UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

11th CONFERENCE ON AIR QUALITY MODELING

WEDNESDAY, AUGUST 12, 2015

ENVIRONMENTAL PROTECTION AGENCY

RESEARCH TRIANGLE PARK, NORTH CAROLINA

8:30 a.m.

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A G E N D A

Presentations by EPA

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P R O C E E D I N G S 9:06 a.m.

Mr. Bridgers: Well, good morning, everybody, and welcome to North Carolina. Thankfully the weather cleared through last night. I'm going to check real quick with our court reporter and make sure that we are--we're clear? Okay. And we have a closed captioning service online, so I'm just making sure I have a mic check with Ms. Tina.

I am George Bridgers. I'm with the Air Quality Modeling Group here with the USEPA. Hopefully most of you will have seen my name along the way with the registration and/or lining up the presentations. But I want to welcome you here to the EPA facility and to the 11th Conference on Air Quality Modeling.

I want to officially open the conference and that of the public hearing that's related to the conference and also with respect to the proposed rulemaking for the revisions to the *Guideline on Air Quality Models*.

Before we have an opening remark and some other remarks from Chet Wayland, I want to go through some logistics real quickly about the conference and public hearing and also with respect to our facility here.

So it is clear, Congress in its infinite wisdom back in--well, it started in '77, but then every three years thereafter per Section 320 of Clean Air Act said that we have to have a conference, a modeling conference, and that is what this is. They have to be transcribed and there has to be a public record.

In addition, this conference, the 11th Conference, is also serving as the public hearing, as I said just a minute ago, with respect to the proposed revisions that we are hoping to make with the *Guidelines on Air Quality Modeling*. So every presentation today that's given will be part of the record. Everything that's said will be part of the record.

Because this is a public hearing that's inter-connected with public--or proposed rulemaking, we will not have a question and answer session, so that's a little different than the 10th Conference on Air Quality Modeling. And as I did when I started, I request that all speakers when they come to the microphone that they identify themselves and if there's any affiliation that they're connected with.

I am the emcee and the public hearing officer, so that means I drew the very short straw upstairs, but that also means if you have any questions, if you have any concerns, find me. Since Tyler Fox up here and Chet Wayland are my supervisors, the chain above me, if you can't find me, find them.

But I will request, again, since we're in the midst of a proposed rulemaking, that all of our other EPA brethren--that if there are specific questions about the conference or anything with the proposed rulemaking, find me or Tyler or Chet, and we'll delegate the questions as appropriate. But we have to be sensitive to questions that come in about our proposal.

We have a full schedule. We always do. Those of you that have been to previous conferences and workshops know that I try to run a tight ship, and I think that we have accommodated many of the speakers because we increased the speaking time for the public presentations from 10 minutes to 15. And that also means that when we get to the open forum or the oral comments that we will also allow for 15 minutes or up to 15 minutes if there are people presenting oral comments.

Most of you know that this is a pretty secure facility. It's harder to get in here than it is to get in most airports. Hopefully most of you through the registration process didn't have any trouble getting in this morning, but if you are leaving the foyer, the auditorium or the cafeteria area here, you will need an escort here on the campus if you're in Building A, B, the upper floors of C, D, E, or the High Bay. So if you leave, you know you have to go back through security.

If you see a gentleman that's carrying a sidearm and he tells you to do something, I would listen, assuming they have some sort of badge and they actually are security. Actually, if someone is carrying a sidearm, I would just listen anyway.

For those of you that have not been to our campus, I also wanted to pass along just some information about the facilities. Bathrooms, most important: you don't have to wait till breaks, although it's nice if we can. If you go back out the double doors here and go across the foyer, there's an alcove where the elevators are. Right before you get to the elevators on the left are the bathrooms.

Snacks and lunch: a popular question, are we offering refreshments? We are. They're for pay and they're across the hall at the Lakeside Café. And we're not trying to support the contractors; we just can't offer anything more than water that's outside the bathroom. That's typically mostly free.

But at any rate, across the way they have drinks, coffee, some snacks during the morning and afternoon, and then they do have a full lunch selection. And I saw the e-mail last week, Tyler. It was--they're having a cookout day today or something, so I--just bear with them across the hall.

But the point that I wanted to make here is that we have a very full room. It looks like we're going to reach standing room only shortly. So at 11:55, which is a little before the normal lunch hour, if all 200 of us get up and go across the hall and stand in line, well, you'll be standing in line with 200 people.

So we tried to make an hour, almost an hour and a half--it's an hour and 20 minutes--lunch period so that some of you may--if you're going to socialize during the lunch hour or the lunch break, you may do it on the front end versus the back end so we can stagger people going through. You're more than welcome to go ahead into the dining room and sit down and chat while the line dies down or stay in here. And there's--you know, you can come find me. We have some WiFi if you need to check e-mail.

But at any rate, hopefully we can get everything done in the hour and 20 minute time period, but the one thing I will say, at least this afternoon at 1:20 we're going to get the train back on the tracks so we can get through the afternoon.

Also--and I will not put on my vest, my safety vest and my hard hat, which I do have upstairs, which is just hilarious--if there is an emergency, if there's fire alarms, you'll hear somebody talking on the fire alarm system. I'm your point of contact too.

The emergency egress for this building and for this room is back up the stairs to which you came in, and then there's a small parking lot just past all the construction right at the front on the left. That's the assembly area. It's technically Assembly Area 8. I think I put that on the slide here.

But at whatever time the fire alarm--if it should go off, I'll also make an announcement. Just follow me in an orderly fashion. And if there's anybody that has--that needs assistance, there's an area of assistance I think right outside the room, but we can figure that out. But hopefully we won't have that. Hopefully there will be no fire alarms over the next couple of days.

And the other thing is that once the emergency is over, myself, since I'm the point of contact for the conference, will be the one that gives the all clear after I get the all clear to come back in the building.

I would be--well, I should give lots of recognition. It takes a team; it takes a huge team here to make this happen. And so my brethren in the Air Quality Modeling Group from Tyler down through Kirk, Roger--I don't know if Jim is in the room yet--both Chrises, Misenis and Owen, Brian Timin, and James Thurman, all have provided invaluable assistance, effort, energy to make this possible today and the proposed rulemaking come out the door.

And in addition we had a lot of help from the front office, from our divisional front office. We had help from OTAQ and also from all of our regional offices and our federal partners. So for all of that, we're very appreciative.

And with that, I think, Chet, you are up, and we're two minutes ahead of schedule.

Mr. Wayland: Very good. Well, thanks, George. Before I make a few remarks, we've got a full house here. How many people think it's kind of warm in here? Are you guys okay there? All right. We will see if we can get the AC cranked down a little bit because this is going to be a packed room and, you know, not that our speakers are full of a lot of hot air, but it could get a little warm in here.

But I want to welcome you guys--Chet Wayland; I'm the division director for the Air Quality Assessment Division here in OAQPS, and the Modeling Group is under my purview in my division. And I'm really excited for you guys to be here. I was telling some folks this morning, you know, a lot of times when EPA puts out a rule we kind of know what the comments might be coming.

With this one I'm actually really excited because I think we have tried to address a lot of things that folks have raised over the last many years. I know we probably can't address everything that everybody wanted us to address, but I'm looking forward to the comments we're going to get because that's how we improve upon something, a product that we've already put out as a proposal.

And in this case, you know, there's been a lot of collaboration already from the beginning. I think it's--I was talking to Jeff Masters just before I came up here, and you know, we talked about in the old days how there used to be a lot of collaboration on the science, and I think we're trying to get back to that. And where we are with this proposal, there has been a fair amount of collaboration leading up to this--this proposal between stakeholders and the EPA here so that we can actually try to put the best science forward in our guideline models.

There's a lot of people that have been involved. I know Pete Pagano at Iron and Steel, Cathe Kalisz at API--those folks have all worked with us on various, you know, field studies or data sets and things that we've been able to use as we've gone through and tried to upgrade the model and improve the *Guideline*. And so I want to thank you guys for that contribution.

I mean we're all at a place today, I think private sector and public sector, where resources aren't what they used to be, and so where we can work together and leverage, I think we can develop a better product.

It is a guideline model, and as George said, this is a public hearing, so we do want to get your feedback on that, and we will be listening carefully obviously as we go through this. But I thought it would be remiss not to thank all of you for not only being here but for what you've contributed up until this point.

It's been ten years since we last updated Appendix W, and that's a long time. I wasn't even in this job when that was--last occurred. In fact a lot of the folks in the Modeling Group weren't even in the Modeling Group when that last occurred. So I think it's--it has been a long time. It's been something that people have been waiting for.

I'm fairly optimistic. I think we have tried to address a lot of the issues that were raised, but I'm also very excited to see what kind of comments we're going to get and what we're going to hear today as well throughout the public comment period.

And I think we are going to try to address those comments in a timely fashion and hopefully get a final rule out, you know, in the time frame that we're looking for, which would be within the year, because we know how much people are interested in having this final and being able to use it.

So, you know, I just wanted to thank Tyler's staff and his folks. I know how much time they've put into this, not only in the last, you know, two or three months getting the proposal out the door, but in the last several years working with many of you, the 10th Conference and other meetings that we've had with state and local partners as well as with our federal partners and our stakeholders here today.

It has been a long process, but I think, you know, if you're going to develop something worthwhile it takes time. And I think, you know, what we have today is a much better product that we had ten years ago. It's a better product than we had a year ago. And a lot of that is because of the work that people have done.

And Tyler, I just want to thank you and your staff. I think they've done a tremendous job pulling the proposal together, pulling these presentations together today, but also, you know, of reaching out and working collaboratively, and I hope we can continue to go forward and do that.

Obviously there are rules as part of the comment period. You know, during the comment period we'll take information in. We'll evaluate it. But I don't want people to think that, you know, that's the end of the process. I would like to continue collaboration as we go forward.

Even after this is final, let's continue the scientific collaboration as we move forward in the years to come because, you know, science never stops. It is always evolving. We're always trying to get better. And even though we do regulatory actions periodically, it doesn't mean that it has to stop at that point.

So I've been really excited and impressed with the collaboration we've had to date, and I hope we can continue that even beyond this rulemaking as we continue to improve the models and make them better and better.

So I hope this will be a great opportunity for you guys to provide your input to us. We are going to be listening carefully, and I'm looking forward to it. I know it's a long process and public hearings can--you don't have as much time maybe as you'd like, but I appreciate--you have a full comment period after this, so obviously what you say today will be put into the docket. But if you submit formal comments, obviously they go into the docket as well and we will be addressing those comments as we go forward.

So with that, I just wanted to thank you guys again for being here. It obviously by the crowd here shows your interest in this particular proposal, and I think we really understand how much this means to everybody and how valuable this tool is because it's used in many, many ways.

The one other thing I wanted to address that we have tried to address is--probably if you've read the proposal you've seen it--was the petition from the Sierra Club to deal with secondary formation of ozone and $PM_{2.5}$ from a PSD standpoint.

You know, we had to deal with that kind of independent of some of the collaborations we've had with you guys because we were responding to a petition, but I think we've put forward a good path there as well with a fair amount of flexibility, so I'm really interested in seeing comments on that.

This is something new. Some of the other things are improvements, but this is something kind of generally new that we haven't had to really address in the past and now we're forced through the petition to make sure we address it. And so I'm really curious to see what kind of feedback we get on that, and to you guys, what do you think about the flexibilities we've provided and so forth with that.

So I'm not going to drone on because I want to get to the heart of the discussion and have Tyler and his folks start walking through some things. And I'm real excited to see your comments or hear your comments later on this morning and this afternoon.

Again, as George said, if you have any questions, you know, logistically, track George down or Tyler or I. We'll be happy to help you. Unfortunately, we can't do a lot of Q and A on the package itself because this is a public hearing, but we'll look forward to continuing that dialogue as we go forward, if not today.

So, well, thank you guys very much. I appreciate your being here. And with that, I am going to turn it over-- to you or to Tyler? Back to George. Thank you.

Mr. Bridgers: Perfect; thanks, Chet. Thank you so much, Chet. So Chet yields two minutes almost to Tyler Fox, so next up we have Tyler Fox, who is the Air Quality Modeling Group's group leader.

Mr. Fox: I wanted to add my welcome to everyone. I'm very excited for you all to be here. What I'm going to attempt to do is provide a road map. You'll hear from each of the individual members who, as Chet and George indicated, have put in a lot of time and effort with you and with their colleagues in getting us to this point.

And so I'm really here just to provide that landscape, hopefully allow you to better connect the pieces and understand how they fit together and what our thinking was in putting these things together.

So obviously we all recognize that the rule was published on July 29th. We are accepting public comment for 90 days. We knew that there would be quite a bit of review and time necessary to provide suitable review by you-all and others. So that comment period goes through October 27th, so even though we're hearing from you-all today, this is not the end of hearing from you. This is just really the beginning.

And so 70 some odd days from now, I'm sure you will be busy testing code, evaluating our evaluations, providing more, you know, input and feedback of great value to us, as Chet said, to then get to a final rule, which we anticipate within the next year, the sooner the better from our standpoint.

We don't want it to go too far and get into the presidential politic season and then have it get kicked over into the fall or beyond, if at all. So it is very important that we get comments, that we then working with the regional offices and the federal partners review those and get to a final rule in a very timely manner.

So let me start by going through the different sections and giving you this overview. Sections 1 through 3 we really didn't do too much to, but they are critically important in terms of setting the foundation for the *Guideline* and what we do. The introduction clearly states the purpose and the applicability of the *Guideline*. That was not altered at all.

The overview of model use--we pulled in a number of pieces from the old Section 9 on model accuracy and uncertainty related to model performance and brought that forward into the discussion of suitability of models, since model performance evaluation is the ultimate way in which you judge the suitability of models in terms of a fit for purpose type of paradigm. And so we brought those types of discussions into Section 2 early on to set the stage for later portions of the *Guideline*. And we also tried to be more clear in terms of the level of sophistication of air quality models and providing definitions: screening/refined, demonstration tools, reduced form models.

In looking at this, we got confused ourselves with screening/refined, screening techniques, screening models, screening--you know, it was just very confusing as you read through it. And so we really set upon a path to be very clear and very structured in how we refer to things because the treatment of these models, given how we refer to them and the type or the distinction that we give them, is important.

And it's important because in Section 3 we provide the rules of the game. And let me say that these rules of the game have not changed, and I don't think they've changed in two decades. They've been the same for a while.

Preferred models, we set out the specific conditions that allows us to put a model in Appendix A, which means it's a preferred model. Those criteria are the ones that we adhere to in moving forward with models like AERMOD and previously ISC--excuse me, and previously CALPUFF, so those are clear so that the community at large knows what we are holding ourselves to and what you hold us to in terms of preferred models, and as you want to put a model forward what those criteria are.

Similarly for alternative models, those conditions are still the same as they have been for decades, and it makes clear to the community when a preferred model is not suitable, when it's not up to the task, an alternative model can be brought forward as long as it meets certain criteria and conditions and goes through a process. That process has served us well for many years and will continue to serve us well, and we provide very--the clarity there in Section 3.

And then we over the years have been using the Model Clearinghouse and we've more formally codified that in the *Guideline*, not that it's new; it's been existing as part of the process for decades. We're just codifying that and making it clear, and George will talk more about that in his presentation.

The next three sections really get into the meat of things where we specifically identify--having identified what the criteria are for preferred models and how we evaluate the suitability of models and view models in general, we identify those modeling approaches for inert pollutants--we give the laundry list in the *Guideline*, so I'm just putting inert pollutants here.

We then have Section 5, a new section for ozone and secondary $PM_{2.5}$, and then a revised Section 6 that then covers the outside of EPA models, guidance, approaches, procedures that other federal agencies are applying in order to meet Clean Air Act requirements.

So in Section 4 we are introducing AERSCREEN formally as the screening model. We are establishing AERMOD as the preferred model or reiterating it as the preferred model. There are other preferred models in Appendix A for specific situations, OCD and CTDMPLUS for complex terrain, and those still exist. They're there.

We are proposing to remove CALINE and replace it with AERMOD for mobile sources, and we have integrated BLP into AERMOD, so that would mean that BLP would no longer be a preferred model in Appendix A. So we're trying to streamline the process, bring better science and better tools, harmonize those models so that we, you know, actually have a more effective and efficient approach to addressing these pollutants.

And then specifically we went in, as most of you know, and modified the multitiered approach for NO_2 as it relates to the ambient ratio method, given work that API has done, as well as the Tier 3 methods and updated those. And Chris Owen will give you more details about that.

In Section 5, as Chet mentioned, we really broke new ground here in response to the Sierra Club petition. It's clear upon looking at the models and the techniques that are available that they are suitable to address single source impacts.

Kirk Baker and Jim Kelly have done a great job and you-all have provided all the information to the literature and reports and the like that substantiate that claim and that assertion. And that's an important one for us to then move forward and say, okay, so now that the models are capable, what is it that EPA would recommend and/or require an applicant to do in the context of PSD.

So we cannot establish a preferred model or technique at this point in time. Instead we're recommending a two tiered approach with detailed guidance that allows the applicants to work with the state and local agencies and the regional offices to come up with the appropriate approach, as Chet mentioned, the flexibility that we think is appropriate and warranted here given the nature of the models and the nature of the pollutants that we're dealing with.

In the preamble you'll notice that we also gave some foreshadowing to EPA rules related to policy tools that are used in the PSD program. Particularly we referenced anticipated rulemakings and developing what we call model emissions rates for precursors, or MERPs. MERPs are a good thing, not a bad thing. You don't need any vaccination for them.

And what you'll notice in the preamble is that we try and provide information and in fact have put two memos into the docket to try and, you know, flow chart show you how the system would work with that with this two tiered approach. In the $PM_{2.5}$ guidance we have a three tiered approach, and the first is a qualitative type of assessment.

What we anticipate is that the development of these MERPs, which would establish an emissions level, that if a source comes in below that level what EPA has done in terms of demonstrating that level in being equivalent to the SIL value or significance threshold is sufficient to meet your requirements in demonstrating compliance for the precursor, so you are good to go and don't have to do any additional analysis.

What now is a second tier and then a third tier would then morph into what we're calling the first tier and second tier of what's in Appendix W, the first tier being using existing information, modeling, reduced form models, other types of information short of full scale modeling to address that pollutant for that source, and then a second tier, which would be full scale modeling that then Kirk's guidance goes into a lot of detail in how to do that.

In Section 6 we clarified and worked very closely with the Federal Land Management community. We have the role of FLMs, the FLAG guidance, and AQRVs, specifically visibility and deposition. We reference the FLAG guidance and other guidance documents that the FLMs are responsible for. And then we also acknowledge BOEM and the modeling of OCS, the outer continental shelf modeling that goes on, as well as FAA and their new tool, the AEDT tool, for air quality assessments that has brought in AERMOD and also has other capabilities.

One thing that I wanted to clarify because we've gotten a lot of questions and it's clear that in the preamble we didn't provide as clear an explanation as perhaps we should have, so we're likely going to put a memo to the docket along these lines, which is we're doing two things. One is we're updating the regulatory version from 14134 to 15181 to address several bug fixes. And Roger is going to go through that to be clear about what goes into now the new regulatory version.

At the same time, as part of this proposal, we are recommending as part of the proposal use of specific data options for public comment that then upon final rulemaking we would codify and make as part of the regulatory default.

So I know a lot of people are saying, "Wait a minute. Why aren't these things part of the regulatory default now?" Well, we're in a proposed rulemaking. They won't get codified until we go through the public comment process and then upon final rule, we'll bring in those aspects, those elements that we're getting comment on, and make those part of the regulatory default model.

That's why these options have remained in beta form in the current version, 15181, to allow your testing and evaluation of those techniques. So I know there was some almost disappointment in the proposal, but I just want to make sure everybody is clear. We couldn't make them regulatory default. That would preempt the whole process. So we're going through the process, and at the end of the process with your input we would expect to then codify those in a final version of AERMOD.

We'll likely allow for some of these options to remain as beta to facilitate continued testing and evolution of things, but again, the whole process is one that would end up with a regulatory default that would reflect those changes, so hopefully that helps clear the air on that.

Also in terms of long range transport assessments, I just wanted to reiterate that we're not--we no longer contain language in Appendix W requiring the use of CALPUFF or any other Lagrangian model for long range transport assessments.

Based on work that James Thurman and Chris Owen have done, based on a variety of source and sector scenarios from the AERMOD Implementation Workgroup, we did very detailed modeling that allowed us to come to the determination and for your comment and input that we feel that near-field modeling is sufficient in doing your NAAQS compliance demonstration. So we do not consider a long range transport assessment necessary for inert pollutants beyond 50 kilometers or thereabout. So we're reducing the burden on the community in terms of doing those assessments.

Now, we do recognize that long range transport assessments may be necessary for a limited number of situations for PSD increment, especially Class I increment. And so we've allowed for a screening approach.

Therefore, even though CALPUFF is not a preferred model, it can be used as a screening technique along with any other Lagrangian model, which are the typical models used in this context, to, again, sequence through a multistep screening with input from the regional office if you get to that point. So it warrants the appropriate model when and where necessary. And given our interactions with the regional offices, I think they can count collectively on one hand the number of instances in which a detailed PSD increment analysis or cumulative analysis was done.

So we really felt that the need had been diminished, especially when you start factoring in once you comply with the NAAQS in the near field, the long--the far field impacts are far less. So we're reducing the onus and the burden on the community of conducting those types of analyses.

And then we ended with Sections 7 through 9 in terms of how to inform and apply the models. So Section 7 had a lot of scrubbing. There still are specific recommendations for dispersion models that you might not find elsewhere and that are important to remind the community in the context of Appendix W, but we removed a lot of details that were seemingly there because AERMOD in 2005 was new and we wanted to err on the side of providing more information.

I think after ten years a lot of that is not necessary in Appendix W. It's more appropriate in other documentation. And so we focused on certain critical areas of informing the model, and in particular dispersion models, for the community to understand and better appreciate and engage with us on.

And then in Section 8 we did do a lot of work in terms of looking at the model input data. You'll hear from George later that the modeling domain we are limiting. We've mentioned over and over again the overly conservative aspects, particularly of the resource manual, and so that will end with this Appendix W. The modeling domain will be no more than 50 kilometers for NAAQS, and that's--I mean that's in there.

We also talk about modeling domains for SIP demonstrations for ozone and $PM_{2.5}$, and we have very much tried to distinguish PSD and single source assessments versus SIP demonstrations for control strategy purposes and ozone and secondary PM. So we're trying to be very clear.

On source data we've clearly outlined that nearby sources for the most part we would prefer that they be captured in terms of their impacts and contributions through ambient monitoring data, and if they need to be explicitly modeled, they can be modeled with actual emissions. Tables 8-1 and 8-2 have been modified appropriately and accordingly.

And in terms of background concentrations, we try and more clearly lay out the construct of single source-- isolated single source situations and multisource situations such that you're putting together more representative, more appropriate characterizations of contribution from the different sources and not overly conservative ones. And so we've tried very much to remedy that situation.

And in terms of meteorological data, you'll hear from James in terms of bringing in prognostic information. You know, we've got difficulty and we know the meteorological inputs are critically important, so we want to have flexi- bility in terms of bringing in more representative data, and the prognostic data allow us that opportunity.

And so we've been talking about this since the 8th Modeling Conference, I believe, and now finally it's a reality. And thanks to the hard work of James, Chris, and a number of other folks in the community, bringing those prognostic data and sharing them for use in dispersion models as they are for photochemical and other models is a great advancement.

And then finally we end with the regulatory application of models, very strong emphasis on modeling protocols, and then provide a very clear description, much clearer than I think we've had in the past, of the multistage approach to demonstrating compliance, the single source assessment of oneself vis-à-vis a significance threshold and then a cumulative impact assessment and evaluation of whether or not you are contributing significantly to a potential violation or a model violation and how that process works.

So we go through the whole process and end with-- you know, once you know the rules of the game, once you know what models to apply and how to apply them, then the context in which you know you do that in your compliance demon- stration. And we end with the use of measured data in lieu of model estimates, not changed too much, but we're still struggling with examples and situations that evidence this type of approach.

So this flexibility is still there. How it will be put into practice is still an outstanding question, and we would very much welcome input and thoughts from you-all if you have situations that you think are evidence of that type of approach.

So I don't know long I went, but thank you very much. And now all the detailed presentations will allow you to better understand each section and change.

Mr. Bridgers: Actually, Tyler, I've got a new tool for our 101s in my yearly reviews right here.

Mr. Fox: It won't work. You always talk

too long.

Mr. Bridgers: Oh, oh, right; that was last night. I want to make two quick announcements, just kind of roaming around the room. I realize that we are full on seats. There's actually still some seats in this front row up here, and there's a row right up here that during the break I'll pull these seats forward so there's a little more flexibility, but there's probably, I don't know, maybe as much as a dozen seats up here and we'll see during the break if we can get a few more. But we had over 260 seats in the room, and so we'll accommodate that.

And the other thing is I do note that the screen is sort of low and I know some in the back can't see everything. I was going to make this announcement later. All the presentations that are given today and tomorrow are going to be posted on the web, but there's an Easter egg, if people know what Easter eggs are. It's actually already posted on the web.

If you go to our 11th Modeling Conference page, which most of you will know, and scroll down to the agenda and click on it, I have embedded links for all the talks. And so Roger's talk that he's getting ready to give is there. So if you have WiFi and you can't see from the back and you can get to our 11th page and you can click through, you can get to the presentations. All these presentations will also get loaded to the docket, as I said earlier.

So I will call Roger Brode to the podium. And Roger is going to give two talks. The first talk is specifically aimed at the regulatory update that we just made with AERMOD version 15181, and then we'll switch and have a separate presentation that will talk about the proposed options.

So hopefully there's a good distinction here between our regulatory release and what the proposed options are in the revised version of AERMOD along the lines of what Tyler gave a primer on just a minute ago. So Roger?

Mr. Brode: Thank you, George. So again, I'll talk about the update to the regulatory options within AERMOD that were just basically bug fixes. In the next talk we'll talk about some of the proposed beta options and what we've been doing there.

So the regulatory version of AERMOD and AERMET has been updated to version 15181, which corresponds with June 30, 2015. And they include several bug fixes for AERMOD and AERMET, which I'll kind of go over highlights of that next. We've also incorporated some proposed enhancements to the non-default/beta options which are going to be discussed in the next presentation. And these updates are documented in Model Change Bulletin 11 for AERMOD and MCB6 for AERMET.

So one of the key bug fixes that's been sort of out there for a while but hardly ever reared its head, but did not that long ago, something we've identified and addressed in the AERMOD Implementation Guide, which is that if you have a relatively tall stack in a relatively small urban area--relative is a relative term, but we've noticed that some unrealistically high concentrations due to the way plume rise is calculated--there's sort of an unrealistic limit on plume rise--may show up.

And this has been addressed in the AERMOD Implementation Guide quite a few years ago, which sort of suggested those sources may be better treated as rural with some adequate justification. And again, this is an issue that didn't come up very often, but did not too long ago from Region 5, the state of Michigan in fact.

So the new version has addressed that as a formulation bug fix, and the approach that we used sort of emulates the penetrated plume algorithm that's used under convective conditions. And the next slide is going to give an example of a tall stack with--an urban area with 55,000 population, and it will show the before and after.

So the before on the left, the red curve is the urban curve and the blue curve is rural. Again, that was before. And the next slide, after, it shows a very, very significant, about a factor of 10 higher with urban option for that source over the rural. And then the right slide shows, you know, that they're in much better agreement, so much more reasonable from what you would expect.

We don't have a lot of data to evaluate this, but this was the case, and the new concentrations with the urban option show much better agreement with nearby monitors in that case, which is in the Detroit area.

So in terms of bug fixes again, there weren't that many, but there was a issue that showed up with the POINTCAP beta option for capped stacks and determined that if you use POINTCAP with the no stack-tip downwash option, you could get some erroneous results because the POINTCAP option itself takes care of how stack-tip downwash would be treated.

We also corrected an issue with the emission rate being modified for area, line or open pit sources in some cases with the FASTAREA or FASTALL option. And there are some pretty anomalous results that had shown up in some cases there. We believe those have been fixed now.

And another issue that had been brought up a while back, and I don't have the details here, but there was an issue if the wind is blowing nearly perpendicular to an area source or a line source, an elongated area source, some very anomalous results showed up there. And it turned out that one of the tolerance levels in the area source algorithm was a bit too splat, so we tightened that and that seemed to clarify that--clean up that issue.

So there are a number of subroutines related to the PVMRM option, one of the beta options for modeling NO_2. And basically a lot of it focused on the penetrated source contribution and did a more explicit treatment of the vertical and horizontal dimensions of the contributing sources for that penetrated plume component. And that turned out to show up with some importance in the New Mexico Empire Abo evaluation database.

We also modified the determination of NO_x concentrations to account separately for the horizontal plume component and the terrain responding plume component. So there are some aspects of the overall general formulation of AERMOD that have been incorporated more fully within the PVMRM algorithm for NO_2.

Continuing on bug fixes, there are some issues that showed up with the use of the DAYRANGE keyword where you could specify a range of days to process for individual days, and those could be specified either as a month/day or as a Julian day. And it turned out there were some issues if you define those day range inputs for a leap year versus a non-leap year. That wasn't being handled properly, so that's been taken care of and those issues, as far as we know, were resolved with this update.

In terms of AERMET bug fixes, there weren't that many, but we did make some changes to the ADJ_U* option in

AERMET that's used without the Bulk Richardson Number method. And we made some modifications basically to be more consistent with that original paper by Venkatram and Qian, or Qian and Venkatram.

And in the process we also noticed a bug with the Bulk Richardson Number option in AERMET where the calculation of the CDN was incorrectly using Z0, or Z2 over Z0 instead of ZREF over Z0. Those are the bug fixes, so I yield some of my time to the next slide.

So this talk will be talking about the proposed updates to the AERMOD Modeling System. So I begin with version 12345, which is a version I wish we could have kept forever because it's so easy to remember, but we incorporated some non-default/beta options to address concerns regarding model overpredictions during stable/low wind conditions.

And we have to acknowledge the contributions of API, which funded a low wind study that AECOM conducted back in 2010, I guess, and that certainly helped move the ball along to address this issue. So there is non-default options that include the LOW_WIND option in AERMOD and the ADJ_U* option in AERMET. And so the proposed updates to these options are discussed here.

So there are going to be some additional updates to the regulatory options that are being proposed, including a buoyant line source option, which was mentioned earlier, to eliminate the need hopefully for the BLP model as a separate preferred model. And also we're going to address the capped and horizontal stack issue. And these updates are going to be subject to public review and comment and then would be codified as part of the final rule action as appropriate, as Tyler mentioned.

So again, beginning with 12345, AERMOD included these low wind beta options. Prior to 15181 AERMOD included a LowWind1 option and a LowWind2 option. And basically this just addresses the minimum value of sigma-v, the horizontal dispersion coefficient.

So the LowWind1 option that we put in there eliminates the horizontal meander component that's a part of AERMOD and also increases the minimum sigma-v from the default, currently at 0.2 meters per second, to 0.5 meters per second.

We also added a LowWind2 option that retains the meander--horizontal meander component, but put an upper limit of 0.95 on that, and then also increased the minimum value of sigma-v from 0.2 to 0.3. And these two options are mutually exclusive. You can't try to use both of them at the same time. So that was part of the initial foray into these beta options for addressing low wind issues.

So with version 15181 we've added a new low wind option, and for the lack of a better option we call it

LowWind3. So this is sort of kind of a hybrid of the two in a way. It increased the minimum sigma-v from 0.2 to 0.3, which is consistent with the LowWind2 option, but eliminates upwind dispersion, which is consistent sort of with the LowWind1 option, but it doesn't just ignore meander.

So the LowWind3 option uses the effective sigma-y value that would replicate the centerline concentration accounting for meander, but then it puts a limit on the lateral spread at 5 sigma-y off the centerline, so it's similar to the FASTALL option that's in AERMOD that sort of does that, so it replicates centerline concentration--or the contribution of meander to the centerline concentration, but just enhances the spread but doesn't include full upwind dispersion.

So we proposed in the notice of proposed rulemaking that the LowWind3 option be incorporated into the regulatory version of AERMOD, while the LowWind1 and LowWind2 options are still available for testing purposes.

So the other key beta option that we've been dealing with especially focused on the low wind issues is the beta ADJ_U* option in AERMET. And there's an ADJ_U* option in AERMET that's associated with the Bulk Richardson Number option in AERMET to use Delta-T data, and that's been modified to include a more refined treatment of θ* and to extend its suitability or applicability to very stable/low wind conditions based on a more recent paper by Luhar and Raynor, and that actually seems to have helped some of the evaluations that we've seen.

So this updated ADJ_U* option in conjunction with Bulk Richardson also includes some modifications in AERMET--in AERMOD, pardon me--to subroutine TGINIT to calculate θ*. And some of the issues that we've dealt with on these new options is, you know, the--is very low wind speed conditions and it can be surprisingly sensitive in terms of predicting the profile of potential temperature gradients.

So we have proposed in the notice of proposed rulemaking that the ADJ_U* option either with or without the Bulk Richardson option in AERMET be incorporated as part of the regulatory version of the modeling system, so it's part of the proposal.

So capped and horizontal stacks, this is an issue that's been around for some time. Back in 1993 the Model Clearinghouse had issued a memorandum that provided recommendations for modeling capped and horizontal stacks, and that procedure involved setting the exit velocity to a very low number, .001 meter per second, but adjusting the stack diameter to maintain the actual flow rate and buoyancy of the plume. So that's something that would be done by the user to modify the inputs to the model.

However, the PRIME numerical plume rise algorithm for building downwash that was incorporated in 2005, I guess, with AERMOD uses the input stack diameter to define the initial radius of the plume, and use of a very large effective radius may alter the results in physically unrealistic ways. In fact, we found cases where the model would crash because the--when that was being done.

So that prompted the need to do some different approaches. The AERMOD Implementation Guide actually suggests just setting the exit velocity to a very low number and use the actual stack diameter as an interim solution. However, that could produce--introduce some bias towards overprediction there.

So we eventually had--since version 06341 we've had some draft/beta options to model capped and horizontal stacks more explicitly, and but they're again not--they're non-default beta options. So POINTCAP and POINTHOR source type is used to trigger these, and the user just inputs the actual stack exit velocity and stack diameter.

So for non-downwash sources it basically implements the Model Clearinghouse procedure from 1993, although there are some subtle differences in AERMOD as opposed to ISC, so the POINTCAP/POINTHOR, that option actually accounts for the vertical profiling of meteoro-logical conditions in AERMOD that's more detailed than within ISC.

For the POINTHOR--the horizontal stack option actually uses the exit velocity assigned input to the model as the initial horizontal velocity of the plume, and so the issues that showed up--again, the prime downwash option uses the numerical plume rise approach, and that actually can account directly for the horizontal trajectory of the plume for horizontal stacks.

For the POINTCAP option with downwash, the initial plume radius is assigned to be twice the input stack diameter--I guess that shouldn't be the plume radius, the diameter--to account for initial plume spread from the cap interacting--the plume interacting with the cap, and the initial horizontal velocity is assigned to be based on the exit velocity divided by 4. So it sort of has some horizontal momentum to it but some vertical as well, rise.

So buoyant line sources--again, we've discussed this briefly, but Appendix W currently recommends the use of the BLP model for modeling these sources, but the BLP model is based on some outdated dispersion theory, P-G dispersion coefficients, and the meteorological data processor for BLP, PCRAMMET, is not capable of processing the current meteoro- logical data that we're using, including the 1-minute ASOS data. So there are some complications and limitations on being able to apply BLP well. It also lacks the processing options that would support the form of the new one hour SO_2

and NO_2 standards as well as the 24 hour $PM_{2.5}$ NAAQS.

So beginning with version 15181, AERMOD includes an option to model buoyant line sources using the BUOYLINE source type. And it allows for using the buoyant line--modeling of buoyant line sources using meteorological data that are processed through the AERMET meteorological processor. It also allows the use of the AERMOD processing options to support the form of the new standards. So basically it just takes--it actually takes the inputs and calls the BLP model directly.

So now we'll talk about some of the evaluations of the proposed updates. There's a lot that's gone on here. I'll try to cover some of the highlights. But we have again the proposed beta ADJ_U* option in AERMET and the Low_Wind option in AERMOD.

And they've been evaluated based on several relevant field studies, including--as I mentioned here, there was a 1993 surface coal mine study, Cordero Rojo mine in Wyoming, that was fugitive emissions of PM_{10} in 24 hour concentrations, and this was done with version 14134. We've also had two low wind studies that were part of the API-AECOM low wind study, the '74 NOAA Oak Ridge, Tennessee study and the Idaho Falls study in the same year.

So just some general caveats on model evaluation: it's a complex business, especially in these very extreme conditions, very low wind speeds. Slight errors or uncertainties in the wind direction or wind speed could significantly affect the concentrations, and it would affect the conclusions from the model performance evaluation, so keep that in mind.

So quickly, the surface coal mine study--we've shown this before, and the results presented here are actually based on the previous version of AERMOD, but it was a two month field study. Again, it was largely driven by fugitive emissions from road dust from the trucks driving around the mine. And we were able to apply the Cox-Tikvart protocol for determining the best performing model to this. We presented these results based on version 14134, but the results are likely to be similar for the current version.

That just shows a schematic of the mine, and this is the composite performance measure that shows with confidence intervals the different options. Starting from the top, the top three are with ADJ_U*. The top one is with ADJ_U* and LowWind2, then LowWind1, and then no low wind. And there's very little differentiation between the low wind options there.

But the bottom three are without the ADJ_U* option in AERMET, so the default, and there's a little bit more difference in the low wind options, but the key thing is that the top three are closer to the left side, and that means better performance, so a smaller value of CPM does imply better model performance.

More importantly maybe, the model comparison measure is the--compared the performance of one model against another. So in the top three, again, that shows performance with and without the ADJ_U* option for the different low wind options, and the key point there is that those confidence intervals, the horizontal bars, do not cross zero, and that suggests that the difference in performance is statistically significant, and that's the key point here. The bottom three just basically show the differences between the low wind options. Again, there's very little differentiation there.

So again, the low wind option--the LowWind1 options in AERMOD appeared to have limited effect on model performance in this case, but it does show significant improvement with the ADJ_U* option.

So that brings us to the Oak Ridge and Idaho Falls studies, which are really the more relevant and key databases that we've been working with that API and AECOM introduced a few years back. It's sort of sad to see that the best tracer studies are from the mid '70s, but at least we still have that data intact.

So there are just some caveats and I won't go over the details, but it's--especially under these extreme conditions some of these issues or decisions you might make may have a little bit more relevance. So EPA assumed a different surface roughness for Oak Ridge, .6, compared to the original assumption in the AECOM/API study of .2.

One of the complications with the Oak Ridge study is the winds were so low that they couldn't measure them, and so the wind speeds reported were based on laser anemometry. And so basically it's the Oak Ridge peninsula, so there are some hollers in there, in the Oak Ridge peninsula itself, and they had laser anemometry based on lasers that were up on the ridges, and where those lasers intersected was about 20 meters above the bottom, where the source was.

So we made a different assumption about the measurement height, and it doesn't necessarily change the results that much, but we also made some adjustments to the surface roughness for these studies.

So that's the Oak Ridge area. You can see there's some terrain there; you can see where the arcs are. So this is some of the results with the version 15181. The paired concentrations are on the left. The predicted to observed ratios are on the right. This is done by arc. So you can see with the default options there's pretty significant overprediction at this site.

When we bring in the ADJ_U* option and LowWind2-- well, without the ADJ_U* and LowWind2 it does improve things somewhat noticeably. On the right side it's the comparison with the LowWind3 option in the newer version of AERMOD without the ADJ_U*, so the low wind option does make some impact here.

This is with ADJ_U* and no low wind. On the left it's the previous version; on the right it's the newer version. And it eliminates much of that overprediction, but there's still a pretty wide spread.

This is with ADJ_U* and LowWind2 versus LowWind3, and it looks pretty good on the left. There's a little bit below the 1 to 1 line on the right with the LowWind3 option, but again, there are some additional caveats here, is that there is terrain as part of the Oak Ridge site, and that has not been accounted for in the evaluation that API did or that we've done here.

This is the Idaho Falls study area. You can see where the arcs were--the 100, 200, 400 meter arcs were situated, but it's pretty flat, much different than the Oak Ridge. So these results are paired by arc again, and with the default options there is some overprediction, roughly about a factor of 2 overall, but it's pretty consistent with distance.

Without the ADJ_U* with LowWind1 (sic) on the left for the previous version, LowWind3 on the right for the new version, eliminates most of that overprediction and actually looks pretty good just with the low wind options.

With ADJ_U* and no low wind, again, it eliminates most of that overprediction, but there's a little bit of tendency with distance for the ratios to go down, but maybe that's okay. With the ADJ_U* and the low wind options, the predicted is really good at the closest arc, which would probably be the most important for this, but still pretty good performance overall.

And this is with the--that was--so these are all--the previous results were the degraded 1-layer data, but the one thing that the Idaho Falls study provided is we got the raw data and we were able to calculate some Delta-T measurements so we would be able to use the Bulk Richardson Number option in here, and this is one of the more surprising results, that without the ADJ_U*, the Bulk Richardson Number option didn't work that well, especially at the closest arc. You can see a pretty wide spread and quite a bit of underprediction at the 100 meter arc. It got a little bit better downwind. With the ADJ_U* and Bulk Richardson, the results actually look much, much better, so that was an encouraging result.

So that kind of wraps it up. I can't take any questions, which is fine by me. Thank you.

Mr. Bridgers: Thank you, Roger. Actually, that was saying 15 more minutes, so---

Mr. Brode: (interposing) Okay. Do you

want me to keep going?

Mr. Bridgers: No. James had already yielded some time to you. I didn't want you to feel too rushed because that was an important presentation because that gets at the heart, at least the front end, of what's in our proposal.

So next up, James Thurman from our Modeling Group is going to give us a quick presentation--I'm not going to even run this, James; I know you'll be done ten minutes--on AERSCREEN.

Dr. Thurman: Okay. This will be the best presentation from EPA today because it's only four slides. I'm James Thurman from the Modeling Group to give you a quick update on AERSCREEN.

This slide shows the status of AERSCREEN through the years, first mentioned in the 2000 (sic) *Guideline* when it said it would be released in the fall of 2005, but it made it till 2011 where we released AERSCREEN and the accompanying meteorological processor MAKEMET to generate the screening met.

We also issued a memo in April of 2011 recommending AERSCREEN as the recommended screening model for EPA, because it's based on AERMOD, which represented the state of the science. And just to remind you, AERSCREEN is only done for single sources only. It doesn't have the multisource capability.

And then for the proposed *Guideline* for 2015 we're incorporating AERSCREEN into the *Guideline* as the screening model for AERMOD, and it will be applicable in all types of terrain and building downwash applications. And AERSCREEN is discussed in detail in Section 4.2.1.1 of the proposed *Guideline*.

I'll just note the latest version of AERSCREEN, 15181. We incorporated the inversion break-up fumigation and coastal fumigation options from SCREEN3. That was probably one of the last reasons people were running SCREEN3 other than AERSCREEN is too hard to run, which as Tyler and I say, real men run AERSCREEN.

It uses the AERMOD equations for the sigma-y and sigma-z estimates used in the fumigation calculations. And I won't go into detail here, but you can see the AERSCREEN User's Guide for full details on how these fumigation options are incorporated.

We also tried to make the code more portable across operating systems by eliminating system calls to copy and delete files when possible, so we actually do Fortran statements to the write and delete. There are still some system calls like clearing the screen, but we've put in the code and commented out for the Unix and Linux options of clearing the screen and also added a debug option to output the intermediate output from the PROBE and FLOWSECTOR subroutines and also output the intermediate fumigation estimates if you want to see what was going on besides the final results, and we also did some bug fixes.

And one thing on the fumigation options, I did change it where you don't have to run AERSCREEN and do all the AERMOD screening runs inside AERSCREEN. It will actually just do the fumigation options, so you can usually get a quick result there.

And then on MAKEMET we incorporated the ability to adjust the surface friction velocity, U*, based on the AERMET adjustment algorithms. That was done to help Chris Owen's work on mobile source modeling. Right now this U* adjustment is not done when you're calling MAKEMET from AERSCREEN. It sets that option to no, but if you want to run the U* adjustment with MAKEMET, you can do that outside of AERSCREEN by running MAKEMET on your own.

We may incorporate the ability in future versions of AERSCREEN to make it an option to do a U* adjustment, not for like regulatory screening runs, but if you just want to get a quick result of how much change the U* adjustment will make on your results. And then that's it, and I yield my time to Chris.

Mr. Bridgers: In the interest of political correctness, it would be real modelers run AERSCREEN. I want to make sure that we stay aboveboard.

While I'm changing presentations, I also wanted to point out, since I'm the point of contact on the SCRAM web site updates, AERMOD 15181, AERSCREEN 15181, and MAKEMET 15181, they were all posted when we posted the proposal.

Just so that we're also crystal--as clear as we can be, if you go to the 11th Conference Modeling page, there are some specifics for each of the postings of the model, but if you're going for the regulatory release, I recommend going to the other part of SCRAM where you normally would download AERMOD or AERSCREEN because all the model change bulletins and the other supporting information from its regulatory application is there. So if you're using the link for the 11th Modeling page to download the model, I'd recommend going over to the other.

All right. So we will transition from screening and the demise of SCREEN3 in the regulatory application to changes with respect to NO_2 with Chris Owen, and Chris, I'm going to give you a little extra time. You lucked out.

Dr. Owen: Thanks, George. It looks like James actually yielded his time to you, but that's okay. I think we can get through this in time. And actually with the NO_2 modeling we're still referring to screening, just of a slightly less conservative nature.

So I'm going to give an overview of the proposed changes to AERMOD and Appendix W with respect to NO_2 modeling. I'd like to thank my workgroup, which consisted o of members from OAQPS, Regions 3, 4, 5, 6, and 10, and the Office of Research and Development.

In short, EPA is proposing to modify both AERMOD and Section 4.2.3.4 of Appendix W. These proposed changes will incorporated ARM2 as the regulatory default option for Tier 2 screening. It will adopt OLM and PVMRM as the regulatory default options for Tier 3 screening, and we will actually be updating PVMRM with additional dispersion and plume calculations, currently dubbed PVMRM2.

This slide gives some details on the ARM2 adoption. ARM2 or the ambient ratio 2 method was originally developed by an API funded study. The study was eventually published in a peer reviewed journal article in 2014 by Marc Podrez in *Atmospheric Environment*. The proposed version of ARM2 in Appendix W and AERMOD has one modification to the version that was provided in the final published paper, and that is we propose to modify the minimum default ambient NO_2 to NO_x ratio to 0.5.

This proposal is to bring consistency between the Tier 2 and Tier 3 methods. Specifically we have a recommendation for the default NO_2 to NO_x in-stack ratio for the Tier 3 methods to be equal to 0.5. The slide here shows some model simulations comparing PVMRM with an in-stack ratio of 0.5 and an in-stack ratio of 0.2.

You can see that when you use PVMRM with this recommended default, 0.5, your ambient NO_2 to NO_x ratios are also equal to 0.5, and thus we believe that the minimum ambient NO_2 to NO_x ratio for ARM2 is most appropriately set to 0.5 to be consistent with the Tier 3 methods.

For the OLM and PVMRM adoption and implementation, this will be very similar, what we currently have in the model and what we've recommended in past *Guidance*. That is there will be no default background ozone value. We're recommending a maximum ambient NO_2 to NO_x ratio of 0.9 for the Tier 3 options.

We're also recommending a default in-stack ratio of 0.5 for the primary source and nearby sources. However, for more distant sources we're recommending an in-stack ratio of 0.2. We do actually specify now in the reg text that PVMRM works better for relatively isolated and elevated point sources and OLM tends to work better for other source types.

With respect to the modifications to PVMRM that we've dubbed PVMRM2, the PVMRM2 uses absolute rather than relative dispersion coefficients under stable wind conditions. There are several modifications in PVMRM2 to the computation of the plume volume, and there are several additional miscellaneous bug fixes that are included in PVMRM2. Our proposal is to eventually replace PVMRM with

PVMRM2. However, in version 15181 we have both PVMRM and PVMRM2 to facilitate evaluations of the two different model codings.

We provide in our technical support document several evaluations of PVMRM and PVMRM2. The slide here provides an example from the Empire Abo gas plant in New Mexico which compares results from full conversion, PVMRM2--I actually can't see it on the computer here--PVMRM, and I think it's OLM Group all. And the slide here doesn't give very good detail. I again recommend that folks look at the technical support document that's provided on this for easier viewing.

The slides here do show if you can see that PVMRM2 is the best performing of the options that are evaluated for this particular--these two particular monitors for this one particular source.

Finally, I'd like to emphasize what Tyler said earlier with respect to beta options in AERMOD, so the status of the Tier 2 and Tier 3 screening methods. All of the NO_2 options are defined as screening techniques. If Appendix W goes forward as proposed, then the NO_2 options will no longer be alternative models. They will not need approval by the regional office.

However, as screening methods, the reg text will specify that their use will occur in agreement with the appropriate reviewing authority, and this is specified in Section 4.2.1(b) of the proposed version of Appendix W.

Additionally, because of the complexities of the Tier 3 options, applicants would need to consult with the EPA regional office in addition to the reviewing authority. This is specified in Section 4.2.3.4(e). And again, this is occur in agreement with the appropriate reviewing authority and consult the EPA regional office, and you will no longer need alternative model approval.

Again, though, this goes into effect with the final version of AERMOD to be released next year. At present ARM2, OLM, and PVMRM and PVMRM2 are still beta in version 15181 and they do require regional office approval at this time. We released a Model Clearinghouse memo earlier in the month on the use of ARM2 and refer readers to that memo to get additional details on the use of ARM2 in regulatory application. That should be July 8th, I believe.

The relevant docket items for this are specified here. The docket items are both on regulations.gov and they can be obtained on the 11th Modeling Conference web site as well. And that concludes my slides for NO_2, and it looks like I've yielded myself 11 and a half minutes.

Okay. Now I'm going to give details on the proposed replacement of CALINE3 with AERMOD in Appendix W. I'd like to first thank my workgroup, which consisted of members of OAQPS, the Office of Transportation Air Quality, Office of Research and Development, and Region 5.

As the title of this slide suggests, we are proposing to replace CALINE3, CAL3QHC, and CAL3QHCR with AERMOD as the preferred Appendix A dispersion model for all mobile source modeling for inert pollutants.

This proposal is based on three elements: first, the AERMOD has updated dispersion model science relative to CALINE3; second, the model intercomparisons of AERMOD show that AERMOD outperforms CALINE3; and thirdly, that the adoption of AERMOD would provide a simplified implementation of mobile source modeling for Clean Air Act requirements. These updates are reflected in Sections 4.2.3 and 7.2.3 of the proposed Appendix W text.

To support the elements of the changes in model science I have some background on AERMOD and CALINE3. CALINE3 was developed in 1979. The dispersion model theory is based on P-G stability classes, and the baseline CALINE3 model can actually only handle a single meteorological condition.

CAL3QHC was developed from CALINE3 for use in screening for mobile sources. It adds a queuing algorithm for emissions from intersections. And finally, CAL3QHCR was developed from CAL3QHC for refined analyses.

CAL3QHCR adds the ability to use one year of meteorological data. It adds an hourly emissions variation, adds additional averaging periods for the additional met that's processed in the model. The met preprocessor that's available for CAL3QHCR is only available for very old meteorological data sets and has not been updated to use any of the newer one minute data.

The model developers replaced CALINE3 with CALINE4 in 1984, so according to the model developers CALINE3 was outdated over 30 years ago.

Contrary to CALINE3, AERMOD was adopted in 2005 with the 2005 revisions to Appendix W. It reflects state of the science dispersion model formulation, specifically the boundary layer scaling parameter is used to characterize stability and determine dispersion rates. Monin-Obukhof similarity profiling of winds are used near the surface.

And the main point here is that in adopting AERMOD in 2005 to replace ISC, one of the major technical advance- ments was to replace the P-G stability class dispersion that's used in both ISC and CALINE with these turbulence based dispersion rates consistent with PBL and M-O scaling and similarity profiling.

EPA has conducted several model performance evaluations and intercomparisons to determine the performance of AERMOD versus CALINE3 as well as several other models. These results were published in 2013 by Heist, et al. in

Transportation Research D.

These model findings were based on two field studies that used SF_6 tracers that were specifically designed for evaluation of mobile source modeling. These two field studies were the CALTRANS99 tracer experiment and the Idaho Falls barrier tracer experiment.

In the next couple of slides I give a very brief summary of some of these results from these model inter-comparisons. The slide on your left shows model statistics for the highest 25 concentrations from the models that were used in these model evaluations. These model runs consisted of the RLINE model, which is currently being developed by the Office of Research and Development; AERMOD using both area and volume sources; CALINE3 and CALINE4; and the UK's regulatory default model, ADMS.

The statistics slide shows the robust highest concentration versus the fractional bias. The best performing or even a perfect performing model would be at the center of the axis that's highlighted in green. The model statistics for CALTRANS show that AERMOD and RLINE have almost identical performance, and you can see CALINE has a tendency to overpredict by a factor of 2 and 3 depending on whether you're looking at CALINE3 or CALINE4.

On the right-hand side I have a Q-Q plot, which just makes it a little bit easier to see the model performance of these different concentration levels. You can see the CALINE3 and the CALINE4 model results are extreme outliers on this plot, the other models doing fairly well, relatively close to the 1 to 1 line. But the model performance for CALINE3 and CALINE4 is not just limited to the top three or four concentrations. Its overestimate extends to about the top third of the distribution of data.

This slide shows the results from the Idaho Falls tracer study. The same set of slides are presented on this as the previous slide. On the left-hand side I've got the model statistics for the top 25 concentrations. On the right-hand side I have the Q-Q plot.

For this particular field study all of the models had a tendency to underpredict rather than to overpredict. The model statistics indicate that AERMOD and this time ADMS are almost identical and have the best model performance out of the three models. And this time CALINE has a tendency to underpredict.

And you may notice on this slide that I have CALINE4 and not CALINE3. For this particular field study we were not able to get CALINE3 to provide reasonable results. We had three or four different doctorates in engineering look at this model and try to get reasonable results and we could not get numbers that made sense to us. It may have been user error or it may have been a limitation of the model. But because of our inability to understand what was going on with CALINE3, we excluded those results from this particular field study. However, we're using CALINE4 as a surrogate for CALINE3 under the assumption that CALINE4 would perform better than CALINE3.

For this field study you can see CALINE4 is the worst underpredictor. In the Q-Q plot you can see that CALINE4 underpredicts across almost the entire concentration distribution range.

The third basis for our proposal is that the EPA believes that the adoption of AERMOD will provide a stream-lined implementation for mobile sources. The Appendix W proposal will bring commonality and consistency in the model analyses that are performed for EPA regulatory applications.

Specifically, AERMOD is already preferred for $PM_{2.5}$ and PM_{10} conformity analyses. The adoption of AERMOD would bring one model choice rather than four different model choices for modeling mobile sources, so it would make the selection of model more simple. AERMOD has additional options for source characterization, computation of design value, and is able to use more updated and refined meteorological inputs.

Finally, I'd like to point out that FAA already uses AERMOD in their EDMS and AEDT model. They moved away from the CALINE3 model in 2005 when EPA promulgated AERMOD as the preferred dispersion model. So the DOT has already adopted AERMOD over CALINE3 in the past.

Finally, I'd like to just point out that EPA fully supports AERMOD with continued development and updates to meet regulatory needs and issues, and that would include updates that are needed to facilitate mobile source modeling in the future.

I'd finally like to highlight EPA's transition plans under the proposed rulemaking. EPA is taking comment on the transition period from CALINE3 to AERMOD in the proposed rulemaking. We are currently proposing a one year transition period for the adoption of AERMOD over CALINE3. That means it would be slightly less than two years from now until applicants would be required to use AERMOD in place of CALINE3. Again, we're taking comment on this transition period.

Additionally, I'd just like to provide a note that EPA plans to provide training and already has a number of training courses in place. We will provide a training package with examples for using AERMOD over CAL3QHC for CO screening analyses. We'll provide webinars and trainings for stakeholders as needed.

And as I mentioned, EPA already has several trainings that are available, specifically the Air Pollution Training Institute course number 423, Air Pollution

Dispersion Models, which outlines the use of AERMOD for regulatory analyses. And the Office of Transportation Air Quality already has training in place for project level hot spot analyses.

Again, the technical details are provided in the technical support document. These are available from regulations.gov as well as the 11th Modeling Conference web site. Thank you.

Mr. Bridgers: And just so I don't get one of our transcriptionists in trouble, I was actually trying to get Chris to slow down because I normally have the problem with trying to get people to stop talking. I needed to--I should do my whole TV thing. It's like stretch it out (indicating).

So we are running a bit ahead of schedule, and I am going to afford a little bit longer break just because of that. But I wanted to make two notes. Chris in that last set of slides had said that there would be a one year transition period with respect to this replacement of CALINE. That's broadly applicable with respect to the transition once we get to 2016 and the promulgation of whatever form of AERMOD we have after we go through the comment and rulemaking.

I'm going to put some filler in here if the--oh, it died. Well, I'm still going to put some filler in here.

You guys can watch a real quick demonstration. In the previous presentation Chris mentioned that we had just issued a clearinghouse memorandum with respect to ARM2. And I'll speak to this a little bit more in the clearinghouse presentation, but in this particular case this is an avenue to which we can bring beta options to the forefront and use them currently, whether proposed or not.

Now, you can see how I get to SCRAM. I don't know the EPA web address right off the top of my head. I should. So I Google it. And it's going to get me to scram001, which I know. But I did want to real quickly, because I won't have this time after the break--so I'm on the guidance and support. It's buried.

I will also mention that we are on the precipice of revising the entire web structure of the EPA web site, and so here in probably a year's time there will not be a SCRAM web site because we understand that that is not necessarily sensitive to the external community.

There seems to be some idea that we're telling people to go away when we say SCRAM, so it--even though it's a very technical web site, we are going to have to make it such that the third grade audience can come in and feel good about their experience. So there will probably be some cutesy pictures and I'm sure we'll have to come up with an icon for AERMOD or whatever Appendix A models we have.

Male Voice: We can keep the name. We just have to change the format.

Mr. Bridgers: We have to change the format; right. So I'm going into MCHISRS, and I know some of you loathe this, but I just wanted to point out--and I haven't sent out the e-mail. It will come out in the next couple of days. I just haven't had time. I'm just going in and searching on Region 2 because Chris said it was a Region 2 memo, and I found 145 records. I'm going to go to the end because it always sorts from the '80s. And see, here it is.

Voices: No, we don't see it. We can't see it.

Mr. Bridgers: You can't see it. Oh, no. Okay. Well, let me start over again. See, this is a great way for filling time. Now, let me see. I don't even know how to get the screen back. Oh, okay. Well, we'll go through my whole process again. I get three more minutes.

So here's the web browser, yay. And it probably has--yeah, here we go. It probably already has it in there. Now I can't see it, so I'm going to have to look over here, and now it doesn't work. So this also proves this is not centric to Internet Explorer, but MCHISRS is under Model Guidance and Support, the Clearinghouse and MCHISRS. One part of the web redesign is things will probably be a lot more logically laid out and easier to find.

So I'm just going into MCHISRS, and there's a lot of options here, but one of them is for EPA region or state. And so I know that it's involving Region 2, so I'm going to click Search. It happens to find 145 records, and as I said, they start, you know, from a chronological order, and I'm just going to go to the end.

And as we have indicated, it seems like there was a lot of activity in the '80s and '90s and then things kind of fell off, and so from the late '90s to 2015 there's a big gap. Things were just perfect in the modeling world.

So anyway, here's the actual record in MCHISRS. There's a brief summary. So that we have the date straight, it's July 16th. And I will point out--I've got a lot of ums in my statements today, but I will point out the request came in on the 18th, the reply went out on the 16th, and this was in the middle of a proposed rulemaking.

So I know there's a lot of built-up pent energy that things take a very long time in the Clearinghouse, but here's one that we had a lot of other things going on and we did drop some things, but we got this out in about a month's time. We've got another couple that are in process and we're going to be following up as soon as we get through with the modeling conference here.

But anyway, here's the signed response back. And so this can be the basis for future ARM2 usage, assuming--

what's that?

Mr. Fox: In the interim.

Mr. Bridgers: In the interim--assuming that you meet the requirements in the memorandum that we put out on ARM2 and are broadly applicable to the justification that was here. So there's a path forward. Now, we talked about this in previous conferences that the bar is much lower, significantly lower now with ARM2 than it has been in the past, because there's a road map people can follow.

And to Tyler's point here, it's also that we've done a lot of work and there's a lot of things put forth in the proposed rulemaking that can also be used as a part of the justification for future ARM2 use.

So ADJ_U*, we've got something on the precipice. We hope to be moving forward with the Clearinghouse action. We're hoping through that action lowering the bar. But anybody that desires the use of the beta option in AERMET of ADJ_U* right now, there's a lot of pieces of the puzzle that are on the 11th Conference or in the docket to this rulemaking, and it's there. And so that's--I just want to reinforce that.

So we have reached 10 o'clock. We're running ten minutes ahead of schedule. Why don't we split the difference? I know the schedule says that we go until 10:30. Why don't we split the difference and come back at 10:25?

That gives us--or do you want to go 10:20?

Mr. Wayland: Go to 10:20 and give a longer lunch in case---

Mr. Bridgers: (interposing) Yeah, let's do--okay, yeah, let's do that. I like Chet's suggestion. Let's go to 10:20. That gives us 20 minutes for the break and what we'll do is on the back end if we have extra time we'll just take a longer lunch, and I think that's what people enjoy. So I will suspend now for 20 minutes. Please be back at 10:20.

(A recess was taken from 10:03 a.m. to 10:20 a.m.)

Mr. Bridgers: So we'll start the second morning session now, and we'll start right off with another presentation by James Thurman with Chris Misenis somewhere in the room, and this is focused on aspects of Section 8 and meteorological data.

Dr. Thurman: Okay. So I'm going to talk about meteorological data for the dispersion models. These are the members of the workgroup. Myself and Chris were co-leads, or as I like to say, Chris is the assistant to the co-lead. He's Dwight Schrute to my Michael Scott. Members from OAQPS and the regional offices, and just some acknowledgements: Kali Frost of Indiana provided the Gibson AERMOD inputs and meteorological observed data for our evaluations. Missouri DNR and Andy Hawkins of Region 7 ran

Herculaneum AERMOD and MMIF, and then Andy and Kirk Baker from OAQPS and Roger for the Martins Creek WRF/MMIF output.

Then Rebecca Matichuk from Region 8 did the meteorological analysis of the Region 8 sites. That's Appendix B in the TSD. And I also want to acknowledge Bart Brashers of Environ for all his work on the MMIF. He's done a lot of work on MMIF and been a great help.

So Section 8.4 discusses the meteorological data for dispersion models. There's two aspects: observed data and the prognostic data. On the observed data side, the main focus was on the introduction of AERMET into Appendix W.

As you know, we introduced AERMINUTE in 2011, and it calculates hourly averages of the winds from the 2 minute winds for ASOS stations. And in 2013 we issued a memo regarding the use of ASOS data and AERMINUTE in AERMOD, and you can see the link under that sub-bullet. And our recommendation is that it should be routinely used when available.

There are some data gaps we found out in 2013 through Region 5 and AECOM, and it's a pretty substantial gap, so we're actually doing an update to AERMINUTE to bring in the five minute wind data to substitute missing hours, and we hope to have that out by October.

From the prognostic side, we're proposing that if you don't have a representative NWS station, National Weather

Service station, and it's infeasible to collect site specific data, you can use prognostic data. We're saying no-- recommending no--or proposing no fewer than three years of data.

We developed the MMIF program to read the prognostic data, such as WRF data, for input into AERMET and AERMOD as well as other dispersion models, and MMIF is the outcome of BARF, the Bret Anderson ReFormatter, so if you BARF you get MMIF.

So we also issued guidance for the use of prognostic met data. Here are some highlights of that guidance. The number of years is a minimum of three years. For developing the meteorological fields, i.e. run in WRF, you would follow the Ozone, $PM_{2.5}$, and Regional Haze Modeling Guidance that was updated in December 2014. I think that's the Brian Timin guidance.

Our guidance also describes some evaluation procedures, and you can see the link to that in the last bullet, and you can also see the link at the very bottom for the Ozone, $PM_{2.5}$, and Regional Haze Guidance.

More details on our guidance: we get guidance on running MMIF for AERMOD. For regulatory applications you should run MMIF to generate AERMET inputs. That's because AERMET is the regulatory meteorological preprocessor for AERMOD and it also allows you to take advantage of options in

AERMET such as the u* adjustment and the upper air selection time. If you're doing a nonregulatory application, you can run MMIF to AERMET or go straight from MMIF to AERMOD to generate the profile and surface file that go into AERMOD.

We also offer guidance on the grid resolution of your WRF or prognostic run. That would depend on the location, you know, the complex terrain or complex meteorological situations.

Guidance on the representative grid cell, you would run through MMIF for your application. For most cases, this would be the grid cell that contains the facility of interest, and if it's something like a SIP that could cover multiple grid cells, it would be a grid cell that's representative of the whole domain. We also have other recommendations in the guidance on postprocessing MMIF outputs for AERMET and AERMOD.

We did some evaluations. Three case studies represented here are the Gibson, Indiana SO_2 study that Indiana had done a paper on; also Martins Creek, Pennsylvania, which is one of the AERMOD databases; and Region 7 did Herculaneum, Missouri, which is a lead--the Doe Run facility.

We did some evaluations of the met data and we also did the AERMOD evaluations using the EPA protocol for determining best performing model or the Cox-Tikvart protocol, and you can see the link to our TSD at the bottom. Here's a map of the three areas. And just to note, all these--none of these case studies used 15181. It wasn't available at the time of the studies.

Here's the Gibson study area. It's southwest Indiana. You see the two grid cells from WRF that contain the facility, Gibson, and Evansville, the closest NWS station used in the modeling.

This is a comparison of AERMOD output for the different model runs. This is the model comparison measure, which compares the composite performance metric of each of the model simulations. Basically here, like Roger said earlier, if you overlap zero, you know, statistically not different.

And as you can see highlighted in the red box, Gib MMIF, which is the MMIF output for the Gibson facility versus the observed data for Gibson, we've got very good agreement, almost a zero model composite metric, so that statistically they're not different. And actually all scenarios are not statistically different, so that was very encouraging. I could just drop the mic and walk offstage now, but I won't.

The next one is Martins Creek. Here's a map of the study area near the New Jersey-Pennsylvania border. You can see ABE, the Allentown weather service station as well to the west.

Martins Creek, not as good performance as Gibson-- you know, complex terrain; we had 4 kilometer and 1 kilometer grid cells to pick from as well as observe met data from the site and the weather station that you can see. The 4 kilometer grid cell almost was statistically not different from Martins Creek observed data at the 95th percentile. If we had gone to the 99th, it wouldn't have probably been statistically different.

Also the 1 kilometers, you know, didn't perform as well, but were not that bad compared to the weather service station, which one of the goals of the evaluation was we would hope MMIF was no worse than using National Weather Service data. So I mean Martins Creek is not as good as Gibson but still, you know, not that bad.

Finally, the Herculaneum study area: we had 4 kilometer, 12 kilometer, and 36 kilometer MMIF output as well as on-site data at Herculaneum and the St. Louis airport off to the northeast. And we couldn't do the detailed statistical analysis for Herculaneum because these are lead monitors, so they only had 24 hour data.

So we did a screening analysis in the Cox-Tikvart protocol, where you take the top 25 concentrations and calculate their mean bias and the standard deviation and plot them against each other. And this small square you see in the plot is the factor of 2 box, and usually if you're inside that box you can continue with doing a detailed statistical test on the one hour, 24 hour, and three hour averages, but we didn't have one hour and three hour, so we stuck with 24 hour. If you're outside of that box usually the protocol recommends no more analysis because the data already has some credibility issues.

So we're really not performing--we're outside the factor of 2 box and we're underpredicting. If your bias is positive, that means that the model is underpredicting because the obs are higher. While it's outside the factor of 2 box, if you notice the two--the MMIF runs, the green, blue and purple, are fairly comparable to the Herculaneum on-site data.

Actually the airport data is doing better, but there could be some emission issues. You know, they may not be capturing all the emissions. This is, you know, a smelter, so there may be some fugitives that may not be characterized well.

So in summary, the Gibson data was pretty good, you know, statistically not different. Martins Creek did show some difference, but not too bad. And Herculaneum indicated prognostic data performance was comparable to site specific, while not great, but still was comparable. So, you know, more work needs to be done. We anticipate comments on the use of prognostic data.

And then finally, here are the links to the draft guidance on MMIF and our TSD. And that's it for this presentation.

Mr. Bridgers: Thank you, Dr. Thurman. I'm going to give Tyler an extra few minutes because I know he'll need it. While we're transitioning, I would also like to remind everybody--I think I might need to do this after every break; maybe I should do it before every break--is just to remind everybody that EPA employees will not be able to answer specific questions about the proposal, so if you ask one of us other than Tyler, Chet, or myself and you get the blank stare and then you can see the wheels spinning as to what they can say, probably they shouldn't say anything.

Mr. Fox: Or they run away.

Mr. Bridgers: Or they run away. So that's just a friendly reminder. They're not trying to be rude. They're just trying to respect the rulemaking process.

Mr. Fox: Thank you. All right. Well, I'm going to address the issues related to long range transport assessments and what we're proposing in the updates to Appendix W.

Jumping right in with background, as you all are aware in 2003 we revised the *Guideline* to formally recommend and bring in CALPUFF as the preferred model for long range transport, meaning source receptor distances of 50 kilometers to several hundred kilometers for primary criteria pollutants.

It was intended and in practice used to address PSD increment and in particular Class I assessments, and therefore quite a bit of interaction with the federal land managers, who under FLAG and in doing AQRV analysis would use CALPUFF as well. So there were some joint efforts going on there.

There's also some then issues that resulted in that in terms of the FLMs having the ability under AQRV to be more flexible in the specification of the CALPUFF model vis-à-vis how EPA proposed it and promulgated it for a particular use for PSD increment.

So right now under the current guideline, it's the preferred model for long range transport. Also, as referenced in Appendix A, CALPUFF can also be considered on a case by case basis as an alternative model, again, subject to approval under Section 3.2, that process that we mentioned earlier, for near-field applications where complex winds or terrain warrant the use of a puff model.

So the *Guideline* acknowledged that in Appendix A that the model could be used, again, following the appropriate processes to get approval as an alternative model, and that would have to be shown as of 2005 vis-à-vis the preferred model in those instances, which would be AERMOD.

And we've got I think a number of examples. One is the New Jersey 126 situation where there was a comparison made and I think is a very appropriate comparison to look at how we went about comparing those two models and then ultimately determining in that situation that there was not a sufficient difference and given the application that AERMOD was appropriate in that use. And the agency went forward in that 126 action with AERMOD as the basis for the demonstration of a violation and for the consideration of controls in that case for the Portland generating station.

So what are we doing in the proposed revisions to the *Guideline*? Well, in Section 4 we are proposing to remove CALPUFF as a preferred a model for long range transport, and rather we're recommending that it be used as a screening--excuse me, screening technique; it gets me choked up--a screening technique along with other Lagrangian models for addressing PSD increment in those situations beyond 50 kilometers.

And so we're no longer providing it preferred status. We're using it in a screening technique that, as I'll describe, we think is more appropriate given the situation for use in the context of PSD increment, and it opens the field for other Lagrangian models to be used. There are other models, SCIPUFF and other things. So again, it provides more flexibility for the community to use those models as appropriate.

As I mentioned earlier, we've also--given the work that James and Chris Owen did, we conducted an analysis--I don't have the TSD link, but there's a technical support document that is referenced that demonstrates the analyses done based on the AERMOD Implementation Workgroup scenarios that we feel and we've stated that near-field modeling is sufficient to address whether a source will cause or contribute to a NAAQS violation, so EPA is not considering a long range transport assessment beyond 50 kilometers necessary for inert pollutants. So for NAAQS you're dealing with a near-field situation, you're applying AERMOD or an appropriately approved alternative model, and that's sufficient.

Again, under the current revisions CALPUFF or any other Lagrangian model could still be available for us in the near field as an alternative model subject to approval, so there's no change in the status of the model in that context other than not specifically pointing it out. And I will notice for folks, we don't point out any models in Section 5 or Section 6. I mean CMAQ, CAM_x, other models--we're purposely not trying to specify models unless they are a preferred model so that there's no inference made about those models.

We recognize that there's going to be evolution. There's going to be changes in those models. There's going to be changes in other models in terms of their availability. And so we've reserved that for guidance and the like, but Appendix W itself does not infer any preference at all in terms of acknowledging those types of models.

And so what do you mean, Tyler, by screening approach for PSD increment? Well, Section 4 lays that out explicitly. We, again, recognize that long range transport assessments may be necessary in limited situations. We've engaged with the regional offices--Region 4, Stan Krivo; Region 6, Eric Snyder among others--to understand what their experiences have been over the past ten plus years.

And again, as I said earlier, going down the road to doing a Class I PSD increment analysis, my understanding is that you can count them on one hand, so we're talking about a very limited situation. And so having a screening approach was deemed both appropriate and necessary in these revisions.

So the first step would be for your near-field application of the appropriate model--as I said, AERMOD or an alternative model, based on approval--you would determine the level of significance of those ambient impacts from your new or modifying source at or around 50 kilometers. You'd have a circle of receptors that would tell you that. Again, the experience will tell you that the vast majority of situations will screen out at that point in time.

If you don't screen out in that instance, then the second step would be in consultation with the regional office you determine the appropriate screening approach using CALPUFF or any other Lagrangian puff model to determine the significance at specific Class I areas of concern.

You're dealing with a specific new or modifying source. You know those Class I areas that are within a reasonable transport distance, and you can look to those specific receptors to determine what the significance levels are in those cases. Again, the vast majority of situations are expected to screen out--if they even get to that second step, to screen out at that time.

If they don't screen out, then for those limited situations you would have to conduct a cumulative impact analysis, and I think memory didn't serve any of us well in terms of being able to point to a situation where that actually had occurred, so if there's public comment to address and remind us of that, that would be appreciated. And then the selection and use of a model would be determined through approval under Section 3.2.2(e), alternative model.

So that lays out the screening approach--again, streamlining the approach in terms of what models you have to use, having them, you know, and the approach be warranted to the nature of the problem. And so we feel as if it was appropriate to offer this flexibility and to reduce the burden on the user community.

Then in Section 5 in terms of addressing secondary pollutant impacts we feel that by not specifying a preferred model we actually provide a lot of flexibility to the user community in estimating these single source secondary pollutant impacts with more appropriate modeling techniques. We stress the full chemistry photochemical models in the preamble, and a number of those do address science issues of Lagrangian models and in particular CALPUFF, and I'll note some of those in the next slide.

And based on the IWAQM, Interagency Workgroup of Air Quality Modeling, the Phase 3 effort, there are reports as well as published literature that support our decisions. And we've placed the emphasis on use of those chemical transport models or techniques that reflect the state of the science in atmospheric chemistry so that we're applying the best science in those situations.

And again, we've got guidance. Kirk Baker and Jim Kelly put together a detailed guidance to support Section 5 for ozone and secondary $PM_{2.5}$, and we will reply upon the regional offices and others and the community at large as these models are there and developed and techniques within those models are improved upon to allow them for use here, tools like source apportionment, other instrumented techniques, and Kirk will get into that in more detail shortly.

Then the preamble discusses in the section for long range transport future considerations for visibility modeling with full chemistry photochemical models. We're limited in our ability to do evaluations with respect to visibility, and so we'll be working very closely, have been working very closely through the three phases of IWAQM with our federal partners.

And we feel as if--and as described in the preamble that consistent with what we're doing for ozone and secondary $PM_{2.5}$ under PSD that as these techniques are used and improved that their application for AQRV analysis for visibility and perhaps even in the regional haze context would not only provide improved science, but harmony and consistency with the models used in other aspects of the Clean Air Act programs.

And so it reduces the number of models you're carrying around. It reduces decisions and flexibilities of determination of what knowledge to work with those models and starts focusing us on best science and allows the community to then focus on developments and research and the like there.

And I think that's evidenced through work that

EPRI has done with SCICHEM from SCIPUFF and the bay releases that they've done and we'll hear later in the public comment about. And so I think there's the community there to develop and improve these models, and we've provided the--I think the impetus to continue that development and leverage the development that's gone on to establish what we've done in Section 5.

So I mentioned the limitations, and so this was documented in EPA's 2009 reassessment, and there was a modification through a memo to the docket to add conclusory or summary statements, and this is part of that.

The chemical conversion algorithms in the regulatory versions are quite old, and they're pretty inconsistent with our current knowledge and state of the science in terms of secondary $PM_{2.5}$ formation.

And even the more recent chemistry algorithms still don't contain photochemical reactions that are important to simulate secondary PM formation. They're not the type of full chemistry model that we feel is necessary and appropriate.

And it does not estimate ozone formation from single sources, which is something that now under Section 5 and Appendix W and through guidance we are looking for and expecting.

So--and then in a wide variety of situations where we've tested and evaluated the model, there's just a lot of variation in terms of an unexplained and very difficult to comprehend and understand sensitivity of the dispersion model with the CALMET meteorological input that necessitated putting a preset to CALMET by EPA in conjunction with the FLMs to try and make it a more manageable process and understand and provide more credibility in the modeling results.

And so it's just been a challenge for us dealing with this model over the past ten years, and unfortunately the community has not come together as was expected to really work on those types of developments, broadly speaking.

And to that point we also issued a memo related to concerns about the management and maintenance of the model. The interactions between EPA and the model developer have been complicated by the changes in ownership and the uncertainty of the development process. That's just a fact. We're not trying to say anything that is anything other than just a fact of our experience and our observations.

And as EPA and as being responsible for a preferred model in Appendix W, it becomes an obligation on the federal government, and we have memos and other things that are in the docket establishing that relationship, and it has just been difficult to adhere to those in a very transparent and open manner. One example is the process that we went through in updating the VISTAS version of CALPUFF, and that was discussed and summarized in detail at the 9th Modeling Conference.

There have been a number of updates to the CALPUFF modeling system just as there have been a number of updates to AERMOD in terms of the regulatory version. It's just that process has been a little hit or miss in terms of under-standing and knowing what's coming and communication to both EPA and the broader community in terms of those things.

And there's been the parallel development process with the series 6 versions, which has just caused a lag in our ability to adequately understand, to review, and ultimately approve changes in a timely fashion. And it's largely due to a lack of an open development process.

And then we recently in the latter part of June were hit with from the current owner of CALPUFF a version 7 version of the model with no prior notice in the middle of this rulemaking, and again, it makes it very difficult, very awkward for the agency to proceed with what it needs to with that type of process. So we do believe that it's been unduly complicated by these changes, and it's already a complex model, a complex world to apply it in.

And so it--when we're talking about a preferred model that has status and that the EPA has ownership obligations if deemed necessary, one option is to take the model under our own roof. We've got difficulty enough maintaining AERMOD and other models and adequately staffing and supporting the regions in the permit arena, so that would be a totally unfeasible option for us to do.

And again, as I said, there are other models out there. We've got a screening approach that adequately meets the regulatory needs, and so from the standpoint of moving forward we feel as if the changes that we're proposing are not just warranted but in everybody's best interest.

And in terms of the Regional Haze Program, we did issue a 2005 guideline separately for the BART requirements under Regional Haze Rule, and that did recommend at the time because there really was no other model capable--at that point in time photochemical models had not been really--they had been some--some had been instrumented with these types of instrumented techniques, but they really hadn't been fully evaluated and understood and put into practice.

So CALPUFF was available for single source assessments. Again, in that process we acknowledge the lack of full evaluation, but it did provide information in a multifactor decision making process under BART. Again, it wasn't the sole determination of things as it would be under a preferred model situation in terms of whether or not you are complying. It was a factor in a multifactor decision framework, and so we felt comfortable in that context.

And in that we also did allow states the ability to use alternative models, and some did use photochemical models and have used photochemical models. The EPA itself has used photochemical models in this context in consultation with the EPA regional offices. So I think as the science has evolved the process is flexible and fluid enough to bring those in so that the best science is used in this context.

That said, the proposed changes do not affect the recommendation from 2005 and past and current BART applications of that model, and so adhering to Appendix W and going through the appropriate process as folks have is still in place, and we do not--we want to make sure that everybody knows that we do not feel that any of the changes that we're proposing which need to move us forward should be retro-actively looked at in terms of these things.

We don't do that in any situation, you know. We don't go back and reevaluate permits, you know, that were done with older versions of the model. There's a reason. You have to respect that, but yet you have to also respect the evolution of the science and the better science because that will always change and evolve.

So in summary, just to close, so we're proposing to remove CALPUFF as a preferred model in Appendix A specifically for long range transport, and we're recommending that it be used instead as a screening technique along with other Lagrangian models for assessing PSD increment beyond 50 kilometers.

For NAAQS demonstrations based on the analyses that we've done, and we welcome comment and new other source sector scenarios that can be fully evaluated to support our determination or question it, however the case may be, that you would not conduct a NAAQS analysis outside of 50 kilometers for inert pollutants.

There's no change in the ability to use CALPUFF, again, or any other Lagrangian model, or other Gaussian model for that case, in the near field as an alternative model for low wind, low terrain, and other specific situations in which AERMOD, the preferred model, isn't working or beta options available in AERMOD are not working. You have that alterna-tive model approach available, and that flexibility has always been there and we continue that.

And along the line of flexibility, the user community has that in estimating single source secondary impacts, and we will continue to evolve. We've in Appendix W provided a broad framework, an appropriate framework, that we feel meets the requirements under the Sierra Club petition in terms of establishing models and/or techniques with reason-able particularity.

We've done that in Appendix W with subsequent guidance that supports that and that that allows for the appropriate use of chemical transport models, and in some cases Lagrangian puff models may be appropriate to use in that context, and we provide the appropriate context for those used.

So again, we're opening the field up. We're allowing flexibility in the user community to appropriately address the problems that they have, and we, again, have a framework and a process by which it can happen and it can be effectively communicated in a transparent way.

And as we update the *Guideline*, you know, we hopefully don't have another decade go by, and I doubt we will be able to let another decade go by, given the advances and the need to continue to refine the *Guideline*, to continue to refine the models. We'll certainly be continuing to evolve what's in Appendix W, what's in the guidance, and our preferred models to respect that. So I think that is it. Thank you.

Mr. Bridgers: Thank you, Tyler. So we're getting back on schedule, if there's a schedule we must keep. We'll transition from the discussion that Tyler just gave on long range transport and CALPUFF to a presentation from Kirk Baker, et al. about the treatment of $PM_{2.5}$ and ozone in PSD compliance demonstrations.

Dr. Baker: All right. Thanks, George. The first thing I want to do is apologize to the rest of my group for not wearing a tie, so I guess we'll keep this a little more informal in this talk.

So secondary pollutants for single source impacts, I'm going to talk a little bit about that today. As Tyler mentioned, EPA granted a Sierra Club petition in January 2012 with a commitment to update the *Guideline on Air Quality Models* to address ozone and secondary $PM_{2.5}$ impacts. The current version of the *Guideline on Air Quality Models* has very little information about how one would go about estimating the impacts from single sources for ozone and secondary $PM_{2.5}$.

So in response to that petition we now have an entire new chapter in the *Guideline*, Chapter 5, that's focused totally on secondarily formed pollutants speaking to ozone and $PM_{2.5}$, and we have a Chapter 6 that's focused on visibility, deposition, and air quality related values.

It's similar to the older Chapter 6. It retains some of those elements, but if people remember the old Chapter 6 it was kind of a hodgepodge of a lot of incongruous information, so now it's just totally focused on air quality related values and other governmental programs.

The intent that we had in going through and making these updates to Appendix W is that the updates we would make would be an appropriate level of detail that is going to be relevant over the long term and put the more dynamic information that would be reflecting the current practice of model application into guidance documents, which are going to be more dynamic and could be more fluid and updated to reflect the state of the practice going forward so we don't always need to go back to rulemaking to update the *Guideline* when new things come about.

So the process for updating Appendix W for the secondary pollutants, the Interagency Workgroup on Air Quality Modeling, IWAQM, has been a process that has historically been used for collaboratively updating regula-tory air quality modeling approaches.

So we reinitiated the IWAQM process and called it Phase 3 in July of 2013 so we had a mechanism for working collaboratively with our EPA regional office partners and partners at the other federal agencies to update the Appendix W, update or develop new guidance documents where necessary.

So the goal with this process was to just start to understand and identify credible modeling techniques for single source secondary impacts for ozone and $PM_{2.5}$. This type of work had been done in the past but not an enormous amount of work, so in a lot of ways we were starting with kind of a clean slate, especially on the ozone side, and just trying to understand what types of tools are appropriate for this, and if someone were going to use these types of tools, how best should they be applying them for this type of purpose. A lot of these tools have been used for other purposes and we just wanted to make sure that when used for a permit type application that they would be used in the most appropriate way possible.

So in Phase 3 IWAQM consisted of two different working groups. There was a near-field impacts working group that was largely EPA regional office and OAQPS staff, and there was also a long range transport workgroup, which is more similar to the past IWAQM phases that people might be more familiar with. So out of that we have technical reports and guidance documents to support the proposed revisions to the air quality modeling guideline.

So this looked pretty good on my computer. It probably doesn't look too good here from where I'm standing, but this is kind of a schematic of the different pieces of the puzzle that we were updating through that IWAQM process. And up on the top we've got Appendix Q updated Chapters 5 and 6 and the preamble language that was relevant to those two chapters, so that was the main, overarching goal was to update Appendix W for single source secondary impacts.

And below that we've got kind of increasingly dynamic documents. We've got the high level guidance documents and moving down into technical reports that kind of provide a snapshot of what the world is right now in terms of the technical approaches that are available for us in these single source impacts in the near field and long range transport.

So on the left side we've got the PM Modeling Guidance that had already been put together. We didn't work on that, but we did develop a new guidance document for using models for single source secondary impacts for ozone and $PM_{2.5}$.

And so the idea behind this is if people are familiar with guidance that we have put out for things like nonattainment demonstrations, the intent here was to provide something similar so that people would know if you're going to use a chemical transport model for the purposes of estimating single source impacts, how would you set it up and apply it for doing a PSD permit type of application. So we wanted to have all that information in one place. That's the intent of that.

And then below that we've got--the IWAQM Phase 3 near-field group had a technical report that just kind of details where we see the science and the feel of that right now with respect to doing these types of assessments.

On the right-hand side the long range transport, the main guidance document being the Federal Land Managers' Air Quality Related Values Work Group Phase I report, the FLAG guidance document. A lot of people are probably familiar with that, and so that's going to be--that was not updated as part of this process. We expect the federal land managers to take up a process moving forward to update that if they feel it's appropriate.

And below that there is also a Phase 3 report from the Long Range Transport Group that again kind of provides a synopsis of the state of the practice and science related to long range transport modeling for air quality related values.

Then at the very bottom, which probably most people in the room can't see, is just--there's a lot of technical reports from EPA, a lot of external reports that some people in this room have put together and things in the literature that we used to inform these reports and the guidance.

So this is just an outline of what's actually in Appendix W Chapter 5. This is the section on Models for Ozone and Secondarily Formed Particulate Matter. There's a discussion of what ground level ozone and secondary $PM_{2.5}$ generally is. There are also some broad recommendations about what types of modeling systems would be appropriate for either doing a single source permit type of assessment or for doing a nonattainment demonstration, which would be a multi-source projected type of modeling assessment for secondary pollutants.

So what we've tried to do in Chapter 5 is really clearly delineate using air quality models for nonattainment demonstrations for NAAQS, which would be kind of multisource or all source projected future year assessment of a control strategy and also have--clearly differentiate the approaches necessary for doing a secondary impact assessment for a permit. So we've got both of those things in there so it's very clear for ozone and similar information for secondary $PM_{2.5}$.

So the highlights for Chapter 5--this is a totally new chapter in Appendix W. As I mentioned, we wanted to have a very clear distinction between nonattainment planning for NAAQS and permit assessments. We want to emphasize the importance of developing modeling protocols and consultation with the reviewing authority.

As Tyler mentioned, what we're doing is we're putting forth a screening approach without a preferred model. We don't even really mention a lot of model names because, given the length of time it usually takes to update these, a lot of times when you go back and read Appendix W it's like pulling out a time capsule and you see references to models that you forgot ever existed or, you know, you don't even know what the reference is supposed to be because nobody has any idea what that model was back at that time. So what we're trying to is just kind of focus on high level information and not get into a lot of specific details with model names and things like that.

The other thing that Chapter 5 puts forth is a multitiered approach for single source permit assessments. We don't expect every single permit assessment to have to do a rigorous, full scale photochemical transport model type of assessment. There's going to be a multitiered approach, one that's going to be using existing information where it's appropriate and available and seeing if that's going to provide the information that will work for the assessment in consultation with the reviewing authority.

And then beyond that if necessary we expect there will be less situations where people would need to use a photochemical or a Lagrangian chemical transport model. But in situations where we do get into that, we do emphasize that it's really important to use techniques that reflect the state of the science (coughing). Like Tyler, this is also very emotional for me. It's been a long three years since the petition was agreed to.

Mr. Fox: We're almost there, Kirk.

Dr. Baker: I had no idea how this was going to change my life. So some of the broader considera-tions for ozone and secondary $PM_{2.5}$ permit modeling, we put forth this idea of MERP, the Model of Emission Rate for Precursors. And information about this has been included in the docket. So we're expecting to have this as part of future rulemaking and possibly guidance.

So a MERP is not going to replace the significant emission rate for permit assessments for determining the applicability of the PSD requirements for sources with emissions above the SER. However, a MERP would represent a level of emissions of precursors that is not expected to contribute significantly to concentrations of secondarily formed $PM_{2.5}$ or ozone.

So if a source has emissions above the SER but below the MERP, we may not expect that additional technical demonstrations would be necessary at that point, but still that would need to be totally determined on a case by case basis with the reviewing authority.

So the idea for the MERP is just kind of an initial screening to screen out people that we don't--that we think are small and the emissions are not going to result in an impact that would be at the level of the SIL in any place, so we want to--the idea is to have a conservative estimate. You know, we think no matter where the source is, those emissions of NO_x or SO_2 would not result in secondary $PM_{2.5}$ above the SIL anywhere, and similarly for MERPs for VOC and NO_x for ozone.

So as I mentioned, I think there's a separate document that's been submitted to the docket where it outlines how MERPs fit into the permitting process, so in the past in the $PM_{2.5}$ modeling guidance, people probably remember the flow charts where if your emissions are above the SER and depending on whether you're in an attainment area or a non-attainment area you kind of go through different processes to determine what types of quantitative assessments may or may not be necessary for you and what types of controls may or may not be necessary. So there's a document that updates that and includes how the MERPs fit into that process.

So with the guidance on the use of models for assessing the impacts of emissions from single sources on the secondarily formed pollutants ozone and $PM_{2.5}$, we've provided guidance so people know what to do for permit assessments.

And I want, you know, to just reemphasize that we expect that a lot of sources will be screened out through the MERPs once those are available. And if they are above the MERP, then a first and possibly second tier assessment may be necessary. And those two tiers are broadly outlined in Appendix W, and we have more information about those tiers in this guidance document.

So for first tier assessments, it's generally expected that applicants would use existing empirical relationships between precursors and secondary pollutants based on credible and relevant modeling that already exists and detailed in this guidance.

It's also possible that some screening approaches could be developed based on full science photochemical transport modeling systems such as reduced form models, and this could provide information that might satisfy the first tier requirement in some situations.

So the use of preexisting credible technical information or a screening model for the purposes of estimating single source secondary impacts would be considered on a case by case basis and done in consultation with the appropriate review authority. So again, we're trying to provide a lot of opportunity for people to do a credible assessment of their emissions against a SIL but not necessarily have to go right into doing a full scale, rigorous chemical transport analysis.

So a second tier assessment could be necessary, and when that would be necessary we have guidance on how you set up the air quality models, inputs, what kind of run time options might be necessary, how you would set up the receptors, and how you would do the postprocessing in order to appropriately assess the impacts of a project source on ozone and secondary $PM_{2.5}$.

And even within the second tier in Appendix W when you get into that situation, we kind of had a subtier set up where there's different levels of rigor, so you could do something a little bit less rigorous and take a more conservative impact being estimated for the project source or you could do something more refined and complicated, and there might be some leeway to move off of the most conservative possible estimate. Those are the things that would be laid out in a modeling protocol and agreed upon with the reviewing authority. But we just want to emphasize that we're trying to build a lot of flexibility into this for people.

So for second tier assessments we do generally recommend that chemical transport models be used for single source ozone and secondary $PM_{2.5}$ impacts. Chemical transport models broadly include Lagrangian puff models and Eulerian grid models such as photochemical transport models.

One challenge with Lagrangian puff models is they need a realistic chemical environment, so you need an input, a three dimensionally varying set of oxidants and mutualizing agents, so you need to get that information from somewhere else, and it could be--you could get that from a photo-chemical transport model because photochemical transport models do estimate a generally realistic or usually realistic chemical environment, and that output could be used as input to a Lagrangian model if people are interested.

And there certainly could be some situations where the three dimensional environment around a project source and key receptors isn't that complicated. You might not need to go to that type of rigor, but that is something that would be, again, decided on a case by case basis.

When using photochemical transport models, we've got a lot of information in the guidance about how they would be used for this purpose. Even though single source emissions are injected into a grid volume, we have done comparisons with in-plume measurements, and this suggests that grid based models can provide appropriate downwind secondary impacts when they're set up and applied appro- priately for that particular purpose. So we do have confidence that these models do work for single source permit types of assessments.

But having said that, clearly given that, you know, there's not an enormous amount of information available up to this point, further testing is needed for different types of modeling systems, both Lagrangian and Eulerian, to better understand what configurations are going to be the most appropriate for permit types of assessments and build upon a broader base of knowledge so that we can understand in different parts of the country and even in different parts maybe of particular urban areas how much secondary PM or how much ozone would we expect to see from different levels of precursor emissions.

So I think that's going to be important going forward is just building upon that body of knowledge and seeing how variable that's going to be from place to place and even within a particular place.

So the IWAQM3 Near-field Impacts Group updated the preamble and Chapter 5, which I mentioned this new guidance document, which is available in the docket, which I just talked about. And there's also a summary report that talks about what we know right now about the relationship between single source precursors and downwind secondary impacts.

There's an overview of published emissions and secondary impacts from single sources to provide some context for what we expect in terms of impacts from these types of sources, and it also talks a little bit about recommended models, approaches, and tools for these types of assessments that are available now.

So estimating source contributions with chemical transport models, Lagrangian puff models are pretty straight-forward. They usually just output the project source impacts. When you use something like a photochemical grid model that contains all the sources, it's really not that complicated, but you just want to keep in mind that it could involve two different simulations, that the simplest way to get the single source impacts from photochemical grid model simulation would be to do a model simulation with all the sources and the project source at preconstruction levels and do a second simulation with all the same sources not changed and the project source at postconstruction levels.

And what you would do is just difference those two things and find out what the impacts on ozone or secondary $PM_{2.5}$ is from your project source. And that's what's represented in the schematic that most people unfortunately from about the fourth or fifth row back probably can't see, but we've got the baseline on the left with the source modification compared to the baseline in the middle.

And on the right you can clearly see with the spatial plot the warmer colors being the higher impacts nearest the source itself, and they kind of fall off as you get further away from the source. And it varies direction-ally based on the meteorology. So it's kind of a physically realistic impact that we're seeing when we use these types of models.

And alternatively, there's more complicated things you can do with a photochemical transport model if you use extensions like source apportionment or DDM. You could track the model--you could track the contribution of a particular source through the model without a second model simulation, although that does require some additional resources.

Real briefly on Chapter 6, this is the section--now it's just focused on air quality related values and other governmental programs, so Chapter 6 just kind of talks about what are air quality related values, how do the FLMs fit into this picture, and what is the appropriate guidance, and here it would be the FLAG guidance.

So in the past, as I mentioned before, Chapter 6 comprised a lot of really incongruous information. It had GEP information in there along with long range transport modeling, so it is really focused on visibility and deposition and other programs.

I'll emphasize again as Tyler mentioned using chemical transport models for these types of purposes, and we expect the specific guidance that people refer to would be looking at the FLAG guidance document. Specific guidance for models and model applications are also available from the FAA for airports and from BOEM for offshore sources that are within their jurisdiction.

If it's an offshore source that's within EPA's jurisdiction, then you would refer to other parts of the *Guideline on Air Quality Models*, Appendix W, for information about doing those types of assessments. And Tyler also mentioned that the screening approach for primary pollutants, that's in a different section of the *Guideline on Air Quality Models*.

So finally, the IWAQM3 and Long Range Transport Group worked on updating the preamble and Chapter 6, and there's also in the docket a report from that group that talks about recommended models, approaches for long range transport assessments of secondary pollutants including visibility and deposition.

Mr. Bridgers: Thank you, Kirk. And it looks like there's an assurance if I can keep my comments to time that everyone will have a longer lunch break. I'm the emcee and the conference host, so I have some prerogative that I'm going to take. I have two talks scheduled now on your agenda. If you see them, I'm going to reverse them, and I'll explain why.

I don't know if it was late one night, I don't know if it was early one morning when I put this agenda together and I just randomly put my presentations on there, and then I realized last night about 9 o'clock--I'm like, "Er, I really should talk in the other order."

A subtle feature that we didn't announce: the agenda today across the morning largely follows the preamble and the proposed actions that we have. And so to talk about the Clearinghouse needs to happen before we talk about the final Chapter 8 and Chapter 9, so I'm going to take the next ten minutes--and good Lord, I need this--to talk about the Clearinghouse and then we'll switch to a conversation about single source and cumulative analyses.

So again, just for the record, George Bridgers with the Air Quality Modeling Group here. As I started off here and want to start off now, I want to kind of frame things with what is already in regulation and kind of frame some history of the Clearinghouse and then talk about what we're trying or proposing to do in the revisions to the *Guideline*.

So to start off with, in 40 CFR Part 51, 51.166--I sound like I'm up in the policy group right now--(l)(2) specifically, the authority for the specification of a model in Appendix W, which essentially happens in Appendix A to Appendix W, it's all granted through writing from the Administrator.

Now, I can assure you Lisa Jackson--oh, excuse me, whoa. Our fair and very esteemed Administrator McCarthy--I'm sorry to her--that will certainly come up in my performance review. See, you get in front of all these people and you mind just goes blah.

So at any rate, yes, she was with the president last week with a very big announcement, and I'm surprised the president's not here with our announcement, but nonetheless, so yes; I do not think that Administrator McCarthy would be personally writing the approvals for the various models.

We do that through rulemaking for the Appendix A models, the ones that are preferred status. And then for the alternative models it happens through a delegated authority with the regions. And I wanted to point out first every-thing--the buck stops with D.C. and the Administrator.

The actual delegation of authority within the hierarchy happens in Appendix W, and it has since the '90s.

So that happens actually in Section 3. I think it's always been in Section 3, and so what we're trying to do right now is to bring further clarity to the delegation and respect what we have next and something that's been--and I have slides in a minute--that's been throughout the process, and that's that the regional offices already have a responsibility through regulation that they have to coordinate with headquarters on anything that could be inappropriately or unfairly or, you know, capricious and arbitrarily applied across the regions.

And so we're the headquarters, and so the buck stops at least with the approval of alternative and preferred models with us in the Air Quality Modeling Group and then with the Clearinghouse the way it's been set up.

So just for the record, it's on the screen as Part 56 and 56.5 is where this responsibility of the regional offices to seek concurrence of the headquarters. If anybody is red-green color blind, it's just blank, but I assure you it's on the screen.

So we have stressed the importance and the consistency of--or trying to have or gain consistency for years in multiple revisions of the *Guideline* in the very first sentence, and that's the "Industry and control agencies"--and this has come through previous public comment, and I think everybody in this room--well, I'm not going to speak for everybody in this room, but I would hope everybody in this room would want consistency in the application of air quality models in the regulatory context. Otherwise, we're not doing our job right.

So just to point out a few things, this one is actually in the docket. We included this on the 11th Modeling web site because we discovered it was not anywhere to be found. And unfortunately, Annamaria could not be with us today, but Annamaria, our Region 2 modeling contact, was able to dig up in her treasure trove of archives the old 1988 Model Clearinghouse Operational Plan.

And surprisingly, being the Model Clearinghouse Director for going on five years now, I hadn't read that. Maybe I should have--another performance review thing, but Tyler couldn't provide it to me anyway. Nonetheless, it was an interesting read because everything--and we got this prior to the proposal--because everything that we're trying to codify in this proposed action was clearly stated and provided to the regions in 1988.

1993 was the first time that the Clearinghouse actually showed up that I could find in the *Guideline*. It was in Section 3. And it was interesting that the first thing that I found there was that the primary function was to review decisions proposed by the regional offices on modeling techniques and databases.

The other two--one was performing audits and then annual reports. We'll get back to the annual reports at some point, but I'm not suggesting--we're not suggesting we're going back to the old days of auditing the regional offices, but that used to happen. But nonetheless, historically the Clearinghouse has been at the center of modeling demonstration approvals in the alternative context and the preferred context.

So subsequent revisions of the *Guideline* seemed to--and this just happens with time. Some of the context was lost through what we sometimes call streamlining, but what we're trying to do today is to codify something that has been in practice for like 25 years.

So that's what we have right now is that the responsibilities and the preferred status approvals all happen in Section 3.1, and in 3.2, this is where the Clearinghouse comes in with the approval or concurrence with the regional office on all of the approvals of alternative modeling demonstrations.

So in the proposed revision, as I said, we have references to the 1988 Clearinghouse Plan. We listed in the new proposal the 51.166(l)(2) regulatory text reference, and that is to bring clarity on that delegation authority with an understanding of what we talked about with the 56.5(b).

We're trying to provide as much transparency--

again, this is a process that's been in place for 25 years. There was a clearinghouse document, the operational plan that I couldn't even find. It was referenced in the 2005 version of Appendix W that's current, but it's one of those unclickable links you can't find, so we're trying to make sure that the process is as clear as humanly possible, not only for our regional offices but for everybody in the regulated community.

And it's also--for the stakeholder community it's what's needed because every decision will be considered--at least on alternative models will be considered in the context of its national importance and not just the regional importance.

So I did want to take just a few minutes--this is the formal process, and there are some roles and responsibilities here that I'll also note. First and foremost, the reviewing authority, whether it be a local program, a state program, in some cases EPA or a tribal situation, they're the first--they're the first rung in the ladder, so that's--when an applicant is having issues, they're the people that need to be addressed first.

When--in case it's not a regional office, if it's a state, local, or tribal program, if they cannot resolve the issue or if it's going to fall in the territory of an alternative model, then they can--they can engage the regional office. And then from there the regional office will engage us here in RTP.

We don't have situations--and I promise you some of you will know. If you call me up and say, "Hey, George, I've got this problem with this facility," I'm going to stop right there and say, "Have you talked to the state," "Have you talked to the region," and "We need to have this conversation in the context of all of them on the phone." And that way the information process stays in its proper order.

At the point that it's determined that the regional office is going--or needs to make a decision on an alternative model through that delegated authority, they will request from the Clearinghouse concurrence on their decision. And so they'll actually write us a request, and it's something that's done in coordination with us--it doesn't happen in a vacuum--and often in coordination with the state or a local program.

A little earlier this morning I gave a demonstration of the Region 2 clearinghouse situation from July. The state modeler, the regional modeler, and the Clearinghouse closely coordinated as we pulled that response together, so it was not done in a vacuum.

The Clearinghouse would receive a statement of issue, the desired approach with an appropriate justification--as the lawyers would like to say, a well reasoned justification--and that would follow what's in Section 3.2.2 of the current Appendix W. And fortunately for mapping from the new to the proposed, it's also Section 3.2.2 in the proposed version. And then the Clearinghouse would engage back with the solutions and write the formal concurrence--well, hopefully concurrence--memorandum.

Let's see. Moving along, so again, we summarize those things in MCHISRS, which I demonstrated before the break, and we also present things at the annual regional, state, and local modelers workshop and at conferences like these.

Fortunately in the last four to five years we also have started having industry days where we will invite outside stakeholders to the regional, state, and local modelers workshops, so again, that should be bringing additional transparency.

And finally--and this I think is something that people lose--generally in the community lose sight of. It's the Clearinghouse memorandums that's another mechanism for bringing issues to us that identify things that we need to change the course of the ship, so to speak, in whether it's the guidance documents we produce or ultimately rulemaking that we need to go through.

So if we were not going through this process right now, this whole proposal process, and ARM2, just to take an example, were presented to us, it would put first and foremost that that's one of the things that needs to be on the docket for the next rulemaking.

And with that, I have a link here for the Clearinghouse--again, that link will eventually change--and then my contact information, but this is for questions specific to the Clearinghouse and not the proposal. So with that I will end that presentation as close to on time.

And then I will move to the final presentation in the morning session, and this is on single source and cumulative impact analysis, which is maybe not the--well, it's a good title. But what I'm going to talk about is really Section 8 and Section 9 of the proposed rulemaking.

So throughout the morning we have heard a lot of discussion about AERMOD, AERSCREEN, met aspects of the *Guideline*, other aspects of single source modeling in the PSD context. We really have talked about all aspects of Section 1 through 7 and portions of Section 8 that we're proposing to update.

And all this culminates--it was previously Sections 8 and 10, but all this sort of culminates at the very end of Appendix W. And so what I'm planning to do right now is to talk about that culmination and what we propose to do. And actually, I probably could take Tyler's talking points from his first opening session because he did such a great job.

But nonetheless, we simplified--I shouldn't say simplified. It's probably a bad choice of words. We've streamlined Appendix W, the *Guideline*, by reorganizing information hopefully, and this is what we expect or appreciate your feedback on in a more logical manner.

The previous Section 9 had a lot of information about uncertainty, and it's one of those classic pieces of regulation. You get to the very end of the old Section 9 and it says basically disregard everything we just talked about because we don't have enough information to bring it to bear in a regulatory context. There was a very awkward set of text there. But nonetheless, we've reorganized information from the previous Section 9, streamlined overall Appendix W, so the previous Section 10 is now Section 9.

Despite us talking from the highest mountain or valley or, you know, podium that we can find saying that there's all sorts of reasons that you should not use the draft resource manual, the old puzzle book, at least in the context of the permit modeling, is that, you know, if you can use the old workshop manual and get the answer that you need to get your permit, have at it, seriously.

But just because past practices have worked for decades doesn't mean that they were necessarily the best practices. Now, I'm a young whippersnapper, so to speak. I'm not one of the old tried and true of the community, but I can tell you that things in that workshop manual were overly conservative.

Were they great thoughts? Yes. They were well thought, well reasoned at the time, but the science, the community has evolved, and we also have some very new, different form standards, different time metrics that we have to take in consideration. And taking those into considera-tion in the mind's eye of the rest of the community and the rest of the tools that we have, we do need to move away from some of the old unnecessarily conservative and complicated practices. So that's one of the things that we're attempting to do in this rulemaking.

So throughout Section 8 we've intended to modify the past practices and provide a more appropriate basis for the selection and the use of the various modeling inputs. I'll have some more slides on that in a minute.

And in Section 9, as Tyler said, what we've really tried to do is get rid of a lot of old, bad or incorrect language that was in Section 9 and bring to bear the policies that the agency has been following with respect to single source and cumulative impact analysis. And then in rare circumstances, Tyler said, we've maintained and will remain to keep the old Section 10.2.2 with respect to monitoring in lieu of modeling.

So in Section 8, and this is new, there is a section now talking specifically to the definition of a modeling domain. That's information that previously was not in Appendix W. We're proposing a new Section 8.1 with the specific requirements that set up the definition of modeling domain, and this is where you would have a radius extending from your source that's either new or modifying out to the point--the furthest point to which it can be demonstrated to have a significant ambient impact. So this is sort of where--the old process of where you use a SIL analysis to figure out what your modeling domain is.

The other caveat is, is 50 kilometers, as Tyler has said, at least for the inert pollutants and the NAAQS compliance, is the limit. And so whichever one of these is less is your modeling domain, and this is what would be used in the cumulative analysis.

With respect to attainment demonstrations where there was not information before, we're now providing some more information that talks about setting and establishing modeling domains in that context too.

Now, this is one that's a little bit different because the nature of the problem is going to be different. You're normally talking about larger areas and multisources, and so that area needs to include all the major upwind areas that could have impacts on the nonattainment area and also all the monitors that are violating the nonattainment area. And as a caveat and a previous modeler for a state, you should really have--although we've seen it--all of the nonattainment area in your modeling domain, but we classify it as all the monitors being encapsulated.

I will say in both 8.1 and 8.2, and this happens in the context of a well developed modeling protocol, these both should be vetted with the appropriate reviewing authority before significant modeling is underway. And that's just an assurance on both sides that what's being done is appropriate.

In Section 8.2 we have made some other changes, and this flows along with the old source input data from the previous Appendix W. Well, I say the previous; it's the current, the 2005 version. And I have listed out here some specific section numbers with the various different pieces.

But we have added new language with respect to, again, SIP attainment demonstrations where Appendix W was lacking previously--in this case for ozone, for fine particulates, and also for regional haze--new language on how to characterize the direct and the precursor emissions, and that's in 8.2.2(a).

We've revised the requirements on how to characterize emissions from nearby sources that need to be explicitly modeled for the purposes of a cumulative analysis, and that's covered in a handful of paragraphs in 8.2.2(b), (c), (d) of the new proposed Appendix W. And then finally in 8.2.2(e) we revised the language on how to characterize emissions from mobile sources, and that's been updated and is more appropriate. And that happened with coordination with our transportation partners.

The most notable change--and this is the one that, you know, flashing lights or whatever that we've changed--is how to characterize the emissions from nearby sources. Tables 8-1 and 8-2--they're still Tables 8-1 and 8-2, and that's for simplicity in all the world, so we didn't change the table numbers up--we have changed that nearby sources will now be characterized by--and I put it in quotations because there's 100 different ways you could classify this--what we traditionally have called actual emissions rather than allowable emissions.

So my next caveat is the next bullet: emissions are based on emission limit, operating level, operating factor. Please look at Tables 8-1 and 8-2 to understand the full context of actual and allowable emissions because they can take on some slightly different connotations.

With respect to the actual emissions, they need to be based on the most recent two years of actual, and I probably should have put a comma there, nominal emissions.

If the facility was shut down for two years for maintenance or for a year for maintenance, you should not use one of those in calculating what their actual emissions are.

I know many of you would like to, but you should have two years of actual operation and they should be typical operation. And so there's a bit of an art there in creating that emissions. Number one question: where's the inventory? Just like with SIPs, there's some work that's going to have to be done there nonetheless.

I do also want to point out--and this is no change in Tables 8-1 or 8-2 with respect to the new or modifying source. They're still going to be characterized by their proposed allowable or the permit limitation emissions, so the only change is with nearby sources.

Then there's Section 8.3, and 8.3 kind of--everything here gets a little jumbled because this kind of plays back on some of the things that we talked about in 8.2 because this is where we're talking about how we construct the design concentration. And that has to be done in context of whether you're an isolated single source or whether you're in a multisource area.

In an isolated single source area, typically you're--and this is in the cumulative context--typically you're going to have some background monitor that's going to be representative of everything, and that's going to be nearby sources and other sources and international emissions, and then you're going to have your project source.

In the multisource area there's some updated language in 8.3.3, and this is where you talk about the culmination of sources that could be nearby that need to be explicitly modeled, the other sources that are typically characterized by background emissions, and the background emissions. And then there's always the other emissions, like I said, and that's typically taken care of by the monitored background.

Before I get to that, I want to say a few more things about 8.3. We also go into some detail here--and I have it as the first bullet; I just missed it--is a discussion of the importance of understanding of what the monitoring data truly represent.

And this is--this is important because this goes back to the bad past practices, because as often is the case, we have seen time and time again that someone includes a background monitor and they include--and I don't want to give a number because I'll miss--somebody will say, "Oh, I've seen less" or "I've seen more," but numerous--underscore, italicize, quotations, whatever, boldface--numerous nearby sources. And there's a significant amount of overcounting, double counting, extra conservativeness that's put into the demonstration.

The community--what we're proposing is the community as a whole, and that includes the states and locals, they need to get out of the habit of just taking everything in the kitchen sink and throwing it at the model and then coming to us and saying, "We're getting these outrageous concentrations," and you've got 1,000 nearby sources in there.

And so there is updating language--I'm jumping around in the bullets, but there is updated language about the concept of using significant concentration gradients to understand where you have situations where you have nearby sources that are just not well classified or characterized by the monitor and need to be explicitly included. But there should be--and this statement is from the proposed guidance, that there should be only a few nearby sources in most cases.

There's already been discussion this morning on the met data side and the met data input, you know, the introduction of the possibility of prognostic data where a National Weather Service is not reasonably available and it's just not feasible to collect site specific data. And then also we brought in AERMINUTE just so it was clearly classified in Appendix W.

Now, everything culminates in Section 9. We stress--we updated the language with respect to 9.2.1; it's a recommendation, it's not a requirement--that the development of a modeling protocol is extremely important. This is the living document that everybody can look to to understand what's going on, and a well developed modeling protocol on the front end makes the whole back end with the public hearing and the public sharing of information much easier.

Information with respect to the design concentrations, previously we had information scattered between Section 7 and Section 10. We had all very, very specific language for what individual standards were. As Kirk got up here and said with the models that were listed in Section 6, you look at it and you go what era, what decade is this from.

We removed that from the current proposed Appendix W. We're not going through and listing out what every current standard is and how to calculate it. That's going to be handled in guidance outside because the standards change and we can't update Appendix W every time we revise the NAAQS. We may need to at times, but we shouldn't do it every time. So it's more dynamic.

We've also improved the discussion on receptor sites in 9.2.2. Along with putting too many nearby sources in, the other thing that we were seeing is people using tens of thousands, if not hundreds of thousands, of receptors out to 50 kilometers in every direction, and that is excessively large and unnecessary. And this goes back to we've updated-- are proposing to update language with respect to the modeling domain, what's in that modeling domain, and then the receptors that you look in that modeling domain.

In 9.2.3 we overhauled the overall recommendations of how to do the compliance demonstration. The language wasn't clear before and it wasn't concise, so now we have as the first stage that you perform the single source impact analysis. Some people refer to that as the SIL analysis. And then only upon demonstrating that you are above or could cause a significant impact, then you would move to the cumulative analysis, which is much more comprehensive.

We also revised--and this was a major overhaul because there were parts of the emissions limit discussion that even our policy folks looked at and didn't understand or realize--I mean most of the regional offices read it and said, "We didn't realize that was in Appendix W." And it was outdated and it was largely incorrect given the form and the time frame of the new standards.

And finally, as I just mentioned earlier, there is some more information provided with respect to the monitoring in lieu of modeling or the use of measured data in lieu of model data, but as Tyler said, this is an area where we are seeking input because this is an area where we don't--we only have a couple of very dated and very old examples.

And so we have provided more, hopefully more clarity and some more structure on how one might step through the process to determine whether or not they can use monitored data, but there's a whole back end part that's not in Appendix W and probably should never be in Appendix W that goes through the whole policy aspects of then how the data is used in actually writing the permit, potentially caveats that need to be in that permit, conditions or postconstruction monitoring or the like. And that's just something that's not relevant or appropriate in Appendix W, but nonetheless we end that.

So Appendix W has this nice little, okay, we defined the universe for models. If you have current models, you can use them, great, well and fine. If you have situations that you need to use an alternative model or there's not a preferred model, there are situations for that. We define how you use your input data, how to put that in a regulatory context. But if all else fails, there's this last piece, and this last piece is the one that we want to get additional comment from the external community. I think with that I am done.

And so seeing that it is almost 11:45, I will take this opportunity to break us for lunch. I'm going to keep us on the 1:20 time schedule, so we get a few extra minutes for lunch today. I'm trying to think of any other caveats. Just try to be back in the room by 1:20 because we'll start then. Have a great lunch, everybody.

F U R T H E R   P R O C E E D I N G S   1:24 p.m.

Mr. Bridgers: So I want to welcome everybody back to the afternoon session of the first day here of the 11th Conference on Air Quality Modeling. As if the modeling conference wasn't already a public forum or public hearing that's being transcribed, this is also a public hearing for the proposed rulemaking on the revisions to the *Guideline on Air Quality Modeling*, as I mentioned that this morning. So from this perspective, it's at this point that we actually start the public hearing officially for the notice of proposed rulemaking. So as the public hearing officer, I call the public hearing to order.

Just as a reminder--I don't want to spend a lot of time on this and we can go right into the presentations--all the presentations today are part of the record. They'll be put in the docket at some point, in the week or so following this conference. As I mentioned earlier, most of all the presentations are already posted online that you can get through the agenda that's posted online. And I'll make that--I'll have more clear links over the next couple of days for others that weren't able to join us here.

I do ask that everybody identify themselves when they come up to the microphone. And to that end, for the court reporter next to me, I am George Bridgers with the Air Quality Modeling Group here at the USEPA. All the docket--

all the dialogue will be transcribed. We're not having any Q and A. Let's see what else in my caveats.

Anyone that did not request a time to speak in advance will have an opportunity tomorrow late morning and then tomorrow afternoon to offer oral comments to the docket. Otherwise, comments then can be submitted to the docket for the next--it depends if you count from today or tomorrow, for the next 74 or 75 days to October 27th of 2015.

We have a full afternoon. Although there are only 15 presentations, there's a lot of material to cover. So I ask that all speakers keep to their set times. And to that end since we're only offering 15 minutes, I will have to cut people off. I will not try to be rude about it, but when we get to 15 minutes, that's your allotted time. We will hold that tomorrow as well with the public oral comments.

So without wasting any time, I would like to transition. And first up we have three presentations, although they're by different affiliations for Bob Paine, they're from Bob Paine. This is not the Bob Paine conference. And so Bob Paine.

Mr. Paine: Thank you. You've already identified me. I'm from AECOM and I've given the court reporter a business card. This talk is going to be on behalf of the American Iron and Steel Institute or AISI. And we're going to talk about near-field modeling and source characterization issues for near-field modeling. I would like to express appreciation to EPA for the dialogue that AISI has had with EPA on these issues and we're going to continue with that dialogue.

I'm going to talk about two issues that I have time for and then there are supplemental issues that are provided as attachments to the presentation, which I will summarize very briefly at the end of my verbal comments.

Highly industrialized areas are mentioned briefly in the proposed Appendix W changes and we would like to expand on that discussion here. However, those with large heat releases over a sizeable area can and should be modeled with urban dispersion option in AERMOD.

The other issue I'm going to dwell upon at some length is stack plumes on or near buildings that have experienced fugitive heat releases maybe not related to the actual stack that can lift off the plumes being modeled. That would--accounting for those effects would reduce inaccurate overpredictions due to the current downwash that does not account for these heat releases.

The supplemental issues provided as attachments deal with some evaluation results for these two items at the top and also two other issues. And that is plumes from adjacent stacks that would be partially merged and result in a higher effective plume rise and also plume rise from moist plumes that isn't really addressed in AERMOD.

I have already mentioned the EPA and AISI have been discussing these, and several technical documents have been provided to EPA. But these documents will also be provided to the docket for this rulemaking by AISI.

Okay. Let's talk about urban dispersion for highly industrialized areas. Right now--and this is really a source characterization effect. It's not really a change in the model, but it's a change in how you characterize a source's input to the model.

Normal assignments of urban versus rural dispersion are important here. And industrial processes in geographic areas of large heat releases but low population, such as areas with a lot of industrial activity where not a lot of people live and there might be water bodies nearby that would make the 3 kilometer circle be characterized as rural, but with all the heat release, it's probably better to model it as an urban area with a large effective population.

And I'm going to talk about how to characterize that effective population. Actually, Appendix W does refer to that, the need to do this characterization. This characterization would then provide the appropriate urbanized treatment of mixing height and the temperature lapse rate for the dispersion calculations.

Now, in the classic urban area, which is shown at bottom right, there is a temperature excess at the core of the urban area. And you can identify the depth of the urban heat island, basically the boundary layer, by the temperature difference between the core of the urban area and the outskirts.

But as I said, these large industrialized areas do not meet the classic definition for an urban area, but the formulation of AERMOD does provide a way to parameterize the effective urban population if you can get an idea of the delta-T between the urban and rural.

The next slide shows how to get that. From the AERMOD model formulation, the delta T_{u-r} is related to the population input to the model with this relationship. Where there's a 12 degree Celsius delta-T, it is related to a population--a reference population of 2,000,000.

You can get at the temperature difference now via satellite data, which I'm going to show an example of. And there's going to be more documents uploaded to the docket that explain how to use satellite data to obtain this very important input to this process.

Alternatively, if you have engineering estimates of the excess heat release, the bottom equation, if you can see it, shows how you relate the watts per square meter excess heat release to the temperature difference, and then the temperature difference can be related to the effective population.

So let's talk about how we can get measurements of this urban-rural temperature difference via satellite data. Available satellite platforms are ASTER and LandSat 8. And again, we're going to provide more technical discussion of how to access these databases. You actually don't get the temperature difference map directly from the satellite data. You have to download the data and then create the map. In the explanation we'll go into how that's done.

We provide an example on the next slide of such a map and also in Supplement A to the presentation that will be online. And what you really get is a brightness temperature that is related to the actual physical temperature difference. Obviously these procedures are relatively new, being refined.

The next slide shows an example of a highly industrialized area with the white ellipse. And you can see on the right side the variation of the temperature, the brightness temperature. And the difference between the core of that highly industrialized area and the outskirts is roughly about 12 degrees Celsius.

And you can then accommodate that to the equation on the previous slides. That would be an effective population of about 1,000,000, which then could be used as input to AERMOD with an urbanized--urban approach with an effective population of 1,000,000. The next--and again, the Supplement A gives more information about how this has been evaluated already with a highly industrialized area.

The next topic I want to talk about is building downwash issues with this fugitive heat liftoff effect. In fact we have a procedure called LIFTOFF.

There is an issue of--there is an issue with light winds and downwash. Sometimes we get in AERMOD high predictions in light winds, which is somewhat counter-intuitive. I list a couple of papers down at the bottom of this slide that discuss this issue of downwash and light winds. The bottom paper, which is a plume lift-off consideration, is the core of this new technique, a paper by Hanna, Briggs, and Chang. And I'm going to talk about a formulation in that paper that we are using in this new procedure.

When we see these predictions under light wind stable conditions, we realize that they are probably not real in some sense or they wouldn't be expected because first of all you'd expect intermittent downwash with the winds fluctuating. AERMOD does not accommodate the fact that you have unsteady downwash in conditions with a lot of wind fluctuations in effect. To my knowledge the PRIME model does not have a meander treatment in AERMOD, so that's another reason why you might get an overprediction in light winds with downwash effects.

So how to adjust for this issue? Actually, there's another model; the Danish OML model does account for the intermittent nature of light winds on downwash, and the publication is available here as a link. There's a weighting factor in that model to accommodate the intermittency of this effect.

Now, let's add the issue of heat releases onto low winds, and we have a treatment in that referenced paper with a dimensionless buoyancy flux that's related to the heat--the fugitive heat release, the wind speed, which is an hourly effect, and a plume width that's probably tied to the building width.

So what we created is sort of a postprocesser to AERMOD where we deal with the intermittency by using an hourly weighting factor between two extremes, the no downwash case and the full downwash case.

As the buoyancy flux, dimensionless buoyancy flux, goes toward zero, you would tend toward a full downwash treatment. As the dimensionless buoyancy flux increases to a large number, it would tend to a no downwash extreme. And in the middle you would have a weighting of the two effects.

The evaluation testing has been--is done actually not only by the studies cited in the Hanna, Briggs, Chang paper, but also in a recently conducted field study that's going to be described more in documents submitted to the docket. Also in Supplement B we had four SO_2 monitors around the site with such heat releases. And the default modeling approach with full downwash did overpredict substantially.

This liftoff approach had much more accurate predictions. We used satellite imagery to document the buoyancy flux. For example, look at this. This was a plume from this facility.

You're going to see in the next slide a thermal infrared image with an intense heat from--they're not really pollutants, but they're emitting heat. You also see that the building temperature is much higher than the ambient. So you have lots of heat being exuded. You can't see them. You can't see this visually, but you can see it with the right kind of camera. So this effect is imparted into the liftoff postprocessor.

So to summarize issues with written comments coming, I'd like to bring back the issue of when stacks are touching or nearly so, I don't think we have a nationwide consistency of treating those as merged. But there is a Clearinghouse record--and I think that should be 91-Roman numeral II, rather than 11. The issue was addressed in a Clearinghouse record such that stacks that are within 1 diameter should be modeled as fully merged, so I hope that can be a national consistency issue that EPA addresses.

Partial plume rise enhancement, this is going to be--this is Supplement C in the presentation. Briggs had an explanation in various classic textbooks, '75, '84, *Atmospheric Science and Power Production* or something like that, where he has an algorithm for stacks in a row with partial plume rise enhancement. That is--we've accommodated that in a procedure we call AERLIFT.

And finally, we have the other procedure for plume rise models for exhaust streams with substantial moisture that we call AERMOIST. And in that case the relative humidity is a factor. What we do there is we preprocess the hourly emission input so that the effective temperature input to AERMOD is actually modified to accommodate the heat of the condensation due to moist plumes. That comes from basically a model that's been validated in Germany, and the details are going to be provided to the docket. And they are also in Supplement D to this presentation.

So finally, the AISI recommendations for source characterization effects to EPA would be that Appendix W should further clarify that the case by case source characterization refinements should not be treated as alternative model options, but should be allowed with adequate documentation as normal, more accurate source characterization.

And besides the urban characterization for large industrialized areas that Appendix W does briefly mention, we'd like it to be mentioned more clearly, maybe in the model implementation guide.

I mentioned the plume liftoff issue for fugitive heat releases on buildings that affect downwash treatment, plume merging, not only due to stacks that are touching or nearly so--that should be a no-brainer--but for stacks that are in a row that can have plume enhancement--that's a function of direction and other effects that AERLIFT accounts for--adjustments to plume rise due to their moisture content.

So each of these issues can be addressed by source characterization approaches that improve the hourly emissions input. AISI requests these techniques be acknowledged as viable source characterization options in Appendix W and perhaps the AERMOD implementation guidance document. And my 15 minute buzzer has gone off.

Mr. Bridgers: You did have one more slide, didn't you?

Mr. Paine: Oh, that's just the rest of the---

Mr. Bridgers: (interposing) The supplements.

Mr. Paine: It will be on the web site.

Mr. Bridgers: And I know some of you saw me running about just a minute ago trying to do some stuff over there, and it's proof positive of government bureaucracy. I had to get a contractor to come dial a telephone number. So we once again acknowledge Bob Paine.

Mr. Paine: Thank you. Low wind speed issues have been brought up this morning as important improvements in AERMOD. I've been talking about that for several years. But now we're going to augment the emphasis on the evaluation databases of lower level sources to tall stack databases. And in fact this study has been written up in a technical paper that has been accepted for publication by the *Journal of the Air & Waste Management Association*, so that should appear later this year in print. I would also like to acknowledge the sponsorship on this study to EPRI and the Lignite Energy Council.

I'm going to talk about the background for this study, but I already sort of have. It's basically augmenting the emphasis on lower level sources to tall stacks, a description of the evaluation databases, the modeling options evaluated, and the evaluation results and the overall results and conclusions.

Now, before AERMOD, you know, model input wind speeds were never allowed to go below 1 meter per second. And as part of AERMET, our committee was--thought we could conquer the world, and so we decided to go lower than 1 meter per second. But we are straining the steady state model plume assumptions, which tend to break down as winds go toward calm.

But AERMOD, in any case, does allow arbitrarily low wind speed inputs down to the instrument threshold, which seem to be getting lower and lower these days with ice-free instrumentation and sonic anemometry. So that's another thing that we didn't foresee in the '90s maybe.

So in an attempt to account for this effect with plume meander, it's a random plume and a coherent plume weighting scheme that's shown in this slide, which is borrowed from a Joe Scire presentation a few years ago whereas we have a wind blowing from the south here in this figure and the stack at 0.0 in the center.

And the coherent plume is predicted as the usual Gaussian plume equation and its concentration is usually much higher than the so-called meander or pancake plume, which I believe LowWind3 tends to chop off the bottom half of that pancake such that we look at upwind concentrations. But that's basically--the weighting between these two extremes is what is done by the meander algorithm in AERMOD.

Okay. What did we bring up in our studies from EPRI and UARG in 2010? We realized that friction velocity, which is an important output of AERMET, was underestimated in very low winds by up to a factor of 2. This resulted in several compound issues in stable conditions--an under-prediction of the level of turbulence, the mechanical mixing height, and other related issues were underestimated, which led to too concentrated of a plume in stable conditions. Perhaps even the plume meander weight was possibly under-estimated.

So we recommended changes in both the friction velocity formulation and also recommended a change to the minimum lateral plume spread in the AERMOD dispersion model to help account for the additional meander you would expect in very light winds.

And I think this has already been explained. EPA started to accommodate these changes in various versions listed in the second bullet and finally in this version have come up with recommendations for a final ADJ_U* in AERMET and a LowWind3 option in version 15181. There have been previous webinars, and of course today's presentation has provided basic recommendations to adopt these changes.

I would concur that the proposed changes should be made a permanent part of the model. I also want to advise EPA that due to hundreds of sources being modeled for SO_2 these days, we may not be able to wait until next spring. And we hope that we can get an interim approval process in place for approval of these options now because modeling is happening right now. And it's very critically important to have these improvements accommodated in the model.

And I want to talk now about the findings from tall stacks, which are a critical part of the SO_2 modeling that's being done nationwide. Two databases we looked at: North Dakota Mercer County with rolling terrain, one elevated monitor and five monitors in all, four years of data; and we talked about--I've seen Gibson before. We happened to focus on three specific years with four monitors. It's a tall stack, flat terrain database. Both of these databases use the data from a 10 meter tower to evaluate standard airport-type meteorological input.

We tested four options of AERMET and AERMOD in default mode. This was model version 14134. Then we added the beta U* option, but not any changes to AERMOD. And then we added changes to the minimum sigma-v with the LowWind2 option in the last two options tested with a 0.3 and a 0.5 meter per second minimum sigma-v.

We have produced various statistical tests which are going to be discussed in that *JAMA* paper. And I'm going to only have time really to present the 99th percentile peak daily 1 hour max statistics during the little bit of time I have here. We did Q-Q plots as well as review of meteoro-logical conditions associated with peak predictions that I will mention briefly today.

The key thing on the North Dakota database is the fact that we have these five monitors that are sort of these square pink or purple objects here. One of them is circled in high terrain, the DGC 17 monitor. Sources that were near these monitors were the Antelope Valley station and the Great Plains Synfuels Plant, the red triangles.

The other four monitors were in relatively low terrain, but this one monitor was in higher terrain. Notice that the DGC 16 monitor was the closest to these sources, and it has a little bit of a different response to the models than the other three in low terrain. Backing up, we also modeled more distant sources, maybe more distant than the new guidance would say because these are approaching 50 kilometers away.

Okay. Now I'm going to dwell on this slide for a little while because we take those four modeling options--from left to right, it's default AERMET, default AERMOD. The yellow is AERMET with beta U*, but no sigma-v LowWind2 options. Then we add the sigma-v minimum of 0.3 and 0.5 as the green and the purple bars.

We see that for--DGC 17 is the one that's next to the--second from the right. That shows a large--with that elevated terrain, that shows a large response to the beta U* option. In the other applications in terrain, I've noticed large responses. The other models show--the other monitors show no real response to the beta U* option because the peak predictions are in daytime conditions, but some response to the minimum sigma-v options.

The DGC 16 had a little bit higher overprediction. By the way, let's go back to that. Notice that on the y-axis, all the models are predicting at or above a 1.00 model to monitored ratio. So all overpredicting were nearly unbiased. But we see that adding these low wind options improves the model performance, especially with the beta U* option for the monitor in high terrain. The low wind options--the LowWind2 options result in somewhat incremental performance improvements.

Also, we noticed for that elevated monitor that the meteorological conditions observed for the highest concentrations were more aligned with the predicted conditions when we added that ADJ_U* option because without it, all--almost every high hour was predicted to be at night. But several high hours were predicted to be during the day--were monitored to be during the day. With the ADJ_U* option, the predicted conditions were more in line with the observed conditions for the highest concentrations.

So the overall results from this database were that the AERMOD default predicted the highest--overpredicted substantially at the elevated monitor. The low wind options did improve the performance at all monitors. It turns out that even a minimum sigma-v of 0.5 was still relatively unbiased, did not underpredict.

The other database is Gibson and the monitors are the four monitors with the yellow triangles. This is a very flat terrain, tall stack database. Similar type of appearance of the results here, but we see that with the flat terrain, there is no real response to the ADJ_U*. In fact with Mount Carmel, the beta U* option has a high wind side effect. Sometimes high winds cause the predictions to go up with the ADJ_U* option.

But by and large they were pretty much unaffected by the ADJ_U* option--this is the yellow--and a little bit of an effect with the LowWind2 option. Certainly the low wind options did not do too much to this database, improved it slightly.

So the overall evaluation results again were relative insensitivity to the model performance on the basis of low wind options because the concentrations were predicted and observed during daytime conditions--there will be more about that in the next presentation--relatively insensitive to, you know, anything you do with stable conditions and a little bit of sensitivity to the minimum sigma-v. But since the winds causing the highest concentrations were a little bit too high, higher than those very low wind speeds, not much of an effect. We still had, though, a general overprediction from 10 to 50 percent.

Overall conclusions would be that the--and as I'm going to say at the bottom, we haven't yet conducted or had time to do any further testing on the new release, but as Roger indicated, we would not expect much of a change from what we've seen so far with the LowWind3 option.

Tall stacks would have the lowest effect with these low wind options with high terrain. There's a minor effect only with flat terrain. But the effect in elevated terrain is very profound, especially as you get very high terrain. And so this ADJ_U* option will be extremely important to put into the model and to have it as a default option.

We note that the LowWind3 option only has a minimum sigma-v of 0.3, so the fact that we still didn't get underprediction at 0.5 would mean that the LowWind3 option in version 15181 is likely to be still slightly conservative. The low wind options also improved the consistency of the prediction of the meteorological conditions associated with the highest observed and the highest predicted concen- trations.

So we do believe that the proposed options will result in more accurate AERMOD predictions and we would like to have the ability to use these options very soon in routine modeling assessments. I think that is the last slide. I gave you 45 seconds.

Mr. Bridgers: Thanks, Bob. So once again I'd like to introduce to the podium Bob Paine.

Mr. Paine: Thank you. These are issues related to--maybe it's an issue that people have not been generally aware of, but you can also call this "Beware of the Penetrated Plume." And this work followed from work we did in the previous--the low wind study, but it's also related to other interactions I've had with other investigators, this time Down Under, as you'll see.

I'm going to talk about the overview of the issues: available diagnostic tools that most people don't have access to that have allowed us to find out what's really happening with the predictions in tall stack releases of AERMOD, available model evaluations that have shed more light on why this is an issue of concern, the evaluation results, and conclusions.

Now, we've noted--we've done a lot of modeling applications with tall stacks and we noticed that in many cases the highest one hour predictions--and this is obviously applicable to SO_2, because that's a one hour standard--we keep seeing daytime conditions with low mixing heights and low winds leading to the highest predictions, so that's interesting.

Observations tend to indicate that, well, the peak predictions for tall stacks are expected to be during the daytime, but they're not always during low mixing heights. They're randomly scattered between low and high mixing heights. So why is the model tending to favor just low mixing heights rather than a variety of mixing heights?

We have the ability, and I'm going to show an example, of debugging output from AERMOD that indicated that the cause of these highest predictions is due to plumes that are actually emitted into the stable air aloft initially, but somehow reach the ground within a relatively short distance, maybe 5 kilometers, maybe a little bit more than that.

And that condition is associated with--and I'm going to show an example of the three plume treatment in AERMOD, but the penetrated plume is the plume that is injected into the stable layer aloft. Previously that plume was totally ignored. In the ISC model the prediction of that plume was assumed to be zero.

Now, believe it or not, it's actually controlling the design concentration in AERMOD for tall stack releases in flat terrain. Obviously in complex terrain it's stable conditions, but this is for simple terrain, tall stacks in AERMOD.

This picture I'm sure is from several training figures that have been provided. Imagine here that the top dashed line is the convective mixing height; the lower dashed line is the mechanical mixing height. The direct material is assumed to be material that does not really interact or bump up against the mixing height in convective conditions and it is mixed to the ground directly, no interaction with the mixing lid.

The indirect material does not have enough momentum or buoyancy to penetrate into the stable air aloft, but it hangs up like a balloon on a ceiling against the mixing lid and then eventually mixes down. But the penetrated plume gets up into there and would not really be expected to get down to the ground very rapidly.

Another depiction shows that the model treats these plumes as separate--almost separate releases that has different calculation do loops for--accounting for their impacts but then adds them all together. So the part of the plume above the inversion layer or into the inversion layer is related to the part--you know, the mass that's allocated to the prediction is the total mass emitted times the penetration fraction. And when that penetration fraction gets toward 1.0, that plume becomes very important in the calculation.

Here's just a visualization of what you might envision as a penetrated plume being. It's daytime. The plume goes up and it hits the stable air and it just sort of goes off to the left. It doesn't really mix down to the ground, visually at least in the realm of this picture.

Now, you probably can't see this, but I'm going to point out we have this debugging output that actually comes from a--the bottom indicates we had actually downloaded this version of AERMOD, version 14134, available for download at the EPRI web site where you can get other things like EMVAP. It has a lot of useful debugging information.

The top part that's circled in red is the mechanical and convective mixing height. In this case--I'll just read off the number--the convective mixing height, which is a little higher than the mechanical mixing height, is 256 meters. We have a final plume height--what happens for each hour is that the controlling receptor is listed for each source model, and all sorts of information about what's happening at that receptor is displayed.

We know what the final plume height is. The final plume height is about 355 meters versus a convective mixing height of 256 meters. So the plume gets up to be about 100 meters into the stable air aloft. But the dominant plume is identified as the penetrated plume. We know that because the debugging information polls that it's--is it direct, is it indirect, is it penetrated. The penetrated wins because it has 90 percent of the mass. And that hour turned out to be the highest predicted hour for that whole simulation.

So we can identify with this debugging output what is causing the highest predicted concentrations. That's not usually displayed in the version of AERMOD that comes out of, you know, EPA. This is additional debugging information, but we have lots of evidences of what is happening.

Now, I've been talking over the years with Dr. Ken Rayner of Perth, Australia, who likes to dabble with code. And if he doesn't understand anything about AERMOD, he would dicker with the code and change it. And he was very interested in using AERMOD and CALPUFF and trying to get the best model, and he had observed data from tall stacks and simple terrain. And he had a presentation with a link here that you'll be able to download when you download this whole presentation.

The map here shows that in western Australia there was a source, Muja power station, which is the lowest red dot there, and the Shotts monitor, which is about 8 kilometers from--circled in blue is a monitor where there was a model evaluation conducted, relatively low terrain between the power plant and the monitor.

The Q-Q plot that Dr. Rayner provided shows both the AERMOD with the penetrated plume and then with the penetrated plume disabled because he went into the code and disabled it. He shows about a 50 percent overprediction at that monitor, and with--you know, with obviously the penetrated plume disabled he can show that the difference is such that you need some of the penetrated plume there, but it makes a big difference and it's really the cause of the over-prediction.

So he had comments in his presentation that he believed that AERMOD mixes the plume to the ground too fast because it has to do everything in one hour, whereas a penetrated plume might be looked upon as a multiple hour phenomenon. The plume is injected above the mixing lid, but somehow it gets down to the ground as if it mixes down into the convective mixing layer in the same hour, so is all that just being squeezed by a steady-state model.

The other issue is the mixing height is assumed to be constant, but it's obviously changing within the hour, so that's another issue with a steady state model. There's a lot of constraints here. So he found an overprediction on the order of 50 percent for his case.

Let's go back to Gibson. We did debugging on that too. Isn't it interesting? We're also getting about a 50 percent overprediction due to a penetrated plume for this database--consistency.

So actually, I'm going to finish quickly here. We're seeing at least for these two databases a consistent pattern for AERMOD peak predictions for tall stacks in simple terrain. We can identify with our debugging output--or Ken Rayner can identify with his debugging, his code changes, the penetrated plume is causing it. It may be reaching the ground too fast, and maybe it's due to sigma-z. It's something that would warrant additional EPA review.

Now, Appendix W does indicate in various places that the AERMOD model uncertainty is in the order of 10 to 40 percent. Maybe we can extend that to 50 percent based on this issue. I would say that I would be happy when the model is only 50 percent uncertain because that's well within the factor of 2.

But with these SO_2 NAAQS demonstrations, if you model--if the standard is 196.5 micrograms per cubic meter. If you model 200, is that enough to say that you know there's a violation of the NAAQS? Absolutely not. You could be 50 percent over the NAAQS with your model and not be able to say that you know there's a NAAQS violation, especially if the controlling concentration is caused by this issue.

We hope to be able to review the new model to see if this issue is still present, but I just wanted to alert the user community to this issue with AERMOD. And that's--okay, I'm done.

Mr. Bridgers: Well, Bob, you've got 3 more minutes if you---

Mr. Paine: (interposing) That's okay.

Mr. Bridgers: So at this point I'm going to call to the podium Richard Hamel, not Bob Paine. And so, Rich, if you'll identify yourself, you're good to go here.

Mr. Hamel: I have to wait till I see the first second tick off, okay. I'm not Bob Paine, but I am wearing the same shirt today. But I am Rich Hamel. I'm a senior air dispersion modeler at Environmental Resources Management or ERM in the Boston office.

And what I'd like to talk to today is the proposed move to ARM2 as the Tier 2 method for refining the NO_x to NO_2 conversion in AERMOD and take it with a bit of practical approach to what does it really give us when we are trying to model compliance, not only with the NAAQS, but also hoping to get a model result that would have our impacts below the significant impact level so we don't have to do cumulative modeling.

Okay. So I'm going to talk about a quick overview of the old--ARM and the old ARM2, which is really the ARM2 with a minimum NO_2 to NO_x ratio of 0.2, a little bit about ARM2 in the proposed revision, a comparison of the Tier 2 and Tier 3 options for NO_2 conversion, what are some of the benefits or changes in the proposed ARM2, what are some of the issues, and then just a quick word about Tier 3.

And you can see there the molecule for NO_2 and the chemical bar equation, ONO, or as we all said the first time we tried to model an emergency generator against the new NO_2 standard and saw the results, "Oh, no."

EPA allows us three different tiers. We know this from our NO_x modeling experience. Tier 1 is just assuming the full conversion of NO_x to NO_2 through modeling. Tier 2 is the ambient ratio method based on analysis of ambient monitoring data. That's the old ARM and ARM2, and then, of course, Tier 3, which is refinement based on the oxidation of nitrogen oxide by ozone to NO_2, and that's the OLM and PVMRM methods by the formula that you see there below.

Where did ARM originally come from? Originally it was designed outside the realm of air dispersion modeling and there was a decent amount of study done. But when annual NO_2 modeling came around, the 90th percentile of the average annual NO_2 to NO_x monitoring data, as it was known at the time, was used and that established a ratio of 0.75. When the 1 hour NO_2 NAAQS came around, that wasn't considered a conservative enough representation for short term modeling. So the ARM ratio was set to 0.8.

So enter ARM2. Mark Podrez in 2013 working for API did a study of all of the NO_2 monitors in the United States and some elsewhere, which amounted to 580 monitors, looking at ten years' worth of data from 2000 to 2010, which gave a data set of over 5,000,000 hours to look at and the ambient ratios of NO_2 to NO_x. Based on that data, he developed a 6th order polynomial curve and found that this curve fairly consistently matched the ratio of NO_2 to NO_x, based on the amount of NO_x in the ambient air.

So it was really designed as a simpler alternative to Tier 3 refinements, a way to get a Tier 3-like effect with a little more conservatism than OLM or PVMRM without having to deal with the whole issue of finding in-stack ratio, documentation for each of your sources, background ozone data, and things like that, of course the advantage being there are no additional inputs needed. You simply have a look-up table against the curve at each of your receptors at each of the hours. It would run faster than the Tier 3 refinements and also wouldn't require case by case approval, meaning not only less time to process, but less time to review.

And this is the original ARM2 curve against all of the hours that were posted. And you can see that the curve for the most part contains all of the hours that were looked at during the study with some outliers at the top and results in ambient ratios anywhere from less than 0.1 at very high NO_x concentrations of 600 ppb and above, all the way up to a 1 to 1 ratio, and this is in very low cases, although there was also some documentation that some of those cases were very specific situations that caused such a close conversion.

So ARM for AERMOD was added as a beta option in version 12345 with an upper limit of 0.9 and a lower limit of 0.2, although those could also be set manually--those are the defaults--required a case by case approval for use in permit modeling.

And the EPA webinar last year around the release of AERMOD version 14134 recommended that if your Tier 1 modeling results were less than 150 to 200 ppb, then the use of ARM2 should be expedited in terms of the approval process. If you had initial results higher than that, then a study of the in-stack ratios of the sources being considered was required. And also, special consideration was given to higher thresholds in situations where background NO_2 was very high or if background ozone layers were very high, although what exactly constituted high was not really clearly defined.

So old ARM2 versus Tier 3 OLM and PVMRM--and remember, again, that Mark Podrez' research is really sort of based around a comparison of those aspects. He used sensitivity modeling around the 2004 MACTEC report for single and cumulative source scenarios and expanded upon those and found that at low concentrations--and now we're talking in terms of micrograms per cubic meters--ARM2, OLM, and PVMRM all predicted NO_2 to NO_x ratios around 0.9.

At the higher impact levels, greater than 300 micrograms per cubic meter, all of the different methods had ratios between 0.2 and 0.4, and ARM2 was consistently a little more conservative than the other two.

At some very high impacts, it was found that PVMRM occasionally had ratios higher than ARM2, and that may have been because of a formulation error that would have been identified and will be addressed with the updated PVMRM2.

So updating the ARM2 development report. For a project that we're doing and we're seeking approval of the ARM2 method for refinement, which just happens to be the one that George was talking about in terms of the Model Clearinghouse, an additional analysis sort of extending what Mark had done in the original ARM2 research was undertaken.

All monitors in the United States were looked at between 2001 and 2012 with a focus on monitors that were similar to the project site, which was a rural-ish project site, so some of the urban monitors were removed. The resulting data set still gad more than 4,000,000 data points and the number of observations increased as the years go on. You can see that in 2001 there were less than half as many as there were in 2009 (sic).

Ultimately, ARM2 was approved. It did get through the Model Clearinghouse very quickly once it got there, but it took nearly a year to get the data and a lot of back and forth with the regulating agencies to get that all put together, ultimately with a minimum NO_2 to NO_x ratio of 0.54, which as it turned out is higher than the recommended for the proposed default now. So if we had waited a year, we could have gotten it a little lower apparently.

Here are some of the observed data points from that research. These are color coded by groups of hours. Because the hours were densely packed, it wasn't possible to put a single dash for every hour, so the colored hours are groups of hours.

And you can see that if we look at the data in three year blocks, from 2001 to 2004, the data mostly fit the curve, the ARM curve being the red line that goes down across to the right. And there were some outlying hours above the curve all the way from 100 to 600 micrograms per cubic meter.

Moving to the next three years, we see roughly the same pattern, although the outliers tend have fallen a bit farther down towards the curve. And looking at the most recent four years, you see that not only have most of the outliers fallen out, but the general curve now appears to even perhaps be a little conservative compared to the predominant amount of observed hours.

The proposed revisions would replace the old ARM, which was, again, 0.8 in the modified version of ARM2. And it's not really a modification of the curve. The modification is that the new ARM2 would have a default of 0.5 instead of 0.2, which is really tied into the Tier 3 refinements that use 0.5 as your standard in-stack ratio.

And a review of the current EPA in-stack ratio database, which has 2,323 entries, show that of those entries about 4.5 percent have in-stack ratios greater than 0.5, about 23 percent have those greater than 0.2, and then the other 77 percent are below 0.2. So the 0.5 is really protective of just about every--or a very high percentage of the in-stack ratios that are found in the database, 95 percent in fact.

So one of the things I want to do is look at, well, if I'm modeling this, what does this really mean to me? So I considered a concept of compliance ranges, meaning if I get a certain NO_x concentration--or what NO_x concentration do I need that's greater than the standard of 188 micrograms per cubic meter that actually would fall into a range where the conversion would put me below 188 and therefore in compliance when I don't consider ambient background or other sources and stuff like that.

So the old ARM, using the 0.8 conversion, would give you a result--if your model concentration landed from 189 to 235, you end up with a number below 188. The proposed ARM2 improves on that, moving the compliance range up to 376, which again is an improvement over the old ARM in that way compared to the current ARM or the beta ARM2 of 0.2. You can see that the compliance range was actually much higher, all the way up to 940, because up at that point you're getting an in-stack ratio of 0.2, or a conversion ratio of 0.2, so quite a difference.

So what are some of the issues, however? Well, ARM2 sometimes provides higher results than the old ARM did simply because the curve exceeds 0.8 anytime your NO_x concentration is greater than--or sorry, less than 149 micrograms per cubic meter. Now, you're already below the standard at that point, but again, that's not considering ambient background. And if you have an ambient background that's up in the range of 50 micrograms per cubic meter, this can be significant. You may find compliance using ARM, but not find it using ARM2.

The same problem or issue--I won't call it problem necessarily--when considering SIL modeling where an NO_x concentration, for example, of 9.4 if you're using ARM, gets you to the 7.5 SIL, whereas a NO_x concentration of 8.4 would be over the SIL using ARM2 because the conversion ratio would be higher than 0.8.

Now, you are allowed in theory to ask for a lower minimum ratio with your ARM2, but there are some problems there that actually might make it more difficult to gain approval than getting in-stack ratios approved for Tier 3. And the issue there is with Tier 3, you deal on a stack by stack basis. So if you have ten sources of varying kinds, you can negotiate an in-stack ratio on each of those sources.

It's unclear based on ARM2 how you would negotiate a lower minimum when you may have several different sources--one has a 0.2, one has a 0.1, one has a 0.5--different operating characteristics, different percentages of the overall emissions. So it's unclear exactly where that goes.

Because I'm running out of time, I'm going to just skip the quick summary of the Tier 3 message and go to the conclusions. So again, ARM2 was originally conceived as a simpler alternative to a Tier 3, but that's no longer the case. That was really a replacement for the ARM method.

You have a greater compliance range than ARM did, but less than the beta version does. In some cases--with 30 seconds to go--ARM provides better refinement or more refinement than ARM2 did when you're modeling against the SIL. And then there are questions as to how does one justify a lower minimum in the case of a site with a variety of sources.

And we see that the ambient NO_2 to NO_x curve seems to be decreasing, either based on less ambient ozone or other factors or maybe because we removed the urban monitors. So the question is does that need to be updated at every certain amount of time or perhaps a study done between an urban curve and a rural curve. And that will be it. Thank you for your time.

Mr. Bridgers: Rich, I was actually going to give you a couple of extra seconds because of the computer snafu.

(Pause.)

Our apologies, a technical issue with Microsoft Office. It decided to make my screen twice as large, and it's not simple to make it the same.

(Pause.)

So with the technical snafu partially fixed, Cathe is going to actually talk from her slides here up there, so Cathe, the podium is yours.

Ms. Kalisz: Good afternoon, everyone. I'm Cathe Kalisz with the American Petroleum Institute or API. And this presentation provides an overview of some ongoing API work that's looking at AERMOD with an alternate NO_x chemistry scheme, an alternate to the Tier 3 NO_2 options.

So the chemistry scheme that we're using comes from the Atmospheric Dispersion Modeling System or ADMS. Some of you may be familiar with it. I think Chris referenced it in one of his presentations. And it's commonly used in Europe.

This work was prompted by a modeling study by one of our API member companies who wanted to compare the NO_2 performance of the ADMS model and AERMOD. And the results of that study suggested that ADMS chemistry might have better predictive skill than the NO_2 options in AERMOD, and so that prompted this project.

So what you'll see on the slides in this presentation compare--when I say the current version of AERMOD, I'm talking about 14134 that's been coded with an ADMS chemistry option and then we're comparing those to the

Tier 3 option. And so we will be updating these evaluations to look at new AERMOD 15181 and the new PVMRM2.

So this is some basic information about the ADMS chemistry module that we're using. The work that we've done uses what's referred to as the standard ADMS module, a little bit more about that in a minute. So for inputs you have your basic source emission rates, but you're also inputting the background values for NO_2 and ozone.

And so the model works by calculating the NO_x and NO_2 concentrations at the receptors, and then it also calculates at each receptor the weighted, by the source contribution, mean travel time of the pollutant. And it adds the background concentrations and then applies the two chemical reactions that you see over the mean travel time.

So with respect to chemistry, the two key differences between the ADMS chemistry module and the Tier 3 options are that it includes reactions for both NO ozone titration and NO_2 photolysis. And it also accounts for chemical reaction rates.

I was asked by someone, you know, do you see any difference in model run times with this, and I guess this is qualified that for the work we've done thus far there's been no appreciable difference in the run time. However, we haven't tested it with a data set that has hundreds of sources, so that may change as we do more work.

This is just a further comparison of the ADMS and the AERMOD options. We've talked about the chemistry. One other thing I'll point out, that with respect to ozone entrainment, ADMS has the standard version that we're using and then there's also a dilution and entrainment option. So the standard ADMS works like OLM, and that's what we used for the work you're going to see.

So in our evaluations we used five data sets. Everyone is probably familiar with the first three: the Palaau and the Empire Abo North and South data sets. We also included Wainwright. That was a small power plant on the Alaskan North Slope and then Prudhoe Bay, which was a drilling operation in Prudhoe Bay.

One adjustment that our consultant did make for Empire Abo and Palaau is after looking at the observations for the data decided to adjust the in-stack ratios from 0.2 to 0.1 because it appeared to be more representative.

So these next series of slides--and I tried to cram a lot of information on them, given the ten minutes. So for each one you'll see in the lower right-hand corner there's a summary of the model versus observed results for AERMOD NO_x and for the three NO_2 options. In the right-hand corner you'll see a correlation coefficient between the observed and modeled NO_2 to NO_x ambient ratios and then of course the Q-Q plots for NO_2.

So if you're looking at Palaau, ADMS, and PVMRM, you know, pretty similar in results. OLM has got higher predicted concentrations. If you look at the correlation for the ambient ratios, very good for PVMRM and ADMS. Unfortunately, they only go downhill from here, at least for the ratios.

Here is Empire Abo North, again, you know, all three options pretty much the same. PVMRM as you get to higher concentrations is overpredicting. If you look at the correlation, they're all positive. ADMS is the highest one there.

Here is Empire Abo South. And again, ADMS and OLM look about the same. PVMRM is a lot higher, although if you look in NO_2 technical support document, PVMRM2 has definitely made a difference in what you'll see here; also noted that for the ratio correlation PVMRM is negative.

This is Wainwright. With respect to the Q-Q plots, the PVMRM looks to be the best performer, although, you know, again, a negative correlation on the ambient ratio was calculated.

And lastly, Prudhoe Bay. One thing I'll mention is because the model was significantly underpredicting AERMOD for NO_x, we're not sure, you know, how much you can compare these various options. We're not sure if this large difference for AERMOD was due to the fact that the monitor was very close to the source or the drilling structures weren't characterized, but a definitive difference.

Here's just a summary of the comparisons for the five data sets. So for OLM, generally overpredicts the NO_2 concentrations, had the lowest proportion of values within a factor of 2. The ratio correlations were generally poor.

For PVMRM, it had the best mean NO_2 concentration, had a reasonably high proportion of values within a factor of 2. However, the ambient ratio correlations were generally poor, and you had--I guess it was three out of the five data sets you had a negative correlation.

For the ADMS module, again, it generally over-predicts the NO_2 concentration. It had a reasonably high proportion of values within a factor of 2. Although they weren't the best, they did show the most consistent performance considering the correlation for the NO_2/NO_x ratios.

As part of the effort thus far, we also did some sensitivity modeling using a single source 12½ meter stack and looked at various met conditions. I've just provided one example here. This is for near-field NO_2 concentrations, stable early morning, moderate wind speeds. And you can see in the upper graph the NO_2 concentration. The ADMS and OLM are practically on top of each other and PVMRM is much higher predicted NO_2. And yes, I won't even talk about the ratio part, which looks even weirder.

What our consultant decided to do for fun was to take the inputs for this sensitivity run and put them in AERMOD 15181, and the results for PVMRM2 were similar. So this is definitely a scenario that we'll look at in our continuing work.

So these are the planned next steps for this work. We'll be adding the ADMS chemistry code into AERMOD 15181 and then we'll rerun the evaluations. We'll also do some additional sensitivity testing using single and multisource scenarios.

We're hopeful that we'll have--be able to do some evaluations using NO_2 data sets that come from a WRAP study. These are for drilling sites in Colorado and Alaska. These are probably the first data sets we have that have much more accurate emissions because for both of these studies, there were CEMS on the engines and the boiler stacks.

And then, lastly, a new task that--or the developer is going to consider making further modifications to their standard ADMS chemistry module to perhaps use a more simplified version of the ADMS dilution and entrainment module, maybe drawing on some of the parameters from PVMRM2.

And so in closing, I would just want to note that for this model development work and for the other development work that we've heard about and that we'll hear about during this conference, I think it's very important that we have a process or a structure that provides for timely testing and implementation of model improvements.

Mr. Bridgers: Thank you, Cathe, and thank you for dealing with the technical snafu here. I will let Bart identify himself, and this one should look pretty normal so you should be able to see it, I hope. It's all yours.

Mr. Brashers: Hello, everyone. I'm Bart Brashers from Ramboll Environ. It used to be Environ before the recent merger. I've been the developer and keeper of the MMIF code for a couple of years now, since I think just after version 1 came out. And I should acknowledge my co-authors here, Ralph and Jason, who are both in the audience here, so you can go ask them questions afterwards. Here's a little bit of a show of the complex terrain that we're going to talk about today.

So switching gears completely and probably one of the--maybe one of the less controversial parts of the changes are this use of prognostic or numerical weather prediction code to drive AERMOD. So I thought I would give you the quick 30 second introduction to MMIF.

The Mesoscale Model Interface Program takes numerical weather prediction models like the weather research and forecasting model and its predecessor, MM5, converts their output to feed dispersion models, in historical order

CALPUFF, AERMOD, and SCICHEM. We're going to talk about AERMOD today.

MMIF supports AERMOD in three ways. You can go in the direct mode or AERMOD mode. I like to think of it as what's the model you're going to run next. AERMOD mode, you run WRF, you run MMIF, and it outputs the profile and service files, the PFL and SFC files, directly and you run AERMOD and you're done.

In AERMET mode you run MMIF and it outputs an on-site data file. You don't have to use a surface pathway at all. And then you run it through AERMET and then you run AERMOD. And it also supports up here--you can barely see it with this screen--in AERCOARE mode. It's nicely grayed out because that's for over water use and we're not going to talk about that today.

Here's the situation. It's the Monongahela River Valley in Allegheny County, southeast of Pittsburgh, Pennsylvania. There are several sources of SO_2 in the area. Mostly they put the industrial sources near the valley floor.

At Liberty High School up on the ridge on the hill there is an SO_2 monitor and has measured a number of SO_2 exceedances and NAAQS violations. So there's been a nonattainment area designated and where SIP revision is required. And Allegheny County came to us and asked us to help them out back when we were Environ.

So we had already done some initial work that looked like traditional AERMET with the station at Liberty, which has a met station as well with the closest airport as backup. It was not producing very accurate results, so we thought we would do a model shoot-out, throw all the models that we can at them and hope for a clear winner. So we're not going to talk today about SCICHEM or CALPUFF. And again, there's CALWRF, CALMET, and CALPUFF in the available there.

But we can run the observations through AERMET and into AERMOD or you can run via the WRF pathway through MMIF either directly to AERMOD or through AERMET. So that's a lot of potential options.

So we ran WRF for them. We ran five nested domains, started out with the 36 kilometer domain, which almost everybody who does CMAQ or CAM_x work uses that same projection, and nested down 3 to 1 ratios all the way down to 1.33 kilometers and 444 meters, which is the red box you see here. The usable domain, fortunately, is the blue box, which fully spans the nonattainment area in bright green and their sources.

There are a few sources that were outside of the nonattainment area. This one up here in Pittsburgh, which is actually outside of the usable part of the domain, screened out, so we didn't have to worry about it.

We ran a little pilot project for about a month.

It looked good, so we ran a production year of one year of WRF data to do the model shoot-out. And while we were doing that, we kept running WRF, so we have a three year period now to play with.

Here is the WRF terrain for that innermost 444 meter domain. You can see WRF for numerical reasons has to smooth the terrain. But even in WRF's terrain here, you can see there's places, several places along in here, where the contour lines here are very close together. It's pretty steep. The difference between elevation between the valley floor and the tops of these crests here is around 130 meters. So it's not quite the Rocky Mountains, but because of the short distances, it's kind of getting close to complex terrain.

We can zoom in a little bit here on the two meteorological sites, observation sites. There's the Liberty monitor up there on the hill and the met station is very close to it. And you can--here's the regional county airport up there on the plateau also. And you can kind of guess by the direction of the landing strips that the predominant wind direction is sort of perpendicular to this valley here.

You can also see two of the sites, two of the sources. And each of these square black boxes is a 444 meter WRF grid cell. So it's about three or so cells that are across the flat part of the bottom of the valley and maybe five, if you think of it from crest to crest. So I had great hopes that this would resolve the terrain reasonably well.

So the key features of our approach, we started out with--we put a receptor at the SO_2 site and then we put rings of receptors at 100 meter increments up to 500 meters radius around it. That was both so that we could see if there was any gradient in the area of the receptor and borrowing from the kind of CMAQ and CAM_x style model evaluations, we often allow for a slight miss. You pick a receptor nearby that has a higher value and pick the max within--near the site so that you're taking an observation and allowing for a slight miss in space.

Probably the most interesting feature of our approach here was that we had this valley with more than half a dozen, around ten or so, sites up and down the valley at different orientations. And rather than using one meteoro-logical data set for all of them, we pretended, by using MMIF, that each site had its own met tower. So we did a MMIF extraction at each site, every one of them, and then you run AERMOD for each site and output to POSTFILEs for the same receptor set, add them up, and do your statistics afterwards.

We did both hourly statistics--and again, I was thinking borrowing from the kind of CMAQ style evaluations where you often allow for a slight miss in time, kind of analogous to a slight miss in space, taking the nearest highest receptor. But rather than just missing by an hour or two, we decided to take the max daily statistic because that's what the max is actually based on anyway.

And then we did the whole lot of sensitivity runs. The most interesting ones that we're going to talk about today are these three questions, how tall of a met tower do you need? Are we going to emulate a 10 meter tower like you would find at a National Weather Service site, an airport, where the profile file just contains one or two layers.

Are we going to emulate a tall, multilevel tower? We started out with the ten levels that are the default for the FLM CALPUFF levels that were the default in MMIF and they still are. And we subtracted a few levels, we added a few levels, saw if that made a difference.

We ended up with 17 levels, kind of going back to the original philosophy of MMIF, which was don't mess with the met, just pass it straight through. So we took the native WRF levels as close as we can, all of the levels up to 250 meters, and just passed them straight through.

We have not yet run the MMIF guidance levels, which is pretending that you have a multi-instrumented 5 kilometer tall tower. That's more information; right? The more information you feed AERMOD, the better it gets.

The next question we answered is about domain resolution--I only looked at the four smallest domains--and then some talk about mixing heights.

But you end up with a whole lot of data. And rather than going all the way though the Cox-Tikvart methodology to the final protocol to the final hot spots, I looked at the original numbers. I don't know if you guys can all read this there in back. Yeah? Okay. I got a thumbs up in the back row.

So I color coded them all. Green is good. Red and blue are underprediction and overprediction in a--sort of bias-like statistics. And red is bad in a--like an error style statistic. So we were hoping that one of these would pop out to be all green and we'd be all good.

I think that you could conclude from this that there are some clear losers, but there's not any clear winners. There's no lines here that have all green. So we can look a little bit more closely at just a few of them here--moderately legible. I was worried about this slide.

So here at the top line we have the observations. The 99th percentile--we added some other statistics that are not part of the Cox-Tikvart set, but the 99th percentile for the year was 257 micrograms per cubic meter. There were five exceedances. And then the rest of Cox-Tikvart statistics--I could flip it down to 2 here. A lot of people like the robust highest concentration. It was 243 micrograms per cubic meter.

And then the top line is traditional AERMET with AERMOD, so this is using the Liberty site through the on-site pathway and the regional airport for the surface pathway. And you can see the 99th percentile is grossly under-predicted. It didn't predict any NAAQS exceedances. The rest of the statistics are all not horrible, but the robust highest concentration really pops out there. So you can't say that AERMOD--traditional AERMOD didn't do particularly well.

The next two lines we have MMIF in AERMET mode first and then two lines of MMIF in AERMOD mode, first with the 10 meter tower and then with the 250 meter tower. So if you really like the coefficient determination and maybe the fractional gross error and the geometric correlation coefficient down here, then I think you can conclude that the tall towers did better than the short towers.

But if you look at the number of--the 99th percentile, it's a little bit higher with the towers, but there are more exceedances with the short--I'm sorry. There's more exceedances with AERMET than there are with AERMOD. And the towers did slightly better, but very slight, I think, with the 99th percentile. And down here at the robust highest concentration, the shorter towers did better, so kind of a mixed take-away here.

I don't think that you can say that the tall tower or the short tower did particularly better or worse, and I don't think you can say that the AERMET versus AERMOD mode produced very much difference. Maybe there's a slight preference towards AERMET mode and a slight preference towards taller towers.

We can look at the Q-Q plots and don't worry about the numbers there. The only thing you should know is that these are in log Q-Q plots, so the factor of 2 is a straight line. And you can see that traditional AERMET grossly underpredicted the high end of the concentration and most of the low end of the concentration. It's in the mid range.

Here are the Q-Q plots for--on the left MMIF in AERMOD mode, on the right MMIF in AERMET mode. On the top is the 10 meter towers and on the bottom is the 250 meter towers. Looking on the left here, the AERMOD mode did pretty good. It had a little bit of a dropoff near the top. And by using the tall tower, it produced worse results throughout the whole spectrum of concentrations and actually made everything a little bit worse--not horrible, but a little bit worse. For AERMET mode, going from the short tower to the tall tower didn't really affect most of the concentrations. But up here at the high end it produced lower values.

Moving on to the WRF resolution, here we have the obs again at the top, traditional AERMET, the line below that, and then sets of three, 444 meters, 1.3 kilometers, and

4 kilometers, for MMIF in AERMET mode with the short towers, MMIF in AERMET with the tall towers, MMIF in AERMOD with the short towers and MMIF in AERMOD mode with the tall towers, and immediately what drops out at you is that the 4 kilometer did horrible. There's lots of red in all the 4 kilometers.

Mr. Bridgers: If you want to summarize---

Mr. Brashers: I'll hurry it up here. So 4 kilometers was too close. The number of exceedances is really awesome for the 1.3 kilometer. It did very much better. And the robust highest concentrations did very well as well.

Can I actually have the 4 minutes that we got from the previous speaker? This is one of the more interesting parts, I think. There's three---

Mr. Bridgers: (interposing) Take two and---

Mr. Brashers: (interposing) Two, okay.

Mr. Bridgers: ---then post it on the web.

Mr. Brashers: So WRF produces PBL height. It's quantized. Each PBL scheme decides its own definition of PBL height. There's no common method. So MMIF rediagnoses it, and then of course there's AERMET's model for the next height.

Here's WRF on the y-axis and AERMET on the x-axis and you can see the quantization there. So on the Q-Q plots it's still okay, kind of a tendency for underprediction low and overprediction high. And this is for the mechanical mixing heights, general overprediction by WRF.

This is MMIFs and they're doing--the general shape is a lot better. There's a tendency toward underpredicts, mostly because there's a cluster of points here where MMIF--sorry, AERMET and WRF disagree about the science of the stability. And here is the mechanical mixing heights. The Q-Q plot looks great, but that's just because it's equally horribly distributed down here at the bottom. You can look at this afterwards, but there's very little difference between any of it. They're all the same color; right?

So for the annual distribution these mixing heights just didn't make very much difference. I think for individual hours it makes a lot of difference what the mixing height is, but in this case, using the different sources of mixing height didn't make much difference.

So conclusions for the Liberty site, MMIF and AERMOD give results on par, maybe a little bit better, than traditional AERMOD. A tall tower is not necessarily better than a short tower. Finer WRF resolution didn't actually give us better results. The 444 meter was not better than the 1.3.

Using too coarse for this situation definitely resulted in poorer concentrations, lower maximum concentrations. So that was too low. Using WRF, MMIF, and

AERMET mixing heights gave a similar statistical performance over an annual SO_2 distribution. MMIF and AERMET and AERMOD modes, we get really similar results. So the parting shots are maybe we should look at that.

The MMIF guidance says that this AERMET mode and AERMOD mode are the same. There are some people in this room who would really like a little bit more help in the guidance to say that we could use AERMOD mode in locations, like say over the water, where AERMET is not applicable. And then we should probably talk about the PBL recalc settings and maybe even look a little bit more at what it does. Thank you.

Mr. Bridgers: I appreciate that, Bart. Just to say in passing--I'm not trying to be rude and I understand typically in our conferences we let presentations run over and adjust things, but just the public hearing nature of the rulemaking, so I'm trying to respect that.

So the last presentation before the break, Tom here is going to present on some more WRF/MMIF experiences.

Mr. Wickstrom: Hi, all. I'm Tom Wickstrom with ERM and I am from ERM's Philadelphia, PA office. I'm going to talk a little bit about some recent experience we've had using WRF, kind of off the beaten path application of WRF. And I'm also going to talk about MMIF, specifically the recent proposal in Appendix W.

So our recent experience has shown that the WRF model can be useful as an illustrative aid for discussions on meteorological data representativeness as it applies to permitting applications. I'm going to give you an example of a recent AERMOD application where the met data representa-tiveness discussion was really enhanced by using WRF data as an illustrative tool.

I'm also going to talk about EPA's proposed changes to Appendix W that includes the use of WRF or MM5 meteorological models as the source of the input meteoro-logical data into a regulatory application of AERMOD. And I'm going to ask the question that I had when I read Appendix W: could we have used WRF/MMIF for this previous application that we had and get similar model design values compared to use of an off-site MET tower.

I'll spend a few moments here looking at our application site. We have here a very wide view. You can tell by the scale; that's 25 kilometers there. But the isopleths here are colored, so anything that is orange, red, purple, black, or yellow, that's all intermediate and complex terrain.

And we have the project site there. That's a 1 kilometer radius drawn around the project site. You can see in very close proximity there's some complex terrain, particularly a purple ridge running from the southwest to northeast just a few kilometers to the northwest of the site.

And we also note that we have a 60 meter meteoro- logical tower in the nearby vicinity of this site. And that was very fortunate because we can see here the nearest National Weather Service sites and airports were considerably far away. We're talking about 50, 60 kilometers for both of them to the northeast and to the southwest. Considering the complex terrain and the situation, we felt that that would be a long row to hoe to justify the use of those distant met data sites given the setting.

So yes, it's difficult to justify the use of those distant airports for this particular site. And there happens to be a continuously operating and maintained tall meteoro- logical tower located just 2.8 kilometers from the application site.

We still had a need to justify the use of that tall tower despite its close proximity due to the close terrain influences, so we decided to look at WRF to get a better understanding of the local wind patterns due to complex terrain.

We ran WRF at a 1.3 kilometer resolution for this analysis. And at the time we used one year of met data because it was convenient to us at that time. It happened to be the year 2005. There's no rhyme or reason why, but it's just the year that we had readily available for this application.

So let's start looking at some WRF outputs here. These are windroses derived from WRF at each node. So they're at 1.3 kilometer resolution and 1.3 kilometer spacing from each other. And these isopleths--these are the same color scheme that was in that large figure, so orange and red, purple up at the northwest there. That's all starting to get into high terrain.

Now, this is at the 60 meter level. We can see in the central part going to the north there's low lying regions where the tall tower is. We see slightly lower wind speed when compared to the elevated terrain. That's, you know, pretty expected. But overall we're looking at a very similar directional distribution of winds.

So if we start going up in the atmosphere in WRF, now what do we see? We see the directional comparability between all these modes start to really come together. We still see, you know, slightly higher wind speeds in the upper terrain areas as opposed to the lower, but even that is starting to converge. And then when we zoom out and up in the atmosphere up to nearly 500 meters, now we're essentially looking at the same windrose at each WRF node for that year, 2005.

So we're trying to determine what level really is important to us in this application site, so we used the AERMOD debug output. We wrote a little program to compile different plume rise statistics and we grouped them by hour of day. And you can see here these little symbols are frequency bins. The plus and the diamond, those are the most frequent occurrences, so generally speaking, over the course of the day, plume rise in the main source at this project site is between 200 and maybe 320 meters. So that's really our level in the atmosphere where we need to really focus on.

Let's quickly look at a direct comparison of the tower observations for 2005 versus WRF observations--the WRF generated wind data in 2005. So on the left is the tower windrose and on the right is the WRF windrose. Obviously they're not the same windrose. You can see there's some artifacts in the tower, particularly that northeast artifact. That's probably due to drainage flow of some kind. It's not well realized at the 1.3 kilometer resolution of WRF. Perhaps if we went down to 444 meters, the next nesting model, we could have started to draw that out, but we didn't end up doing that.

Regardless, the average speeds here we felt were pretty comparable. The tower has an average wind speed of 3.4 meters per second at this level and the WRF model is generating an average wind speed of 3.7.

So our conclusions on the met representativeness discussion where we used this WRF run to really supplement, at the 240 meter level, WRF shows a consistent windrose pattern across the study area. And we identified that 240 meter level as an important one in the application due to the expected modeled plume heights that it showed in that frequency by hour of day plot.

Also, we can comment that the wind pattern in the immediate vicinity of the tower and the application site is similar at 60 meters. As we saw in that previous slide, the average wind speed is slightly less at the tower site. And the tower observed wind speeds themselves are generally biased slightly lower than WRF.

So our overall conclusion here was that there was acceptable directional representativeness, slightly lower tower wind speeds, and those wind speeds will be conservative when they are extrapolated to plume height by AERMOD. So we took five years, the five most recent years of tower data, at a 10 meter and 60 meter multilevel tower. And the end result was we had a successful air quality modeling analysis using those data.

So switching gears again, with the advent of the new proposal for Appendix W from July 30th or whenever it was, we wanted to take a look at actually running MMIF as proposed in Appendix W for this site. And I just want to note some of the language included in the proposal, specifically talking about cost prohibitiveness or infeasibility being a trigger for when you can use the prognostic data. Let's talk a little bit about that.

For the sake or argument, if we assume that that nearby tower data wasn't available, could we have used MMIF and WRF to generate the meteorological data for AERMOD? So we know we had questionable representativeness of the distant airport met data sets. And this particular application likely could not have accepted a 16 month or so delay for a meteorological monitoring program.

Now, on-site met monitoring for this site would likely have included a tall tower at 60 meters, likely 100 meters, a SODAR, and then the time to acquire all that instrumentation, time to construct it, time to compile the monitoring protocol, a minimum of 12 months of actual met data that needs to be collected, and of course that met data has to meet all the completeness requirements.

And there's a lot of time that has to go into a met monitoring program beyond just that 12 months. Things can happen over the course of the monitoring that can delay things, and SODARs are particularly susceptible to vandalism. Just things like that can really ruin your day when you're trying to collect a year's worth of met data.

So what we did was we executed MMIF 3.2 following the EPA July 2015 guidance. What we're doing here is to take a quick look, an initial impression. We're not doing a full model evaluation. You know, we did this, you know, in the weeks leading up to this conference.

And I just want to point out that the tower data isn't site specific, but it is a high quality, multilevel data set. It's not a National Weather Service site. So I just want to point out that the data that we're looking to compare to WRF is of higher resolution than we can find at a National Weather Service site because there's more than one level. And the instrumentation itself is, you know, of real high quality.

So we used 2005 again because that's what we have WRF data for. And we also have tower data all the way back to 2005, so we have a nice year to year comparison here. The model results that I'm about to show you are based on an actual application that went through permitting, but these results themselves are for a theoretical project at the same site.

So here's a plot of the model design value for NO_2, and this is using WRF/MMIF data. It's very hard to see, but the project site is in the southeast corner there. And the high concentrations are occurring on a complex terrain ridge just to the northwest. And that's really the extent of most of our elevated concentrations. And this is, you know, typical complex terrain, stable conditions causing the elevated concentrations.

We're comparing this now to the tower data for the same time period. And we can see that the maximum concentrations are occurring at that same piece of the ridge on the right-hand side of the slide there. We can see a little bit more than what's realized from the WRF data along the grid as it goes off to the southwest. And the design values--I forgot to note that the previous design value for MMIF was 89.5 and this design value is 91.75. So we're getting extremely similar results.

Let's take a little bit closer look here. We have source by source at the project site how do results compare from the two data sets. And I have the high first high and the high 8 high design values shown.

So you can see that between high first high and high 8 high for source 1, that's the main source. It's a tall stack, you know, very high flow. All of its impacts are very episodic in complex terrain. Once you get to the more stable design value, there's a big step off there for the design value in the high first high, not so for the ancillary equipment. Those are much more stable and much more--extremely comparable between the two data sets.

But even for the main source between the two data sets, we have good comparability, at least from this initial exercise here, you know, 32 versus 35.8 micrograms per meter cubed. So our initial observations seem to suggest that there's reasonable comparability between the two data sets.

So our initial conclusions and some comments here, we feel that utilizing WRF and MMIF as a source of meteorological data for AERMOD for this application shows similar model results compared to representative multilevel observation of meteorological data.

If no observational meteorological data were available, finding representative airport data would have been challenging. And use of WRF/MMIF as suggested by the new Appendix W could possibly have saved this project in that case if that nearby tall tower wasn't available.

So we strongly support the proposal in Appendix W to allow the option of using WRF or MM5 through MMIF to generate meteorological data for regulatory applications.

Mr. Bridgers: Thanks so much, Tom. As we prepare to go to break, I know I cautioned earlier about not approaching EPA folks to ask them a bunch of questions. But all the speakers from this afternoon, anything that they presented, feel free to talk with them about all that. Just don't do it with EPA folks standing right there. We live around y'all around here and we work around you.

But seriously, the presentations will be posted--I know Bart was a little rushed just because of the time limit, but his presentation will be posted online and feel free to follow up by contacting him directly and asking questions if you have them.

We are just past--we'll stay on schedule with respect to when we come back from break, so we'll break now until 3:35. And then we'll round out the afternoon through 5:20, so about 20 minutes, guys.

(A recess was taken from 3:14 p.m. to 3:37 p.m.)

Mr. Bridgers: As we take our seats, we now have three presentations that are going to be given in succession by the AWMA, a subcommittee of that, and David can introduce that when he gets up here. So we've allotted 15 minutes for three different topics. And I'm going to let the three different topics kind of run semiautonomously, but like I said, with these guys, I'm still going to try to keep them to their 15 minute blocks. So over the next 45 minutes we'll hear from AWMA. David?

Mr. Long: Good afternoon. My name is David Long. I am an engineer with American Electric Power and today I'm speaking to you as my role as chairman of the Atmospheric Modeling and Meteorology Committee of AWMA.

The Atmospheric Modeling and Meteorology Committee is the technical coordinating committee for air quality modeling and meteorology issues within AWMA. We have roughly 100 active members on the committee and our objectives for our committee are to provide technical support for the annual meeting, support specialty conferences and workshops, which I'll mention a little bit about later in my part of our presentation, contribute to various technical programs sponsored by AWMA, and provide comments and review on regulatory and technical issues relating to modeling in a constructive manner.

For working on the Appendix W revisions, we put together an ad hoc review committee chaired by George Schewe of Trinity. And the committee consisted of myself, Justin Walters of Southern Company, who's our vice chair; Michael Hammer of Lakes Environmental, who's our secretary; Pete Catizone from TRC; Bob Paine from AECOM; Gale Hoffnagle from TRC; Ron Petersen from CPP Wind; Ralph Morris from Ramboll Environmental; Mark Garrison from ERM; Tony Schroeder from Trinity; and Abhishek Bhat from Trinity. And then as part of our process, we solicited comments from all the various--all the committee members and tried to work those into our comments as best we could.

Our topic areas we're going to be discussing are general comments, which will be the area I'll be speaking on, AERMOD, the enhancements, new algorithms, and applications, which will be spoken about by Mark Garrison, and finally, single source modeling for ozone and $PM_{2.5}$ and long range transport modeling, which Gale Hoffnagle will speak to.

Looking at general issues, EPA has produced a lot of useful information to address many challenging tasks in air quality modeling. However, looking at the current record as it exists today, we see some of the guidance documents that have been placed in the docket do not yet appear to be complete or appear to still be works in progress, and we're not sure they completely support the final rulemaking.

Now, where we see potential incomplete modeling procedures are for ozone and $PM_{2.5}$ guidance, the Tier 1 emission rate guidance--and we view that as an essential piece of the Tier 1 process and it doesn't appear to be available based on what our members have been able to locate to this point. Some of the long-range modeling procedures don't appear to be well defined, and some of the promulgation of these issues could occur with future rulemaking once the more complete procedures are defined. We feel that would make a better record.

We also--we do think that some of the incompletely defined approaches can cause problems working on permit modeling. You know, one of the things that was mentioned earlier today is, you know, protocols are going to be much more important. And one of the problems that we've had that our members have had over the last number of years is protocols can take a very, very long time to be approved. And with some of what we see as potentially open issues in the *Guideline* and more Model Clearinghouse review, the timing--we don't feel the timing will get better. We're very concerned the timing will be worse as time goes by.

Regulatory review for protocols we feel should be able to be done in a fairly limited time, but you get into a number of agencies that sometimes don't see eye on how something should be done and, you know, it causes some problems. So we would encourage EPA to try and help move the process along.

Obviously with these problems we see that that increases the expense for entities that are trying to get through permit modeling. It's going to take more effort to prepare the protocol and then to work it through the review process with things not maybe as well defined as they could be.

You know, this increases greater--increases costs and uncertainty, especially in the areas of ozone and $PM_{2.5}$. And it potentially leads to a greater effort to defend a permit that would ultimately be issued because the procedures may not have been as well defined in Appendix W.

You know, consistency, one of the things that, again, we've heard mentioned earlier today. You know, we see some of the proposed changes as potentially causing less consistency amongst modeling activities and--because it seems like things may be going more to a case by case situation instead of a more uniform modeling approach throughout the country. Now, the consistency issue is something that we've seen as an effort of past guidelines. And again, lack of consistency can lead to challenges to permit and more litigation.

Potentially, it could drive companies to try and avoid PSD type modeling, which increases the time and expense for a permit. And it's also potentially going to take a long process, getting a PSD or NSR permit, and make it an even longer process, which may not necessarily be the best utilization of agency or regulated community time.

You know, we would also recommend to EPA in their changes to Appendix W that they not take positions that cause special approvals to be restricted to single sources and then not make them reachable for any other purpose.

And we also--as we've looked at the guideline proposal to this point, it appears that special approvals will be much more extensively needed for everything but a basic demonstration. And we would encourage EPA to retain the current system where the permitting authority has more discretion to approve a modeling protocol in most cases. Obviously there are going to be cases where things are going to be done that are not standard within the protocol and special handling is required for those, and that's been the case all along.

We'd also suggest that EPA consider forming an independent expert model science advisory panel to advise EPA in planning and review of model component changes and guidance on how models are applied. The focus of this group would be on model evaluation changes that are scientifically justified rather than on just simple sensitivity studies. And EPA should demonstrate that model formulation and guidance changes will indeed result in improved model performance.

We also would suggest that EPA move to a tiered approach for model changes and updates to allow new and improved modeling formulations to move into use in a more expeditious and better reviewed fashion.

Now, the first tier would be changes to models in Appendix W, which would be major changes, and this would require a formal public comment process with *Federal Register* notice and a public hearing, would include a 90 day comment period, and we'd recommend allowing a one year period for testing and debugging of new modeling procedures with additional comments limited to just the testing and debugging and not the whole model formulation itself.

Final implementation would then occur after the one year period is up, including a review of the 90 day comment period information and the results of the testing and debugging activities. And potentially the new techniques could be allowed to be used immediately, but subject to change due to the testing and debugging and public comment.

Tier 2 would be formulation updates to Appendix W models. And this would be things such as the low wind speed options, changes to downwashes affecting stacks at or above GEP height, and some of the options that have been set up for CALPUFF but have not always been approved in a timely fashion.

Now, these are more substantial than simple bug fixes and should be reviewed by the public. But a Tier 2 change would not require a *Federal Register* notice or a public hearing. There would be a 90 day comment period, but it wouldn't require the reopening of Appendix W and allowing, again, a one year period for testing and debugging with additional comments outside of the 90 day period limited to just testing and debugging information.

Then final implementation would be after that one year period with review of all comments and the testing and debugging activities. Again, we'd suggest some of these techniques would be available for use immediately, but again, subject to change based on the results of the testing and debugging and public comment.

The final tier is simple bug fixes or procedural clarifications. And again, we would suggest a comment period on this of 90 days, but no testing being required and the new techniques would be available for use immediately, but subject to change.

Now, EPA, we also feel, should allow for review of alternate modeling approaches through the Clearinghouse without tying such requests to permit applications. This could be a case where an entity sees an issue with the model and wants to bring it to EPA's attention, but it isn't going to--it isn't happening in the context of a permitting process. And we also would encourage collaborative field experiments with EPA input.

As I mentioned earlier, we do--our committee is responsible for specialty conferences, and we are planning one for 2016. It's going to be our sixth specialty conference on air quality modeling. It's scheduled for April 12th through 14th at the Sheraton Chapel Hill in Chapel Hill, North Carolina. The call for papers is open and more information on this conference is available at aqmodels.awma.org. And now I would like to invite Mark Garrison up to start our talk on AERMOD.

Mr. Garrison: I've got 15 minutes? Thank you, David. Thank you, George. I appreciate the opportunity to provide some comments at this conference. I'd also like to thank Bob Paine, Ron Petersen and Pete Catizone for providing a lot of the technical content of this presentation. I think I was nominated to give this presentation so that the impression wouldn't come across that this is a Bob Paine conference, but nonetheless.

We do provide a number of feedback and questions regarding the new algorithms and enhancements. We did provide some recommendations for possible future enhancements to AERMOD for EPA's consideration. We also provide observations, comments, recommendations on various aspects of the application of the AERMOD system in Appendix W.

There are a lot of questions in our presentation. I think I'm going to have to go through it fairly quickly to get through the time allotted. Listening to the presentations this morning and this afternoon, however, I think a lot of the questions and issues that we raise have been addressed and in some cases answered by others. I'm going to try to sort of point this out as I go through with--as I go through this. And the committee is planning on providing additional comments in the comment period, either additional things that we think of or amplifications to the comments that we're making today.

Well, 15181 incorporates, as we have heard and as we know, some new algorithms including PVMRM2, LowWind3, Teriminator4--sorry, Terminator4 is not in AERMOD--and of course, buoyant line source type that has been added to the modeling. 15181 also contains some other options, beta options that have been in the model since 12345. Our comments are addressed to those too.

I think it's fair to say that for all the committee members that these are very welcome and appropriate enhancements to AERMOD, and the committee does very much appreciate EPA's hard work in their ongoing efforts to consider and incorporate changes that improve the AERMOD system. And I think that reminds me, did I introduce myself? Mark Garrison, ERM. Thank you.

The first topic is NO_2 modeling options, on which we've heard a couple of presentations already. And I think obviously ARM2 is a more realistic approach to modeling that conversion than the existing Tier 1 and Tier 2 options, although there might be some issues with going to ARM2 directly from Tier--the existing ARM, especially since the minimum ratio recommended is 0.5.

The committee feels that it's likely to be much too conservative for many applications, and the language on alternatives--this is actually a misrepresentation. That is actually at 4.2.3.4(d) in the proposed Appendix W. It is very long. And improvements to PVMRM, as we've heard previously PVMRM2 addresses some of those limitations and issues with the previous PVMRM.

ARM2 is now indicated as a beta option. We've learned the process of, you know, removing it from the beta option has to wait for close of the comment period and EPA's response. So we simply want to encourage elevation to default status as quickly as possible.

These two comments basically ask for a little bit more guidance in terms of how to model increment consumption, net air quality benefit analyses involving NO_2. The bottom part of this graph simply--it's very hard to read, but the horizontal axis is ozone concentration. The vertical access is time to complete conversion. And the point is, I think, that for some situations with very near, very close impacts, that can be an important consideration. And the suggestion is that some consideration of the time of conversion be incorporated into the AERMOD.

We heard about LowWind3, and I think this issue hasn't been answered very much, what LowWind3 is compared to the other low wind options. And again, we kind of encourage the low wind options to become regulatory default options.

The buoyant line source algorithm is a welcome and encouraging addition to AERMOD. It allows for modeling of buoyant line sources along with more traditional sources. And we think that the current version should be treated as a beta version due to the limited user input and limited user experience until such time as we kind of gain some experience and can provide some feedback on that.

This suggestion is to include test runs in the BUOYLINE source algorithm to be distributed with the AERMOD system. And I think this question, it kind of is answered by the understanding that incorporation of BLP into AERMOD is intended not to create a new model, but to simply take what would be predicted by BLP and put it into AERMOD.

It produces some sort of strange, you know, a need in other words, within AERMOD to determine a Pasquill-Gifford stability category and some other issues like that where the algorithms between the two models are different. But I think that this is one area that need--certainly needs some more review and study.

And this is really sort of the same issue. I mean the intention as I understand it and as the committee understands it is to include what would be predicted by BLP in AERMOD so that you don't have to run two models and kind of mesh the two results in a close processing step.

In terms of mobile sources, I think we did hear that the intention is to replace CAL3QHC in its refined version with AERMOD. The issues listed here included, you know, what to do about queuing algorithms and a couple of other issues--a couple of other treatments within the mobile source models. It's not clear how AERMOD will handle those, but I think they will hopefully become clearer as we learn more about 15181.

Just a quick note on secondary $PM_{2.5}$ application. The committee feels that possibly a reduced form model for secondary $PM_{2.5}$ could be adapted for AERMOD as opposed to adding a constant value at all receptors. It can either be done through a postprocessor using a look-up table or other means of calculating a transformation rate, or probably even more straightforward, could or should be incorporated into AERMOD directly.

Several slides on background concentrations--I won't dwell on these too much. I think there have been some helpful discussions already today. The first point here, that focus should be on actual emissions, not allowable. And the new Table 8.1 or 8.2--I don't remember which one it is--is certainly a welcome change to how nearby sources are modeled.

And I think--again, I'm not going to go through each of these in detail, but the overriding point is that background concentrations should be--should not have influences from nearby industrial sources that are not going to interact with the source in question. It's a very difficult thing to accomplish, but we think that it's important to achieve that goal. I'm sort of reading through here to see---

(Pause.)

Again, I think--I won't go through these in detail, but one thing to consider I think to the last point is that the use of lower percentiles, perhaps the 50th percentile, should be used as a reasonable and viable option to account for a true background in refined modeling.

In the area of building downwash, I think the committee feels that there is still some sort of long-standing questions about performance for certain situations, including long and narrow buildings, low wind speeds, which we've heard a couple of presentations about already.

The issue that's been on for a while, the downwash for stacks at or above GEP, is an issue that probably needs some further review and discussion, and I think the committee would plan to amplify on that comment in its comments. And of course the last bullet, we do encourage EPA to seek feedback from external stakeholders.

There were a number of theoretical issues that were raised in the comments. And I won't go through these, but I think these theoretical issues in part are addressed by considerations about the heat island effect in certain buildings and the issue with long narrow buildings that the committee is going to provide additional comments during the comment period.

Equivalent building dimension approach has been around for a while as well, and I think the committee feels that it is still a viable alternative for complex building cases, including porous structures, streamlined structures, et cetera. And that should be considered--or guidance for, you know, preparing that kind of an analysis and EBD should be addressed.

We have heard--these last two bullets, we're heard presentations about, you know, low wind speed downwash and situations where excess heat in a building or an industrial area can cause plume liftoff, so I won't go over those.

And finally, our last topic is in terms of using prognostic meteorological data in AERMOD, which we've already heard a couple of presentations about. And I think, you know, all of us feel it's an encouraging and very welcome option for cases where airport representativeness is uncertain.

And the point is that the use of MMIF should be encouraged and should eventually become a default option. I understand that some guidance is currently being developed, but I think the committee feels that it's a great alternative and should be pursued.

Additional testing and comparison I think may reveal some areas where, you know, the use should be cautioned, and I think that's one area that we feel needs some attention, not just sort of widely apply it, but understand the limitations.

And I think the--just simply the option to work with the appropriate reviewing authority or agency and development of a protocol as to how to do this is absolutely welcome for situations where measurements are not--in situ measurements, the on-site measurements, are impractical or cost prohibitive.

This is a specific reference to MMIF and I think kind of in keeping with not referring to specific models and model versions and the references in the AERMOD users guide.

The issue of land use in WRF versus land use eventually in AERMET is an issue that needs some attention and study as well. WRF cells, as we heard earlier, can go as low as 400 meters or so, but that is still--there is still some question as to whether that 400 meter land use is representative enough for a particular application. So I think the idea is that, you know, maybe have WRF through MMIF provide wind and temperature profiles, but then use AERMET to specify land use in a more detailed, site specific area.

We do have I think a few more slides on prognostic met data. I think the first question obviously has been asked and answered, and another comment on a citation in 8.4.2 that might need to be reviewed and possibly changed.

We did hear--I guess Bart was saying that his AERCOARE option was grayed out and it was not addressed currently, but I think that is something that needs to be considered, that the AERCOARE algorithms and approach might be appropriate for including in AERMOD for over water applications. The AERCOARE has been approved for and implementation of an AERCOARE type approach would be similar to a BLP inclusion.

Okay, summary. I think--again, I think the proposals are encouraging and reflect considerable hard work by EPA and are welcome changes, welcome updates to the *Guideline on Air Quality Models*. We anxiously await the elevation to default status of several important updates.

BLP is a welcome addition, much work to be done. Mobile sources, some clarification is needed on the status of AERMOD with respect to CAL3QHC and particularly how certain algorithms within those models are handled in AERMOD. Background, current procedures are still very conservative. Downwash, work is needed on long buildings, low wind speeds. MMIF, the use should be encouraged. Maybe there should be a clearinghouse for WRF data sets in the IM, and we're done.

The next speaker is Gale Hoffnagle. I'll let you introduce yourself, Gale.

Mr. Hoffnagle: Gale Hoffnagle from TRC. I'm going to talk about single source modeling for ozone and PM_{10} (sic) and long range transport modeling, and my overall theme is case by case is not guidance.

This modeling issue is very challenging. The ozone and $PM_{2.5}$ is very challenging. We recognize that has EPA spent a good deal of hard work to date on the proposal package. The proposed approach, while having merit and being a good start, is preliminary and needs more development before becoming part of this rulemaking. It's not ready for prime time.

Currently there are no clear modeling approaches, which is a significant departure from the very specific default options specified by EPA for AERMOD and CALPUFF modeling in prior guidance. Has EPA considered--this as one of the overview items. Has EPA considered the interaction of secondary formation and Class I increments? That's a big question that's unaddressed.

So we have a three tiered approach, a qualitative waiver of modeling requirement if new emissions are less than model emission rates for precursors or MERP, which is not available. I don't know how to evaluate the three tiered process without MERPs being available. And I don't know whether it's going to be a separate promulgation or not.

The next tier is a screening approach based upon relationships between emissions and impacts, which may have a reduced form model or a screening model. This tier is to be appropriate for most permit applicants. How does EPA know that before it's done? I don't know that.

The final tier is use of more sophisticated case by case sophisticated photochemical modeling analysis and necessary only in special situations. I don't know how we know that before the three tiered approach is finished.

MERPs need to be specified through a proposal and public comment. I guess that's a future rulemaking. This will help the user community to understand what this tier covers.

The IWAQM3 near-field document states, "At this time, it is not clear that a robust reduced form model exists for either ozone or secondary $PM_{2.5}$ for the purposes of assessing single source downwind impacts of these pollutants." Well, if there isn't such a model, how are we going to get a workhorse model for the second tier? I don't know. I don't know. We don't know how that is and we don't how to evaluate it.

More specifics are needed on the application of Eulerian photochemical grid models or advanced Lagrangian models in future rulemaking. We need a second--"Single source secondary impacts are...usually highest in proximity to the source." I don't know that. Is that true? That's an issue. It's been an issue. Are they long range transport? Are we making more stuff long downwind or are we making more stuff right there next to the source. I'm sure it changes depending upon the situation.

But anyway, we don't have much data within 10 kilometers of a source, and we run into problems with the grid size in photochemical grid models when we get down to those kind of distances. We've seen the problems at MMIF at 4 kilometers and 1½--or 400 meters and 1½ kilometers. A focus on near-field evaluations would be helpful. We need more data.

So if peak impacts occur near the source, careful attention needs to be paid to modeling near the source, and plume-in-grid treatment would come up for debate again. Plume rise and source related effects are therefore very important. Where is the plume in elevation? Where is the chemistry in elevation? How does that chemistry in elevation affect ground level concentrations? Those are all issues that have to be discussed. Lagrangian models avoid this problem, so such models should be seriously considered for ozone and second $PM_{2.5}$ modeling, especially in the workhorse category, if you will.

Relative versus absolute predictions: EPA recommends that absolute photochemical grid modeling predictions should be compared to the SILs. We don't have a SIL, but when we have a SIL for ozone I guess we'll do that, which brings up the whole question of SILs. If the $PM_{2.5}$ SIL is under remand, when and how are we going to have an ozone SIL?

What is the ozone SIL? Is it 1 ppb? Does the ozone SIL change as the ozone standard changes on the 1st of October because that's when we know it will change. So there's a whole bunch of issues there that make it difficult for us to evaluate where this is all going.

In many PGM applications, a relative reduction factor is applied to minimize model uncertainty. That happens in the SIP program. But in the guideline program, we're not allowed to make calibrations, right, so there's a big difference in the way that these models have been run for SIPs and run for the *Guideline* in using them for the *Guideline*. I think there is a pretty good reason to suspect that we ought to do some calibration of PGM models if we're doing regulatory analysis under the *Guideline*. But this is sort of a, you know, absolute issue.

Who will determine how to run the advanced models? The widespread use of the top modeling tier may be because the scope of the tiers is not yet clearly defined. We think that's a problem. Model users need more specification of which top tier model and which technical options should be used. That is, where's the guidance? We don't have any guidance.

What group of experts is available to determine how to run the designated model, because we always get involved in the question of which switches to use? Will regional modeling platforms including existing source databases be set up and designated for use? If so, we will need to plan that carefully.

I can't imagine that each model, each permit applicant is free to go out and create a new smoke input for their PGM model. That's ridiculous. That can't happen. It will make modeling for a permit a $200,000, $300,000 job, not good.

Independent peer review program: the promulgation of previous major *Guideline* model changes were preceded by an independent peer review. These important modeling development changes warrant the same level of peer review, which would be subject to public review and comment. This process can be conducted in association with future rulemaking, but we need--I believe that EPA needs some outside guidance on how these models perform, et cetera. And AWMA is offering that that's what should happen.

Additional evaluation databases should also be in the review. Come on, guys, we need more data. Now the models are being asked to do things that we've never asked them to do before and we need more data. I applaud API for bringing some new data, EPRI bringing new data, but we need more data. And I think EPA needs to sponsor data evaluations again. So as I said, this three tiered approach is not ready.

Long range transport models, CALPUFF and others--I don't understand why EPA believes that there isn't the need for long range transport modeling that there was before, but I can tell you that we have had a recession, if you don't understand. And people are not building new plants. And if there's less permits being put in over the last six or seven years, that's the reason.

When we get back to putting in permits for new plants as the economy gets better, these are all within 300 kilometers of Class I area and we're going to need to do a lot more of those analyses, or at least we hope we're going to get to do a lot more of those analyses.

CALPUFF was recommended by IWAQM in 1998, used for long range transport modeling, adopted in 2003. EPA proposes not to have a long range transport guideline model. The reasons for this appear to be more focused on CALPUFF manage-ment than CALPUFF performance. However, we are hopeful that the management of CALPUFF can be worked out with EPA.

CALPUFF is used widely throughout the world. We have limited chemistry in the approved version because EPA hasn't seen fit to evaluate any improvements in CALPUFF. So version 6.42 has improved aerosol thermodynamics and aqueous phase chemistry, which should be considered by EPA. It has not been considered at all.

States and the user community have familiar with CALPUFF, and its use could be retained at least as an advanced screening model. Use of CALPUFF in this capacity will also formally support the recommendations of FLAG 2010 and use of BART, which I think we've covered before, that those are going to happen.

Running CALPUFF is much easier than running PGM for single sources, saving applicants and states time and money. We need an advanced screening model for stringent Class I SILs and recommend that EPA retain the use of CALPUFF for that purpose. Failing that, if the nearest Class I area is well beyond 50 kilometers, but less than 300, we have a question: have you considered whether AERMOD could be run beyond 50 kilometers as a screening tool?

Next, could the FLAG 2010 Q/d less than 10 waiver for modeling of AQRVs also be applied to PSD increment for each pollutant? There's another screen that you could use that would help us reduce the time and effort and energy.

And in conclusion, AWMA would welcome the opportunity to work with EPA on resolving any of the issues addressed. Details and discussion of our comments will be submitted to the docket to supplement our presentations here. And AWMA appreciates the opportunity and EPA's effort to accommodate our request to present these comments. Thank you very much.

Mr. Bridgers: And our appreciation to both David--well, all three, David, Mark, and Gale--for their comments, and we're staying on schedule.

So we will switch from AWMA comments--I believe I've got the right presentation. Is that it? And next up, Chris, I'll let you identify yourself.

Mr. DesAutels: Thank you. Good afternoon. My name is Chris DesAutels. I work with Exponent. I'm here to offer comments on behalf of Exponent. We are the developers and the maintainers of the CALPUFF model. Listed here are some other members of the Exponent team who have been involved in developing and maintaining the CALPUFF model.

The primary purpose of this presentation is to address some concerns that have been raised about CALPUFF as part of the rulemaking process. Specifically up to this point, CALPUFF has been part of the guideline models and it has been an integral part of the modeling process. "CALPUFF dispersion," as stated here, "had performed well and in a reasonable manner with no apparent bias towards under or overprediction, so long as the transport distance was limited to less than 300 kilometers."

There have been several documents that are included as part of the proposed regulatory docket that have raised concerns about the CALPUFF modeling system. And I just want to address some of these and at least open the conversation about possible resolution of these matters so that CALPUFF can remain as part of the available models that can be used and be part of the suite of models that will allow us to implement the best science because there are going to be needs for non-steady state modeling. There's going to be needs for long range transport modeling, complex terrain. And CALPUFF is well positioned to achieve these goals so long as some of these issues can be resolved with all the stakeholders involved and there can be the confidence developed to move it forward.

So there are three specific documents that are part of the docket that I want to address or at least discuss today: the preamble to the proposed rulemaking had some specific statements and concerns raised; the supplemental information for the IWAQM Phase 2 recommendations; and then there was a memo on CALPUFF's ownership since 2003 promulgation.

Initially with the preamble to the proposed rulemaking notice there was expressed concerns about the management and maintenance of the model code given the frequent change of ownership of the model code, and it also refers to uncertainties in the development process of the model.

Initially here I'd like to address the issues of the ownership. There is some uncertainty as to why this is a significant concern despite--there have been two changes of ownership of the CALPUFF model, but the personnel maintaining the model have continued. There's been a continuous representation of the same personnel maintaining the model. So there has been continuity.

The model has been freely available at the same web site, so there's no mystery as to what the official model is or where you reach it. And the model developers have provided EPA with a copy of the CALPUFF updates and maintained both an EPA regulatory version which incorporates primarily bug fixes, and a separate version which incorporates model enhancements. CALPUFF does meet all the requirements list in section 3.1.b of the *Guideline* for an EPA approved model.

So the question is how do ownership changes fit into the structure of a guideline model or any model for use in regulatory purposes? This is not to say that any change of ownership is problematic. It's just to point out that it is fairly common. It happens in the industry with modeling, and there's a lot of update to all models. So how are we going to proceed forward if change of ownership is a significant concern for any of the models that are addressed here and are part of the future modeling suites that are going to be used?

The second section of the preamble that discussed CALPUFF was the change in the language for complex winds. It has been removed--it has removed the use of CALPUFF specifically. There is no specific technical basis really provided for this change. It refers to technical issues, but there's no specific citation of what the technical issue that's being referenced at this point is.

And the current guidelines state that "The purpose of choosing a modeling system like CALPUFF is to fully treat the time and space variations of meteorology effects on transport and dispersion." This is a necessary process that's going to continue to occur and it's continually going to need to be addressed.

There will be need to be a model to address this, so we believe that CALPUFF is still well situated to provide this service, to do this type of modeling. And we don't see the reason for there to be a change in the status for that specific purpose.

The second document that I referenced here is the supplemental information for IWAQM's Phase 2 recommendations. EPA observes that CALPUFF--it has a series of specific concerns about the technical nature of CALPUFF, some of these which were mentioned earlier today.

EPA observed that CALPUFF does not include photo-chemistry for modeling of SO_2, NO_2, sulfates, or nitrates. CALPUFF has however up to this point been extensively used in regulatory applications for Class I AQRVs, for modeling deposition of sulfur and nitrogen and for visibility.

And we believe that it can be enhanced, that there can be improvements to the science and the model of CALPUFF that will allow the Lagrangian type model to interact with grid models to ingest ambient fields of oxidants and ammonia and achieve more accurate results and achieve some of the goals in a reasonable fashion that could be productive and useful going forward.

And we have interest in seeing that happen and working to achieve that goal with EPA and any other stakeholders that are interested in that possibility. It will offer another opportunity for how to accurately predict secondary $PM_{2.5}$ and will advance the science of modeling.

EPA states also in that document that CALPUFF cannot model single source impacts on ozone. And in general, we agree that probably a full chemical grid model is more appropriate for those purposes. That's a new area, and a Lagrangian model is probably not the best served--best suited for that purpose.

The final observation, which is mentioned a few other places also, is that CALPUFF predictions are very sensitive to the CALMET meteorological processor. And different switch settings, different CALMET fields will produce different dispersion results.

There are alternatives available. We've heard some presentations today about using weather forecast models and MMIF in order to drive CALMET--I mean in order to drive CALPUFF or other dispersion models. That is a very productive and possibly a development that its time has come.

In the past when CALMET was originally developed, those models were not ready for providing that resolution of data. MM5 runs at that time were typically 80 kilometer resolution. We needed a tool that would ingest observations and available prognostic data to achieve something that was realistic and useful for dispersion modeling. Now we may be ready to start looking at the use prognostic models more directly and we support that possibility.

Concerns about CALMET should be addressed and looked at, and we hope to examine those closely as they arise, but it shouldn't affect the status of the CALPUFF because there are other options. I'd also like to point out, though, that all models, especially all three dimensional, non-steady state models will be sensitive to meteorological inputs.

And there is going to be a lot of skill in developing those accurate meteorological fields, no matter what model is in the process flow stream, whether it's CALMET, whether it's MMIF, interpreting WRF. WRF has a variety of different schemes and settings that can produce very different results. And they have to be evaluated for each application to ensure that they're producing accurate flow fields because they will also produce sensitivities in the meteorological dispersion models that come after them.

So this isn't a problem that is exclusive to CALPUFF or CALMET. It's something we're going to have develop skill and expert judgment on going forward and have procedures for identifying when we have accurate meteorological fields for any dispersion model.

The third--the other concern identified in that document was generally about evaluation studies and CALPUFF's performance in various evaluation studies. A specifically cited group of evaluation studies included a couple that have been reevaluated as time passed and they were looked into in more depth.

And some of the concerns or poor performance that was shown by CALPUFF were identified to be other issues, sometimes related to meteorological issues, some switch settings, and specifically you're speaking about the ETEX model. And also some of those evaluations extend far beyond what would generally be considered to be long range transport studies. They extend well beyond 300 kilometers up to several thousand kilometers.

So a more general recommendation about the evaluation studies is that they shouldn't necessarily stop at developing a scorecard. And that's not to say that the evaluation study that does develop a scorecard is problematic or improper or not helpful. It's just that can't be the final step of the process.

There needs to be an evaluation of why models didn't meet the performance criteria that they were expected to. What happened? What went wrong? Was it poorly performing model algorithms, things that should be updated, things that should be changed and proved based on better and more current science? Were there problems with the input data, especially meteorology, which, as we said, is a very sensitive input to the dispersion models? Do you need more meteorology, better meteorology, more accurate? Is it performing correctly?

Were there problems with model setups? There are a lot of options and switch settings that have to be set. Are there things that are just not set correctly in a given evaluation? That guidance should get out to the community so people know which switch setting--they're very sensitive and for which applications they should be applied, or is a limit on the model formulation? Is it something that a plume or a puff or a grid model just does not handle well?

Those are all possibilities about why a model does not meet performance goals that it might have. And determining which of those possibilities or what caused the poor model performance is critical to improving the model and getting the best science out of them.

Additionally, the statistics that are used to evaluate this model should be consistent with the goals we have for dispersion modeling so that we're measuring the correct things. So that's something to just--I know there's been a lot of work on developing the statistical measures, but that's something we should always keep our eye on.

The final document that I wanted to address was the summary of CALPUFF ownership. In addition to statements about the changes of ownership, there was also a citation that described "a lag in the ability for EPA to adequately understand, review and approve changes largely due to the lack of an open development process."

We'd like to develop that open development process. We believe it's important that there's confidence in the model and that all stakeholders feel that they understand what's included in it. We're committed and willing to work with EPA to do that and we're willing to discuss a wide range of options of how to achieve that goal, what it would take. I'm not going to try and formulate what that will be here, but that's a conversation that I think is probably--it's time and needs to be done.

I'm going to turn now to a few brief comments about AERMOD. Some of these have been well addressed. Mark covered many of these points and they've also been discussed today. And I think a lot of these were questions that--very helpfully a lot were addressed this morning. I'm sure they'll continually be addressed as the rulemaking process proceeds and people have more time to look at the models and the recommendations come forward.

There were some questions about how BLP performs. There's going to need to be some testing by all the parties.

Is BLP in AERMOD equivalent to BLP externally? Does AERMOD treat calm and low wind speed hours in the same manner?

We have some questions also about CAL3QHC similar to the ones that Mark had listed and involving negative emission rates. And the first two points up here have been addressed earlier this morning and that's very helpful to know the future status of the beta options within AERMOD and the plans for them. And that appears to be a very good advancement of the science.

There is still concern with the potential for long--for building effect about GEP stack height, which are now subject to downwash, how that was evaluated and further evaluation of that decision within AERMOD. PRIME was developed using data below GEP stack height--or stacks below GEP stack heights. These circumstances are outside of the general constructs of what was evaluated during the development of PRIME, so there should be more evaluation of that modeling. That concludes my remarks. Thank you.

Mr. Bridgers: Thank you, Chris, for those remarks. And as I said off the record during the break, I'll say on the record we do wish that Joe could be with us to be in the dialogue today.

So I just wanted to make sure I had everything right. So Mark is up next. And Mark, you do need to identify yourself.

Mr. Garrison: Thanks, George. Thanks for the opportunity again to present some comments. The three topics that I've listed here, CALPUFF, 30 miles, and roughness pretty much deal with some issues that are currently considered settled policy or settled guidance.

Of course the Appendix W proposals that we have paid so much attention to recently kind of put us in a brave new world in terms of--for the modeling community in terms of a couple of topics including the use of prognostic models for developing representative met data for local scale models and the development of guidance and policies related to the use of chemical transport models for ozone and $PM_{2.5}$ on the local scale.

I think I and probably most modelers are pretty excited about these developments and look forward to proceeding down that path. As a matter of fact, as some earlier presenters attested, I get choked up when I think about this. But anyway, EPA might not agree with this, but I would think there's no time like the present, given these--in light of these developments to possibly reconsider or at least think about some of the settled policy and guidance issues.

The things I'm going to talk about today are CALPUFF. As an Appendix A long range transport model, I'm not going to address that particular comment. That comment has been made by others. My focus is on keeping CALPUFF as a candidate at least for local scale analyses. This presentation is focused on that.

30 miles, of course, if you haven't figured out by now is equal to 50 kilometers. And the discussion is about using straight line, steady state models out to 50 kilometers. In terms of the transition from real sort of steady state conditions to non-steady state should really not be a bright line with discontinuities.

Lagrangian models in theory can simulate this transition without discontinuities. And I guess in my view there ought to be something between the true steady state local scale analysis and analyses have to look out to 50 kilometers.

The last topic is in terms of roughness length, how to specify roughness length for input to AERMET. And the question is, you know, roughness at the measurement or the application site.

Well, why do we need the Lagrangian model at all? I think it largely has to do with wind speeds and plume transport distances. These two circles are both 50 kilometers. The first one represents transport of a plume from the center of this circle outward to 50 kilometers, and each of the smaller circles represent 1 hour transport time.

And this kind of stuff I think is kind of intuitive to modelers, but when you look at it this way, you know, it takes 13 hours, nearly 14 hours for a plume to travel from the center of the circle out to 50 kilometers. And the plume can experience changes in land use, changes in winds, changes in stability, night could turn into day, day could turn into night during that transport time.

And especially, if you have sources in that area that you're modeling in conjunction with the source in the middle of the circle, it raises issues that make modelers cringe sometimes that the time sequence is not really correct. The plot on the right of course looks a little bit better at higher wind speeds, but quite often the low wind speed cases are the controlling cases.

And I think, you know, it's encouraging to hear in the presentations and in the proposal that, you know, to do multisource analyses we should really be focusing on areas from 10 to 20 kilometers and not beyond that. But there are questions that frequently are raised about sources at distances greater than 20 kilometers, and it would be nice to have a tool to deal with those distance ranges.

Again, why do we need the Lagrangian model? Well, the atmosphere is a complex place and complex winds exist even on the local scale. And we do know that there's an option in the guidelines to justify a Lagrangian model on the local scale due to complex winds. It's a very difficult process that I've tried to go through a couple of times without success.

But I have some illustrations here that take a look at a 1 hour event with variable winds throughout the hour. I used CALPUFF in ten minute time steps based on meteorological data that was actually collected at five minute intervals. So this was sort of an unusual situation, but not too unusual if you consider that with AERMET we could theoretically develop this kind time resolution even with airport data. And then I look at AERMOD on an hourly average time frame.

This is basically a theoretical source located in complex terrain. The plots illustrate each ten minute time step starting with the first ten minute time step. So in the lower--the newer puffs that are released from the source by CALPUFF in green--they kind of go down in age as the colors suggest. It's kind of hard to see the colors, but I think you'll get kind of the gist as we go through these.

The contours are sort of relative concentration contours. This is the first ten minute time step, second ten minute time step, third ten minute time step, fourth ten minute time step, fifth ten minute time step, and final ten minute time step. And if you look at the hourly average wind speed and direction for this generic source, this is what AERMOD would predict.

Now, absolutely this is not intended to invalidate AERMOD nor is it intended to validate CALPUFF. But it is intended to kind of get across the point that it would be helpful to have a Lagrangian model available and an Lagrangian approach for all scales, ideally one that simulates the steady state result for the appropriate settings for steady state situations and also ideally simulates the atmospheric chemical transformation at all scales that we are looking for in the Appendix W proposals. And I know we're going to hear later this afternoon about SCICHEM and SCIPUFF. And I think, you know, certainly that direction provides a promising direction for this. And pretty much only a steady--a non-steady state model can handle the transition from steady state to temporal variations without discontinuities.

So pretty much the recommendation is to keep CALPUFF as a candidate for local scale analyses for the time being. And as policy guidance and models are developed for chemical transport models on a local scale, consider--this will never happen--consider reevaluating the 50 kilometer applicability range for AERMOD, and also consider evaluating CALPUFF with some of the suggestions that Chris had possibly, along with the evaluations of other models.

The second part of my discussion is on roughness with a focus on z_0, which is roughness. Current policy of course is to specify land use characteristics for the measurement site, using AERSURFACE to determine land use characteristics based on the data set for which it's developed, 1992 NLCD data.

These characteristics then inform the AERMOD interface in terms of its creation of a complete profile of winds, temperature, and turbulence. So this presentation will--this part of the presentation will look at three things.

As we all have encountered from time to time, the 1992 data can be out of date and sometimes badly out of date. I'll have a brief discussion about site characteristics versus measurement location characteristics, and then another quick look at what is upwind or how do you define upwind in terms of determining the surface characteristics.

This is an example of NLCD 92 for a power plant site where most of the area is classified as either water or quarry, strip mines, and gravel, obviously clearly out of date and incorrect. I think many of us have encountered this before and have developed methods to essentially redo the land use classification here, which is, you know, more reflective of what that site actually looks like in terms of development and areas that are not fully developed and enforested areas.

One of--I thought it was kind of an interesting example that Rich Hamel found in Victoria, Texas. If you're looking at the site characteristics for this airport southwest of Victoria, it might look--well, it sort of looked like an airport, but then with access to Google Earth, we realized that it is no longer an airport. It has a road running through it and the runways have all been developed. So just a word of caution in terms of using 1992 land use.

As I mentioned, the surface characteristics, especially Z_0, inform the AERMOD interface in creating a full profile of winds, temperature and turbulence. If there are differences in roughness length between the airport and the site--and I have yet to encounter an airport that is a perfect match for an application site--what do you do?

I mean, you know, one conclusion, the airport is not representative enough to collect on-site data, or the other option is to run AERMOD both ways with both sets of land use, which is not a very satisfying way of answering that question, or perhaps using the site roughness provides a better profile representation.

And of course I'll have to mention that the potential for using prognostic meteorological data, wind and temperature profiles, also calls for some consideration of how to characterize land use at the application site.

This is one of those hard to read slides and I apologize for that, but this is what the AERMOD interface does. It takes the surface characteristics from AERMET. In this case--in this one hour case, the wind speed was 0.9 meters per second. The airport roughness length is 0.13. The site roughness length is 1.12 meters, so clearly very different.

And if you look at the profiles, both in terms of where the mechanical mixing height is, the wind speed profile, the temperature reading profile, and the profiles of turbulence, they are obviously very, very different. And this would lead one to the conclusion that the airport was not representative of the site.

But I think just taking a step back for a minute, the important thing to remember is that the only parameter you're getting from the airport, the only measurement, is really the wind speed. So if you can make the case that the wind speed is representative of the site, however you would do that, then I think that it is pretty clear that the site roughness length actually creates a better profile for modeling at that site than the--than using the airport roughness length.

The last thing I want to look at is sort of a quick, simple look at a different way of defining upwind for AERSURFACE. And this is actually recognizing that AERSURFACE is not part of the formal AERMOD system, just a tool to develop the appropriate surface characteristics, this approach might be one to be considered.

AERSURFACE--if you're looking at particular sector to develop Z_0, the sector ends in a point at the application site. If you have a site where stacks and sources are separated by, in some cases, several hundred meters, it might be more appropriate to use kind of wedge, as you see here, to characterize upwind characteristics for that particular site.

This is the kind of thing that can be done outside of AERSURFACE. The geometric weighted average, Z_0, can be calculated fairly easily outside of AERSURFACE, so just a suggestion as to something to consider if a site has sources that are not at the same point.

So in the brave new world, I guess the summary--the suggestions are keeping CALPUFF as an alternative for local complex winds. And I think Tyler's presentation indicated of course that's still an option, so it's not--the mention of it doesn't mean that it's not an option. But I think the suggestion is made to keep it in there as a example.

Consider revisiting the 50 kilometer application distance for AERMOD and ideally eventually substituting with an appropriate Lagrangian model; consider allowing the use of application site roughness in some situations. Using WRF and MMIF should be encouraged. And then, finally, you know, consider and evaluate different options for determining land use specifications with MMIF generated wind and temperature profiles. 26 seconds left.

Mr. Bridgers: Thank you again, Mark. We're getting in the home stretch now, a couple more presentations. We're going to switch focus from CALPUFF to SCICHEM.

Mr. Chowdhury: Good afternoon. My name is Biswanath Chowdhury, and I'm a senior engineer at Sage Management, and I'm part of the team--development team for SCIPUFF and also SCICHEM. I would like to thank you for the opportunity to present the work on SCIPUFF.

So first, a lot of you know about AERMOD and CALPUFF, but very few modelers here know about SCIPUFF or SCICHEM, so I'll just go through the base development history of SCIPUFF and a description of the use of SCIPUFF.

So SCIPUFF is acronym for second order closure integrated puff model, so as the name implies, it uses second order closure for modeling of the turbulence parameters. And it's a puff model. More specifically, it's a Gaussian puff model. To represent a concentration field we use the sum of overlapping three dimensional Gaussian puffs and we step the model by solving ordinary differential equations for puff moments. The puff moments are the mass, the centroid, and the sigma.

This is just a brief development history of SCIPUFF, and I'll just give the highlights, and it's not a comprehensive list. The development of SCIPUFF started in 1984, and it was funded by EPRI. And in 1991 DOD used SCIPUFF for nuclear cloud rise model, and one of the important highlights is that DOD decided to use SCIPUFF as the core transport and dispersion model for HPAC, which is Hazard Prediction and Assessment Capability model, so SCIPUFF is the core transport model, and it has been so for--since today. So a lot of our work is funded by DOD.

In 1998 SCIPUFF was approved by EPA as an alternative model, and in 2000 EPRI funded development of SCICHEM 1.0 where we put in gas phase chemistry and aqueous phase chemistry in SCIPUFF so that it was named SCICHEM.

Other modifications for the SCIPUFF model development is that we added urban wind field model in 2001, then again in 2001 SCICHEM was included as a plume in grid model for the CMAQ advanced plume treatment. I won't go through the whole list, but the PRIME was added in 2004 to take into account building effects. We have WRF and RAMS support, which was added in 2011.

In 2012 a lot of the updates to the SCIPUFF model which were not there in the SCICHEM 1.0, so EPRI decided to update the SCICHEM model, and that's when we included all the updates which are made to SCIPUFF into SCICHEM 3.0. And Eladio, who is the program manager for SCICHEM, he will be making a presentation right after me.

So the development team is led by Dr. Ian Sykes. He is the Environmental Sciences Group manager. And he is in charge of overall model development, turbulence closure monitoring of dispersion and concentration fluctuation intensity. He has been the leader of the group for more than 30 years.

Similarly, Dr. Stephen Parker, he's also with the group for more than 30 years. Doug Henn, he's an expert in the meteorology section, and he has been with us more than 25 years. And I am responsible for the SCICHEM development. I'm one of the lead developers, and also I do the source estimation part of SCIPUFF, and I have also been with the development team for more than 15 years.

So what are the model capabilities of SCIPUFF? SCIPUFF can transport gases, liquids, or particles. It can-- it includes the primary and secondary operation for liquids, and it can do dynamics. For example, it can do dense gas effects, and also if you have a jet or if you have a burn plume, it can handle that.

And there are a variety of release types that it can handle. The generic types are the instantaneous and continuous releases. It can have a moving release or a pooled release. It can also model jet releases, which can be horizontal or vertical jets. It can do burn sources or stack sources and also area and volume sources.

So some of the unique characteristics of SCIPUFF is that in addition to the mean concentration, each puff carries the variance also, so this allows SCIPUFF to take into account the rambling nature of the turbulence dispersion and also uncertainty in the source or in the regularity.

Each puff takes its own time step based on its evolution grid, so a puff which has been released for example at high momentum or buoyancy will take a smaller step. Similarly, it has an adaptive grid for the output, so the smaller puffs will have a smaller grid and the bigger puffs will have a bigger grid.

To properly represent the wind field, we split the puffs so that we can take into account wind shear and other effects, but when we split we get more number of puffs. So we have a merging algorithm also so that when the puffs grow they can merge together to reduce the number of puffs. And SCIPUFF can be used for multiple scales. It has been used from laboratory scale to global scale.

We do the model validation using various typical and experimental studies. Some of these are listed here. We have the PGT curves for short range and surface releases, the instantaneous dispersion data from Weil, Mikkelsen, and Hogstrom. We have used SCIPUFF compared with the laboratory dispersion data from Willis and Deardorff and also fluctuation data from Fackrell and Robins.

We have used SCIPUFF for continental scale field experiment ANATEX, which is across North America experiment. Also we have done validation with EPRI tall stack emissions experiment such as the Bull Run and Kincaid experiments.

Some of the other tests are listed here. One of them is ETEX. Eladio I think will be presenting a slide on ETEX. And we have found that it performs favorably compared to other long range transport models.

So what are the current research and development work that we're doing, and we are collaborating with a lot of other groups. One of them is the Los Alamos National Lab, where SCIPUFF is being integrated with the QUIC-Urban model so that it takes into account the building effects.

We are working with ENSCO for chemical deposition. SCIPUFF has been used as a plume in grid model for the CHIMERE model, which is a European model. We are working with ENVIRON to put in the gas, aerosol and aqueous phase chemistry for SCICHEM. We have worked with Penn State University group for ensemble modeling. And for source estimation we have worked for Aerodyne, worked with Aerodyne and NCAR.

So the systems which use SCIPUFF are--SCIPUFF is the core transport and dispersion model here for SCICHEM, and then the other one is the Hazard Prediction and Assessment Capability, HPAC, and the Joint Effects Model, which is also part of the DOD models. And then we have the MSRAM, which is the Maritime Security Risk Analysis Model, and there are slightly different flavors for different departments.

We have been trying to parallelize the SCIPUFF code, and we have tried to use OpenMP, and as we were saying, we are working with LANL to get the QUIC-URB model integrated in SCIPUFF. And other work we're trying to do is with SCIPUFF as an inline component of WRF-ARW simulations, and also source attribution.

So we have had success with parallelizing SCIPUFF in that initially the challenge is that when you run a parallel--the code in parallel and in serial, you tend to get slight differences in results. And we have set up the code now so that there's hardly any difference in the concentra-tion and there's very insignificant difference in the deposition and the dosage.

And in the QUIC-URB integration, we--the QUIC-URB represents building flow and dispersion in near field using Lagrangian particles, and the model runs concurrently with a continuous transfer, so once the puff grows bigger, it hands over--the QUIC-URB model hands over the puffs to SCIPUFF for longer range dispersion.

And for the WRF integration we are investigating embedding SCIPUFF inside WRF-ARW so that we can run the dispersion in sync with the meteorology. And using this we will have direct access to the full meteorological field from WRF.

Another area that we are working on is trying to get source attribution. In this we want to tag each source so that when we merge a puff we know that how much mass comes from that source, and using that we should be able to query the sampler and find out what is the contribution from an individual source.

So I would like to summarize that SCIPUFF R & D is ongoing in a managed environment, and the science in SCIPUFF is continuously being updated. The source of the core transport model is public domain, and we have worked with multiple contributors to advance the capabilities.

There is extensive model verification and validation. DOD has their own validation process. For example, for defense analysis we have found that SCIPUFF was underpredicting for convective cases, so we improved the SCIPUFF model to include skew turbulence and the results are much better than what it was before. So we are also committed to the regulatory air quality community.

Some of the applications that SCIPUFF is currently being used is for air quality permitting. It's part of the Appendix W alternative model. And also it's used for emergency response for DHS, Department of Homeland Security, and DOD and Coast Guard. If there are any questions, I can send by e-mail.

Mr. Bridgers: Thank you, Biswanath. As I'm transitioning slides and we hit the 5 o'clock hour, I know that some people may be leaving today for flights that are not going to be with us tomorrow. So if you are leaving today, I do wish you safe travels and appreciate your participation today.

And also, after we end the session, because I know there's going to be a mad dash for the door, I do ask if the regional modelers from the EPA would all congregate somewhere up here close to the front. I'd just like for all of us to get together for a minute or two. So now we will change presenters on SCICHEM to Eladio.

Mr. Knipping: Thank you, everyone, and thank you, EPA, for this opportunity to speak on SCICHEM. I'm Eladio Knipping and I'm with the Electric Power Research Institute. I'd like to recognize my colleague, Naresh Kumar, who's in the room, and also the SCICHEM development team, particularly Biswanath, who just finished speaking, and Prakash Karamchandani from Ramboll Environ. They have been instrumental in developing the SCICHEM model.

As Biswanath mentioned, SCICHEM and SCIPUFF both simulate the evolution of puffs in the atmosphere. These are three dimensional Gaussian puffs, but the models themselves are Lagrangian models. In fact SCICHEM is a Lagrangian photochemical puff model with different options for gas and aerosol chemistry, the most detailed of which are consistent with the mechanisms found in photochemical grid models. In summary, SCICHEM is also a photochemical model.

It is able to model the dispersion of primary pollutants and the formation of secondary pollutants. It can explicitly model the conversion of NO to NO_2. It can be used to model ozone and secondary $PM_{2.5}$. It can be used for near-source applications as well as long range transport applications. There is an option to simplify the chemistry for near-source applications. This refers to the NO to NO_2 conversion.

The features of SCICHEM 3.0. Its chemistry--the gas phase chemistry is based on the carbon bond 5 mechanism. And the aerosol and aqueous chemistry modules are based on CMAQ 4.7.1. So these are consistent, again, with photo-chemical grid models.

The dispersion, as Biswanath had mentioned earlier, incorporates the last ten years of improvements in the SCIPUFF model. It can treat point, area, and volume sources and it has the PRIME building downwash algorithm. It is able to be run in a manner which should be familiar to AERMOD users. And we have also the ability to specify background concentration fields based on photochemical grid modeling simulations.

A little bit of SCICHEM history. SCIPUFF, the dispersion component, was evaluated with tracer experiments and AERMOD databases, and then we developed SCICHEM in order to add chemistry into SCIPUFF. And it in turn was evaluated with power plant plume measurements. There were only sporadic incremental upgrades up to 2010, at which time a major upgrade effort was initiated around 2011.

SCICHEM was released as a public domain open source beta, the first beta of which was focused on modeling one hour NO_2 and SO_2. It was released in the middle of 2013. The second beta for modeling both primary and secondary impacts was released in the middle of 2014. And what we were able to do during these beta periods was obtain extensive user feedback from a variety of federal, local, and consulting groups.

And the final version, SCICHEM 3.0, was released on Monday, August 10th, 2015. Several of you probably got spammed by me announcing the e-mail. It is located on the Source Forge web site, sourceforge.net/projects/epri-dispersion. Again, it is available as a public domain, open source model.

SCICHEM evaluations have included theoretical studies and also evaluation with tracer experiments such as the European Tracer Experiment--I'll show a result of that--and also the AERMOD evaluation databases. Most importantly, the photochemical grid modeling component has been evaluated with aircraft measurements, for example the TVA Cumberland plume during the Southern Oxidants Studies, the Dolet Hills power plant plume, which I'll show some results.

And ongoing, we have an evaluation with the 2013 SENEX measurements from the Southeast Nexus Experiments. These were flights conducted by NOAA in 2013 as part of the Southeast Atmosphere Studies. And those include measurements of ozone and $PM_{2.5}$, so these will be rather exciting evaluations to perform. We also have an exploratory research study using measurements located at the Southeastern Aerosol Research and Characterization Study network sites.

On this slide I show the results of SCICHEM on the left and observations on the right for long range transport evaluation using tracer studies from the European Tracer Experiment in 1994. What we see is that there are consistent transport of the tracers, both when comparing the predicted concentration fields with the observations.

Now, this result is from the Dolet Hills power plant plume transects from the Northeast Texas Air Care (NETAC) 2005 Air Quality Study. And what we see for this simulation from left to right, NO_x, NO_y, ozone, and SO_2. What we see is that, you know, the peaks for NO_y, SO_2, and ozone are all within 20 percent of observed values. We are doing rather well with simulating this plume. This is an advanced

Lagrangian photochemical model accurately simulating ozone.

For the 54 kilometer downwind transect, the plumes tend to diverge a little bit from their center lines. And as many other presenters have said, it's really difficult to get the transport, you know, completely aligned. But the plume results are very consistent with the observations. And again, for ozone we are simulating the production of a 20 ppb ozone peak in the observations with an advanced Lagrangian photochemical model.

Now, one of the comments that we received during the SCICHEM beta periods was that the model needed to be stress tested, that we needed to be able to assure the community that the model could be run for annual simulations for different types of sources and in different chemical and meteorological environments.

So the objective of our stress testing is to test the robustness of the model for long term, annual applica- tions for these range of conditions and to demonstrate the calculation of secondary impacts in Class I areas by doing so. Our hypothetical sources are a power plant, a flare with highly reactive VOC emissions, and a petrochemical complex plume. In the interest of time, I won't be showing results for the domains that we have modeled. I will focus on the Southwest--what we're calling the Southwest Four Corners domain located in the Four Corners area.

For the power plant simulation--again, these are hypothetical sources--we are able to simulate $PM_{2.5}$ values in the range of .5 to 4.3 micrograms per cubic meter. Most of that is due to nitrate formation in the range of 0.4 to 4 micrograms and maximum PM sulfate ranges from 0.1 to 0.4 micrograms per cubic meter. Our ozone, fourth highest 8 hour average ozone impacts ranges, depending on location, from 3.3 to 8 ppb.

For the highly reactive VOC flares, we have $PM_{2.5}$ impacts ranging from 0.3 to 0.6 micrograms per cubic meter, with the details following. The fourth highest 8 hour average ozone impact ranges from 0.6 to 3.9 ppb, consistent with the emissions that were used in this hypothetical scenario.

And for the petrochemical complex PM impact, we have also now some small amounts of secondary organic aerosol precursor emissions, toluene and xylene. So not only do we simulate the formation of nitrate and sulfate, but we simulate a very small amount of secondary organic aerosol. But we are able to simulate secondary organic aerosol. In fact we are able to simulate secondary PM formation consistent with the emissions in all scenarios, and as well as we can model formation of ozone consistent with the emissions that were generated from these sources.

So in summary of the stress--let me summarize the stress testing. We were able to conduct stress testing for selected domains and source scenarios. And the average--the run times for these annual simulations range from 20 to 80 hours depending on the domain and source scenario. And what we're finding is that the model is robust.

So in conclusion, SCICHEM has been thoroughly evaluated throughout its history of development and shown to be a robust model that can handle different sources under different chemical and meteorological regimes.

SCICHEM has been demonstrated that it can be used to simulate pollutant concentrations accurately for different applications such as short range SO_2 simulations, short range NO_2 simulations, and long range ozone and primary and secondary $PM_{2.5}$ simulations.

Representative run times is around 15 to 30 minutes for annual SO_2 simulations, 20 to 40 minutes for NO_2 simulations, and 20 to 80 hours for annual simulations with secondary pollutants. Let me just reiterate one more time: an advanced Lagrangian photochemical model that can simulate ozone and secondary $PM_{2.5}$.

Additional details on SCICHEM can be found in the following peer reviewed journal publication in addition to the documentation included with the model. The citation is shown on the slide. It is an open access article, so it is free to download, and I will not say the actual URL because that wouldn't be nice. Thank you.

Mr. Bridgers: Thank you, Eladio. Eladio is helping you get out the door just a little bit sooner. So we have one more talk. In this one Rob Kaufmann is going to give some comments on behalf of the NAAQS Implementation Coalition. And Rob, just to be nice, I have a background slide for you.

Mr. Kaufmann: Oh, boy. I'm honored.

Mr. Bridgers: So Rob Kaufmann.

Mr. Kaufmann: Well, you can all read the slide. I'm Rob Kaufmann and I work for Koch Industries, and I'm here on behalf of the NAAQS Implementation Coalition. And Chet at the beginning of the day told me that since I go last, I have as long as I want. Fortunately for you, I do not have a 30 slide deck with embedded videos. I'm not planning to do any song and dance.

For the record I want to note that I am not related to Andy Kaufman, so I'm not planning to sing or lip-synch the words to the Mighty Mouse theme. However, I think it might be appropriate, if you are familiar with the Mighty Mouse them, with a couple of subtle changes, it could have been the theme song for this conference, "Here we come to save the day. EPA's Appendix W fixes are on the way."

Audience member: Sing it.

Mr. Kaufmann: What I do have--and I'm not looking for any comment from EPA on that, but it would have been good to start the day with that theme song.

I do have a very brief statement, and fortunately or unfortunately for you, it was drafted by lawyers. I'm not a modeler. I'm not an engineer. I'm not a lawyer, so bear with me. For those of you who aren't familiar with the NAAQS Implementation Coalition, it's comprised of trade associa- tions, companies, and what the drafter of this called other entities who confront challenges in the permitting and operation of their facilities under increasingly stringent NAAQS.

And our coalition has been in regular contact with EPA starting at the very highest levels, Gina McCarthy, Janet McCabe, and down to the level of Chet and his team here at the Office of Air Quality Planning and Standards. And we have been working with them and discussing the development of tools and policies and guidance to address the issues that arise as the NAAQS have been pushed beyond their limits by new and more stringent air quality standards. And we hope to keep that dialogue open and in fact plan to keep that dialogue open.

A lot of coalition members--and there are a lot of coalition members in the audience, API, AISI, AFPA, NCASI-- they've been investing resources and testing and modeling tools that have been provided to EPA. And in fact some of those results were the basis for some of the fixes to Appendix W.

And we really appreciate all the work that EPA has done over the last couple of years. They've identified some serious problems with the models. They've attempted to address them. However, as a coalition, we think that some of those problems still exist and have not been resolved.

And it's probably no surprise to you that since we represent industry that it's our view that current implementation policies and modeling tools continue to over-predict and in some cases significantly overpredict emission impacts, resulting in model results that do not reflect local air quality or public exposure.

Now, in our far distant past when NAAQS were far less stringent, there was what I might call headroom that would allow the overly conservative assumption of the models, especially as applied to PSD permitting, to not really present any significant modeling problems.

But as the standards have gotten tighter, the conservative nature of some of these modeling tools leads to the overprediction which I just referenced and could cause states to have to incorporate overly burdensome emission limits in both their attainment and nonattainment SIPs.

The proposed changes to Appendix W and many of the justifications for those changes were just released, as we all know. And coalition members are still evaluating them, reviewing them, and testing them. Some of that testing has been discussed at length today.

We are pleased to see that some of the--that based on our preliminary reviews some of those changes have resulted in significant improvements, but we believe that there is a continued need for collaboration between industry and EPA as we go forward with some of those model fixes, and AWMA presentations noted that as well. So we concur with that finding. And we will be providing some more in depth comments for the record once we've had time to fully dive into the Appendix W *Federal Register* notice.

In closing, in closing, we would note that although EPA acknowledges that there are some instances where, quote, the preferred air quality model may be shown to be less than reasonably acceptable, unquote, the new document shows a preference for modeling analyses over monitoring.

And it is our ongoing belief that a modeling based approach will increase the challenges to businesses and detract from the Clear Air Act's goal of ensuring that economic growth will occur consistent with the preservation of existing clean air resources. And that's it. I'm done. And I guess we can adjourn with George's permission. Thank you.

Mr. Bridgers: Thank you, Rob. Yes, actually that's one of the next official duties that I can do. But as I go through the official process of suspending for the night the conference and public hearing, a quick reminder that we do start at 8:30 in the morning. We do have ten more public presentations before we get to any additional oral comments.

The only other thing I would have to say is I think they're a little grouchy if you're hanging around here after 6 o'clock. So if you are a visitor and not an EPA employee, probably aim to be off campus in the next, you know, 30 minutes or so. But again, I hope you have a wonderful evening. For those that are traveling, I hope you have safe travels back. I suspend the conference and public hearing until 8:30 tomorrow morning.

STATE OF NORTH CAROLINA

COUNTY OF WAKE

C E R T I F I C A T E

I, Kay K. McGovern, do hereby certify that the foregoing pages 5 through 246 represent a true and accurate transcript of the proceedings held at the United States Environmental Protection Agency in Research Triangle Park, North Carolina, on Wednesday, August 12, 2015.

I do further certify that I am not counsel for or employed by any party to this action, nor am I interested in the results of this action.

In witness whereof, I have hereunto set my hand this 10th day of September, 2015.

/s/ Kay K. McGovern

Kay K. McGovern, CVR-CM
Court Reporter