual epidemic that we are in the middle of with allergic disease, asthma and allergic rhinitis or hay fever, plus the fact that even if you don't have live bacteria, there are endotoxins that are present on surfaces all over in our environment and on plant degradus, ground up material of plant origin, and those endotoxins are very potent inflammatory agents.

So, it is a range of things. It isn't a simple question, but it is lumped together in a concern about materials of biological origin.

SPEAKER: I guess this hour long...this hour frequency, what would you propose in there? Are you proposing all of this, or is this...

MR. LIOY: Well, it depends upon

what is available for different fractions of biologicals. Again, we'll take as good as we can get. If we can get down to an hour, that would be very, very valuable.

MR. GREENBAUM: Okay, thanks very much, Paul. Next, we are going to turn to the needs of the source/receptor research process, and Glen Cass who was one of the leaders that discussion is going to give us the results of their work.

"Source/Receptor Relationships"

MR. CASS: Now, the group that met

on the issue of using supersites for source apportionment work was considering a relatively detailed proposal that was laid out in the back of the document that was provided at the start of the conference. So, I'll be talking about suggested modifications and advice regarding that basic plan.

So, you need to understand that you have to refer back to the underlying basic plan. I'll try to review it for you very quickly, however.

The general notion was that if there are going to be seven or eight supersites set out around the country, that the data collected might be usable for advancing the ability to evaluate the performance of models that are used for assessing source/receptor relationships which, in turn, are critical to the evaluation and establishment of control programs for fine particles and ozone and regional haze, et cetera.

We begin with the premise that the supersites, if they are to be useful in this regard, are going to need to be located strategically within the areas that are used for air quality modeling purposes at present. So, on this diagram, I have sort of sketched out the large eastern United States modeling region that is used for particulate matter model development in use in the United States and the modeling regions that are set up over the State of California for aerosol processes model and a co-dependent model evaluation. And, as we'll

talk further, there are additional areas to be considered as well.

But the general notion is to try to look at what the modeling community is generally interested in doing and looking at how the supersites might be used in that context.

The group, then, discussed the number of monitoring sites, their placement, the equipment that would be used at those sites, the appropriate measurements to be taken, the modeling process itself, and so forth and came up with the following remarks. What I am going to be doing is to summarize and select from a list of much longer...a much longer list of comments that we have prepared and presented to ourselves upstairs earlier this morning, but let me try to summarize those discussions.

Basically, the group was in favor of a coordinated program of supersites and satellite sites spread out throughout the chosen modeling regions in such a way that they could be used for model evaluation, as distinct from the default alternative which is to just let supersites happen and represent single local areas and their immediate vicinity.

If you are going to look at the eastern United States air quality model evaluation and source apportionment problem, you have to be willing to look across multiple supersites and multiple numbers of

satellite sites in order to understand what is going on. You have to be able to look at them all at the same time.

We should be packaging these sites, the supersites and the satellite sites, so that we can address not just particulate matter as a $PM_{2.5}$ mass problem or composition problem or size problem, we should also be looking at regional haze questions and looking at the relationship between ozone and PM, because half of the particulate matter in most locations is secondary to one or two important atmospheric chemical reactions, and the precursors that are driving those reactions are essentially the same ones that are driving the formation of ozone in the atmosphere.

The program of measurements should last at least three years for several reasons. First, in the case of selection of episodes to be monitored, it is possible to encounter one year that is simply an anomaly. We had experiences last year where El Nino substantially wiped out much of the usefulness of some rather large field programs. We don't want that to happen here, so we need multiple years of observation to make sure that we encounter typical conditions during the experiment.

In addition, we were reminded that the PM standard itself calls for averaging over a multiple year period, with the result that a three-year period of

observation is also valuable from the point of view of comparison against the standards.

Now, this is not to say that the monitoring program shouldn't continue beyond that three-year horizon. It may be that the supersites should become some improved and permanent feature of the landscape, but from the point of view of source apportionment and model evaluation, we need, we think, about a three-year experiment as a minimum for the reasons I just stated.

Now, it is very obvious to us that the source attribution objectives cannot be accomplished without a concurrent program of upgrades through emission inventories. You can't just collect ambient data and verify the models, because you have to put in what is in the models at other times. That also includes meteorological data as well, but we have included within our program plan an obvious meteorological upgrade element.

We have to add to that a source emission inventory upgrade component. This consists of several different kinds of activities. First, it is going to be necessary to make the measurements of the particle emissions at the sources of major source types by methods that are comparable to the methods that are being used at the atmospheric sampling stations.

That is, if you want to verify models to predict the size distribution and chemical composition of the

atmospheric particle complex from source emissions, you have to make comparably detailed measurements of what the source emissions look like as a function of size and chemical composition. All right? That is beyond the capability of the present regulatory source test procedures and is, therefore, going to require research in and of itself and then, accordingly, source testing application to gather the necessary data.

Once the emissions evidence has been made at individual sources, the emissions inventories have to be compiled across the geographic areas of interest to represent how the sources and their activities across those geographic areas are translated into net inputs to the atmosphere.

Particular emphasis is going to have to be placed on upgrading the ammonia emissions inventory. Ammonia, because it is a currently unregulated pollutant, has not been inventoried with anywhere near the effort of the other important components involved here.

In addition, we are going to have to upgrade the biogenic hydrocarbons emission inventories in order to inventory the emissions of the semi-volatile biological molecules such as the higher terpines that lead to secondary aerosol formation.

Now, another important observation is that the costs of data analysis and modeling will be comparable

to the cost of the field ambient air quality measurement program. If you are not prepared to spend at least as much money on the emission inventory upgrade, on model development, and on analysis of the data that is collected, the money you spend on the ambient measurements is going to be completely wasted, and that has happened so many times in the past that I can't warn you enough about that. You have got to budget in advance if you want to see that the work is actually completed rather than just collecting a lot of data for the shoe box.

Another important point to note is that personnel issues are going to be as critical as the ability to order up the equipment to make the measurements. We could well be in a situation where we are short of skilled personnel relative to the needs to operate these stations, and that needs to be looked at very carefully at the outset. You can't just place purchase orders for the hardware needed to do this and assume that the people who know how to run that equipment are available in the right numbers in the right places. Some thought’s got to go into that problem.

Now, in terms of the monitoring program itself, we envision both a year-long, meaning continually, monitoring program at the supersites with a set of measurements that were basically described within the

original document that you were handed two days ago. The committee seemed to be reasonably in agreement with most of the recommendations that were made within the preliminary planning document, but they wanted to add things to it.

So, at least, we can begin with that list and recognize it encompasses a medium intensity sampling effort that goes day in and day out at the supersites with certain kinds of continuous monitoring instruments and certain 24-hour average measurements, and then we have a separate plan for kicking into an intensive monitoring mode during those periods of time intended for evaluation of episodic aerosol and photochemical oxidative models that make predictions that have to be verified on a very short-term basis.

In terms of the numbers of those intensive episodes, it was decided that approximately ten episodic experiments are needed over that three-year period of approximately 5 to 10-day duration each. The duration was determined by the time needed to flush the initial and boundary conditions out of the models, and the number of intensive experiments is determined by the number of meteorological conditions that need to be examined if you wish to use the episodic models to replicate response of emissions controls to an annual average standard attainment objective.

Basically, the presently recommended

procedure for modeling annual averages using the high quality models would be to construct annual averages from a weighted sum of episodes that represent the year adequately, and we figure it would take about 10 such episodes to reconstruct a reasonable annual average response of a control program.

Now, special studies are going to be needed to select the times for these intensive experiments so the episodes can be used to represent that year. In other words, someone is going to have to sit down with climatological and historical particulate matter data base and determine the meteorological classes and the times of the year in which they occur and to select approximately when these episodic experiments need to be run.

The supersites, from our point of view, should probably be located in populated areas. That doesn't mean just in the central business district but in areas where there is substantial population density.

The reason for this is that the supersites, in that case, can be used both to observe regional air quality which overlays all the cities and the countryside as well as the urban or population center increment that occurs locally, and both of those phenomena are going to be important in understanding a control program in the long run.

The satellite sites, on the other hand, the

group of satellite sites that we mentioned in the original plan are envisioned as a means for filling in between the very small number of supersites and for solving or answering specific questions related to what are the concentration of particles and their compositions and size coming across the boundaries of the air quality modeling domains that have to be used for source apportionment research, what do the concentrations look like in the rural areas, what do upwind/downwind relationships look like across population centers, what are the trans-boundary fluxes from the United States into Canada and from Canada into the United States, across the boundaries with Mexico, and so forth, and also to fill in the very large distances between the major supersites.

If there were to be a supersite in Atlanta and the next one, on a diagonal, is up in Chicago, it is fairly certain that you would like to have at least a satellite site halfway in between those two locations to tell you what the heck is going on in the middle.

The satellite sites, I might remind you, are envisioned as being sites that are part of the speciation network that are capable of being kicked into higher gear during the intensive monitoring episodes. As the gentleman from the State mentioned earlier, this is going to require some thought, because many of the speciation monitoring sites, in fact, are the province of

specific States and localities.

At the same time, there will be 50 speciation monitoring sites that are under EPA's direct jurisdiction, and it might, in fact, be those sites that need to be used as the satellite sites. So, people who are going to be placing those 50 sites should think about that possibility.

Now, there is interest in a supersite in the northwest, particularly in the Seattle area. This is motivated by concern over wood smoke concentrations in the area and the possibility that prescribed burning for forest management will be increasing in those areas.

There appears to be an incipient air quality modeling effort in the northwest that could be expanded upon. The reason why we had not put Seattle down as a supersite initially was because we were unaware of a concurrent modeling effort that would be able to use the data. That still would have to be resolved.

In terms of siting the other supersites, we have just put down seven or eight modeling locations that were reasonable choices. Those choices, of course, can be adjusted to meet the needs of the health effects community who have reasons for picking particular locations.

For example, there would be no problem in...one could debate whether or not the Denver

supersite recommendation could be moved to the Utah Valley, for example, if there were health effects study in the Utah Valley would benefit from that. People were discussing the relative merits of the upper midwestern site being Chicago versus St. Louis.

These sorts of small adjustments are at a level of detail below the level of the discussions that we need to be conducting here. The more important issue is how many supersites and satellite sites can we afford, and I think we determine that, you can place them logically.

We want to be able to encourage Canada to place a supersite in Toronto. It is probably not economically practical to move a supersite across the border to Toronto, but if we were to provide enough and strong enough recommendations, we have reason to believe from the Canadian representatives in the meeting that Canada would be more likely to join the effort in that case.

We talked a lot about the ratio of satellite sites to supersites. We clearly need the satellite sites to fit in between the supersite, and we simply don't have enough locations represented to evaluate the air quality models particularly well.

The ratio of satellite sites to supersite is an open issue. There is one group of individuals that always, as you can imagine, that thinks that more is

better. Of course, more is better unless it drains all of the money needed for the emissions measurement program, the modeling program, and the data analysis.

So, my view of the subject is that we have got to economize on supersites, that the ratio...or, excuse me, economize on both supersites and satellite sites. A ratio of about 6 satellite sites to 1 supersite has been about the ratio that we have used in past studies in California, something in that neighborhood, and that has largely been an economic decision and probably will remain so.

A special study was needed to select the locations of the satellite sites. They need to be placed intelligently, and that will take some time in order to think about all of the purposes to which satellite sites could be put and where they should be put.

We should be considering the incorporation of existing supersite prototypes into the program, possibly as replacements for or substitutes for brand new supersites. The prototype supersites exist in places or will exist in places like Atlanta as part of the extended Southern Oxidant Study program.

The measurements that are needed at one of our supersites look very much like the measurements that are going to be made at their Atlanta site. Department of Energy we hear is planning on putting a supersite-like station in Pittsburgh that might be a

substitute for our recommendation in Cincinnati.

The San Joaquin Valley study in California is making a large program of measurements that might be configured to look like a supersite. Toronto is the location of efforts in Canada that can approximate a supersite and so forth.

Our sense is that there is not going to be enough money to ignore the economies that could be attained by picking up one of these other efforts as a member of the family of necessary supersite, one or more of these.

The same thing is true of the satellite sites. A survey should be conducted to find out if there are other organizations running satellite site-like operations that could be used to meet some of those needs and, further, to plan on incorporating not just the EPA speciation monitoring network as a third level of satellite site, meaning 24-hour average data if you have the right chemical characteristics, even though it doesn't have time limits, because those data are going to be taken anyway. You might as well acknowledge that they exist.

The same thing goes for the improved sites. Data is coming in that would be useful to this effort from improved. It may be necessary, as was suggested in our meeting, to meteorological observations at some of the improved sites in order to upgrade them a little

bit, but the possibility of bringing existing satellite site, the large operations, into the program to save money is certain something to be thought out.

If we start incorporating the efforts of other organizations into this program, then it is going to be very important to ensure a necessary level of compatibility in quality assurance across the sites that are being operated by different groups at that point, and that would become a difficult problem, nevertheless, one that economics may dictate will have to be addressed.

Now, we went through a long list of modifications to the initial straw man plan of those measurements to be made. I think a quick summary will suffice at this point, and then anyone who was not in our meeting and is interested in the details can come talk to me after the meeting.

Basically, some of the larger recommendations were that the proposed program of fine particle measurements be supplemented by a program of PM_{10} measurements to apply the same kind of chemical information on PM_{10} properties, because, as was mentioned earlier by the folks in the health effects community, it is not yet a sure thing that the PM_{10}...that PM_{10} will not remain in the future as a parameter against which control programs have to be designed and against which health effects studies have to be

conducted.

The recommendation is being made that we add condensation nucleus counters and light scattering/light absorption devices to the satellite sites. This would give us a nationwide network of ultrafine particle number counts, and it would give us the ability to look at fine particle properties through light scattering techniques and enhance the ability to use this program for studying regional haze phenomena as well as fine particle phenomena at the satellite sites.

We need to add to the basic program plan, as I had mentioned earlier, a serious program of source methods, and then there are nine other recommendations for specific kinds of instruments to be added to the network and things of this sort that I think that we probably don't have the time to go into that.

Now, we had a long discussion about the relative importance or merits of moving the supersites around, and there are some really serious disadvantages to moving the supersites around. From a practical point of view, you are talking about delicate, elaborate equipment that has to be run by dedicated, highly trained operators. For example, the site that operates in Erfurt, Germany on one of the HEI studies has a Ph.D. who did his thesis on that equipment combination. He now operates that station and literally

sleeps with it to keep it running.

It is that kind of personnel dedication that is going to be needed to operate these supersites. You are not going to...you are going to limit the ability to find people to do that work if you are insisting that they not have a family and remain steadily moving all over the place all the time with this equipment.

And, beyond that, the equipment itself is rather delicate. It takes time to reestablish its stability once you have moved some of the stuff from one place to another.

The result is if you move the sites around a lot, the supersites in particular, you are going to be down a lot of the time, and for the purposes of trying to evaluate air quality models that are trying to represent annual conditions, that down time is going to be harmful to the source apportionment use of the data. So, from the point of view of data quality, the ability to get personnel, the stability and lifetime of the equipment, the quality of the measurements, and the ability to use the data for modeling over long periods of time, there are serious disadvantages to the disruptions that occur if you try to move the stuff all over the place all the time.

So, that has to be considered and balanced against the desires on the part of other people to have other kinds of experiments that move all over the place.

MR. GREENBAUM: Thanks, Glen. I trust that the last urgency was not involving actually relocating the population.

SPEAKER: Actually the real recommendation, and the other extreme to that was to move the population to the existing site in Erfurt.

SPEAKER: I mean, we all have to make sacrifices.

MR. GREENBAUM: Right. Well, we can always speak to our colleagues in the transportation field about relocation and its pros and cons.

We have a question over here from William?

SPEAKER: Was any consideration given to using an elevated site above the nighttime mix layer in order to differentiate between regional transport and locally generated...

MR. CASS: At the level of the nine specific equipment-based recommendations that I didn't itemize, there were several recommendations on aircraft-based sampling aloft and a recommendation on use of wide-arm, for example, to continuously locate the elevation of the particle radiant mix layer directly. So, yes, there is interest in third-dimension measurements above the ground.

SPEAKER: But no recommendation for a TV tower where you would have continuous

measurements to go with...

MR. CASS: That was not discussed explicitly, but it was discussed...the need for third-dimension measurements was acknowledged, and if anybody has a good suggestion on how to implement that in a cost effective manner, you know, we would certainly appreciate it. It is just a matter of how to meet a recognized need.

MR. GREENBAUM: Other questions?

MR. KOUTRAKIS: Are we going to have time to talk about these issues, or this is our last chance to comment about it? Because there are a couple of things here. Can we do it at the end or...

MR. GREENBAUM: Well, if you would want to raise an issue, go ahead.

MR. KOUTRAKIS: A couple of issues here. I don't have my LOTUS program here, but if I do the calculations, we are talking about $100 to $200 million for this. Is that correct? The question I have...

SPEAKER: Can't hear.

MR. KOUTRAKIS: I said I don't have my LOTUS program here, but my guess, because of this business, we are talking about $100 to $200 million to do these studies, and the question I had is that could we probably assign two of the seven or five supersites

to do this kind of research, learn how to do it, and until we find out more about the list of particles that focus on specific components? That is my first question, and I had a comment.

I am convinced that we don't really know where people live, but I think 70 percent of the people in the United States live east of the Mississippi or...and I saw here a list of sites, and they are mostly western United States, Denver, Utah, Seattle...

MR. CASS: No, no, no. Those were discussions. If you look at the map that I put up initially, it had about 70 percent of the sites in the eastern United States.

MR. KOUTRAKIS: The supersites or the...

MR. CASS: Yes, supersites.

MR. KOUTRAKIS: Okay.

MR. CASS: What we are talking about were the deviations from the original plan that people had discussed, and those involved the possibility of moving the Chicago site to St. Louis which is within the eastern U.S., of moving the Denver site to Utah. Neither of those change the overall spatial distribution of the sites.

Most of the monitoring would, in fact, be conducted in the eastern U.S. where the population resides in general and where the existing data base is

the weakest.

MR. KOUTRAKIS: How about my first question? Do you see, envision...a way that we can do only two, focus on the source relationships and maybe, you know, after we finish those, we do some other ones? I cannot see having the resources, money, and as you said, the expertise and only have to do to engage ourselves in this.

MR. CASS: Okay, the question of the availability of the resources is a very serious issue. We were not...

SPEAKER: You want to use the microphone?

MR. CASS: The question of the availability of the resources to do this work is a very serious issue. I probably spent a third of the time or 25 percent of the time upstairs discussing the economic side effects of this kind of an issue.

Basically, the task given to our group was to answer the question how could seven or eight supersites be used as part of a program to conduct air quality model evaluation and source apportionment research. That was our charge, and we were not asked to do this within a particular budget, and we were not told to do it with two sites instead of seven or eight. We were not told to do it with fifteen sites instead of seven or eight. We were asked if the speciation

monitoring network, the supersite network of about this size were to be constructed, how could it best be used?

Now, I would agree that the cost is very steep. At the same time, it is not going to be very easy to do that source apportionment work with a whole lot less than this if you want it done very well.

The reason for this is that the entire eastern half of the United States is effectively one big airshed for the purposes of this problem, that if you try to carve out a small geographic domain within the eastern U.S. and model it, what you would find is a model works really well, because your boundary values determine all the concentrations inside the modeling domain for at least half of your pollutants. But then, at that point, you know nothing about the sources that contributed them.

So, if you want to do a good job of source apportionment, you have to put the boundaries of the modeling domain in the relatively clean air areas that exist within the boundaries of that large grid, and that then determines that this is a big problem and, therefore, an expensive problem to deal with.

Now, of course, people will do the best they can with whatever they can get, and the fact of the matter is people are preparing to run models against the existing data bases on PM fine in the east which consist of a handful of 24-hour filter samples and a

couple of special studies here and there patched together, and, you know, people will always do the best they can with what they have got, but this study that we just described here represents a translation for the eastern United States of the technology that has been used in southern California to support aerosol processes model evaluation and source apportionment work, and it is probably needed at about that level if you want to feel confident of what you have got.

MR. GREENBAUM: Thanks. I do think that is a tough set of decisions. I think we all know there will be choices made along the way.

One of the things that I noticed in this discussion was that a set of discussions have already gone on around the routine speciation sites. The States have already done a lot of thinking about where those are going to get located in their own thinking. Glen nicely referred to all those as the satellite sites. They are no longer called routine speciation sites, but they...and he suggested some things that would be useful to collect at that which isn't part of the normal piece.

And I think it is important to understand that we are going to have to come up with a mechanism to bring those together in some way and think about that and to think about how the States interact with the research community and the modeling community to do

those things and understanding Charles' comment from New Jersey is that they have certain needs that they have as much as...I am sure Charles would agree that most of what New Jersey has at its boundary is what the issue is in New Jersey. They also have point source issues and other things they have to deal with with those monitors.

MR. CASS: But it should be clarified that we are only talking about using 30 or 40 of the 300 speciation sites for satellite sites. So, it is, in fact, possible that that number is within EPA's capability to select the sites and parameters to be monitored.

The real issue is economic, how many satellite sites can you afford.

MR. GREENBAUM: No, I thought it was very useful that you didn't...weren't suggesting that you needed 300 satellite sites, and I don't...I think part of what we...we have been focusing on supersites, but I think all the discussion has talked about how any supersites get integrated into a much larger network.

Okay, with that, we are going to turn to the next work group which tried to wrestle with these issues of accountability and how this program of monitoring can help us...move us further in the direction of knowing that, down the road, we would be able to be accountable for what we have accomplished or not

accomplished with any changes in air pollution. Ken Demerjian will lead that discussion.

"Accountability"

MR. DEMERJIAN: Well, our group, first of all, there was reasonable consensus that everyone agreed that accountability needs to be brought into the $PM_{2.5}$ air quality management system, and it should be an important part of the implementation program. The advantage we have of introducing this at this time is that this is very early in the process, and we can build this system in now as the implementations of, for example, of the core program probably won't be considered for several years down the road here. Plus, we have the opportunity to have some influence on how the monitoring would be incorporated into this process.

So, there is a general consensus and a lot of interest in the regulatory community to start building this into the system, unlike the ozone management

program where we were playing catch-up and, basically, trying to patch a system together after the fact to build accountability into it. We now have the...we have the opportunity within this program to build it into the process.

There was some confusion about accountability in terms of whether it had anything to do with accountability at the supersites program. And even though that is important and, presumably, any program we propose under the supersites, I am assuming EPA will be accountable to someone, whether it is OMB or their...some other part of the public sector that is going to ask them what they have accomplished for investing this month.

That is not what I am talking about here. I am talking about how do you build accountability into the air quality management system that is going to be used to implement and manage the $PM_{2.5}$ activity. So, to the extent that the role of the supersites has on this exercise is that it is the super...we see the supersites as contributing to the backdrop of accountability in terms of the baseline routine measurement programs are going to be in place. The supersites we see as providing the issue information both in the form of augmentation of that network, providing the potential direction or indication of what might be changes you would want to consider in the operational network, and

transitioning those changes so that they get built into the operation network such that it can be used to create the foundation for this accountability system.

In order to decide on what might be measures or what might be the kind of components that you would want to consider to measure...to make the system accountable, it is worthwhile to try to anticipate what would be emissions changes that are going to be envisioned to the exercise to accomplish the $PM_{2.5}$ standard. And it turns out that most of those will not be anticipated or acted upon for several years in the future, but it turns out that there are some emissions changes that are targets of opportunities that are occurring right now, and we discussed those.

And in discussing those, we wanted to then identify within the current monitoring network what might be measures that could be considered to build a measure within the system either retrospectively in terms of some of these parameters or prospectively in terms of some of the things that are going to occur in the next few years that are already on the books in terms of emission control.

And some of the factors that...I mentioned one yesterday, was the Title IV emission reductions that have taken place under Phase I. Phase II is about to be implemented, and it does look like there would be some measurement parameters that we would want to consider

in terms of anticipating the effects of those controls.

In addition, there has been a diesel particulate reduction program that has gone in place in terms of heavy-duty diesels, as I understand, that started in 1991. That program, in a sense, has probably become pretty much fully...the market has been fully penetrated or, at least, a large fraction of the diesel fleet has now turned over with these new emission controls in place. So, there has been a substantial perturbation presumably, in diesel particulate emissions that has occurred already, and the question is could we go back and look at any of our data and actually see the effects of that kind of perturbation. I am not sure if that has been done, but it seems like it is possible that it would be worth looking at.

In addition, there are a bunch of...there are several actions that will be occurring in terms of ozone oxidant control in terms of mobile source, NOX, and VOC controls. Those all have potential implications as well in terms of $PM_{2.5}$, and would it be possible to tract some of the responses to those components as well.

Then, finally, one example...and I am sure there are several that exist, and there are probably some that exist in California...is that there have been selected controls that are being implemented within certain areas. The one example that we talked about

yesterday was the fact that New York City is about to deploy a fleet of natural gas-driven buses and, basically, moving away from diesels and being able to discern the impact of that kind of change would be another accountability metric that would be of interest to monitor.

So, given that these current controls are...current or near future controls are about to take place, what are some of the things that we could anticipate monitoring within the $PM_{2.5}$ measurement system?

We would be interested, of course, in tracking trends in sulfates, nitrates, ammonium...ammonia concentration, H^+ and, actually, other cations of interest that would allow us to understand not only the trend in the sulfates but, for example, if there is going to be a repartitioning between sulfate and nitrate particulate as a result of these stationary source reductions, we would like to have sufficient chemistry to be able to reconcile those changes, if they occur, as part of this trend analysis.

With the introduction of both VOC controls and the oxidant program as well as diesel controls that are related to this heavy-duty emissions change, it seems like to have a handle on the PM organics and their change with time would be very important. Now, the current speciation network that is being envisioned,

I do not believe it is going to have a lot of detailed organic information.

So, we would look to the supersites as providing some initial indication of how well one can handle that problem, and I think, in actuality, many of the things discussed by Glen in terms of the source/receptor community's interest would also be of direct interest to the accountability people because of the fact that, in essence, they are trying to attribute sources to air quality. We are actually trying to attribute emissions changes as a result of those sources changing. So, that seems like a natural coupling there.

Another example that...and, obviously, this may not have a total or any significant impact on the current $PM_{2.5}$ mass standard, but in thinking about changes that are going to occur in terms of combustion process changes, whether they are changes in control programs for diesels or, potentially, something that might occur as a result of controlling hydrocarbons for the automotive controls for the oxidant program, one of the question is, as we look at these controls and fuel switching, is there a potential of having the $PM_{2.5}$ mass come down but the ultrafines go up? And would we be in a position to monitor that kind of an effect from a particular control strategy?

And, obviously, if it turns out that ultrafines

1 become a more predominant...of greater interest in
2 terms of a health effect, it would be nice to know what
3 the tradeoffs are in terms of that kind of activity.
4 To close this accountability process, of
5 course, we talked about besides being able to
6 demonstrate the relationship between an emission
7 control action and a change in air quality is that one
8 wants to then go to the receptor and determine whether
9 the receptor, in the case of the indicator, whether it is
10 a health indicator, an ecosystem, or a welfare, whether
11 it has responded in a way that is comparable to
12 expectation.
13 And one of the problems that we see right now
14 is that we could...at this point, we do not see a
15 comparable collection of systematic data on the health
16 side that could be tied into this accountability metric.
17 There is some potential for an ecosystem response
18 trend data that is being carried out by a variety of
19 agencies.
20 As a matter of fact, EPA used to have a
21 program that was called the ecosystem monitoring and
22 assessment...I don't know if it was program or project,
23 but, I mean, that is...one of its prime purposes was to
24 look at sensitive ecosystem indicators and track them.
25 And, of course, we would like to be able to tie that to
26 this same paradigm.
27 Then, finally, I think the welfare community in

terms of, certainly, visibility, the visibility impairment group community has used this as a metric, and that is certainly something that could be demonstrated within this paradigm in terms of the controls that are going to be considered in the future.

I guess what we would like to ask the $PM_{2.5}$ supersite groups, whether they are the measurement groups, the exposure groups, or the source/receptor groups, is that as you think about the deployment of your various instrumental systems, please keep in mind that, ultimately, the system has to be responsive to the actions taken, and we would love to know or we would very much be interested in your introducing techniques that you think would be very helpful in terms of our identifying particular source emissions and source emission impact and how they could be brought into this process and used operationally.

I think one of the problems is that unless the incremental changes that are talking about are dramatic like what happened with Title IV in the last several years where we had a 20 or 30 percent reduction of SO_2 in a region which was actually fairly easy to see in the data record, things like the introduction of diesel controls which take maybe 8 to 10 years to penetrate into the marketplace, the incremental change we are talking about is very small. So, therefore, we have to measure over a longer period of time.

So, in reality, what the supersites' contributions will be will be in terms of identifying those measurements that are going to be effective in being able to track some of these constituents and transitioning those methods into the operational network. So, we really feel that that is an important part of this exercise that these $PM_{2.5}$ sites are going to, in essence, make the operational network more comparable to the implementation plan.

So, with that, I will stop.

MR. GREENBAUM: Thanks, Ken. Dr. John?

SPEAKER: Yeah, Ken, one of the...mostly a comment. We have primary and secondary standards for fine particles. Secondary standards for fine particles are intended to protect visibility, and, in fact, we have for years been...the best example I can think where we can say here is the environmental effect we care about, visibility. We can measure it directly, and we can see whether or not it follows, and we have seen it follows environmental trends in the past. So, that is one we can keep doing, obviously.

Unfortunately, the Weather Service is changing the way we do visibility and going to transmasometers that aren't going to do the same thing, but other than just in the regional haze locations where

we are going to...have been doing it for a long time, we also now worry about...are going to continue to worry about urban visibility and how we measure that. So, that is a direct environmental measure of accountability.

MR. GREENBAUM: Yeah. A comment that John made for those in the back on secondary benefits under the...but measuring visibility benefits is one way of measuring accountability.

MR. DEMERJIAN: Yes, agreed.

MR. GREENBAUM: Will?

SPEAKER: One question. Given the climate variability and meteorological patterns, what length of time do you envision we need to detect trends that you are going to take samples?

MR. DEMERJIAN: Well, as I mentioned...

MR. GREENBAUM: Would you repeat the question?

MR. DEMERJIAN: Yes, the question was given the meteorological variability of climate effects, how much data does one need in order to get at some of these signals within emission changes to respond to the trends, and it very much depends on the parameter that...and the magnitude of the emissions change that is happening and over what courses of period. Like I said, with the Title IV emissions, that

signal was fairly easy to see, though there is variability in it, and as I showed, it looks like there is a turn up this last year, and we need to verify that that is really a true turn up as a result of an emissions change or is actually variability within the data.

My instinct is, in looking at the data and seeing the typical variability that occurs in it, that it has more to do with emission than it has to do with any climatological factor.

But that...all of that has to be factored in, and, typically, the rule of thumb is with regard to time series trends is people want ten years' worth of data, and that is why the supersites are not going to be the basis for doing this kind of work. It is going to have to come from the operational network which is the question can you get the details that you need to be able to perform some of these.

Certainly, some of the things we'll be able to do, but there may be other aspects, other markers that we would like to have that are too sophisticated to collect in the operational network, and then the question will be is do you do special studies over increments of time, every five years or something. That might be a possibility.

MR. GREENBAUM: Thanks, Ken. I think one of the things you point out very nicely here is...I am sorry, Judy. Did you have a question?

MS. CHOW: Just a concern that, apparently, this group focused on...used the terminology $PM_{2.5}$ supersite, and I heard even in your discussion an interest in ultrafine, an interest in other pollutants, and I just wanted to caution us about limiting terminology.

MR. GREENBAUM: Yeah. Well, we have had plenty of other people commenting on the need to stay focused on the whole range of PM, not just $PM_{2.5}$.

I think one of the things that you mentioned, Ken, and I think it is the...while no one would expect supersites to be the long-term trackers of accountability, the ability, potentially, to capitalize on changes that are underway and use the high resolution kinds of measurements you are talking about at supersites to see whether you can quantify those or, at a minimum, develop the technique for future use, but it may actually give you some good case studies of examples.

Often, the way we know anything is happening is through case studies in a particular metropolitan area or where a fuel is implemented or other types, so I think it was a nice thought that you could tap into that.

Our last but by no means least, because I suspect it is of interest to a large number of people in the room, is the group that tried to think about how the

supersites might serve the needs of those who want to try to develop and test some measurement methods, and Susanne Hering is going to present their results.

"PM Measurement Methods"

MS. HERING: Thank you. Our measurements methods group met and, through the discussions, we defined our objectives in these ways, one to...first of all, to provide comparison among or the opportunity for comparisons among methods that are going to be used over the next few years, perhaps the speciation type monitors, on the order of the core measurements that Paul Lioy was talking about, that this would be a platform to be able to compare those measurements among each other and among more advanced methods.

Secondly, to provide a platform for future comparisons for new emerging methods that will make it

possible to either measure parameters that are now too difficult to measure or to measure parameters that now can be measured but to make them measurable in the more routine manner in a way that can be continued and for monitoring in the future.

And, thirdly, this is something that came out of our discussion was to address the issue of standards and calibration methodologies for particles. We have calibration span gases for sulfur dioxide monitors. We have developed methods and transfer standards for ozone. What can we have for particles?

This is a difficult question and one that we feel should be addressed through this program.

Accuracy question, in looking at how methods compare and trying to assess how accurate they are, there are different ways of looking at this, and this needs to be brought out. One is are we comparing against the standard? Are you looking at how well you replicate the FRM mass, for instance, or are you trying to assess how representative the measurement is of what is actually in the air?

These are two very different questions. They both have their place, but looking at these issues can be incorporated into defining data quality objectives.

As we went through our discussion, these slides are a combination of what I made up last night and what was added this morning by hand. Data

archiving was brought up as a very important issue that needs to be dealt with up front, as is disseminating results from the methods comparisons and from the measurements.

Daily exchange issues, results of publications of these, we'll touch on those in later slides.

What we did in our sessions was we started off yesterday looking at specific parameters. We started with a list of ten which I think you know what I mean by that now, the list that Joe Mauderly put up. We also added parameters that were brought up as measurement needs in the source/receptor sections, the cytosol chemistry, physical characteristics of the particles.

We asked ourselves what kind of time resolution is desired, and here we were really looking to get answers from the other communities or the other panels, the health panel and the source/receptor panels, but these are the assumptions we made in reviewing these data.

We assume that, for the health studies, they really need uninterrupted data as in daily data or, in some cases, the short time resolution data for certain specific studies. Source/receptor, understanding source/receptor relationships, it depends upon what parameters they are looking at, what approach is being used. Suggestions as short as 10 minutes for looking

at secondary pollutants, 1 hour for transport modeling, 12 hour data for receptor modeling.

We went through our list, discussing the status of our current measurements, our needs, possible approaches for addressing the current needs. For some of the parameters, we really were just addressing analytical needs such as for the organic fractions. For others, we addressed approaches for automated high time resolution measurements.

I thought I would give...I am not going to go through this whole list of 10 or 12, as it is, but there were some cross-cutting issues. When we talk about field comparisons, it is very clear that these cannot be done in a haphazard manner. It is not sufficient to just put all measurements at one site. You are not going to really get the answers that you need.

The field comparisons need to be planned. They need to have a written protocol, and there has to be specific measurement hypotheses addressed with respect to how these measurements perform.

We thought that it would be best to include traditional and emerging methods together. In other words, you run these at the same time even though they are different answers, because it optimizes the information gain.

You need to test individual aspects of the measurement, the sampler, the operator, lab analysis,

and this is done in a few of your measurement hypotheses and while you are planning and through your protocol, considering differences in inlets, especially for low flow rate instruments that may have very different inlets, co-located measurements.

The comparisons need to be done at multiple sites because of differences in the ambient, at multiple sites, multiple seasons, but these comparisons don't necessarily have to be done at the same time.

And very important, it was felt that the comparison study should be coordinated with an intensive study such as a source/receptor study, the intensive type of measurements that Glen was talking about perhaps in an acute health effects study so that the data would be more generally used than just the measurements comparison use.

With regard to the Federal Reference Method, it would be run as part of the comparisons and with, as appropriate, chemical analysis of the FRM filter as well as the math in order to assess how does the FRM measurement relate to the best estimate of what is airborne.

We talked about concurrent measurements, meteorological measurements, solar radiation, gas chemistry, measurements of boundary layer structure. These are measurements relating to source resolution in many ways, meteorological measurements aloft, and

we sort of felt it would be an unwise use of funds to just do a measurements comparison without some of these additional data and emphasizing that you have to have a concurrent data analysis plan. This is all part of the planning so that data analysis is all a part of the study.

Another cross-cutting issue had to do with reference materials and also, on the same sheet, a related issue is the calibration issue. There are...reference materials came up in two contexts. The first context we heard about from the other speakers, that is, can we collect reference airborne particles that can be used for other purposes, either toxicological or for comparing organic characterization methods. There was reference to some work along this line that is ongoing at NIST and that support and motivation from EPA would help this.

The qualification that, of course, you can't really collect and save airborne particles exactly as they are airborne, and there needs to be recognition of limitations of what you can do with this, but that is...it was still felt that it should be...that the attempt to do this as well as we can, even though we know we can't really do it quite right, should be done nonetheless, but there are many types of reference airborne particles.

Because of these limitations, there are many types of ways it could be done that will have varying strengths and weaknesses, and that whole issue really

needs to be addressed quite carefully. It is not going to be sufficient to just go out there and try and do it.

Calibration issues, this has to do with talking about can we have a standard aerosol with no size, no composition or, for instance, just something that we could take in the field for calibrating instruments, and the idea here is that there are approaches possible. None of them are proven. None of them are really developed enough, that it should be addressed. We need a defining path. We need responsible parties, workshops to address this one issue which is going to become bigger and bigger. It is going to move into more and more particle measurements.

It was also brought up that this issue still exists for gases, interferences, low concentration measurements and that the calibration standards, whatever development stage they are in, as possible, should be included with methods comparison.

Well, I wanted to give a little bit of an example of some of the issues we talked about with respect to specific measurements. Organics this is. Well, I can't really...I think I'd rather just leave it off. Okay.

Organics. Okay. The status right now we see is we can only identify a fraction of the organic compounds, and even so, the list is very long. It is something that epidemiologists would probably just say

oh, forget it, you know, we can't deal with it.

And there are sampling issues. The sampling is difficult because of the partitioning of the volatile organic compounds, the VOCs as they are listed here, between the gas and the particle phase. And there were recommendations that we look at new analysis approaches or concentrate on analysis approaches for classification of species, keeping in mind that a compound classes may be divided between polar and non-polar.

The marker compounds, carboniles came out as specific things that should be appropriately, even though they are not necessarily just a class, still belong in this list of characterizations. Other discussion points on organics was looking at pesticides as a whole, PAHs as a whole, amino acids, grouping amino acids together as a way to address the biologicals.

Again, the idea of archiving samples for testing by multiple methods in the laboratory. With respect to the sampling...that is sort of the analysis end of it.

The next issue addressed was the sampling issues, comparing impactor versus filter collection which is a very specific thing, but what it is really saying is we are looking at collection methods that a priori you expect to have very different types of

artifacts and one would have, so that when you look at extremely different approaches, that tells you a lot more about how accurately you are sampling your atmospheric aerosols than when you just look at different variations of the same basic approach. Denuders and concentrators were also mentioned as ways of looking at particles. Aerosol mass spectrometry, what does this tell us about the organic fraction.

So, we were talking again about special focused experiments in organic properties and associated measurement artifacts. Issues came up, too, with regard to surface characteristics and the role of the uptake of water by particles. We got a little...this is sort of like...

We talked about size resolved chemistry, because this is something that has provided very valuable data when it has been done in the past. It has been done by impactors and by electron microscopy.

The amount of data that has been collected have been limited by cost and the labor intensive nature of some of these measurements, but there are...we shouldn't just say, you know, let's turn away from this. There are new methods that may make this type of measurement much more feasible. I mean, the emerging mass spectrometry method, automated microscopy methods, possibility of including size

resolution in some of the automated real time methods.

We talked about physical characteristics. At least one nice starting point about physical measurements are particle number and surface distribution, scattering, absorption on these instruments that, for the most part, these measurements already have the time resolution that we are after.

And we felt that there was generally reasonable agreement and consistency among the physical measurements for the aerosols. Not always, but, generally, it is there.

Limitations have to do with the fact that size distribution measurements are not easily done. It is not a routine measurement. It requires...I mean, there will have to be some advances before these measurements can be routinely done.

Number counts, although there has been a lot of discussion, and just put in condensation nuclei counters...that is what the CNC here stands for...at sites, one does have to keep in mind that the actual value that the particular counter puts out depends upon what is the lower limit. Does it detect particles down to 20 nm, or does it detect particles down to 3 nm?

In the urban areas, you could get a...you know, it is not difficult to conceive of factors of 2 or more difference in number concentrations, depending upon the performance of your condensation nucleus

counter, and that initiative needs to be taken...addressed if this is going to be incorporated as a more routine measurement.

We talked about also many sort of research questions that could be addressed through special studies, looking at particle-bound water, looking at particle density, refractive index, and it was felt that a lot could be learned about the aerosol, and this was coupled with models and what was happening with the aerosols.

Then we put down here...this is...we talked about upper air measurements of particle chemistry, and much of the discussion, we talked about thinking three dimensionally, not two dimensionally, and upper air measurements are, for meteorological parameters, are becoming much more routine, and for ozone, it has become possible for particle concentrations, there are some light air data, but as far as doing upper air particle chemistry, it is important, we put it down as something that is important. Right now, the idea is that the high time resolution measurements would make this more feasible for aircraft studies and allow you to get more data from the aircraft studies. It was sort of listed as a measurement need, as you would.

We also looked at the more, shall we say, standard things, mass and mass surrogates, comparing real time and surrogate methods for mass with a whole

list of possible ways of doing it, assessing the bias in the approach as part of the comparisons as well as in the other measurements.

Looking at inorganic ions of sulfates and nitrates. Hydrogen ion we should have discussed, but we didn't. There are traditional filter and denuded filter methods. Even though these have been around for quite a while, there are various approach...you know, modifications or, I could say, variations on doing these measurements, and if they are to be part of a larger network...and there will be more than one study...it would be good to compare these at one place and, at the same time, include the emerging methods for automated high time resolution and some methods such as the wet denuder in Europe that is being used in Europe already.

Same sort of considerations for organic and elemental carbon measurements. Here, the denuder methods are not at all well established. I think you will see a lot of advances in that area in the future that can be compared in these measurement sites.

Gases and interactive particles. We shouldn't just limit ourselves to the particles, and we should look at the ammonia and the nitric acid and the semi-volatile organics, the VOCs. Again, there are denuder methods. There are some real time spectroscopic methods, chemical ionization, mass spectrometry methods.

Well, how can we synthesize all of this? Our group was sort of characterized by a lot of far-ranging discussion, and then we tried to just bring it all together at the end. These are...we listed some sort of measurement development priorities. We looked at where our current...after we went through all of this, what really were our current gaps.

The reference materials and calibration methodology is a big one. Another big one and one that is not listed in the draft document organics. The sampling issues, the characterization issue, the cost as another very large priority. Thirdly, as just a practical thing, characterizing...the issue of characterizing the aerosol as it actually is in situ, addressing the semi-volatile question.

When we are dealing with artifacts, at least quantify them and try and minimize them. Next, evaluating emerging technologies which is a stated goal of these sites. Looking at what can be gained through real time defined as anything with less than 1-hour time resolution right now.

Measurement approaches that tie into the emerging technologies. Some of these are automated with immediate results, and then, thirdly, the other issue that is brought up all the time is the spatial variability and ways to address that.

But as we went through our discussions...so,

these are sort of our measurement summaries, but there are...since we have a measurement group, okay, there are some overall issues with regard to supersites that just came up over and over again, so I put them down on one slide, all right, and this has to do with overall operations on these sites.

First of all, there need to be well defined hypotheses in order to properly and effectively plan what is to be done at these sites. Secondly, the planning and management is critical. Protocols, written protocols on the measurements, how they can be done, how they can be coordinated. Protocol also includes quality assurance, and the quality assurance plan includes defining data quality objectives.

Another key component, data management and archiving, and, really, where we ought to start is data analysis, trying to avoid the shoe box phenomenon that Glen referred to earlier. We don't want to just throw our data into a shoe box. The data analysis and how the data are to be used needs to be planned up front.

Also, the reporting of the results and looking at how scientists are involved, communicating with one another, whether we have journal and web publications. These issues are very, very key to making any of the components felt.

So, that is our...

MR. GREENBAUM: Thank you.

Questions? Bill?

SPEAKER: Well, a comment. One is that a lot of people seem to consider receptor modeling as only looking at tracers and that one needs to have longer samples in order to get better detection limits. One of the things you can also use is temporal or spatial variability.

So, short-term time resolved things, if the time resolution is such relative to the source variation, one can use that as well. So, we have to look more broadly...think more broadly in terms of receptor modeling uses for some of these measurement methods and not just that the fixed longer-length duration filters.

MS. HERING: Yes, it is exactly that point that we have 10-minute time resolution down there needed for source resolution for a certain...and we were specifically thinking of looking at secondaries and what primary pollutants they correlate with on a short-term basis. So, we did think of that.

MR. GREENBAUM: Will?

SPEAKER: The top of your list, the priorities, is calibration of the particle size selected inlets, as an example. Was there any discussion of the recent provision in the transportation bill that requires a report in two years of what I read to be a field calibration of your 2.5 size selected inlets, developing

technology to do that?

MS. HERING: Well...

SPEAKER: Could you repeat the question? We didn't hear it.

MS. HERING: I am unfamiliar with the transportation...he says the transportation bill requires calibration to $PM_{2.5}$...

SPEAKER: To develop the technology to assure that your size selected inlets are calibrated in the field.

MS. HERING: And...

MR. GREENBAUM: Well, let's talk about this. In the latest transportation bill, in other words, there is a requirement for EPA, I believe.

SPEAKER: Yes.

MR. GREENBAUM: To do an evaluation of the FRM technology.

SPEAKER: We are going to do that.

MR. GREENBAUM: In two years.

SPEAKER: Right.

MR. GREENBAUM: And you were just asking for a comment whether this group has considered that or thought of that?

SPEAKER: Because calibration seems to be at the top of their list, and there is a motivation for you right there.

MS. HERING: Yeah, I think we were

thinking the size selection characteristic of the inlet is actually, in terms of some of the calibration issues...perhaps other people can comment...is probably one of the simpler issues. I mean, there are issues with accurate sizing of particles for measuring size distributions. There are issues of how effectively you measure semi-volatile constituents.

But mass standards, for instance, if you have...let's say you take an automated sulfate instrument. How do you assess its characteristics in the field? So, I think we were thinking more in terms of the broader terms.

The FRM inlet has been carefully calibrated. It probably will be calibrated again. When we look at $PM_{2.5}$ measurements, they are not all going to be using the FRM inlet, because it is not appropriate for all measurements, and so, you are going to be having...you will have different inlets. I can promise you that, because of flow rate considerations, because of contamination from the oil in the FRM inlet. So, it is not an appropriate inlet for many, many measurements that need to be made.

MR. GREENBAUM: Thank you. Any other questions?

(No response.)

MR. GREENBAUM: Thank you, Susanne, and thank you to all of our work group

leaders. I think these people as well as their partners in crime who helped them write the chapters in the draft you got had already done a lot of good work before they got here, but we have obviously, in each of these cases, seen some added value today, and I thank the members of the work groups themselves for providing that.

We are going to break how for lunch. I think lunch is set up as it was yesterday with tables outside. So, people can get their lunch quickly. We will convene back here as scheduled at 2:00 which gives us a little extra time, but we will start right at 2:00 and aim to be out of here by 3:00 o'clock, and then we are going to talk about what we are going to do with all this.

(**WHEREUPON,** a luncheon recess was taken.)

"Summary of Findings, Commonalities, Priorities and Future Actions"

MR. GREENBAUM: Okay, I promised you we would get started right at 2:00 o'clock, and that is what we are trying to do, as close to it as possible.

So, well, everybody has done all their talking and all their work, and now, we are going to give you the answer. Right? Well, actually, one of the Dans is going to give the answer. We are not sure which one.

What we are going to try and do this afternoon is take from what we have seen in the draft, what we have heard people talking about over the last day and a half, and what we saw this morning coming out of the working groups and give you an overview of, first, some of the guiding principles that we think are going to have to guide any program such as we are now talking about, and I am going to do that.

Second, to try and give you a sense of how, if we look across the different groups and how they have tried to answer the key questions of what and when and

where, how that plays out, and Jim Meagher is going to do that.

Third, to bring out some of the next steps and the challenges ahead, and Dan Albritton will do that, and then, finally, but by no means least, Rich Scheffe of EPA will describe some of the plans that they have both to take in the output from this workshop but then to move on from there.

Overall, what we are trying to do is get to an integrated PM research measurement program, one that serves many different needs, the needs of all of the communities, and there are five guiding principles I would like to talk about.

The first is that it needs to be a comprehensive an integrated program; the second that it needs to be a learning program, one that we learn from, not just one that we take measurements in; third, that as we look across this program, we need some consistency, but everything does not have to be in a straightjacket, everything does not have to be identical and shouldn't be; fourth, we really have to think about this as a leveraged investment; and, fifth, we need to build in from the start analysis and evaluation.

This really has to be viewed as a comprehensive and integrated program. The supersites...and I put them in quotes for a reason...are only one part of it, and we have talked about that a

little bit, but we haven't...there is a base program going into place of attainment monitors, FRM monitors, really giving you...that will be the base for some time to come of long-term, broad-based mass measurements.

There is the routine speciation program, both the trends monitors and then the State programs to augment that, which we have talked about a lot today and which we really need to think about how that fits in with the agenda and the items of our different work groups.

Then, there are these representative airsheds...and I didn't say representative sites; I said airsheds...where we want to talk about putting in sites and putting them in the context of all of these other pieces so that, in the end, we can get a measurement program that really makes sense.

Obviously, an essential part of this is going to be ongoing coordination among EPA and the States and the local agencies and the different pieces of the research community that we have brought together here. We really need a sustained, mutual commitment to make this happen, and we'll talk later, Dan will speak a little bit and I think Rich will speak a little bit to some mechanisms and ideas on how we begin to think about how we do that.

We cannot forget that this is an international program as well. Air moves between the border, up

across the border between Mexico and the U.S. quite freely. We saw an example of that earlier this year, and it does the same thing with Canada, and we need to be thinking and there was a lot of thought during the discussion about how we could work to integrate the efforts we do here with those in other countries.

So, what is a learning program? Well, what we are talking about is designing experiments to answer questions and then identifying the measurement needs, and that is a lot of what our work groups have been trying to do instead of designing the measurement system and then saying well, what questions could we ask of the data we are getting. It is a very important difference. I think everybody understands that at one level, but it bears repeating.

We also, in thinking about learning here, have to recognize that although there is a need to move quickly to take advantage of interest right now and funding things like this, there is also a need to plan for and expect to have to do some pilot work, some first-stage work, before we go full scale in some of these things, because there are a lot of unknowns and a lot of uncertainties, and while we know we are going to have to take some risks, it is just going to make common sense to take some first steps in some of the pieces of this program.

We heard today a number of the presentations

about the need for some core set of measurements, and this is something that we think is really important, a core set that could be agreed upon in each airshed so that even though an airshed and a supersite within that airshed might be trying to do a variety of different things in some aspects, we have some ability to go back again and again and have a core of comparability among the different sites.

There is room, we think, and there needs to be, for substantial flexibility beyond the core to take advantage of the differing needs we have identified among health and exposure and source/receptor. Not everybody is going to make the same use of every site, depending on what...a number of other variables...to take advantage of different geography, source mixes, transport patterns, et cetera.

Also...and this came out of Ken's comments today, to take advantage of opportunities that there may be around some of these sites to begin developing the techniques for accountability measurement where you might have a situation where programs have been implemented, and you could begin to measure or see if you could measure changes.

And, finally, the flexibility to explore something that was not unanimous among our groups today, this possibility of movability, not mobility, movability of the platforms, and we heard pros and cons

to that, but it is a concept that is interesting and one that at least needs to be kept on the table. The idea that every one of these needs to be movable all over the place is something that I don't think anybody here is ready to conclude.

I suppose the use of the term leveraged or leverage as an adjective or as a verb is overdone these days, certainly, in any government circle where you are trying to maximize the selling of your new investment, but this is a leveraged event. This would have to be viewed that way.

Obviously, EPA is talking about making a major investment in this, but we would be crazy if we didn't try and make maximum use of other things that are already thinking about and going on. Glen Cass noted this, and others have noted this as well. We should be looking at other existing atmospheric and health effects efforts and figure out are there opportunities to co-locate some of these sites to take advantage of those already. Are there cohorts that are already being pursued or followed in an area.

The timing may or may not work...I think it probably will...the co-location as much as possible with the new PM centers which gives you some opportunities there, and that doesn't necessarily mean in the same city, but some sense of geographic connection could be useful.

Also...and this came up a lot, and exactly the mechanism we use to do this is going to be tricky, but I think we need to recognize that not every State will have its thinking about its speciation network in quite the same...they may all have slightly different objectives, but there may be some sense in identifying groups of States or States that are trying to coordinate their own speciation networks and then placing a supersite in amongst them as a way of facilitating that kind of collaboration.

All of this is going to be expensive. I think, in the end, what we could see is five to seven sites instead of being five to seven sites becoming either five to seven or even more airshed programs, and that is really where we have to be looking, I think, not just at a platform and a set of measurements.

I told Dan that when Susanne Hering put up her last slide, I wondered if he had written it for her, because when we had breakfast this morning, I had some initial thoughts, and he said well, we have got to put in these things about making sure analysis plans are done up front and pieces are done up front, and then she put that slide up there.

But in one sense, this goes without saying, but in another sense, I think it was Glen who pointed out that the sheer cost of analysis is likely to equal or exceed the cost of doing the measurements, and the

last thing any of us wants to do is be in the position of having to be accountable in the narrow sense, not in the Ken Demerjian sense, for this expenditure of funds when all the data has been collected and nobody has the money to do anything with it.

But analysis plans and protocols from the start mean you have to think...we will have to figure out and think about how to get the resources together, and we know this is not going to be cheap. You need to pre-establish methods as much as possible, or how are you going to do inter-comparison among the different techniques, among the different sites? How are you going to test new technologies and compare them?

And you can think about that now before you get too far into it. It goes without saying that you need to build into this quality assurance and quality control, but it needs to be said anyway.

We heard today several places where people talked about the need for thinking now about things like banking of samples or archiving of the data. I can tell you about a health study that I know of right now which has enormously valuable data but which does not have adequate data archiving plans, and we may be on the verge of losing it, and we clearly need to be thinking about that up front.

And this one thing that we all like to talk about is never really do is we really need to think up

front about how we are going to measure success and build in an evaluation process for assessing whether we are succeeding.

So, with that, I am going to stop there and move away from the general and guiding principles and ask Jim Meagher to come up and try and look at, across our work groups, what we have actually seen in the way of people putting forward ideas, the similarities and the differences among them.

MR. MEAGHER: Let me start off for a second and tell you what I am not going to do. I am not going to go back over all the presentations which were made this morning which, I think, went into each of these areas in great detail and talked about the results and why those results were formulated and what some of the implications of those results were, because I think that would be helpful.

What I tried to do as each presentation was being made is, right from the back of the room, all the pieces of information that...the four questions that we have, and the first question really had to do with hypothesis and science questions. Really, the commonalities of those are very difficult to track, because those are very specific to the various areas or the various disciplines that were involved, but what we should measure, where we should measure it, and when we should measure it have some commonalities, and I

think that, to echo the comment that Dan made a few minutes ago, this is not to say that all of these sites would do all of these things. There are opportunities to improve and to maximize the benefits by looking at commonalities and take advantage of those where we can, and some places it is appropriate, and some places it isn't.

So, since I just sort of collected this information, I thought what we would do is look together at the list that we have, and I think that I sort of can include a very quick look at what I saw as the commonalities, and I think you will see other ones, and you will see parts of the list where I didn't capture maybe everything that people spoke about properly, but I think you will see some things that are very interesting in these results.

And I think what they do, largely, is reinforce what Dan said, and, of course, those are the fodder, if you will, for the decisions and the analysis that Dan made and talked about as well.

First of all, what species are we measuring? And here is the list. I am not going to go through the list. It is clear that the source/receptor people are the winners hands down. They will measure anything that is possible and have more capabilities and interest in those areas than anybody else. So, anything that I would have underlined anywhere, I could underline

there, because they want to measure all of those things, and I admire them for it.

But there are a couple of things that I think you see here very clearly. First of all, Joe and the health effects people were very successful in a couple ways.

First of all, you see in a red underline that people are looking at measuring, first of all, those things which were indicated in the famous ten hypotheses. Everybody recognizes that these may not be the final ten hypotheses or any of the hypotheses and all that sort of thing, but it gives us a focus, a place to go and a place to make measurements and something that we can start with. And we can eliminate NO_2 or whatever, but it really provides a focus for the program, and I think, for that reason if for no other reason at all, it was very helpful, and everybody, as I said, understands the caveats involved with this.

Secondly, it is encouraging to note that everybody wants to measure $PM_{2.5}$. I think that that's something we had hoped for for a variety of reasons, actually, but that is okay.

Again, as I say, you will see commonalities here that I am not going to talk about. I just wanted to point to a few that are really interesting.

Underlined in black in some of these areas are a subset of measurements that appear in virtually all of

the output from the working groups which looks a lot to me like the speciation sites. Basically, people want to know what the mass of materials are. There was a strong comment in many groups about not only looking at $PM_{2.5}$ but also looking at PM_{10}, because we are interested in coarse particles as well as fine particles, but also looking at the basic species that make up those things that help us look not only at health effects but help us look back at source/receptor relationships and things like that.

So, we know we want these sulfate, nitrate contents, the trace element content so you can look at wind blown dust, things like that are very important.

A couple of other things that were, for me, interesting. A lot of people in each of the groups expressed that meteorology is a co-variable for the health effects and for understanding some of the chemical measures. Very, very important.

Also, there was an interesting appeal, in many cases, to look at vertical structures, to look at the three-dimensional nature of the atmosphere in terms of meteorology and in terms of chemistry as well. So, I think there are some very interesting things to look at there.

And I think you can find from these lists maybe the kind of core compounds and the core program that Dan mentioned a few minutes ago. So, that is what

people said about what.

Let's look now at what people said about where, and, again, I think you all have heard this, but it is kind of interesting, I think, to put them up side by side, and you see some of the things that we talked about before. First of all, again, I will reiterate something that Dan said, and that is the movable capability, I think, is very important. It allows us to go in to scope out areas, to extend, if you will, the capabilities to the most important areas where the measurements will have the biggest value, and having a preliminary study involving mobile sources or mobile capabilities, I think, is very, very important.

The second thing, I think, that you will see in a couple of places is interesting both, first of all, urban sites, because those are where the people are, and that is where the exposure is, and that is important, obviously.

And when you talk about urban sites, in two of the areas, there were lists, if you will, of cities that people suggested where those urban sites could be made, and, again, reinforcing in a couple places that we should look at places where there are existing sites, existing national sites with health things going on, exposure studies of some kind. We can take advantage of other resources that are available to the program so that we can extend those measurements and will be a

more valuable and useful thing for the country as a whole.

So, if you look at the list of cities I have sort of underlined in green just as an initial go-around, these are the places, as I understand it, where exposure studies are already occurring, and look at the sites where, for example, the source/receptor people, who have a very different perspective and objective in their program, selected for areas where they might make useful measurements, if you will.

Again, remember, we are not saying that all these sites should be doing all these things, but there are opportunities here where we could co-locate these sites and get multiple advantages from one set of measurements. In fact, again, Susanne, in her wonderful way, as her last comment, was talking of the value of co-locating even places where you are doing method development so those stations could be used for health effects to extend the benefit of those measurements, if you will, to a larger community.

So, again, I think you see the genesis of some of the comments that Dan talked about in this particular area coming in as the analysis we look at by looking at these compounds or these parameters, if you will, and places in parallel.

Now, last but not least is the when question, and when really is a question of frequency and

duration, and for this particular application, I was thinking sort of pull these out of them. I underlined the frequencies in blue and the duration estimates in red. Let me start with the last ones first, duration.

If you look at this, I think you see a strong message here that, first of all, we should be looking at a program that is a multi-year program. I think it is clear that you can't answer the kinds of questions we are trying to address with a very short program that might last a year.

It must last multiple years. In fact, you will even see in two locations decades of use and whether or not we can support and sustain supersites for decades, certainly, the kinds of things we are trying to look at in terms of chronic effects on the health side, in terms of long-term trends and accountability issues, those things, if we want to be able to separate the other co-variables out and co-variants out, we have to have long data sets. So, either this program or some follow-on has to support those kinds of time scales.

So, we want a program that is multiple years from this, and it is a program that has to have a commitment probably not only from EPA but from other institutions as well.

The other thing which I think is interesting is to look at what frequency questions were. I think that, at first glance, it looks like there is a wide range, but I

think there are some significant consistencies in terms of the call for relatively short-term measurements for a whole host of reasons, that you can combine in some ways to produce statistics that average up to values that give you longer-term average estimates that can be used for other compounds.

One of the things I think was interesting is the relevance and the time history, for example, in the health effects is dependent upon what endpoint you are looking at. Some of the endpoints require relatively short, acute effects in very, very short time scales, hours or maybe days. Some of them were quite long in terms of chronic effects, and then you can be satisfied with longer duration measurements extended over a longer period of time.

The other end extreme is the people in the source/receptor who are trying to look at detailed, physical processes in the atmosphere where you have to look at very fast response, sometimes making measurements from aircraft, and you have to look at high-speed response to look at processes that are occurring on sub-second time scales, and, therefore, you have to have those kinds of variables.

But even those fast response measurements can provide information that is useful for doing exposure assessments and supplying information that is important to some of the other things you see up there.

So, I think, at a first glance, I think we see some opportunities, and I think a lot of them were captured in the sort of general principles view, to combine the uses of these sites for multiple purposes to everybody's advantage and to the advantage of the country in terms of saving money.

The other thing I didn't mention when I mentioned the country was when we talk about the location, one of the things that the source/receptor mentioned and Dan mentioned a lot is that trans-boundary flow is an important issue that we have to look at as well, and as we look at the time scales and things like that, if there is a way to coordinate programs in Canada and Mexico and integrate the works of the two efforts, it would be very valuable to all concerned as well.

That is all I have.

MR. ALBRITTON: Can you hear me in the back? Thank you, God.

The first Dan laid down what we heard from you and the authors of the sections on what really seemed to be very clear overall sort of guiding principles that should show us the large-scale features of the landscape and for our planning and our directions in that sense.

And Jim, the only Jim, in fact, the one and only Jim, has described to us actually the nuts and

bolts of this enterprise, and that is what are the measurement variables and why for each of the five disciples and began to look at the commonalties which will, of course, go further as we continue to look at it in that vein.

What the second Dan is going to try to do is to say okay, with those guiding principles and with this input of information on the five disciplines, where do we go from here? And I am going to do that by covering three points.

First of all, just to give you a brief description of how we intend to finish the workshop report. The components, I've already given some comments to you on who we see as the audience for this report and the utility of the report.

Secondly, to dig in a little bit into what one might call some first thoughts and some examples of a research strategy based on those guiding principles and the details and the scientific meat of that that Jim described. And what we will try here is to make a short list of five goals, five research objectives, based on the guiding principles and the readiness and the need that we saw from each of the five sets of experts.

The focus here is going to be on the near term, namely, what are things in a feasible number of years that should be aimed at and could deliver goods to those who pay for that activity.

And, third, for each of those five, we will try to give short rationale as to why those five examples.

Then, fourthly, to underscore for you that the commonalities orientation of how those five address so many of the things we heard here was a key point in trying to pull those five examples out of that.

Then, finally, I will close with a summary that we put together of what we see are some of the major challenges. In fact, we see three major challenges that have to be addressed in the very near term, and we put that down as the next two months. And, secondly...thirdly...to point out that all three of these challenges won't be science oriented. They will be people and institutional and organizational commitment and interaction oriented.

So, this is our proposition to describe at least some initial thoughts on where we go from here.

First of all and straightforwardly, I hope, where we are headed on the report, point number one, we will have a conference report. It will be a revised version of this. It will be published as a stand-alone report. We plan to put a lot of effort into that to make it something that we all would feel comfortable looking back through and feel highly comfortable in giving it to colleagues and using it in our organizations.

It will have three parts, and, of course, the heart of it is the people that you heard describe their

initial thoughts, how they were going to revise them based on the discussions with you. They will be furnishing us revised sections for those five topics of the health, exposure, and source/receptor, accountability, and the methods development.

And as you will see, they will be using the very excellent input that all of you have provided and the excellent start that they provided for this draft.

We intend to use much of what we talked about today and, to some extent, the summaries of this morning to expand the last section which we held as a place holder in this draft and just told you what our intent was in that, and that is how do we move toward an integrated health/atmospheric PM research activity in North America. It will have what I think will be useful appendices, very useful appendices.

We have in progress, and several of you have that, a site inventory, that is, an inventory of things that resemble and are related to, quote, supersite-type activities that are already occurring in the U.S. now, and we heard many, many times about leveraging and how to most cost effectively build on what we already have.

And the work done by Jeff Cook and Shelly Eberly in putting together a very nice compendium of what is out there and what is happening, we will draw from that and have in there a current atmospheric

observation site inventory.

Secondly, John Vandenberg has been helping put together the health analog of that, and we have gotten good information and input here from people to put that up.

Both of these are short, direct, punchy, map-oriented who is doing what and why, and we hope these, then, will be the genesis of something that, perhaps with Agency sponsorship, we can maintain as part of this effort as an updating web activity where people can see what is occurring on the atmosphere, the health, and the exposure side of this.

This is not so much projects funded, but it is activity and area and what are the goals of that. We will, of course, also document all of you from having been attendees, because so much of this depends on what you have described in terms of improving our first draft.

Finally, we are open to a lot of suggestions on this last point. We will print a bunch of copies, and they audiences that we see is, of course, ourselves and our colleagues, and to be able to see...put together both the health, exposure, and atmospherics all in one booklet, I just...I found the draft was great in that respect.

Our communities, in all of the senses, including management and policy and research,

education, we think that our communities would benefit from seeing this in one place, and we will make sure we have got enough for that. And then, our sponsoring organization or the parent organizations, as we describe this endeavor and our activities to them, we want to be sure to do that, and several have mentioned follow-on in terms of a focused description of what was tried and what was the outcome from the workshop, and there will no doubt be some opportunities to take advantage of what you have done to describing in a real nutshell form to people in our management or decision making chains.

Now, in terms of trying to pull together the important overall guiding principles that the first Dan described and Jim's details in the five disciplines and the cross-connecting commonalties, we have some initial thoughts to propose to you on perhaps some major elements of a PM research monitoring strategy.

As Dan did and as Jim did, I put that in quotes, because we know now, I think, that those words don't just mean fixed observatories running forever on species, but they embody airshed concepts, they embody hypothesis testing, and they embody the whole idea of instrument development, and they embody an element of accountability. It is a package there now, and it is not just a site operating.

And I think this is what we hope to capture in

a report, and we tried to capture it in these five examples. And let me go through each of these. They are examples. They are organized in a certain fashion which I hope will become clear.

If there is as job 1 for this group, it is probably to characterize the FRM out there in the real world run by real people under real circumstances. And we believe, as each of these will have, we believe that the concept of supersite type measurements, along with the FRM, has high payoff. Now, here is why we think it has high payoff.

First of all, planning and dreams are great, but the more you can anchor it to something that is gives you a bigger payoff. And there are going to be a thousand of these things out there run for purposes that we fully understand and we can get as much science as we are smart enough to do, and we thought that the step where we characterize the FRM from the standpoint of what it is measuring and may not measure as well and characterize that in a scientific fashion, that this data set which will serve policy, as its intended purpose is, will also probably be the major data set from which the next round of research and testing can occur.

One can think of several examples of this type of thing: Doing it in different environments. Doing it operated by different institutions. Doing it from the standpoint of what the potential artifacts might be that

weren't captured, that is, measuring those with analytical instruments that would be like supersite type instruments, and characterizing those that we do believe it is measuring and look at that parameter set to define what can be the scientific focus of this data set.

The second point is related to that but takes it one step further, and that is perhaps the second best thing we can do is to move one step beyond mass, move a few components that are a step or so past mass. And in the spirit of the same argument, smart money says there are going to be chemical speciation sites out there, and there may be up to as many as 300 of them.

Now, that is measuring more than mass, as we heard from Petros. The best chance for perhaps a future enriched scientific data set is for the species, the ensemble of species that those chemical speciation sites are doing, is do this same endeavor where you run those activities in parallel and ask questions about artifacts, ask questions about trends and how long term things are stable.

We would see that the stewards of the next decade are probably going to be writing using either data from this or data from that, and the more it can be characterized, the richer that science will be from these two sets that are out there, of course, for policy-relevant questions.

Those two we found leveraging in perhaps the

clearest example of where we are.

Third now moves beyond things that we are leveraging off of in a large sense and are leveraging off things that are probably either somewhat underway or could be stimulated in a very major way, and that simply says let's take the best analytical approaches that have been discussed here, and let's just go to the various places in this continent and see what the PM is. We have some glimmers of that.

We know how the East looks and how the West looks, and we know what natural looks like in the Midwest. We think of organics in the South, we think of visibility changes from east to west, and we think of total loading from east to west, but we are a pretty PM-diverse continent, and we think that such look-see type efforts over a reasonable period of time is probably the best single investment in the surprises that are going to mean that, ten years from now, we will be talking very differently about PM.

It is also probably the best investment we could make to design what is going to be the next generation of planning for PM research. The richness of this data set with its speciation, its length of time, the variable lengths of time, and its variable places, we think, in the next five to six years is going to provide information that will change the future from what we see it how.

Point number four...and this goes beyond look-
see...this says stay put in a few of those airsheds that Dan mentioned, a few of those PM regions, and try to get a first order...now, I'll come back...well, we all heard what we think the different meanings of that are...get a first-order picture of the PM climatology in some number of strategic regions, either chemically...either health-oriented strategic regions, airshed strategic regions. The idea is to think about just beyond a picture but think of a seasonal or annual or inter-annual or multi-year variability.

The key element of payoff here is that, sooner or later, when decisions have to be made about who is going to stop doing what for the benefit of somebody else on PM, it will be, as Glen Cass has elaborated, it will be a model which we either have betted very well or we have not betted added very well.

It is the only tool you have to make such linkages and to make such what-if type decisions, and, therefore, as was described by his group and many others, the concept of having the proper data set to build on this point is going to have high payoff when it comes time for somebody in Washington and their counter in Mexico to say and here is how we are going to implement these regulations.

Linking both source and receptor also, we

heard, from purely a health research stimulating standpoint is very important. You are seeing effects. You are asking I have got ten. I sure would love to narrow that to three. What sources are bathing this study area that I have found these effects in? Beyond regulatory science.

The third point...and this brings me...getting close to the home of people who are paying us to be here, and that is people tend to think that they live regionally. They associate regionally. The manage their affairs regionally. They vote regionally.

The concept of integral units being examined over a multiple number of years, as we see it, has several payoffs.

Finally, the last sort of example says let's get going now and make as much commitment as the fickle budget process will allow into building a time series. Let's get going on a time series for a few indicator things.

I am deliberately vague on indicator. It could be a source variable so that you might have a first chance to show the response of change in emissions. It might be an impacts variable to where it is the thing next to a health effects so that you could get closer to what Ken Demerjian has spoken about on accountability.

The rationale for getting started now is that

things have to start sometime, and the base line that we will be referring to ten years ago can be met here.

Two points. The variation of something with time, in addition to all the points that I have mentioned above, is pretty science-rich information. Secondly, from a policy standpoint, whether things are getting better or worse and why is very policy-rich, very socially-rich information.

So, we see those five tiered elements of a strategy as something that perhaps would be useful for us to consider and think about as a single-page, perhaps, description of what we are doing and why we are doing it and what are our near-term steps in that regard.

Finally, let me turn to the part that I don't have all the bottom lines for in any way, in spite of all the help of the authors who met with me, and that is beyond research and beyond the science, what is going to make us either lose momentum or keep momentum or gain momentum after this meeting?

The first thing is to state what we realize we have got to do, and, again, this is a very general statement. It is one that one would expect to see, and that is to implement a well-designed, integrated, and sustained program with the continued active involvement of...and we have worked on those adjectives. For example, integrated is kind of a theme

we have had here, between health and atmospheric and different types of studies on different time scales for different purposes.

Sustained was underlying several things, saying that if you have a decadal need, then somehow, we as program managers need to be smart enough that, by hook or crook, then, we want to try to sustain that.

And in terms of involvement, the idea of that, we are involving all aspects of EPA, other U.S. agencies, so that it is a continuity issue dealing with States and regions and acting locally, along with the help of the private sector as well as, of course, the fundamental information provided by the research communities on this.

We believe that while this is a general apparent type statement, if one thinks about the meaning of a couple of those words and how we maybe didn't meet them in other types of activities, the point was pointed out earlier by the first Dan that we just do have to restate the obvious when you notice that it wasn't done in an earlier sense. So, that was crafted with some care rather than hitting the blurb button on the word processor.

Now, there are some things that have a lot of open questions associated with them, and we saw three of them that relate very specifically about what we do after we break up today, and I have heard many...many

people have asked us this. How will, for example, the EPA with its central position in this, the U.S. as an ensemble, and Canada, U.S., and Mexico, how we will coordinate whatever we would try to plan from here by way of observations? Simply asked, who are...who being a singular or collective word...who is going to be in charge?

Second, how will this measurement oriented effort be coordinated with what we know is a much broader problem? And that is we know we must address science questions and hypotheses that only measurement...that measurements alone cannot fully answer. And, therefore, as we have already said, the diagnostic model, the prognostic model, the process oriented lab studies, and periodic pulling of all that together to see where we stand, how are we going to coordinate the measurement oriented component of this with what we know must be a package deal to get success?

And most importantly which this workshop, from my perspective, has really, really been a firm level up in cultural interaction between impacts community, in this case, and the atmospheric community where, frequently, we feel maybe that a standard separates us, where one defines what the standard ought to be and the other defines how to meet that standard, I think, here, we have taken a somewhat different start and one

I believe is going to have payoff from a scientific and effectiveness of understanding.

How will the interaction that we have done here as multiple communities, how will that interaction be maintained? Because, as we all know, entropy in molecules is to homogenize, but entropy in human affairs is to separate. That is, if left to its own, we will go our separate ways.

So, we see three broad questions. There has been discussion of those, and following that now will be Rich who will comment on some practical aspects, perhaps, of these three questions of where we go.

MR. SCHEFFE: Do you want to take a little minute to answer questions of...

MR. ALBRITTON: Actually, I would be happy to. I didn't know whether you wanted to get through all four and then we just open...

MR. SCHEFFE: Why don't we do that?

MR. ALBRITTON: And then we just open it up for our concluding discussions, because they will say well, what are you going to do here, and Rich is...

MR. SCHEFFE: Well, it goes without saying that the Dans and Jim are a very tough act to follow. They are incredibly smooth. Now, you get the coarse part which you’ve already said you’ve

overlooked. So...

A couple of things I would like to do first. Being the last EPA speaker, I would really like to thank a lot of people. Especially, I would like to thank the Dans for running this workshop, not only doing such an excellent job in coordinating this workshop and organizing a lot of the elements of it but making it enjoyable and so engaging. I mean, it is just a pleasure. I could have listened to Dan for another two hours. I think we should all applaud them for their efforts.

I really am so appreciative of the steering committee. I mean, the folks that are here that...I don't know. Pretty soon, Glen Cass is going to become irrelevant. Nobody will use his advice anymore, because he comes to so many of these meetings and provides us with so much guidance and advice, and that is greatly appreciated, and I am just using Glen as one example. I mean that for everyone.

All the participants here, of course, this is an excruciating, painful couple of days. I mean, yeah, it is nice to come here and see old buddies and friends and, incrementally, we have learned just only a very little bit, but in the long term, we hope that the synergism and the coordination pays big dividends, and that is why we are all here, but it is a painful process, and I think we all realize that.

There are a lot of other things behind the scenes that people don't realize, and I just want to go through it real, real briefly. The major organization that was done for this committee...for this workshop, a lot of that was done internally by Russ Wiener and Bob Fuerst, and that is greatly appreciated.

There was a lot of work also done, and I want to mention again Jeff Cook and Shelly Eberly and Jim Meagher for putting together this compendium of monitoring network and data which is really going to be valuable. I also...and Jim Meagher has done a lot of this behind the scenes the work that I think a lot of you see.

Among others, I want to mention Joellen Lindes, William Wilson, John Bachmann, Jim Vickery, Paul Solomon, John Vandenberg, Linda Sheldon. These are EPA people. Lucas Neas. These are all people that contributed to developing EPA's mission statement, objective statement, for this.

Finally, there are a lot of people on the administrative end who are trying to figure out how we can actually run an ethical program and...people like Mike Jones and Vicky Preznell and John Cline. And I have omitted probably a ton of people, but that is how it goes. And, of course, EPRI and API being the sponsors for the food for this program. That is appreciate as well.

Now, I would like to...I mean, they said everything. I just want to make a couple of points really quickly. The real challenge in this program is coordination. There is no doubt about that, and the coordination goes in a lot of different areas.

I am particularly concerned about coordinating in the source testing, emissions, and modeling areas, because we have basically a measurement community here and a field program community. This is really a challenge to a lot of us here and a lot of the upper level managers within the different organizations.

And I think what we are talking about here is collectively...somebody...Petros mentioned $200 million and $100 million. Well, you know, that is what the resources are. When you combine all the resources that is done in the field measurement programs, it is on the order of a fraction of $1 billion, and if we, collectively, can coordinate that somehow, there will be geometric benefits to all of us for how we do this work.

And there is no formula for this coordination. I don't have it. I mean, there isn't a formula. It is meetings like this. It is people taking individual and collective responsibility in being aware of these different programs and trying to coordinate as much as possible.

One last thing. The overlaps, I don't like Dan's picture where he has a small overlap between the

measurement interests between the health and the atmospheric science guy. I think the overlaps are much bigger than that. I might pose a question, what atmospheric metrics would either community throw out? I don't think there are many at all.

So, anyway, I am up here to try to give a little bit of insight in terms of what is going on next from EPA's perspective. Again, the theme here is that this truly is a much...this is not an EPA program. We do have some funding and accountability responsibilities, of course, but this is a program that is managed by this whole community, and I feel very strongly about that, and that is the message we are trying to send.

Several things are going to happen. There will be a workshop summary report in September. Dan has promised that. He is on record that he...

SPEAKER: Pre-print.

MR. SCHEFFE: Pre-print. Okay. Anyway, there will be that report. He...no, I'll be quiet. I was going to make this analogy to a favorite guitarist of mine, Doc Watson, and when I saw Dan, he reminded me of him, just the clarity and the forcefulness and the consistency. But, anyway...

The action plan. We are internally, an EPA team, is trying to work on the nuts and bolts of how we are going to actually implement this program, the various funding vehicles. We are looking at a suite of

different contract vehicles.

You saw in this presentation that there is a need to do quality assurance work, data archiving work, to have consistency not necessarily doing the same thing at sites but having consistency across sites. We see there being a need for a coordinating contract to do a lot of that activity. We see a lot of research-specific activity which will lend themselves to different kinds of cooperative agreements, such as with universities.

We are working on those mechanisms. We don't have any meat on those mechanisms yet. We are working on those, and we are also developing the scope of activities which largely will come from this workshop report as well as a schedule.

We have to have...one of the difficulties, we set up a lot of programs, historically...and this happens in a number of areas...where there is a lot of momentum at the beginning, and then it trails off. You know, how do you maintain that interest, that momentum, that buy-in, that engagement?

We are in the process of setting up a government oversight group. I would like to say this is different than this is a government expert panel oversight group, but there are ethical...there are restrictions and so forth. It is very clean for us to set up a government oversight group that will include various State and local agencies, EPA, NOAA, perhaps

other Federal agencies. That is just an example.

That will be a small working group that will be responsible for a lot of...I shouldn't say responsible but will oversee the actual logistics of how this program is going to be implemented, and that group will be existence for the duration of this program.

More important or just as important, we are extremely pleased with this steering committee in which we had a group of scientists from the health and exposure communities and the atmospheric sciences community, and we need that kind of oversight on a frequent...on somewhat of a frequent basis, and we have to look into how we are going to develop a mechanism for doing that, but this steering committee has been very, very effective over the last couple of months.

We would like to see something that plays a role similar to that for the duration of this project as well, and we have to work...we are open to suggestions for that, and that is an area we want to work on.

Some of the other activities that are going on. There will be a presentation to the National Academy of Sciences. I think it is September 21st. Is that...

SPEAKER: No, it is later in the week.

MR. SCHEFFE: 24th? Okay, toward the end of September in which, at that time, we will

have a further crystallization of our ideas for this program, and we will talk about that at that meeting.

We, as part of...you know, all of you know about the language, all kinds of Congressional language and agreements in terms of this program, the whole monitoring program being...major parts of the monitoring program being reviewed. This program will be reviewed by CASAC sometime in October. Phil, what, end of October or...

SPEAKER: Somewhere third or fourth week.

MR. SCHEFFE: Somewhere at the end of October.

In terms of when we see this program actually getting off the ground, we see sites being initiated...and I believe one of the Dans showed you that we need to start with perhaps one or two sites as prototypical sites and then expand into that. We expect to get sites initiated next summer/fall time frame and implement a full program in about the year 2000.

I have left out an awful lot. There is probably an awful lot of questions you might have, and there are probably a lot of answers that I don't have, but feel free to bring those up. Or, actually, there is...

MR. GREENBAUM: Why don't we take a moment for asking any questions? And I got up so that all the tough ones, I can just call on Dan. Will,

did you have a question?

SPEAKER: Just a suggestion. On your little circle graph on the last presentation, I am not sure how the exposure in the PM context are one circle. I didn't...

MR. GREENBAUM: Well, that is actually...we spent three-quarters of the steering committee meeting discussing that. That’s why there were three examples. No, no, I think we guys do understand this. Well, I think what is important is to distinguish them in that exposure is also non-atmospheric. There is an informal link there, and it is different.

Other comments or questions?

(No response.)

MR. GREENBAUM: Well, we have either exhausted you and you want to go home or have answered all your questions and it is all taken care of, but it is not taken care of, because we are going to...oh, wait, we have a comment here. Go ahead, Ellis.

MR. COWLING: I would just like to offer two philosophical comments about what you said about early programs and maintaining momentum. Oliver Wendell Holmes was a wise observer of human affairs, and one of the things he said was that man's mind, stretched to embrace a new idea, never gets back to its original dimension. Man's mind, stretched to

embrace a new idea, never gets back to its original dimensions.

A lot of health scientists got their minds stretched about measurements, and a lot of measurement people got their minds stretched about health this week in Chapel Hill. I think that is a very good thing.

And connected to the question of momentum and how to maintain it, when the history of air quality management in North America is written in the year 2025...

SPEAKER: By Dan Albritton.

MR. COWLING: ...wouldn't it be splendid if July 22nd and 23rd was one of the red letter days of that history? This was a day on which health scientists and atmospheric scientists came together and planned together, to work together, and if they were to sustain that effort for those two decades, let's say, that might be necessary before we can really begin to manage particulate matter air quality in North America, wouldn't it be fine if this workshop was one of the events that we could look back on with considerable satisfaction?

And I suggest that it is up to us in this room and many others who did not come to ensure that that happens. Health scientists and atmospheric scientists have not a long history of working together effectively,

but wouldn't it be splendid if we could do that so that that history could be written in a way I think we would love to see it written if we do what we must do now in these next few years.

Thank you.

MR. GREENBAUM: Thank you, Ellis. I don't think we can allow any more comments. We all want to end right there.

But other than to say...and maybe you want to say also...I want to say thank you to all of you...

MR. ALBRITTON: Yes.

MR. GREENBAUM: ...for your participation, your active participation, in this, because that is why we have had a good product and a good result.

Thank you in advance for your continued participation, because this is not the last time. We are going to try and keep people talking to one another.

I want to thank...I won't mention the whole list, but I do want to thank the EPA committee and all the staff at EPA as well who helped immeasurably in the organization of this and the steering committee and the leads there who made this document what it is already, and we heard their great work earlier today.

And I think on behalf of Dan and myself, I want to particularly thank Jim Meagher without whom this wouldn't have happened.

So, thank you all and a safe trip home.

(**WHEREUPON,** the Workshop was concluded at 3:05 p.m.)

C A P T I O N

The Workshop in the matter, on the date, and at the time and place set out on the title page hereof.

It was requested that the Workshop be taken by the reporter and that same be reduced to typewritten form.