STATE OF VERMONT
PUBLIC SERVICE BOARD

RULE 5.700

IN RE: WIND GENERATION FACILITY SOUND RULEMAKING

May 4, 2017
9:30 a.m.
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112 State Street
Montpelier, Vermont

Workshop held before the Vermont Public Service Board, at the Susan M. Hudson Conference Room, People's United Bank Building, 112 State Street, Montpelier, Vermont, on May 4, 2017, beginning at 9:30 a.m.

P R E S E N T

BOARD MEMBERS: James Volz, Chairman
Margaret Cheney
Sarah Hofmann

STAFF: John Cotter, Staff Attorney
Kevin Fink, Policy Analyst
Thomas Knauer, Utilities Analyst

CAPITOL COURT REPORTERS, INC.
P.O. BOX 329
BURLINGTON, VERMONT 05402-0329
(802) 863-6067
EMAIL: info@capitolcourtreporters.com

P R E S E N T A T I O N S

P R E S E N T

David Grass, Vt. Department of Health
Aaron Kisicki, DPS
Ben Edgerly-Walsh, VPIRG
Austin Davis, REV
Annette Smith, Vermonters for a Clean Environment
Dorothy Schnure, Green Mountain Power
Sash Lewis, Dunkiel Saunders
Greg Pierce
Paula Kane
Sally Collopy
Paula Pearsall
Bill Kaplan
Dustin Lang
Christine Lang
Elizabeth Cooper
Penny Dubie
John Brabant, Vermonters for a Clean Environment
Lynnette Combs
Hal Cohen, DPS
Howard Weiss-Tisman, VPR

CHAIRMAN VOLZ: Okay. We are ready to start. Good morning everyone. We are here this morning for a workshop as part of the Board's rulemaking process regarding sound from wind-powered electric generation facilities pursuant to Section 12a of Act 174.

The purpose of this workshop is to discuss the technical aspects of the Board's proposed rule on sound levels from wind generation facilities. We have received six requests to present at the workshop, and based on those requests we have set out a schedule. I think all of you got a copy of that earlier. There are presentations from Vermont Public Interest Research Group, Vermonters for a Clean Environment, Renewable Energy Vermont, Star Wind Turbines. Then we will take a lunch break, and then we will resume with Resource Systems Group, the Department of Public Service. We also got a late request from Les Blomberg to present on behalf of Paul Brouha, and we will allow him to do that if there is time. We are going to try to hold everybody to the time. We are going to hold everybody to the time that was allotted to them. So be sure you keep that in mind as you're going through your presentation.

Vermont Public Interest Research Group has 20 minutes. Vermonters for a Clean Environment has 40 minutes. Renewable Energy Vermont has 20 minutes. Star Wind Turbines has 35 minutes. We are going to take a one-hour lunch break, and then Resource Systems group has 60 minutes, and the Department of Public Service has 30 minutes. And then Mr. Blomberg, if there is time will go, and I don't know off the top of my head how much time you asked for.

MR. BLOMBERG: 15 to 20.

CHAIRMAN VOLZ: 15 to 20 minutes. So that's the plan for the today. I would like to remind everybody final written comments on the proposed rule will be filed by May 11, and the target date for making the filing with the Secretary of State and the legislative committee is May 16. So we have -- we have got a pretty aggressive schedule to deal with.

So with that, I would like everybody in the room to identify themselves. I'll start on my left here with the Department.

MR. KISICKI: Aaron Kisicki on behalf of the Department of Public Service. I'll be joined later in the day by Payam Ashtiani of Aercoustics

Engineering Limited. Mr. Ashtiani will be attending telephonically. I appreciate the Board's willingness to allow him to do that.

CHAIRMAN VOLZ: I think the phone line is open now for -- we got requests for people to call in and listen in. There may be people on the phone from the public who are listening.

MR. GRASS: David Grass, Vermont Department of Health.

MR. DAVIS: Austin Davis, Renewable Energy Vermont.

MR. QUIN: Howard Quin, sound consultant representing Star Wind Turbines.

MR. DAY: Jason Day, Star Wind Turbines.

MS. SCHNURE: Dottie Schnure, Green Mountain Power.

MR. DUNCAN: Eddie Duncan, RSG.

MR. LEWIS: Sash Lewis from Dunkiel Saunders.

MR. PIERCE: Greg Pierce, private citizen.

MS. KANE: Paula Kane, private citizen.

MS. COLLOPY: Sally Collopy, private citizen.

MS. PEARSALL: Paula Pearsall, private citizen.

MR. KAPLAN: Bill Kaplan, Fundamental Energy.

MR. LANG: Dustin Lang, resident of Swanton, Vermont.

MS. COOPER: Elizabeth Cooper with Vermonters for a Clean Environment.

MS. LANG: Christine Lang, private citizen.

MR. BRABANT: John Brabant, Vermonters for a Clean Environment.

MS. DUBIE: Penny Dubie, private citizen.

MS. COMBS: Lynnette Combs, private citizen.

MR. COHEN: Hal Cohen, Department of Public Service.

MR. WEISS-TISMAN: Howard Weiss-Tisman. Vermont Public Radio.

CHAIRMAN VOLZ: Okay. Back to the table.

MS. CAMPBELL ANDERSON: Olivia Campbell Anderson, REV.

MR. BLOMBERG: Les Blomberg for Paul

Brouha.

MS. SMITH: Annette Smith, Vermonters for a Clean Environment. We are sponsoring --

MR. AMBROSE: Steve Ambrose, private -- consulting acoustics, and dealing with wind turbines for many years.

MR. EDGERLY WALSH: Ben Edgerly Walsh with VPIRG.

MS. WOLFE: Sarah Wolfe with VPIRG.

CHAIRMAN VOLZ: We are going to send around a sign-up sheet so the court reporter can get the spellings of the people who attended and are speaking.

One thing I forgot to mention, after each presentation there will be 15 minutes for questions from people -- everybody in the room. Yeah. And then just so people know who we are, Kevin Fink is a staff member. Sarah Hofmann is a Board member. Jim Volz, that's my name, I'm the chair. Margaret Cheney is a Board member. John Cotter is a staff member. And Tom Knauer is a staff member.

MS. HOFMANN: You guys is the -- are the mics live?

MR. KNAUER: No.

CHAIRMAN VOLZ: Do we need them?

MS. HOFMANN: There are people on the phone, so if people could speak up when they are speaking. We will see if we can turn on the mic so whoever is presenting will use the mic.

CHAIRMAN VOLZ: Okay. I think we are ready. So are there any other preliminary matters we need to discuss before we start with the presentations? If anyone -- is anyone on the phone right now? I'm only asking so that we know whether we need to worry about being able to hear.

(No response)

CHAIRMAN VOLZ: I guess we are okay for now. When you use the mic, you have to push the button to turn it on. And when you're done speaking, you should turn it off, because if too many mics are on, the system doesn't work right. You need to speak clearly into the microphone right in front of your mouth. Otherwise it doesn't work.

So I guess we are ready to hear from VPIRG.

MS. WOLFE: Thank you very much. Again my name is Sarah Wolfe. I'm the clean energy advocate at VPIRG. I'm joined today with Ben Edgerly Walsh, the climate and energy program director at VPIRG. We have been working on this proceeding since

the fall and the workshop process that happened then. We are engaged closely with acoustics expert Scott Bodwell of Bodwell Enviroacoustics who unfortunately couldn't join us today.

MR. KNAUER: I think you're getting feedback from the two mics.

CHAIRMAN VOLZ: All the mics need to be off except the person who is speaking. Make sure your green light is not on. There will be a green light if it's on.

MS. WOLFE: Thank you very much to the Board for allowing us time to speak this morning and for your thoughtful consideration of ours and the other parties' comments in this proceeding.

Because Mr. Bodwell can't join us today, and because we have spent significant time throughout this proceeding discussing the modeling and the monitoring protocols of the proposed rule, I'm not going to dwell as much on that today. As we said in our comments, we largely support the construction of this rule, and we think it is based on acoustic best practices.

We did note several technical areas that could have significant on-the-ground impacts that we would appreciate the Board's careful review

of to ensure that this rule is not unnecessarily more restrictive than it's intended to be. But because we support the construction of the rule, our primary concern here today is a policy question really rather than a technical acoustic question, and that question is should this rule set forth in this proceeding allow for the development of wind in the state or not.

And we have looked at the research. If we had learned that there were health risks at the levels of sound that we are talking about, we would have advocated for a lower sound standard at the beginning of this proceeding. If we had learned that there were health risks at a sound level so low that wind would not be possible in the state, we would have gone to the legislature and advocated for a stop -- to not build this technology anymore.

This is what we have done. We have successfully advocated for a ban on hydraulic fracturing for those reasons, a ban on toxic chemicals like BPA and phthalates in children's products. The research doesn't support that ban. The research doesn't support a ban on sound levels at this level, at the levels that we are talking about. It's not supported by the evidence, by precedent, or

by Vermont law.

I want to discuss before I move on to the other aspects of this specific rule just the important context that is in place whenever we have a discussion about energy generation, which is that here in the United States when we turn on the light switch, we expect the light to come on. That demand is a constant in this discussion. Even as efficiency and conservation technologies improve, and we continue to work to expand our efforts in those areas, we expect -- and ISO New England the Department of Public Service have forecasted -- that our energy usage is going to increase not decrease over the next few years. And that's largely due to increased investment in electric heating and transportation alternatives.

The Board is very familiar with the Act 56 tier three implementation process which encourages the already heavy investment in those areas. That new technology, that increase will call for new generation. And if that new generation does not come from renewable sources, it will come from fossil fuels. Taking a critical renewable energy source off the table right now, which again to be clear, that we think this decibel limit will do, means that we are

inherently encouraging new fossil fuel generation. I'm not going to dwell here today on the significant proven health and environmental impacts of fossil fuel generation other than to say that it's clear that the impacts of that generation lies primarily on the communities that host that generation, and that generation is not found in Vermont. And we cannot continue to let other states bear the burden of our energy needs in this way.

But also to be clear, those impacts do not know state lines. Even if the primary impacts do occur to people in other states and in other countries, we still feel them here today both economically and environmentally. And that's why state policy dictates that we move towards renewable energy and away from fossil fuels and other non-renewable resources. So that's an important context as we continue this discussion and any discussion under renewable energy in the state.

As I will discuss, the evidence doesn't support this low of a decibel level as it relates to public health. So what we are talking about is more of an aesthetic or annoyance-based decision. However, based on the studies that we have looked at around annoyance from wind turbines, the nighttime

limit of 35 decibels is contrary to Vermont law and the precedent around aesthetic decisions. There are two basic regulatory principles at work here when we are talking about aesthetics in Vermont. The Quechee standard which holds that noise or negative visual effect is an undue adverse impact when it would be shocking or offensive to the average person, and the common law which protects landowners when impacts cause substantial interference with a normal person's enjoyment or the use of their property.

We looked at a number of these studies that specifically examined annoyance, and it's clear that there is some level of annoyance from wind turbine sound, but the number of respondents who said that they were annoyed at all levels of sound between 35 to 45 decibels was a small minority of the respondents. Neither the Quechee test nor the common law is intended to protect against noise from a small minority of residents. This falls far short of the standard of being shocking or offensive to the average person. And by the same token, it could be characterized as a substantial interference with a normal person's enjoyment of their property. So based on this evidence that -- neither the Quechee test nor common law support a standard that's this

low.

It's also unprecedented, and we have talked a lot about how this is -- there is no other standard in U.S. that's as low as what's being proposed here. But I want to dwell a little bit on Denmark and Germany as two jurisdictions that have been brought up frequently throughout this discussion as places that do have comparably low standards and have continued investment in wind power throughout the modern day. Really that comparison is unsupported. The two lowest land use designations here, the noise sensitive land use and the purely residential land use, are considered in these countries to be their dense urban zones. This would be the equivalent of where we are today; downtown Montpelier, downtown Burlington, downtown cities in Vermont having the lowest sounds limits.

This is an acknowledgment in these countries of the working landscape and the desire to allow the land to be continued to be used for economic and environmental purposes including renewable energy. And an encouragement for urban density, for people to move into these urban zones. Here in Vermont we have a similar appreciation and prioritization of the working landscape, the similar

acknowledgment that we want it to be continued to be used for those purposes.

Most areas with strong wind resource here would be equivalent to the open countryside and heartland, mixed villages, mixed areas designations which are between 42 and 45 dBA. I want to touch a little bit on the studies that were listed in the Board's filing in the source documentation of scientific information list. These studies we went over in detail in our comments, but I've provided a high level summary here.

As you can see, the conclusion from these studies is that none of them support a level of 35 dBA LEQ at 100 feet from the residence even when discussing annoyance specifically. Most of these studies have an inherent recognition that annoyance can lead to secondary impacts like sleep disturbance which can lead to tertiary health impacts. These studies take this into consideration when setting their health recommendations, which all either explicitly support a short duration limit of 45 dBA or an annual limit of 40 dBA which is shown by our expert's testing in Maine, which we discussed in our December presentation, would be achieved by a short duration limit of 45 dBA when paired with the

conservative modeling approach that has been laid out in this proposed rule.

I would also note that the exterior recommendations found in each of those studies are measured at the facade of the home. We very much support the protocol of measuring at 100 feet from the residence, but it's worth noting that, of course, in that hundred feet the sounds actually measured at the facade of the home would be quieter than those measured a hundred feet away.

To reiterate, none of these studies support the nighttime limits set forth in the proposed rule.

I'll briefly touch on setbacks again. We touched on this significantly in our comments that we filed in January. But I want to be clear that this setback as proposed in this rule is also highly restrictive and unnecessarily so. Given the low decibel limit that has been proposed, the setback is largely duplicative. The restricting factor will be the decibel limit.

In the rare instance where the setback is in fact the restricting factor, that setback would be unnecessary since the levels of sound at that residence would clearly be below the set decibel

limit. Even if the decibel limit were to be increased, a setback would still be unnecessary for regulating sound because the decibel limit would be set based on public health best practices and would adequately protect against potentially harmful levels of sound.

I would also just point to this illustration which we also shared in our December presentation as a good example of just how significant the shift from 45 decibels to 35 decibels is. You can see the level of 45 is the inner line of the red band between the yellow and the red, and the level of 35 is the inner band of the white band there. And so you can see it's about 3,000 feet from the middle of the turbine string to the 45 decibel line, and I would estimate that it's over two miles to the white decibel line -- sorry, to the white 35 decibel line.

That concludes my presentation, but I'm happy to take any questions from the Board or others in the room.

MS. CHENEY: I have a question. So on this map that you just had on the wall, I can see where 3,000 feet -- did you just say that the white is two miles from the turbines in this illustration?

MS. WOLFE: I haven't measured it, so I can't say for certain. I was just looking at the 3,000 feet and then estimating out.

MS. CHENEY: Okay. Thank you. And one more question. You mentioned a small minority as being annoyed, and I'm wondering if you're using -- if that is the same as on your next to last slide where you mention the 10 percent annoyance cited by the Health Canada study. Is that what -- the same?

MS. WOLFE: That was one of the studies that we looked at. We additionally in our comments reviewed several of the primary studies that were cited by the Massachusetts DEP review that actually were the folks who went out and asked these people how they felt. And the numbers found in those -- the 2004 study found that seven and -- sorry, 20 percent described themselves as very annoyed between 37.5 and 40 dBA. 36 percent described themselves as very annoyed above 40 dBA. And other numbers were similar, you know, actually larger sample size only six percent in the 37.5 to 40 dBA range and 15 percent over 40 dBA range reported annoyance out of 754 people that responded in that second study.

MS. CHENEY: In which study are you referring to there?

MS. WOLFE: So these are peer-reviewed studies that were cited by the Massachusetts DEP. This is on page 12 of our comments. This was Pedersen & Waye. They're 2004 and 2007 studies that I just cited.

MS. CHENEY: Thank you.

MS. HOFMANN: So you indicate that our nighttime limit is unprecedented. Aren't there some jurisdictions where they are using 10 decibels over ambient as the standard, and thus, couldn't they be similar to what we are talking about in our proposed rule?

MS. WOLFE: We are unaware of any place where that 10 decibels over ambient would be treated as low as this. Because this is so --

DR. QUIN: May I offer a correction on this please? I used to work in Massachusetts DEP. I was the state noise analyst, and we took a look at some projects like this in a few locations.

We actually did find a one or two spots in the Berkshires where that the 10 over level was pretty comparable to what you would have gotten in Vermont, so we actually had -- one of the projects we were looking at, which we could not -- we took a look at them, and the developer came, and obviously we

reviewed it carefully. And it was about -- the ambient was around 25, and it was about 35. So it actually does occasionally happen in very quiet locations, but that was an extreme case. It only happened once or twice in the very hollows below large mountains.

MS. HOFMANN: I'm sorry. I know we went around at the beginning. Could you identify yourself please?

DR. QUIN: Howard Quin. I used to work at the Massachusetts DEP. I was the state consultant -- wind analyst for all the wind turbines, so we looked at this a lot.

MS. WOLFE: Thank you. I would just reiterate that even if sounds were -- even if sounds were so quiet that it would be 10 dB over the ambient, setting the standard of 30 or 35 dBA based on that, is trying to -- is overly extreme based on the studies that are set forth here.

So even if there were -- there was occasional or sort of unique instance where that might occur, that would be sort of overly extreme based on the Act 250 review, based on the common law precedent, where we are trying to protect the average person, not the sort of unique case.

MR. COTTER: Ms. Wolfe, this is a question about the comments that you submitted in advance of today. So I understand your consultant is not here, so I don't know if you're able to answer this or not. But the other acousticians in the room, if you could keep this question in mind, and then when it's your turn to present, you could go ahead and answer it at that time.

You recommended -- the proposed rule says for modeling, we should model a receptor location at four meters I think it was. So roughly 14 feet. And then for the operational monitoring phase the microphone height is set at four to five feet, and VPIRG recommended that the modeling receptor height be brought down to be consistent with the four to five feet for the monitoring height.

And I was curious, do you know what happens to the output of the model if you lower the model receptor height from four meters to four or five feet?

MS. WOLFE: That would be a question for our expert. This was a comment that, you know, he encouraged us to include. It was based on consistency. We think that if the model -- if the model is going to be consistent with what's

ultimately monitored, then the microphone height should be in the same place as the microphone was essentially modeled to be.

MR. COTTER: My understanding is that the point of modeling the receptor up at that height is because it's assuming that there are bedrooms on the second floor of a house. And so I'm curious if you know, or if other folks can address it when their turn comes up, if consistency is that important should we be lowering the modeling receptor height or raising the microphone height for monitoring purposes?

MS. WOLFE: I won't address that question. I'll leave that to the other acousticians in the room.

MR. COTTER: Thanks. I didn't mean to ambush you.

MS. WOLFE: It's okay. I appreciate the question.

MR. KNAUER: In your written comments you state that the proposed rule would be a functional ban on wind development in Vermont. Do you have an opinion as to whether it's the proposed decibel level or the setback or both?

MS. WOLFE: So certainly the more

restricting factor is the decibel level. However, we would be very concerned with even just the setback, as we feel it's unnecessarily restrictive and would likely take a lot of potential wind sites off the table.

MR. KNAUER: Okay. And I know earlier in the proceeding, if memory serves, VPIRG was supportive of a 45 decibel level. Am I accurately characterizing that?

MS. WOLFE: Yes.

MR. KNAUER: Above 35 is there a level that would not be a functional ban?

MS. WOLFE: Well we continue to support a level of 45 as paired with the conservative modeling practices that's currently set forward. We would also support a level of 42 if the modeling parameters were set to match what's happening in Maine.

Currently they are even more conservative than what's happening in Maine. And so with 42 it would potentially still take too many sites off the table. But we would support that if it was made to match what is working in Maine with a level of 42 in very similar terrain.

MR. KNAUER: So is it VPIRG's opinion

that anything below 42 would serve as a functional ban?

MS. WOLFE: We would have to look at exactly what the modeling parameters were. But we were very concerned even at the level of 40 in the draft rule in February, with the conservative modeling parameters that that would not allow for more wind in the state.

MR. KNAUER: Thank you.

MR. EDGERLY WALSH: Two brief points. One, we haven't asked the acoustic engineer that we contracted with to review the 35, 36 each decibel level on up. Then I would also refer back to our earlier comments that made clear, and Sarah referenced this in her presentation today, that with this kind of conservative modeling we are actually talking about a decibel level that's significantly lower than the number on the page in the limit. And that's why we think that, you know, pairing something in that 42 to 45 range with this kind of conservative modeling is actually quite protective from a public health standpoint, and perhaps even a little bit more restrictive than is strictly necessary to be protective of public health.

CHAIRMAN VOLZ: Any other questions

from anybody? Okay, VPIRG. Thank you.

I think we are ready for Vermonters for a Clean Environment.

MS. SMITH: They have some computer -- technical things to set up, so I'll make some comments while they are doing that.

CHAIRMAN VOLZ: Okay. Identify yourself for the record. We know who you're.

MS. SMITH: Annette Smith, Executive Director of Vermonters for a Clean Environment. We have been working in the public interest with the neighbors on these issues for eight years. And I would like to make the distinction that while Vermont Public Interest Research Group has those words in their name, they actually represent the industry, and their interest is to see more wind development. Our interest is to make sure that the people of Vermont are not harmed by the industry.

And it's been consistent throughout our work on many issues in the state. And so we are here to assure that people's health is protected, that people's quality of life is protected, that people have the peaceful enjoyment of their properties, and that they don't have to do what we have had -- what we have watched happen which is people abandoning

their homes and getting sick as a result of the wind industry.

We are strong supporters of renewable energy and want to see the renewable energy business succeed and believe that what has happened in recent years has actually caused more opposition because we have not addressed the noise issues in an effective way. And so we know that the standards that we have aren't working at 45.

And so we appreciate very much this opportunity to educate, and it looks like we are ready. So thank you.

MR. AMBROSE: Can someone shut the lights down, please? Because I ended up using white in a lot of my slides.

CHAIRMAN VOLZ: Could you identify yourself for the record?

MR. AMBROSE: I'm sorry. My name is Stephen Ambrose.

CHAIRMAN VOLZ: Thank you.

MR. AMBROSE: The bottom of the slide. I've been an acoustician, noise control engineer, environmental acoustics 40 plus years, and it's a profession I have thoroughly enjoyed having come from the background in civil engineering. And I have

learned this trade by doing. And one thing I learned early on from my mentors was people do not complain about how loud the sound is. They complain about how loud it is above background.

And the correlation -- we basically say it makes it very simple for a noise control engineer. It's much easier to put a noisy noise source in a noisy environment than to put a noisy noise source in a quiet environment. And this is what happens with quiet; sound travels great distances. It's when it runs into the background sound level that it disappears. Urban areas you end up having the sound level disappear into the background fairly close to the noise source because there are so many other manmade noise sources participating in the environment. What happens in quiet areas, it's quiet. There aren't any other noise sources. And to end up saying that wind exists as a noise source is false, and I will discuss that.

Wind is a contaminant. We do not want wind on the microphone because it distorts and ruins measurements. So I'm here because I'm frustrated by my profession. They have lost track of why we do noise control engineering, and that is so industry can be good acoustic neighbors. I know when I

succeed doing my work, when the client and the neighbor says, gee Steve, is that all the noise there is? That's not bad. That's success. When you put something out there and they go, oh, that's awful, you missed your mark.

The hard part of noise control engineering, which is the wind turbine is making it fit into the environment that it's in, and you have to use your ears. Your ears are the most powerful tool. A sound level meter is nothing more than a volt meter that's been designed to measure the response of a microphone. It only measures volts. There is no intelligence to it. They can collect lots of numbers, no intelligence.

Okay. This is what I have observed in Vermont, Maine, Massachusetts, throughout the country. We have acoustic experts who are missing the mark. We have international standards that do not address people sufficiently. We have measurement protocols that deal on the science of the measurement not on the listening of the neighbor. And it's not working, and it's sad.

Okay. Here I am. My background, I have been doing private consulting since 1990. I worked for Shaw Group and Stone & Webster. And they

kept calling me back to work, so I worked into the 2 thousands, 2010 I think was the last time I worked with the Shaw Group. I love my profession. And I've kind of gone through this already. U.S. regulators, you're not the experts in acoustics. I'm the expert. You tell me how loud you want it to be, and if you tell me it's too loud, I go back to my experience that says, no, 45 is too loud because the area is so quiet. You need to address the neighbor. You do not want complaints. And I've hit on this, noticeable increase in noise level. Loudness when it warbles. Objectionable sound character like a Harley-Davidson motorcycle. Tonal frequencies like a bad ballast transformer in a fluorescent light. Or if it interferes with normal human activity. A conversation. If a Harley goes by, you kind of have to pause your conversation, wait until the sound goes away, and then pick it up again.

The most critical is sleep. And this is where lives are being devastated. I know of two people, and I've met one of them who have committed suicide because they could not leave their home for relief from their wind turbine. Sad. This is why we are here. This -- I could end my speech -- my presentation right here. If you look at the red line

this is based on EPA studies that go back to the 1950s, '60s, '70s, those dots represent samples of communities being classified and the human response to noise levels.

What I have done is I have normalized the receptor background sound level. It's kind of twisted what the EPA had done, so I can end up saying how loud can a sound be in this environment. And I look at the studies, and I go old rule, strong appeals to stop the noise. What's the sound level? 40 to 45 dBA. Amazing.

And you look at those gray lines, those are the Pedersen & Waye studies. Strong correlation with EPA. Amazing. And Vermont being in green at the bottom, those are the sound levels where in most communities 25, 27 dBA and quieter. But one of the things about the human response is when does it interfere with activity? And the most sensitive activity is sleep, and the trigger point, the onset, is 30 dBA.

And so what I have always ended up saying if I'm in an environment that's 15, and I want to protect people, I can go up to 30 dBA, a 15 dB increase or even maybe marginally 35. So the noise level increase is much more generous in the very,

very low. But the trigger point is sleep which is 30 dBA. The onset. Now some people like my wife, you can haul her away in the bed when she is sleeping and she won't even wake up. She is on the 40 dBA sound or above, but most of the population is in the range of 30 to 35. A good compromise, 35 dBA. That's -- and we will find other evidence I'm going to present that shows that.

And my feeling is with Maine since we know, excuse me, with Vermont, we know the environment is quiet. Why don't we just mandate we have a quiet environment except in our urban areas. Burlington. And let me tell you, having been there at night, it's quiet after the bars close and the college kids are snoozing.

So the ambient baseline for Vermont, 27 dBA, even though it gets down to 22, 25. Even RSG has measured 19 at sites. You adopted a 42 for daytime. It's reasonable. EPA would end up saying daytime ends at 7 p.m. So you set a noise limit of 35 dBA. Well this agrees with ANSI S12.9 part 3 which most acousticians should use as a guideline for when do people complain. And when you want to end up having compliance measurements you want an observer, someone to listen there.

What's the first thing I do when I get out of the car to do a noise measurement? Do I hear the noise source? I mean it's that simple. And if I don't, then I go to the operator and say what's going on. He says, oh, we shut it down for maintenance. So it's simple. If you're going to do a wind turbine noise measurement, you better hear the turbine, and for wind turbines they're worst when they are about 60 percent power. But I would like to measure at 80 to a hundred percent.

Okay. I spent two weeks off and on trying to read your sound rule. It is -- I can't believe it. When I grew up and was learning this profession, sound regs were one page; gave the limit, and followed international standards on most. This one got so twisted, have experts transform a simple sound assessment to very complicated, thereby making enforcement impossible. That's where you're at. It's unbelievable. And this is the one that gets me the most. These companies work for the Mass. DEP and clean energy to promote wind turbines. And they have captured you, regulatory boards, in Massachusetts, in Vermont, and around the country. I cannot believe it. People who are basically installing wind turbines writing the rules. Careful. And this is my

-- I just said that.

Okay. Ambient sound measurements. Verify. What's verify mean? Listen. Acousticians have well-documented environments. As a matter of fact, here's a company highly respected HMMH. They have got a noise thermometer that shows quiet rural nighttime it's about 25 dBA. Look where Lowell and Sheffield are. 20. That was measured. Here's another company. They are in agreement. Same thermometer. Different presentation. Measurements have to be made in proper locations. Out in the open away from obstructing noise or noise source. Wind and trees. Why put a microphone under a tree if you're going to hear leaf rustle. It raises the ambient. It's a false measurement. Putting it near a snowmobile trail you're going to get a high LEQ because the loud snowmobile goes zipping by. Only a matter of seconds, contaminates the measurement for that period.

Here we have got microphones in the woods. This is here in Vermont. The wind screens are so close to the branches that I can't tell for sure what -- if a leaf rubs against the wind screen it's going to make a fuzzy sound. Contaminated measurement. This one gets the heck out of me. Here

we have got a microphone out in the field exposed to wind, and the anemometer is behind the trees not exposed to wind. So we are going to get microphone wind noise with no wind speed. And this is the coup de gras. This happened in Massachusetts. First set of measurements were made in the trees. Second set of measurements made in front of a reflecting house for a compliance test. Not good. And these were plotted. They gave the coordinates, and I plotted them. This is where the -- I have to curb my tongue, they're only estimates. Wind turbines are measured at test facilities. They are flat ground for miles. And they measure at 1.5 times the height of the hub. So they are in the near field to the wind turbine. You really need to get three to five height distances away before you get into the far field where the sound spreads out in a predictable pattern. ISO 9613, the rule that they use to regulate or to predict, it only predicts the long-term average for stable weather. Remember, they measure flat ground. Varying topography like in Vermont has all kinds of weather. We do not understand the layering of the atmosphere with altitude. Different wind speeds, different temperatures, different humidities, all those variables in there. When we are in close to

the noise source, those variables have very little impact. But as we get farther and farther away, they become more significant.

So the noise model is only good for a thousand meters. 3,000 -- 3,300 feet away. And it has an accuracy of plus or minus three dB. The height difference between the noise source and the receiver should be 30 meters. No greater than that. Because the model doesn't work, it hasn't been calibrated for that. And I'm going to show you why. I did the layering structure, but here's -- from the CADNA model, the people who write prediction models for the noise standard. Problem, nobody knows layer structure. This is why the models are deficient. And that was from a lead writer for CADNA.

Okay. In ISO 9613 which is the standard, it tells that it's a ground which is approximately flat, horizontally over the constant slope. This section disqualifies itself. You can't use ground attenuation. The alternate method is only valid for dBA. Wind turbines are very rich in low frequencies, so dBA is not really an appropriate term to use at all. So what that means is ground attenuation doesn't exist in the model. It's basically -- it should not be used, should not be

permitted, because it's going to introduce an error between two and four dB, if used, depending on the distance.

Now this is one that's going to take awhile to go through. The bottom is distance. Then on the Y axis is height to 30 meters. This is the differential height. Everything underneath that yellow line is where the model has inaccuracy. And above that line, which is all of Vermont, the model doesn't work. It does not work. You have to go back to the basics. Sound power level predicted to a distance with atmospheric absorption. That's about the basic that you can get.

And the problem with wind turbines is when you get far away, and you're up on a ridge, they are not a point source. They are a line source. The difference between a point source and a line source is they decrease at different rates. A point source decreases at six dB per doubling of distance, which means 90 at 50 feet, at a hundred feet it's going to be 84. And at 200 feet it will be 78. That's how it decreases. A cylinder, much smaller decrease, wind turbines when you're at a neighbor's house, appears online source. It's a much lower -- this is why we are getting errors here of predictions that are under

what they measure. And it's not because they are measuring wind. They are wind contamination. This was done years ago. And I remember it was done by Ron Hornjeff a consultant. He's retired, in Massachusetts. He looked at all these wind turbines that are operating, and compared predicted versus measured. And we normalized it to what the level of predicted was being zero.

So all those red bars indicate how much the model missed it from the actual measurements. Kibby. That's a huge site. And they are all missing 3 to 12 dB. What I was taught at Stone & Webster since we have unknowns about our noise source, how loud it actually can be, and how the atmosphere works, we put in a design margin depending on the source it would be three to five dB to account for this so that we would not surprise the neighborhood with it's louder than we thought.

Okay. They are up -- there is two noise prediction models. One is the Nord 2000 which is an European model that's being used, and it's versus the ISO 9613-2 which is predominantly used here. Wanted to point out that the measured is an actual level predicted as an estimate. You look at the red line there, that's the Nord model, and those

little diamonds represent the measurements. The green -- the ISO -- is down at the bottom of the curve, and you can see in the 500 hertz band it's missing by five dB. That is why we have to be careful with noise models. They are not more accurate than a measurement, because the measurement accounts for what nature is doing to the sound.

I'm sorry. The baby had to come back. I tried to read this and understand what it meant. And my little friend, same amount of hair I have, they can go on forever because you've got to keep getting 12 samples, and they get to choose which samples get put into the protocol. And they use a technique called binning, which means how is the measure compared to what we predicted. And if it's too loud, we can end up saying, well, that's wind noise, that's contamination. We can throw that data out.

And I took 12 measurements, and I had five that exceeded the noise limit, yet when you average all 12 together, they complied at 35. Yet when you do the true math in acoustics where you add logarithmically, they exceeded. People don't take a year, six months, an hour to decide that they like a sound. They let you know in an instant. It really

is. It's just if they know the sound is temporary, they will tolerate it. When they don't, they know it's forever, they are persistent.

Here is the simplest of compliance tests. Turbine on, turbine shut down, with an impact assessment. I'm sorry that -- is there a focus on this?

MS. WOLFE: That's a little better.

MR. AMBROSE: Just too bright in the room. It was great on my wall at the house. But you can see the modulation of the turbine, the fluctuation people are always complaining about. It's always going thump, thump. Then they are going to the shut down. That's where you get that rising peak because the blades now aren't working efficiently and everything is starting to shut down. And as it goes down you get that little blip which is as the mechanicals kick in. And then it's off. And there on the bottom, that's the ambient. And what it's saying there it's 27 dBA in the ambient. The peaks are at 46. Well that looks like a 20 dB increase. Yes. People will complain.

What I tacked on the end of this is an impact assessment. And it says the people will complain. Widespread complaints, yeah. It just --

it sounds awful. Appeals to stop the noise. Sounds like Vermont. And this was done way back. Wind masking. Faux argument. That is -- these are rationales that they are being used. These are all faux. The only way you can get these to work is if when you average the data over time. And if I was to speak, and you were going to listen to my average sound to make an evaluation of what I've said, this is what it would be. Mmmmmmmmm. Doesn't work. It just hides everything. Everything.

And this is Karl Bolin. His doctoral thesis shows that a wind turbine can be heard -- tend to be quieter than the ambient sound level. It's because of its unique acoustic signature, its sound character. We recognize things because we can process a signal-to-noise ratio. We can pull information out.

Infrasound. This is serious. I can speak from personal experience. I have been a wind turbine victim of this infrasound. Anyone on the Board prone to motion sickness? Because if you are, beware. If you're not, you're blessed.

I was a radio navigator in the service. We used to joke and said why don't we give Ambrose an airsick bag with a clear bottom so he can navigate

while he's sick. Well we never got lost. I was always able to navigate, but it's a miserable feeling. Absolutely. And this graph here shows what it looked like outdoors. Kind of a fuzzy black line. And but indoors, due to the structure of the house filtering out a lot of the higher frequencies, these are the pressure pulsations that are occurring in the house that the ear senses and the brain responds to. And here's -- this is me. Nauseagenic frequency motion sickness when the ISO standard. It shows as the wind turbines are getting bigger and bigger, they are getting lower in frequency. So they have moved down into the nauseagenic range. Early on, wind turbines did not do that, but once you get into the one hertz range and lower, you're going to be sick.

And I will give you this slide. I wasn't able to print it out. And this is my evidence doing the Bruce McPherson study, and it has been a peer-reviewed report, and we correlated about three months after the fact the reason why we were having such a hard time getting data is because we were sick. And when we plotted our journals of measurements and what we are measuring and what we are doing and how we felt, we knew nothing then about wind turbine syndrome. Nothing. It turned out there

is a strong correlation to electric power output to how we felt. So I think we validated Sue and Ed Hobart in their house. We met them. Five minutes later they told us, use our house. They invited us in. We set our instruments up on the dining room table. They bought dinner, brought it in from a restaurant. And then they said the beds are made up. We are going to go sleep elsewhere. We are taking the dogs. Abandoned their dream home to us. That's the third time. I have had two others do it to me.

Okay. This is what your noise standard does not -- your noise rule does not address. Wind turbines cause these, they are not audible, but loss of well-being, you know, feeling good about yourself, feeling good about being at home. Cognitive ability. How about having, with 35-years experience, having to pull out the manual on a sound meter to calibrate it properly that you've done for years. Stress. Sleep disorder. Interruption. Okay. You can wake up at night, but when you never can go to sleep, that's bad. And the nausea, the headaches, the vertigo. Yeah.

You guys have done excellent, I was -- you could have pushed me over a feather when I heard that you were considering 35 dBA. Absolutely. And

you also ended up doing the setback. Sound level correlates to setback. The higher the sound level, the more the setback. And indoor 30 dBA with the WHO. That is so you protect everyone. Everyone deserves sleep. By having 35 outdoors, the structure of the house will provide some protection. It will bring the level down from 35. The advantage, 35 is called by ANSI as marginally compatible. We are not going to protect everyone. But we are going to get the majority of them. 30 is fully compatible. We will protect everyone, even the ones that are most needy, children and all that.

You did very well. I compliment you. I would end up saying that we have to be very careful about that's low frequencies getting into the nauseagenic frequencies as these turbines get larger and larger. This is where the serious problems are going to be occurring.

So I conclude there is no G in the computer model. There is no wind masking. That's a contaminant. Predictions are unreliable especially beyond a thousand meters. And all measurements need to be attended. It's just lazy to go out there with a meter, set it up, and walk away and think that you're assuring quality measurements by saying, oh,

I've got a thumb drive. It's going to capture wave files, or I've got a wind speed monitor that will advise me when I have too much wind. No. You go out there, and you measure when you hear the noise source and all other sources are at a minimum. I mean it is, yeah, it's pretty lousy to get up from a hotel at 11:00 at night and go out and stand there at one o'clock in the morning the only person there and do measurements between 1 and 4. But if you want to do your job right, that's what you do. And it's hard. It's hard.

And I want to thank you very, very much. I think -- I am so impressed with the Board's decision in this direction. I have been working at this almost six years all across the country. And Vermont was the last state that I thought would be the first. But you've got it. You're superior to Maine because Maine was just a feeble compromise at 42. It should have been 35.

As a matter of fact, Maine and Massachusetts before they wrote their new noise standards it used to be -- or Maine was five dB above ambient before they rewrote the rule in '87, '89. Massachusetts, they deal with the background sound level in a 10 dB increase. It's a very, very fair

way to do it, because it deals with the way people respond.

The thing is that we know now that the fact that the trigger point for the human response starts 30 to 35 dBA. And this is where we are at today.

Thank you very much. I really appreciate it.

CHAIRMAN VOLZ: Thank you.

MR. KNAUER: Mr. Ambrose, you said using a ground attenuation factor in the modeling would cause a two to four decibel error. I just want to have you speak about that a little bit more. And does that result in an understatement or an overstatement of the modeled sound level?

MR. AMBROSE: Ground absorption, I'm going to try to stay away from the science. It's a way of attenuating the signal, the sound level with distance. A wind turbine, remember that slide where I had the -- Vermont was up the side? The noise source has to be near the ground for ground effect to occur. And they found these ratios where they can -- 30 times from the height of the noise source to the -- you can get ground attenuation in that 30 times from the receiver. So a wind turbine you have no 30

times. It goes out tens of miles.

The other thing is a wind turbine on a ridge is like an airplane. It's up in the air. When you're on the ground listening to the airplane fly over, is there any ground attenuation as the sound travels across the ground to get to you? No. Because the sound is coming down from above. Well the wind turbine same thing. The sound is coming down from above. It doesn't -- ground attenuation is absorption of the ground for sound that hits it perpendicular on that. It's -- wind turbines they don't. They are too high. This is where the errors are coming in. You're playing -- they are playing with a model. I mean you can -- there is so many parameters in it that can be manipulated, it's just sound power level, distance. Semicircle of divergence, spherical, cylindrical. Use what's appropriate for the distance on that.

Traffic noise is viewed as a cylindrical. These guys are always filling in the gaps so it radiates as a cylinder like this. Wind turbines on a ridge is individual point sources, but when you get far enough away where the points are closer together than the distance separating you, it transitions into a cylinder.

The thing you need to understand is we are here because neighbors are complaining. We need to understand why they are complaining and not argue the science, the math. They are complaining because the sound level increased too much. It's our responsibility as acousticians to accurately predict it, to represent what they are receiving. We are not. We are depending on the science. Computers have been -- I love computers. I've enjoyed it. I remember doing long additions with the calculator and I had to -- forget it. I mean it was a very tedious way of doing it, where a computer you can do it in an instant.

So the neighbors are complaining. We are dealing with a community response problem first. Now the problem is for the acousticians to do it right.

MS. CHENEY: I have a follow up to your question. And I noticed on the slide where you showed the ground attenuation measurements by both Nord 2000 and ISO, the Nord 2000 actually --

MR. AMBROSE: Follows much better

MS. CHENEY: Follows it. So in that case is it more a matter of which model as opposed to the fact that --

CHAIRMAN VOLZ: You need to let us finish asking the question.

MR. AMBROSE: I know where she is going.

CHAIRMAN VOLZ: Wait anyway, because everybody else doesn't know where she is going.

MS. CHENEY: Now I don't remember. Let me just say at least to my eyes the Nord 2000 tracking looked more accurate. And was wondering how that reconciles with your saying that ground attenuation should not be used.

MR. AMBROSE: Well that was the prediction model, how well they tracked. It wasn't ground attenuation.

MS. CHENEY: It said ground attenuation on the slides.

MR. AMBROSE: Okay, I'm sorry. Let me get back to it.

MS. CHENEY: And then in general, while you're looking for that, I would be interested in the source for some of the slides. For example, the one showing a nauseagenic zone which I was not familiar with.

MR. AMBROSE: That -- here's the nauseagenic. That comes from ISO 1996. 2000. And a

lot of this work was -- had -- Dr. Paul Schomer, a recognized acoustic expert.

MS. CHENEY: Dr. who?

MR. AMBROSE: Paul Schomer.

MS. CHENEY: How do you spell Schomer?

MR. AMBROSE: S-C-H-O-M-E-R. And he was a colleague of mine. Robert Rand, he's the one who did this slide. I pasted it in on what's to the left of it.

MS. CHENEY: Perhaps while that's loading maybe there is other questions.

MS. HOFMANN: Tom, do you have follow ups?

MR. KNAUER: No.

MS. HOFMANN: I have one, Dr. Ambrose, which is there was a slide that you showed of microphone too close to the house. I couldn't get any sense of scale from your slide.

MR. AMBROSE: It's probably --

MS. HOFMANN: So how close to the house was it?

MR. AMBROSE: It was probably within 15 feet.

MS. HOFMANN: Okay. And what would be an appropriate distance from the house in your

opinion?

MR. AMBROSE: Oh, the way I would do it would be 50 to a hundred feet. I mean just to be sure that I'm not getting some unique wavelength that's going to reflect off there and get me. I just -- when we get to low frequencies, low frequencies have very long wavelengths on that. But the key thing is measure too close to the house, it wasn't the prudent thing to do. And I do fault the measurement because the person wasn't trained fully on how to select that location. But the previous one under the trees, that's a no-no.

MS. HOFMANN: Thank you.

MR. FINK: Mr. Ambrose, in your work as an acoustician, have you conducted any attenuation studies of specific residences to measure how much residences' facade reduces sound transmission level?

MR. AMBROSE: Well no. But the -- generally it's -- EPA says that with a sound attenuation through an open window is about five dB into a house. When I was at the Hobart house, that was built as a retirement dream house. Mr. Hobart was an oceanographic engineer. House was well insulated. Premium windows, 16-inch thick walls. We measured 42 dBA outside. We measured 20 inside.

When we looked at the low frequencies which we measured as pascals, barometric pressure, we measured in the low frequencies six dB louder indoors on that. That's why the people end up saying well I get some relief when I go outdoors. Well I can attest to that. I got some relief when I went outdoors, but when I come back in it's looking inside a drum. All those low frequencies, and this house was -- it had a great room. It was combination dining area, living, foyer and the kitchen area was all big, open. So it could support low frequency energy very easily, but a structure of a house, the volume is what determines how much low frequency reinforcement occurs in the house. But it's one of those things that I thought I was coming down with a cold. I felt lousy. Maybe the flu. Quasi nauseous. I'm sitting there at the table with my computer looking at the measurements on the screen, and I go back to when I'm flying in an old Grumman Albatross seaplane navigator seat, and you -- just a little porthole window here, and you've got instruments jumping up and down in front of you. You're trying to look at the radar screen and the Loran, and it was the same feeling. Same feeling. I mean I had that image, and I go I hadn't had that image since I was in the Coast Guard when I was 20.

So --

MS. SMITH: Can I ask him a follow-up question to that?

CHAIRMAN VOLZ: Yeah, sure.

MS. SMITH: Could you address the appropriateness of the type of test that is being used for inside and outside testing where they put the speakers up and --

MR. AMBROSE: Oh.

MS. SMITH: Please.

MR. AMBROSE: More faux measurement. It's false. And the reason why is wind turbines are very rich in low frequency sound. We haven't got a noise source that can produce those low frequency sounds. Now wind turbine is coming down from above the noise and enters through the roof, which is a lighter weight structure than the walls of a house. And it comes in, and it floods the room from above on the low frequencies.

Putting a speaker outside on a tripod elevated, it may sound good, but it doesn't do it. You need a bigger noise source. More speakers to spread it out, because the energy is coming as a giant wave, not as this little small hemispherical wave.

And so these indoor to outdoor tests I wouldn't do it with a speaker, because it's not -- you can't get it up high enough. It's similar to what they ended up doing at Logan airport. They discovered this, because they were trying to noise proof houses, and a syntac went out with big boom box trucks and tripods and lifts and were trying to mimic aircraft. But they could not get the sound attenuation that they needed using the boom boxes. They used aircraft instead, the jet fly-overs, because it's a big low pressure wave that comes down.

CHAIRMAN VOLZ: Okay. Yes.

MR. DUNCAN: I just had one question of the Board. Eddie Duncan, RSG. Are the presentations today going to be made available to the public for review?

CHAIRMAN VOLZ: If people want to provide them to us, we will put them on our website. And we have the transcript from the court reporter as well.

MS. CHENEY: That will be on our website as well.

MR. AMBROSE: I will provide this for you.

CHAIRMAN VOLZ: You can send us a copy

of the presentations, that would be perfect. Other questions for this witness?

DR. QUIN: I would like to make one comment with regard to Mr. Ambrose's statements with regard to --

CHAIRMAN VOLZ: Identify yourself.

DR. QUIN: Howard Quin. With regard to the G issue. I believe Eddie at RSG are aware of studies done very carefully in 2009. They wrote a paper on ground attenuation for wind turbines. They studied a number of them. I believe that is a paper which the Board would want to have a look at which clearly showed that it was possible to choose appropriate modeling parameters for wind turbines, if you did it right you got numbers that were very close to what they actually got.

A number of studies that Steve referenced in his slide I took a look at that were pre 2009. Not all of them, but a significant number were pre 2009. That was some of the stuff I worked on, but we were not at that time aware of what the actual -- there was a problem with the way G was done prior to that which RSG straightened out in their paper. So the Board I think really needs to have a look at this paper. It answers the question very

clearly.

CHAIRMAN VOLZ: Thank you.

MR. AMBROSE: I would like to rebut on that. The one thing with the RSG is they have not revealed in their big Mass. DEP -- Mass. CEC study have not revealed the wind turbine sites, where they are.

DR. QUIN: Can I answer that since I was there? There are issues -- since I was at DEP we picked the sites. The developers specifically requested for proprietary and confidentiality for reasons the sites not be identified. Otherwise we couldn't have got any sites at all. There were legal issues in terms of compliance and enforcement which were occurring at the time and they wanted to make sure that the data was not being used for compliance and enforcement of legal issues.

MR. AMBROSE: So it's not peer reviewable.

DR. QUIN: No, but that was a legal issue. It was a legal issue, Steve. They couldn't have the sites and be out there, it was going to get used in court.

MR. AMBROSE: But you've got to have peer review.

DR. QUIN: Legal.

CHAIRMAN VOLZ: We understand both of your positions. We don't need to have an argument about it.

MR. AMBROSE: I apologize to the Board.

CHAIRMAN VOLZ: We are going to take a 10-minute break and start back up at 11. If the next presenter could get the overhead and everything hooked up, so when we get back we can start right in. That will be helpful. Thanks.

(Recess was taken.)

CHAIRMAN VOLZ: We are back from our break, and now it's Renewable Energy Vermont's turn.

MR. BRABANT: Hit the lights?

MS. CAMPBELL ANDERSON: My name is Olivia Campbell Anderson. I'm Executive Director of Renewable Energy Vermont. For the record Renewable Energy Vermont represents businesses, utilities, and individuals and non profits committed to reducing our use of fossil fuels and increase achieving the state's 90 percent total renewable energy goal.

MEMBER OF THE PUBLIC: I'm sorry. We can't hear.

CHAIRMAN VOLZ: Can you make sure you use the microphone?

MR. COTTER: And make sure the little green light is on.

MS. CAMPBELL ANDERSON: Okay. Can you hear me now?

CHAIRMAN VOLZ: That helps. Just get closer to it.

MS. CAMPBELL ANDERSON: All right. So I'm going to cover five topics. Technical capabilities of small wind turbines, a GIS analysis of the impacts of proposed setbacks and sound limits, health impact studies, sound measurement methodology, and economic impacts.

So first in talking about small wind, I realize that is a little hard to see --

CHAIRMAN VOLZ: We have the handout.

MS. CAMPBELL ANDERSON: Thank you.

MS. HOFMANN: It's a little blurry. I don't know if you can get a little -- that's a little better. Thank you.

MS. CAMPBELL ANDERSON: That's as far as it zooms. Okay. As you all know, there is many different types and sizes of turbine technology, projects as small as 1.6 kilowatts have come before the Board and been approved for installation. REV is -- I just want to bring to the Board's attention

again REV's not aware of post-construction sound complaint issues from any of the 155 residential farm or other small wind projects permitted in Vermont to date. When -- REV is requesting that the Board consider creating a residential and small commercial scale category. You could determine the levels. You know, you can see here the chart of different generation levels, but at a minimum would be 25 kilowatts and less. And you could go higher than that based on the information on what is on the market.

But looking at the products that have been installed to date in Vermont for small wind and looking at the complaint records, I believe that would be appropriate to separate out these small-scale wind turbines so that it matches what they're presently available on the marketplace.

The exterior dBA level in the Board's rule cannot be achieved by any small wind turbine on the market. Small wind turbines that are less than 34 kilowatts certified for sound range independently, they range from 41 decibels to 55 based on the output, and as you can see the various details in the chart here. In terms of economic impact on small wind, it's notable that Vermont is home to Northern

Power Systems which manufactures a significant number of small wind turbines every year in Barre, Vermont.

Our locally designed and built small wind turbines cannot be installed now in the State of Vermont under this proposed rule. Northern Power System employs more than 70 people, and has received recognition from the U.S. Department of Energy for their product design and manufacturing efficiency innovations. So you'll hear from another Vermont-based small wind turbine company later today. So I will let them tell their story separately.

Again, given these facts, REV recommends a standard no lower than 45 dBA for these small projects. The same standards -- applying these same standards of larger projects to these very small projects is really inappropriate, and the manufacturers' specifications are tested and may be further assessed in the CPG process as the Board determines, if that's a need for a specific project proposal.

There is also no need for or basis for requiring any sort of sound modeling for these small projects or ongoing monitoring. If required, in many cases doing so would actually exceed the cost of the turbine itself, particularly if there is no

complaints.

Also for these small turbines, the setback in the rule that's proposed is not necessary because it's related -- the rule's related to governing sound. Looking at other jurisdictions Ontario has a setback, but it does not apply to wind turbines and -- that have a capacity of less than 50 kilowatts.

So moving on to setbacks. A properly set sound limit and enforcement mechanisms within the rule do not necessitate an arbitrary setback and would have a drastic impact on the feasibility on wind in Vermont. Given the numerous site and project-specific factors influencing sound such as the number and arrangement of turbines, topography, vegetation, REV suggested the Board maintain flexibility through the CPG process regarding setbacks.

A one-size-fits-all setback required for sound does not make sense in light of these differences as well as new emerging turbine technologies. It's likely that a new turbine would come on the market and not be able to be installed even if it met the sound standard because of the setback. So we don't want to in any way discourage

in -- the use of innovation and new technology which, as we all know, is constant in the renewable energy sector.

I want to walk through some slides about the proposed impacts of the sound limits and the setbacks specifically in Vermont. Vermont Environmental Research Associates developed maps using data from the Renewable Energy Atlas of Vermont and the Vermont Center for Geographic Information to inform the impact of these proposed rules on wind electricity generation in the state. So that is all the underlying data behind these maps. The maps are -- all of these maps are for the context of community and utility-scaled wind where the individual turbines have a generating capacity of 1.5 megawatt and higher. So that would be the larger category in the Board rule.

The first map shows areas that are not windy enough to support wind electricity generation because obviously, you know, we have constraints. You wouldn't place a turbine in an area where wind is not at a speed high enough to generate adequate electricity. So about -- when you layer on that first layer, only 10.5 percent of the land area in Vermont has adequate wind speeds in order to support

that scale of wind electricity generation.

Okay. So I'm moving on to the second map. Okay. So the second map shows areas that are currently potentially viable for wind electricity in Vermont, but -- and then it layers on top of that the existing constraints. So sufficient wind resource, proximity to transmission lines, conserved land, surface waters, river corridors, rare species habitat, deer wintering yards, proximity to other existing wind projects. So when you layer on those environmental and economic restraints, constraints, you get only 2.1 -- just a little bit over 2 percent, 2.14 percent of Vermont's land being potentially viable for wind electricity generation.

So I'm going to move on to the third slide. So the third slide buffers were generated using E-911 structures that were identified as residences. VERA used E-911 data to map all of the land located at least 4,920 feet away from residences. This is the estimated distance -- actually that's the fourth slide. That's the next slide. I got a little ahead of myself. So this slide -- sorry.

This slide shows what the restrictions are at 45 dBA based on the E-911, which I described,

and the setback. At a 45 dBA, you -- modeling would look at a setback that's 2,165 feet as you can see in the legend. And then the lavender areas are the other constraints from the higher chart, prior map. So we are layering on top here. So that leaves you with -- leaves you with about one percent of all the land in Vermont available suitable for wind electricity generation.

Okay. So moving on to the next layer. 35 dBA. This is the one where if you look at only the 35 dBA sound limit, and require that you're a hundred feet away from residences at least, and then this is where you factor in -- we model out what 35 dBA would be estimated to be. Of course it's different based on all those other factors that, you know, we have previously discussed. But that would be 4,920 feet away from any residences as an estimate.

And it looks like this rounded up on the printout. So this rounded up on the printout, but did not -- so it leaves you with .022 percent of the land in Vermont then available under 35 dBA limit. It says .22 percent is the little orange slice at the top. I'll have to fix -- I don't know why it printed out differently.

Okay. So moving on to the impact of the setback. That's in the Board Rule that's 10 times the turbine height. 10 times the turbine height setback alone amounts to a de facto ban as it would make wind development virtually impossible in all but a minute portion of Vermont's land, so you're now down to point -- you're now down to .2 percent of all land in Vermont.

So the remaining -- let's talk about what those remaining areas are in the .2 percent. Again, I'm sorry. For some reason in the printout the percentages -- the printer somehow rounded up. So I will get that fixed. But what it shows there is .2 percent instead of zero.

MS. CHENEY: Just quick clarification on this map. You're saying it's .2 percent but on the previous map .022.

MS. CAMPBELL ANDERSON: .022.

MS. CHENEY: Is it .022 or .22?

MS. CAMPBELL ANDERSON: 0.22.

MS. CHENEY: And this one?

MS. CAMPBELL ANDERSON: Is 0.2.

MS. CHENEY: Thank you.

MS. CAMPBELL ANDERSON: So talking about that .2 percent that's left now. Once --

should the Board's rule move forward as proposed, this land area that's left is so small we are not able to confidently quantify meaningful potential of wind electricity generation and certainly not at levels that would enable the state to achieve our Comprehensive Energy Plan and greenhouse gas pollution commitments. Wind turbines have to be separated by large distances. Typically those are over 1,400 feet in any direction. Of this .2 percent very minute area that's remaining, many of these are not going to be available or suitable for project siting. You have to consider residences that are going to be constructed, suitable parcels of land may not probably -- there are going to be some that aren't available for sale or lease to access. So you can't assume you're going to be able to access all of that.

There are also quite a significant number of unmapped wetlands, unmapped critical habitats as we found when we go out to ground truth after first layering on the ANR data that exists and is available. Rare natural communities and unique view sheds are currently being identified by towns through the comprehensive energy planning process. So we didn't have further data to dive deeper. But

it looks at this point like there were only a couple areas where it may be possible to site a few turbines. And that is that would effectively be at such levels where you're looking at very close to a ban. Locating suitable locations in those patchy fragments that are left, the fragments that are left are the orange. That's it. And you can barely see most of them on the map. It would be theoretically possible, but pretty hard, pretty next to impossible. Restricting renewable energy so severely is simply not reasonable.

So we would ask you to reconsider this. And again, emphasize that it runs directly counter to Vermont's renewable energy goals. So in summary, this slide pulls out the pie charts of the different sections which I have discussed. So the proposed 35 dBA rule and the 10 times turbine height setback eliminates 99.8 percent of all land in Vermont from generating wind electricity, leaving just .2 percent that is potentially viable, and that's a very unstable potential situation.

So I want to move on to talk about independent scientific studies and public health. Oh, actually one other thing on the setbacks, I apologize. The only jurisdiction that REV was able

to find that has adopted a setback such as, you know, the 10 times the turbine height is in the -- Germany, and that's in the state of Bavaria. According to figures from Germany's public utilities regulator, the number of wind projects moving forward dropped drastically by 90 percent after the 10 times setback rule was adopted. You know the maps that I provided plus, you know, evidence that has occurred in another jurisdiction is providing that the economics are the same catastrophic effect would be likely to occur in Vermont. Mandatory setbacks again are just unnecessary. If a turbine can't meet a sound limit, then it should either be located farther away or not at that site, and your sound limit will take care of that for you.

It's also important that -- to recognize that when we are, you know, talking about public health and talking about decibel levels -- did you have a question?

MS. CHENEY: Just your time limit is up.

CHAIRMAN VOLZ: No, not yet. She started at 11:03. Got three more minutes.

MS. CAMPBELL ANDERSON: Two or three more minutes. Let me wrap it up. Thank you.

MS. CHENEY: Sorry. I'm just passing it on.

CHAIRMAN VOLZ: It's all right.

MS. CAMPBELL ANDERSON: So we will also submit this for the record. But a 35 decibel limit is, you know, approximately like 10 times the level of a 45 decibel limit, so it's a significant difference. Across the board a 35 decibel limit singles out renewable energy for far greater restrictions than other commercial and industrial activities and is out of step with site-specific inquiry that's required even under Act 250 case law.

So let me skip over some things. Most importantly for the record I just want to state that Vermont's proposed wind standards are unprecedented and not grounded in peer-reviewed science setting an impractical and lower sound level than any other state and Canada. So we will -- related to the public studies you can see are on the next chart here quotes. Some of these have previously been submitted in the record, but we will note them again in our written comments. More than 487 gigawatts of wind has been installed all across the world. So it's important to recognize that for at least the last decade the scientific consensus studies, literature

have consistently shown that sound levels of 45 dBA have no discernible effect on human health. These facts have been confirmed by the Vermont's Department of Health to the Board as well as the Vermont Department of Public Service and the independent consultants that they hired that you heard from earlier in the proceedings.

So let me move on from that. To sum up economic impacts, it's important to note there are 328 local workers in Vermont employed in the wind electricity generation sector of our economy. The existing wind that is installed in Vermont directly contributes more than 2.25 million state and local taxes annually. And that is just from the projects. That does not include other economic factors such as those wages, et cetera, that's just what those projects pay directly every year to the state and towns. Between the 10 times setback and the 35 dBA sound limit, none of Vermont's existing community or utility-scale projects would have been constructed or could be built under this proposed rule.

Based on the tax contributions of the existing wind projects in Vermont, we did some analysis comparing to the capacity of generation that the state has based on wind resources and are

estimating that the rule will result in a loss of at least probably more than 4 million dollars annually in state and local tax revenues directly from foregone wind energy generation projects, adding up to over 100 million dollars over a 25-year life of a project.

And again that does not include any ancillary project economic impacts. That is literally just direct payments to the government, state and local government from the projects themselves.

So to wrap up, in conclusion, the proposed rule imposes significantly lower levels than are required by majority of other jurisdictions, well below levels that are needed to protect public health. As comments you have received and peer-reviewed literature states, we would respectfully request that the Board reconsider the sound level given these facts and literature concerning aesthetics and annoyance.

So thank you very much for your patience and your time. We will submit more detailed written comments. Hopefully the legislature will wrap up soon, and I will have more time.

CHAIRMAN VOLZ: Okay, good. Do you

have questions?

MS. CHENEY: I have a question. So you refer to the draft rule as 35 and you modeled your mapping on the 35 decibel level. Did you consider the daytime 42, nighttime 35 which is the -- the draft rule -- was that double noise sound level -- you just referred to 35. So what about 42/35?

MS. CAMPBELL ANDERSON: So when you're developing a project it has to be designed based on the lowest standard. So and that's how the economics are modeled. I think your question though is related to the setbacks and the maps.

MS. CHENEY: No, no. The fact that our draft rule has a 42 decibel along with a 35. So but you simplified it to 35, and I was wondering why and whether you considered the 42/35 which the draft rule actually --

MS. CAMPBELL ANDERSON: Yeah. Because none of the existing projects can meet 35. It's also technologically -- you can't have that level of difference -- in these turbines, you cannot go to NRO at that sweeping of a difference in decibel levels. It's not possible. So you will have to turn them off at night. They can't -- the NRO cannot operate in that level of difference in decibel limits.

CHAIRMAN VOLZ: For the record could you say what NRO stands for? Noise reduction operation or something?

MR. DUNCAN: Noise reduced operations.

MS. CAMPBELL ANDERSON: Thank you.

CHAIRMAN VOLZ: Okay. You're saying if you build a project that could produce 42 -- was big enough project that its noise level during the day was 42 when it was operating at full capacity, it's not possible to dial that back to 35 at night?

MS. CAMPBELL ANDERSON: No.

CHAIRMAN VOLZ: Because that's too big a difference.

MS. CAMPBELL ANDERSON: Yeah.

CHAIRMAN VOLZ: So people wouldn't -- with a 35 nighttime standard even with a 42 daytime standard, the project developers would not build to 42, they would effectively build to 35 is what you're saying.

MS. CAMPBELL ANDERSON: Yes, yes.

CHAIRMAN VOLZ: I just wanted to make sure I understand.

MS. CHENEY: Also she is saying the differential is too wide too, is that what you're saying?

MS. CAMPBELL ANDERSON: Yes. There may be others in the room that can explain that better than I. But the machines cannot --

CHAIRMAN VOLZ: How much of a reduction can you get in NRO mode?

MS. CAMPBELL ANDERSON: Typically it's three to four. I believe there is only one turbine on the market --

MR. DUNCAN: I'll be presenting on this topic during my presentation --

CHAIRMAN VOLZ: Great.

MR. DUNCAN: -- in detail.

MS. CAMPBELL ANDERSON: Let someone else who can fully answer those questions well.

MR. COTTER: I have one. When you did your mapping based on the decibel levels, I'm not going to talk about the setback, you must have had some sort of assumption about the sound power level of a project in order to determine how far out the sound was going to go and at what level. What was your assumption for that?

MS. CAMPBELL ANDERSON: I'm not sure that I fully understand the question. But in the modeling that's done, you insert in the sound level that you need to meet, and then it extrapolates a

distance as an estimate.

MR. COTTER: I understand that. But you have to have an input for how loud, what's the sound power of a project. I mean let's say --

MS. CAMPBELL ANDERSON: At the --

MR. COTTER: -- one project was twice as loud as another. Some projects are louder than others. Different turbine models, different turbine sizes. I'm wondering did you pick a worst case scenario from the sound power level when you did this, or did you pick a moderate case or a best case?

MS. CAMPBELL ANDERSON: It may be that --

MR. DUNCAN: Yeah. So the REV had assistance developing these maps from VERA. And VERA had asked us to estimate what the setback is to get back to 45 and to get back to 35 decibels at the existing projects in the state. So that setback that was used for 45 and 35, provided VERA used those numbers that we provided to them, is based off of the existing projects in the state, the average distance to get up to 45 and 35.

MR. COTTER: I guess I'm still trying to understand it a little bit better. Because for instance, we have Georgia Mountain and we have

Lowell. And they are, you know, Lowell is a significantly larger project than Georgia Mountain. Would they -- generally you would have the same sound power input for each of those projects? I just don't know. That's why I'm asking.

MR. DUNCAN: Yeah. It depends on whatever the sound power of the turbine that's being used in that project is. And so to calculate the setbacks that were, I believe, used in this mapping, we have the noise maps from all the projects in the state. And then we can literally measure how far does it take to get out for each project to 45 or 35. That number is going to vary a little bit based on the difference in sound powers between the projects, but the average of existing projects across the state are the setbacks that are used in the maps, I believe.

CHAIRMAN VOLZ: But doing the calculation you used the actual power levels from each project?

MR. DUNCAN: Yes. The sound power levels from each turbine that was used in each project.

MR. COTTER: I'm sorry if I'm just being a little dense here. But I could see that if

you wanted to look at a specific project and say, okay, here's the setback at 45, here's the setback at 35 that would end up being required for that project. But my understanding of this map is it's not project specific. It's looking at all areas in the state that are potentially, you know, have a valuable wind resource. And so you don't have a specific project to plug in to get to do this map over the entire state.

MR. DUNCAN: That's correct. It's using essentially an average sound power from all the wind turbines that are used in the state, yes.

MR. COTTER: Bingo. That's what I wanted to know. Thank you.

MS. CAMPBELL ANDERSON: We can specify that in a little more detail in our written comments.

CHAIRMAN VOLZ: Okay. That would be helpful. Thanks. In other words, you'll describe the assumptions that were used to develop the map.

MS. CAMPBELL ANDERSON: I'm sorry?

CHAIRMAN VOLZ: You'll provide us the assumption that you use to develop the map and run the program?

MS. CAMPBELL ANDERSON: Yes.

MR. KNAUER: I have a question. The

small wind independent certifications slide. For the record can you -- there are a couple of acronyms; SWCC and AWEA. Can you --

MS. CAMPBELL ANDERSON: Yes. So this is the national independent certification, it's the Small Wind Council. I can provide you with their website so that you can see. They are essentially -- think of they are where you go to get your certifications for small wind turbines in the United States. Think of it like a third-party organic independent verifier for food. If that is too of a layman analogy. But it's providing independent verification that this turbine is going to meet that sound standard.

MR. KNAUER: Okay. And AWEA is?

MS. CAMPBELL ANDERSON: That's AWEA. So that's based on the -- I'm sorry, the American Wind Energy Association standards, and perhaps I could get some -- further explain that and link to their website to get the details. But they use, you know, specific criteria that you have to meet as what does peak, you know, peak output mean, you know, those definitions. So that everyone is judged under the same criteria.

MR. KNAUER: Okay. So I assume under

the column the rated sound level, the -- whatever the standard is specifies the distance that that sound level is measured at? Is that true?

MR. DAY: 200 feet or 60 meters is what it's measured at, at five meters per second average.

MR. KNAUER: Wind speed?

MR. DAY: That's the standard. It's on their website.

CHAIRMAN VOLZ: Can you identify yourself please?

MR. DAY: Sorry. I'm Jason Day, Star Wind Turbines.

CHAIRMAN VOLZ: Thank you.

MR. KNAUER: And there are a number of what look to be footnotes on here, but they didn't show up on your chart.

MS. CAMPBELL ANDERSON: Yeah. I think those footnotes are -- I will provide that in our comments. It's literally explaining what each of those means, those categories.

MR. KNAUER: That would be helpful.

MS. CAMPBELL ANDERSON: Sorry. It's also directly on their website which we will provide to you.

CHAIRMAN VOLZ: Great.

MR. KNAUER: And you made a statement that 42 decibels cannot be achieved by any small wind turbines.

MS. CAMPBELL ANDERSON: No. I said 35.

MR. KNAUER: Okay.

MS. CAMPBELL ANDERSON: Smaller wind turbines most of them don't have the more sophisticated NRO management systems available to them, that when you compare to what's the technology that's available for large turbines.

MR. KNAUER: One last question. In preparing the various maps that you presented with the layers, I'm assuming there is not a layer that looks at whether the residents are participating or not participating in the project.

Did you give any consideration to the fact that the proposed rule applies at non-participating residents?

MS. CAMPBELL ANDERSON: I didn't really think that would be relatable because we are talking when you say not participating, could you further explain when you say not participating? Because for this scale of wind project it's not going to be someone who is engaged in the ownership or of the site.

MR. KNAUER: Right. Yeah. The rule.

MS. CAMPBELL ANDERSON: You're also saying like if they had a lease or something?

MR. KNAUER: Well the rule has --

MS. CAMPBELL ANDERSON: I just didn't have it right in front of me.

MR. KNAUER: The rule has a definition of what a participating landowner is. And so the setbacks and the decibel limits apply to the homes of non-participating landowners. So that was the basis of my question.

MS. CAMPBELL ANDERSON: Okay.

CHAIRMAN VOLZ: Non participating is someone who doesn't have any affiliation or association with the wind turbine developer.

MS. CAMPBELL ANDERSON: Yes, correct. So that would be the case for almost all of the projects that have been installed to date. With the exception perhaps typically of one home on the site.

MR. FINK: So just to clarify the discussion, I think it might be helpful to actually state the definition in the rule for folks. Is that a participating landowner is defined as a landowner who has signed a written agreement with the Petitioner stating that the sound emission standards

established by this rule do not apply to the landowner's property.

CHAIRMAN VOLZ: That's participating.

MR. FINK: Right. So a non-participating landowner is someone who isn't a participating landowner.

MS. CAMPBELL ANDERSON: Right. There is no way for us to know if someone would be signing an agreement. So we can't assume, you know. We can't assume -- make assumptions about that.

MR. LANG: Dustin Lang. May I make a suggestion for an example that may clarify this? If a homeowner's association with nine homeowners wanted to put up a small turbine, they would be participants. That way your range would be increased because it wouldn't be one of the homeowners in the subdivision putting up the turbine and affecting the non-participating neighbors. Isn't that how --

MS. CAMPBELL ANDERSON: Yes. I understand it's not what has occurred in these size projects.

MS. CHENEY: I had another question. In the beginning of your presentation you talked about different categories and therefore different standards depending on the size of the wind project.

MS. CAMPBELL ANDERSON: Yes.

MS. CHENEY: Are you suggesting more than one category for what we might think of as small wind? So in other words, small, medium and large? Or --

MS. CAMPBELL ANDERSON: Yes.

MS. CHENEY: And could you be more specific about your recommendation as to size and also -- yeah. What would be small, medium and large, and I'm assuming there would be different standards in your recommendation for each category.

MS. CAMPBELL ANDERSON: Yes. So for the small turbines which I was talking about, you know, looking at something that's a scale of what would power a home, what would power a farm, or a small business, and also looking at that scale of turbine that is currently on the market and what their different power levels. So that's why I provided the list that you can see the range.

MS. CHENEY: And is this range in your -- the way you're describing --

MS. CAMPBELL ANDERSON: Yes.

MS. CHENEY: -- small or medium?

MS. CAMPBELL ANDERSON: This is small.

MS. CHENEY: Okay. And then what would

medium be?

MS. CAMPBELL ANDERSON: So medium it would be sized above that. So --

CHAIRMAN VOLZ: Up to?

MS. HOFMANN: How do you describe the large? You have three.

MS. CAMPBELL ANDERSON: Well probably above 500 kilowatts or more. I mean most large turbines are 1.2 megawatts and larger.

CHAIRMAN VOLZ: So medium would be above small and up to large.

MS. CAMPBELL ANDERSON: Yes.

CHAIRMAN VOLZ: Okay. So if you want to put that in your written comments, a suggestion for what that would be.

MS. CAMPBELL ANDERSON: Okay. Thank you.

CHAIRMAN VOLZ: Other questions?

MS. HOFMANN: I have one last one, which is do you have a recommendation from REV as to what the -- should there be a range? Right now we are at 35/42. And if so, what would that range be or what number would you be falling upon?

MS. CAMPBELL ANDERSON: What's -- I think to -- it's important to note that looking at

all the scientific evidence REV's position is that we feel that 45 dBA is acceptable to protect both for public health and for aesthetics or annoyance based on the studies that are available and peer reviewed.

CHAIRMAN VOLZ: And based on your earlier comments, I take it you don't think there should be a range, just should be the one number. Daytime versus nighttime, in other words.

MS. CAMPBELL ANDERSON: Yes, at this time.

CHAIRMAN VOLZ: Okay. All right.

MS. CAMPBELL ANDERSON: Our members are still --

CHAIRMAN VOLZ: Didn't mean to put you on the spot.

MS. CAMPBELL ANDERSON: That's certainly fine and completely appropriate. Our members are discussing this as you can imagine extensively.

CHAIRMAN VOLZ: If you're not sure about that, then you can say that.

MS. CAMPBELL ANDERSON: Yeah.

MR. FINK: If I can take you back to your chart of small wind turbines, and I understand what your recommendation was, essentially that

turbines with the capacity of less than a certain rated output would be exempt from the requirements or the rule. Did I more or less --

MS. CAMPBELL ANDERSON: Not completely exempt.

MR. FINK: But would have some sort of alternative.

MS. CAMPBELL ANDERSON: Yeah. So we would recommend they would be appropriate. I'm sorry, Kevin. I didn't mean to interrupt you.

MR. FINK: Go ahead. I think I got the gist of the question.

MS. CAMPBELL ANDERSON: Yes. For the small wind turbines, you know, to look at something between, you know, 25 kilowatts or 33 kilowatts, I also looked at all of the CPGs that the Board has issued to date for small wind. And there was almost all of them were 25 and under. There was, I think, one that was 33. So that's why I was like well maybe 33, you know, in being -- looking at these data. But that's kind of around the size. And you know, 45 certainly would be appropriate as meeting the sound limit. And then you have, you know, you can require the independent certification for that sound level.

MR. FINK: And perhaps -- not sure I

understand what you're proposing then, because you're proposing a different sound limit at a neighboring residence?

MS. CAMPBELL ANDERSON: No. The general framework.

MR. FINK: You're proposing a different --

MS. CAMPBELL ANDERSON: We would not propose setbacks. So the framework for -- that the Board has for, I believe you're at a hundred feet from the residence at 45 through the current definitions, unless you're participating on your own property. And I think you -- perhaps when you hear from Star Wind Turbines they could also better address that in detail.

MR. FINK: And part of what I'm trying to understand is that framework would appear to require some sort of modeling and monitoring to confirm that a turbine would meet those -- you know, that the sound output from the turbine at a neighboring residence would be less than 45 or something to that effect, which would strike me as posing a potentially significant additional cost.

MS. CAMPBELL ANDERSON: Yeah, no. I'm not recommending that. Yes. Specifically they

should not be required to do the modeling and monitoring, because there have been no complaints to our knowledge for those small projects. And they are independently certified. So if they have the independent certification by third party saying this is what my turbine manufacturer says, that you could rely upon that, if there were a complaint, but there has never been a complaint for a project that size in the state. And 155 of them are installed to my knowledge. When they are, you know, operating properly. Sometimes there is some hiccups when it first gets installed but after it's installed and --

MR. FINK: So correct me if I am wrong, and I think you may be hitting on an alternative I wanted to explore with you. When -- your reiterated sound level here, that's effectively the rated sound power output of the turbine. I believe the gentleman from RSG said it's measured at 60 meters per second. Am I understanding that correctly?

MR. DAY: AWEA -- the certification document it's called AWEA 9.1. And the sound rated is -- everyone's measured and judged at the 60 meter or 200-foot mark at a five meter per second, that's considered 11.2 miles per hour if you want to put it that way. And then they measure it in dBA. They

don't measure octaves or tones or other spikes.

MR. FINK: And so that's an attempt to capture the sound power output from that turbine; correct?

MR. DAY: That's basically 95 percent of what you're going to get out of that turbine. And you know, the maximum levels are higher, but we are going to go over in our presentation is what the actual percentage of the maximum sound levels are in these turbines.

MR. FINK: Okay. So what I'm getting at, and what I'm trying to understand is obviously the, you know, if that's at 200 feet, a residence that is further away is going to have a lower sound level due to attenuation.

MR. DAY: Yeah.

MR. FINK: And so one possibility I think it may -- I wanted to just broach for you to consider thinking about -- is whether instead of having an exemption that is based on the capacity of the turbine, because when I look at this chart, there is not a particularly strong relationship between capacity and the rated sound power output. I mean the third lowest capacity turbine is six decibels louder than the highest capacity turbine on this

chart.

MS. CAMPBELL-ANDERSON: It's a good range.

MR. FINK: Would it make sense to instead structure some sort of exemption or alternative treatment based upon the sound power output of the installed turbine? Is essentially --

CHAIRMAN VOLZ: The certified sound power output.

MR. FINK: Correct. The rated sound power output. And that's something you can address.

MS. CAMPBELL ANDERSON: Okay.

MR. FINK: But I would be interested to understand what you think of that approach.

MS. CAMPBELL ANDERSON: Okay. Thank you.

CHAIRMAN VOLZ: For the smaller turbines you're talking about?

MR. FINK: Correct.

MR. BLOMBERG: Just to clarify, I think you guys are talking about sound pressure and not sound power. I don't think these numbers are sound power.

DR. QUIN: That's sound pressure up there.

MR. FINK: Thank you, Mr. Blomberg, for the clarification. I believe you're correct. To the extent I know what I'm talking about.

MR. BLOMBERG: It's important because it's measured at a distance as opposed to -- okay.

CHAIRMAN VOLZ: Okay. Do we have any other questions? Okay. Other questions? We are getting short on time. Yes, sir. In the back.

MR. PIERCE: Greg Pierce, private citizen. Just like to make an observation about setback distance. There is a precedence for greater than 10 times turbine height. Freedom, Maine has an ordinance that specifies 13 times turbine height as a setback distance; mandatory.

CHAIRMAN VOLZ: Okay. Thank you. Ms. Smith?

MS. SMITH: Annette Smith, Vermonters for a Clean Environment. A few comments. There has been one CPG revoked on a small wind turbine over noise in Shrewsbury. It was done voluntarily with the neighbors and landowners, but we have received a lot of complaints frankly about small turbines. I suggested a property line setback is more appropriate. Also I think the Board is aware of the problems with the NPS 100 in Vergennes. And that is

960 feet away from a home. And so I think it's about 125 foot or 150 foot tall. So keep that in mind.

Again, these noise levels can go out quite a ways, and the one suicide that Mr. Ambrose mentioned was over an NPS 100.

I'm glad you brought up the opportunity for waivers. If these projects were done with the setback, then there would be the opportunity for better community engagement by getting waivers from people to sign in. I don't see that that is an issue. I think that we are -- we need to move in that direction. Regarding the Bavarian decision, it was litigated over the 10 times total setback, and I recommend that you read the decision. There is a translation you can get of it, and it talks about how the argument was made this is a ban on wind, and the court did not buy it. And Bavarian constitutional court, and they said that it just means they may have to use smaller turbines.

I think that she's made an excellent case for the big turbines not being appropriate for Vermont's terrain and topography, but this was litigated very well. I'm aware that there are at least four sites in Germany that curtail at night in order to meet the 35 dBA. It is not a constraint

that has stopped wind development in Germany. As far as our state's goals, wind is not being used to meet our state's goals now. None of these wind projects are counted towards the renewable energy standard, and none will be based on the way the legislation has been written because all the wind and solar RECs are being sold out of state. They are meeting Connecticut's and Massachusetts' RPS but not Vermont's.

And she made a good case about how much money is being made. And I think that also makes a point that these wind operations can be better neighbors and do continuous sound monitoring, and do better to compensate people who have to leave their homes. And acknowledge that there are issues and, you know, there is plenty of money being made, but it's not being shared in our communities in a way that's helping us meet our renewable energy. Thank you.

CHAIRMAN VOLZ: Okay. Questions? Any other questions? Because we are running late. So -- need to go to Star Wind Turbines.

MS. CAMPBELL ANDERSON: I do want to make a quick point related to the renewable energy standard in Vermont that RECs are sold as on an

annual basis, because they are created, so it's not appropriate to make assumptions that the existing or future projects are not helping to meet the state's goals or won't be as the RES --

CHAIRMAN VOLZ: We need to move now to the next people. Thank you.

MR. DAY: We have lost our battery. We have a technical problem. In the meantime I can talk.

CHAIRMAN VOLZ: That would be great.

MR. DAY: I can give you some handouts. Maybe you can add to our time or give us something after lunch or something.

CHAIRMAN VOLZ: We will see what we can do.

MR. DAY: Dr. Quin didn't -- I think I have enough to share. I'm not sure you're going to be able to read everything up there. So I would just like to talk about -- I would like to talk about the certification agencies that are out there already established in the industry. They have already established pretty much the definitions of large, small, and medium-sized wind turbines. If you go by what Inner Tech and SWCC are certifying, these are the organizations that are sponsored and funded by

NREL to come up with a third-party certification and testing mechanism.

So AWEA 9.1 is the specification defined -- to define and test small wind turbines. And under their -- you can look it up on the SWC website, SWCC website, it's defined as a turbine under 50 kilowatts, under 200 square meters which is basically a 52-foot diameter, and that's kind of where they draw the line. And they had to come up with, before 2014, they just had one specification, IEC 61400 which basically everything was large turbines above that. Since then, they have seen the void, and they have come up with another category called medium wind which is defined as 200 square meters to 1,000 square meters. And it's defined as the power levels -- they don't define the power level on it. So it's kind of a blurry area, but they say that to go from a medium turbine to a large turbine they really consider the criteria of whether you go -- have to go inside the nacelle in order to service it. If you service it from outside the nacelle, they say that's medium. Today that's what the dividing line is.

Vermont has defined small wind turbines in many different ways. There is a hundred kilowatts

and below is in the standard-offer program. You defined in other things like the net metering program 150 kilowatts, under 150 feet. So you have other different categories of your net metering rule dot 5. 100 which has another category for 50 kilowatts and below. Then you have another area that's 15 kilowatts and below.

So all of these things are, you know, everybody has a different definition of small and medium. Okay, so it looks like we are --

DR. QUIN: I'm ready to begin your presentation. I appreciate her helping me out with the Internet.

We would like to discuss the issue of change in the state wind turbine noise regulations with all wind turbines. This was something I looked at in Massachusetts while I was at DEP. We looked at wind turbine regulations quite extensively there. It's a complex process involving multiple stakeholders. I think everybody here agrees there is a lot of things going on here.

I think there is a lot of agreement existing standard of 42 is too high. Proposed is 42 decibels for day, 35 night. These levels as far as I can tell would be about the most conservative in New

England, and as I stated earlier, that would only be exceeded by a few locations in Massachusetts -- where I can't even think of anything much lower than that. So this would be the most conservative levels in all New England, much lower than Maine and New Hampshire levels.

Measure criteria we specified which we agreed from DEP is important to understand because there are issues with the criteria not being specified in advance, and people found out the measurement criteria were different than what they modeled, which was a significant issue in Massachusetts.

But the most important thing we want to point out here is that the levels proposed are the same for large and small turbines. And we want to in this presentation show that this is -- we do not believe this to be appropriate for a very lengthy list of reasons. I started this -- a lot of the issues of wind permitting when I was at DEP in 2012, 2013. At that time there were a number of projects coming online in Massachusetts. There were considerable issues with compliance enforcement, a number of problem projects, especially ones with the coast had come on, and at the time DEP did not have

much understanding with wind turbine acoustics. It's something I worked in for nearly a decade with a number of projects with developers. So DEP; I know a pretty fair amount about it.

At the time there were a number of complaints in Massachusetts, but not all projects had complaints. The majority of the projects were actually well received. It was maybe about I would say a third to a quarter of them had significant noise complaint issues. But more importantly, what we found is that most of the complaints were near the larger turbines. We did not have complaints for small turbines. And this echoes what she said earlier about the situation in Vermont where there are no complaints about small wind turbines. That's exactly what we had in Massachusetts. We did not have any complaints near turbines less than 1.5 megawatts. All the complaints were in larger turbines. Small wind was not an area where we had any significant issues. And the reasons why this is true, a number of them, first we studied -- if you look at the studies, there is -- a problem with small wind turbines is there isn't that much data available about the dose response.

The larger turbines is the Pedersen

Waye papers, of course, well known. And usually these papers are written about turbines which are at least 500 kilowatts. So in fact the smaller turbines that we are discussing here there is very little usable data about dose response. In fact, if anybody has them, I would be glad to look at it. I was not -- Greg Gocci and I were not able to locate accurate papers showing exactly how the small wind dose response occurred. It was a problem -- was simply not considered important enough for anybody to spend the time and money studying it. So I was not able to locate accurate dose response papers for turbines under 100 kilowatts.

And one of the other issues are dose response, which is true for larger turbines, and I think you who have read the Pedersen Waye papers know this, is when people are looking at turbines, there is a tendency with large turbines to use sound as a pretext for other issues. And this is especially true in places like rural Massachusetts and Vermont where people don't want to look at them, and they use sound as a pretext for visual issues. They didn't like the way the permitting process was done. They didn't get a good deal, or the town didn't get paid enough. People have a tendency with larger turbines

to be annoyed by sound for other reasons. In other words, they don't like them. They are predisposed against them for other reasons. They turn the turbines on and say, oh see, I'm annoyed.

That does not generally occur with small turbines. Small turbines simply don't have the other factors involved; visuals, you know, permitting issues, to which all would naturally be predisposed against them.

Now another significant issue is small versus large turbines, is the issue of in terms of where you put the turbine. If we are putting a small wind turbine up, what you're generally going to do you put it in a farm or residential area. What does that mean? It means you're putting it up in relatively flat ground. Most farms are flat. You don't have a farm on top of a mountain. You have a farm that's flat where you can farm. That's where you're going to put your turbine up. What does that actually mean in terms of noise background? It means when you have a small wind turbine that's been put up, and you have residents nearby, you're hearing wind -- the wind is blowing at the turbine, but you also have wind blowing at the residence. So when you power a small turbine up, you usually have --

typically have higher wind noise background. So as Steve pointed out in his presentation, the background makes a significant difference in the way people perceive it. The small wind turbines if they are on flat sites and people are nearby, you have a significant amount of masking background during operational conditions.

Now the larger turbines -- this is a picture of Sheffield. Take a look at what you've got up there. Turbines up on the top of the ridge; right? You've got the residences, as you can see some farms down below. What happens under operational conditions? Well if the wind's blowing from -- if it's on the lee side of the mountain, you can have a situation where the wind is blowing 15 to 20 miles an hour or more at the top of the hill, but there is little or no wind at the bottom of the hill. What happens then, you don't get masking background. And this happened in Massachusetts a couple of locations in the Berkshires. We went out and measured the wind, you know, the turbines were produced -- cranking way at the top. There was almost no masking background down below at all.

So point of it all is the masking background issue with small turbines and large

turbines is significantly different. Usually with small turbines you usually have masking background of some types because wind is blowing at the turbine, blowing at the residence too, but it's not always the case with large turbines. In fact, levels I measured at a farm in Vermont. There is my microphone out there by my car. In the winter. You can't really read that. But if you could, it would say that the levels were -- I had background levels of 35 to 40 decibels in the winter from the wind blowing. And that's comparable to the levels you're going to hear from a turbine at say 600 feet.

So the point of all this masking background for wind turbines, for small wind turbines, is clearly significantly higher. It's almost always a significant amount when the wind turbine is blowing; when the wind's blowing.

Another difference between small turbines and large turbines is the issue of amplitude modulation. This is one that's Steve brought up. And it was -- at DEP we found this to be a very important matter, is that this is a consistent problem near the larger turbines. It's more prevalent at the side wind, if you got the four decibels of peak energy, even more.

Here's the picture of amplitude modulation with large wind turbine, and you can see that the turbine going up and down; whoosh, whoosh, whoosh is a significantly -- it's significantly noticeable. With a small wind turbine you have much lower levels of amplitude modulation. The blades are spinning a lot faster; swish, swish, swish. So the amplitude modulation is significantly less, and the frequency of the amplitude modulation, the blade passage frequency, is typically significantly much higher. In fact, some of the very small wind turbines spin so loud they have almost no amplitude modulation at all. Some of the larger ones, 1,500 kilowatt, there is some of those, shw, shw, shw. So it does go up and down some, but significantly less than what you get with the large turbines. So the actual perceived noise goes down significantly with smaller turbines.

Now a third major difference in small or large turbines is the issue of --

MS. CAMPBELL ANDERSON: It should go away. You can click the little X's.

DR. QUIN: Well that's -- there is issues with infrasound. It's clear -- it's become clear with large turbines. As Steve pointed out, a

number of people have. That infrasound production from large turbines clearly it does exist. It's clear that anecdotal evidence it could be an issue. It's agreed that infrasound cannot be detected by the ear, but it may actually be -- there are mechanisms by which it may be detectible by the inner ear. Makes you feel queasy or gives you motion sickness or what have you. And it can penetrate walls and windows in a couple of the buildings. This is what we get for large turbines. With small turbines it simply doesn't happen this way. The infrasound level, the levels, the whole frequency curve is shifted over into the higher frequencies. There is much lower levels of infrasound. There is higher -- the levels are at higher frequencies is more readily blocked by the buildings.

And what also happens is that with small turbines a large amount of the small turbine infrasound is being masked by the wind because the wind itself creates infrasound. There is actually background from wind, so the turbine -- the infrasound from the small turbine is going to be more readily masked by the wind because you're getting continual wind masking background with small turbines.

I am not aware of any potential reported infrasound related effects from small turbines. It may have occurred. It's possible. I mean there is hundreds of turbines out there in the country, but I am not aware of any. Certainly if there are, it's much, much less in the case for the large wind turbines. It's not something that I found or believe to be the issue. It may -- some may have occurred, but I don't know of any.

Now another issue with small wind turbines is the issue of the speeds at which the turbines run, operate. The small wind turbines typically run at lower wind speeds for two reasons. First, they are closer to the ground. Secondly, they are not located on a ridge. They are located on farms, so they are not getting the high wind as you get on the ridges. So typically a small wind turbine is going to be running at five meters per second versus maybe seven to eight meters per second for larger turbines. What it means is if you're going to permit the small wind turbine that's rated power, and that occurs at 11 to 12 meters a second, you're actually under operational conditions getting much lower sound production from the turbine than you're actually permitted. So -- which means that there is

a significantly lower time near the permitted sound levels than for large turbines.

Examination of the viable curve here shows about how this would work. I don't know if you can read this too well, but what this shows is that the actual total amount of wind, it peaks around 11 to 12 miles per hour. Well what's the sound level being produced at the sound power level? This is for Excel, Bergey Excel. You're getting 84 decibels of sound power production, sound power level of 84 decibels at about say 12 miles per hour wind. Well the rated -- the rating power at 10 meters per second, 11 meters per second, is 94 which is 10 decibels higher than under typical wind operating conditions. So if you're going to permit the turbines at their peak rated and sound power level, you're permitting a level which almost never actually occurs under operational conditions. You're permitting a level which is much, much higher than what you actually would hear under typical wind turbine operating conditions. And even under a case where the turbines were say operating at say 16 miles an hour which is getting -- which would do more -- less than 90 percent of the time, you're still at seven decibels lower than what you're getting from

the peak -- the actual peak rated power.

So the point of all this is if you're going to permit small turbines at their peak rated power, that's not what you're actually hearing under most circumstances. This particular turbine the peak rated power would occur .2 percent of the time, which is less than half a day a year. So you can see then that it's important to realize you're not actually hearing the peak rated power from the turbines most of the time.

Getting back to the issue of annoyance. As I stated earlier, one of the problems we have had is locating quality studies of wind turbine annoyance. The most of wind turbine annoyance studies you see, the one here to the left, is when from medium to larger turbines. So it's very hard to come up with accurate levels of annoyance for small wind turbines because it hasn't been studied that carefully. And what we find is if you look at the industry standard, which is the purple one, which is shifted well to the right, what you find is small wind turbines sound -- they don't sound the same as large wind turbines obviously, but they would be shifted somewhat closer to the industry level sound noise curve which is for continuously operating

equipment, which is considerably higher. Unfortunately, I simply don't have the data or could not locate the data to come up with an accurate curve to show exactly how much the shift is. If somebody has it, I certainly would be glad to look at it, because it certainly could be very important to have that in order to accurately establish the levels.

MS. CHENEY: What are the X and Y axis here?

DR. QUIN: One is the day/night sound in decibels. And the other is the percent highly annoyed. Percent of highly annoyed by it.

MR. AMBROSE: Can I interject here?

CHAIRMAN VOLZ: Sure.

MR. AMBROSE: There is a new term, it's LDN. That's a day-night weighting. And it differentiates the nighttime from the daytime by 10 dB. If you were to normalize that, in other words take out the LDN and make it just a level, it would shift down six dB. Those curves.

CHAIRMAN VOLZ: Okay.

DR. QUIN: I appreciate that.

CHAIRMAN VOLZ: Thanks.

MR. AMBROSE: As a matter of fact, Pedersen Waye does track it.

DR. QUIN: That's right. And you know, it would be very helpful, and I think the Board -- I think it would probably -- if anybody knows of an accurate dose response curve when they go to actually make the actual regulations, getting that I think would be very important. Because we were not able to locate one we could rely on.

So in conclusion then, a small -- all turbine sound noise is not included in wind turbine -- in noise studies. The sound characteristics are closer to continuously operating equipment than larger turbines because they spin faster. They don't have that much amplitude modulation. They don't have the infrasound. So they are closer -- they sound closer to continuous operating equipment than larger turbines. That means that the sound curve -- the actual noise curve is going to be closer to the continuously operating equipment than -- it will shift closer to continuously operating equipment.

So what this means then the actual noise levels for small wind turbines are much higher than the 35 decibel proposed level. These 35 decibel levels are considered low even for large turbines, and for small turbines they are much, much too low. All right. These are -- there is no evidence

anywhere to support a 35 decibel limit for small wind turbines. Nothing. As far as I can tell, I haven't seen any noise studies, complaints, anything that supports that.

It may be some evidence here, but I have not seen it anywhere. So what does this mean in terms of turbine setback distance? Well for large turbines the new regulations would require nearly 4,000 foot setbacks to meet the new standard. That's for a single 2.5. For multiple 2.5s, it would be even more, 4,500 to 5,000 for all sound. That was just for a large turbine.

For small turbines you would require nearly 15 hundred foot setbacks to meet the 35 decibel limit. That means you have to have a farm more than half a mile square, you know, to get -- put a turbine up, that means to put it right smack in the middle of the farm, not even the highest wind point location, it would be in the middle just to meet the setback distances. This would become an effective ban on small wind turbines at small residences. 35 decibel level you would not be able to put up anything. Almost nothing. There might be a few locations here and there that were very far removed, very large farm, somebody's house is in the middle of

nowhere. In effect, it's a ban on small wind turbines.

The number we came up with being conservative, which is also due to the fact we don't have the detailed information we need to establish it, would be 42. And it could go as high as 45, but we are being conservative about it. The other guys were saying 45. We would obviously agree with that. But it shouldn't be any lower than 42. 42 would be the bottom limit. That's getting at the bottom of the large turbines. In Maine -- for large turbines, so 42 decibels would still be very conservative for small turbines. And you would be practically speaking about a 600 to 700 foot setback for that. And that's still a considerable setback. That's two football fields. That's a decent size farm to get a small turbine in. 42.

Some of the other turbine people want to weigh in, they might want to raise it as high as 45. We wouldn't object to that. 42 would be the bottom you could go to get anything built.

So conclusions. Proposed noise regulations are very conservative for all wind turbines. Significantly different conditions indicate that they are not appropriate for small

wind. The background levels are different, the sound production is different. The perception of the turbines due to the smaller size is different. The masking is different. Amplitude modulation is different. The infrasound modulation is lower. Infrasound is different. Small turbines have much less effect for given sound levels. The proposed regulations would be an effective ban on small wind in Vermont. A better level for small turbines would -- minimum would be 42 decibels day and night, and that's still conservative.

CHAIRMAN VOLZ: Thank you.

DR. QUIN: That's my presentation.

CHAIRMAN VOLZ: Okay.

MS. HOFMANN: Ask you a question about the difference in the small turbines in terms of the NRO and their ability to change operations from day to night.

MR. DAY: Well most small wind turbines, in other words, if you could afford them, are all fixed blade. All the turbines on the SWC website are all fixed blade.

As I understand, the way that the NRO is going to be performed, is to pitch -- have a pitching blade that's going to be able to slow the

RPM of the rotor down and therefore reduce the noise. And turbines available for Vermonters to buy today, that are certified, cannot do that. So you would basically be sending the entire industry back to redesign, rebuild and recertify in order to do an NRO.

I mean we are all working as hard as we can on new technology, but as of today, that's your choices.

MS. HOFMANN: Thank you.

CHAIRMAN VOLZ: I just want to clarify your -- about your presentation, Mr. Quin. I guess you just gave one. Do you have another one you want to do?

MR. DAY: Yeah, I have another one.

CHAIRMAN VOLZ: You signed up for 35 minutes. You've used 21 or 22.

MR. DAY: Do you want to take a lunch break?

CHAIRMAN VOLZ: We are scheduled for 12:35 to do the lunch break. So just keep going. Yes.

MR. GRASS: David Grass, Vermont Department of Health. For your presentation can you tell me what your operating definition of small wind

turbine was?

DR. QUIN: You know, that's a question that it seems to vary a bit. I think most people would agree that anything under 25 is considered small. I would tend to believe based on my experience that it would be under a hundred, that usually the turbine is the 50, 75 -- 50 kilowatt usually don't see the kind of sound issues with anything under 100. Some under a hundred clearly have some problems. I would probably not include a hundred in small wind.

MR. GRASS: So the generalizations that you were making, that would apply to wind turbines with less than a 100.

DR. QUIN: Less than 100. Yeah. Any other questions?

MR. DAY: Okay, I'm Jason Day from Star Wind Turbines. And we manufacture small turbines from 5 to 50 kilowatts for individual ownership. These would be turbines that would be truly distributive. They would be for going into a farmer's field or into somebody's backyard that -- somebody that wants to make their own energy for their house.

And what I've noticed for the last

several meetings that we have had in this work group is that everybody has been pretty much talking about large wind turbines. And all of the data and argument, et cetera, et cetera. So we want to step forward and identify the small wind turbines are not large wind turbines. And we want to emphasize what the differences are.

So small wind turbines make less noise than large wind turbines. And you can check out the data sheets. I can give it to you later if you like, but you're going to typically see either, if you measure it in sound power levels or sound pressure levels, you're going to find that small wind turbines are going to be quieter. They do not make the same low frequency and infrasound as large turbines. They are smaller mechanisms. They don't have step-up gearboxes. They don't have the amount of vibrations and low frequency sounds because they are spinning faster, the mechanisms are direct drive. They are on shorter towers. And have smaller diameters. This means that the ground and the forest is going to absorb the noise. The sound not going to travel as far. And obviously they are not going to have as much of a visual impact. The -- okay, they will -- typically these are going to be located closer to

neighboring residents. Low visual. Unlike what REV pointed out. They don't necessarily have to be on ridge tops. They are going to be in the Champlain Valley. They are going to be in the Grand Isles. They are going to be on farms. They don't necessarily have to have high wind speeds in order to be feasible, in order to make useful energy.

So therefore, it's going to be a great economic benefit for -- the average landowner can put up a small wind turbine on their properties and make their own electricity, and Vermont is special in that you can actually get paid cash. So we had talked about the definitions of small wind in that, you know, there is a definition out there that's less than a hundred kilowatt. You see 50 kilowatt. The AWEA 9.1 specifies 50 kilowatt. It has a small wind -- standard-offer program in Vermont specifies it at 100 kilowatt. Okay. So here's a typical difference. That's a Vestas V117. I think it's on top of some of these Vermont wind farms, and that's the Bergey down there at the bottom on a hundred foot tower. You can see the visual distance. You're going to find that if you get the data sheets, you're going to find that the tower heights are much higher, 450. Blade area is 384 feet versus 23 feet. It's a difference of

10,000 square meters versus 38 square meters. So the differences in the actual sound pressure and sound power coming out of a large turbine and a small turbine, I mean hearing -- I hear stories about people putting their hand on the wall and feeling vibrations and all sorts of things. That's not going to happen with a small wind turbine. It does not have that type of sound power.

So the differences you'll find between that Vestas and the Bergey is almost -- almost 10 dB of difference. Okay. So that makes a difference. That's why you need 4,000 feet for this large turbine and the Bergey, you know, to make 45 decibels, you could probably make 45 decibels in 5 or 600 feet. So this is the difference.

What you're going to find out in the world, you know, we have all seen these turbines. There is the Sky Stream at Northern Power down the street makes a hundred kilowatt. We are making the turbines like this. You're going to see them close to houses. This is what they are designed for. You're going to see -- and this is what AWEA 9.1 is all about, is they specify it, and they anticipate the use of a small wind turbine to be -- start at 200 feet. And then you can go out farther from there.

So what they do is they specify a rated power in dBA which is sound pressure not sound power. At that point you can, as a rule of thumb, if you double the distance, the sound pressure in dBA will go down about six dB. And you can do an estimate that way.

We are all using modern software, you know, to show this in a graphical way such as Windpro or DNV software, et cetera, and that's not too hard to do. But these -- so you can see farms and houses, et cetera. It's -- this is what small wind turbines look like. And so this is a certification data sheet out of SWCC's website. This is about the Bergey 10 kilowatt. The reason I'm talking about the Bergey 10 kilowatt is it's the most popular wind turbine in the United States. It's in Vermont. There are turbines down to one kilowatt, and there are turbines up to 65 kilowatt on the website.

Okay. So you can see -- the point I want to make on this is that the -- you can see the high, the maximum noise level up there, around 55 or 57. That's the maximum noise level. If you go down in meters per second, it's somewhere closer to meters per second. It's somewhere around -- you can convert meters per second to miles per hour. 12 meters per second is about 25 miles an hour. So you can see --

DR. QUIN: You can see the background there too by the way, that is Texas which is even lower than what you have here in Vermont.

MR. DAY: That's a good point. I'm going to point out this background noise.

DR. QUIN: You've got plenty of it there.

MR. DAY: I know that site. That site is grass. This is the sound of grass. This is not trees, not houses. This is the sound of high grass. It's not even corn. This site is going to be making -- when the Bergey is up there at -- making maximum sound at 55, 57, the background noise you can see is somewhere there around 45 decibels. Et cetera.

Okay. In order to get -- and I hear these stories about 18 decibels and 20 decibels of background noise. Yes, that can happen if you have absolutely no wind on a frozen day. Okay. If you go out into any average Vermont woods even in the wintertime, when there is no leaves, okay, you cannot get -- just average wind four miles an hour breeze or five miles an hour breeze. You cannot get less than 40 decibels, 35 decibels of background noise. It won't happen.

So what we are saying is -- and I'm

going to get back to this point. Look at this data here, and this is grass. This is not trees. Now a deciduous tree with leaves on it will make 55 decibels of noise, 50, 55 decibels of noise in that high wind. Okay. So this is the same -- this is as Dr. Quin's chart -- this is sound pressure instead of sound power.

What I want to show is if you can see this is the Wiebull curve which shows the probability of instance. How often does this -- how often is the wind going to be at 11 miles an hour. You can see the peak. This curve is an average of 11 mile-an-hour peak. And it's showing about, you know, 12 percent of the time. So the majority of the time up there is between 6 and 14 miles an hour. But if you look at 26 miles an hour where the Bergey makes its maximum sound, its maximum noise, you can see it's less than a fraction of the percent of the time, and you calculate that out. You know .2 percent of the time up there between 24, 25 miles an hour, is somewhere around 16 hours out of 8,760 hours per year. This is what we are talking about.

Okay. So you can see this is the list that was presented by REV of the same turbines. She represented and put the data up on the rated sound

power. I went through and I marked down what the maximum sound power was on these turbines. And you can see it there, and right next to it there is the distances that you would be required to have in order to make 35 decibels. And that's probably very conservative. You probably should add 10 percent to that. We will get back to that.

Okay. So my customers ask me, how many acres do I need to install a wind turbine, and they say 15 acres enough? Is 10 acres enough? And I have to tell them that if you have a property and you have to maintain 1,300 feet, you need 155 acres to install a turbine, a Bergey turbine. In order -- if you were to have a house on every side, around that turbine with the 100 foot buffer.

This is -- and so if you put that on, you know, the Vermont landscape, you can see the property lines there of an example of houses that have long slender property lines, that go up the hill. And, you know, in a practical application that would make it an excellent wind site. There is the row of houses down there at the bottom of the hill. And where that turbine, that yellow dot is at the top of the hill, so you would -- perfect place for a turbine. And there is your 155-acre square there.

And then you would do your Windpro software. Either this software or the software by DNV. These are the worldwide recognized software programs to model. You would see the yellow line at the outside there, would show you a 1,300 feet, and that's the 35 decibel line. The pink dot on the side there is the house. So this turbine could potentially meet the sound pressure. But if you look at the setback distances, you have your two times the top of the blade. So this would be automatically disqualified because this property is only 310 feet wide. And the top of the blade of the turbine could be 200, 250 feet.

So you know, what we are requesting is you look at each case individually and not automatically eliminate because of an arbitrary setback limit. We talked about the sound environment. This is an example here again when I hear stories about 27 dB of background noise, or we were at the Bennington meeting and a gentleman talked about or people talked about 18 decibels of background noise. Well okay. It's possible to happen. But when that happens, a small wind turbine -- you can see it off there to the right is in the same neighborhood. And therefore, it's going to have zero sound output at that particular time. If you're

talking about the same time. It's not the big turbine up the hill that could be getting the high wind and making -- potentially could be making high noise, highest maximum noise at that point, when the terrain is blocking the wind and therefore you have -- and therefore blocking any background noise from happening.

The small wind turbine is going to be in the same vicinity, and it's going to have the same -- it's going to be making low noise when there is low background noise, and when the background noise of trees and grass come up, for that small percentage of the time, the small wind turbine then will make its maximum noise, and we will get into that scenario.

So things to consider. Small wind turbines make their maximum noise when the wind is high. Okay. This is 15 to 25 miles an hour. At that time a neighbor will likely go inside and shut his or her windows at night. So what we are saying is that when you're outside, and it's six or eight miles an hour, that's going to blow your hat off. Okay. And if you're -- if the wind goes up to 11 miles an hour, you're going to cancel your picnic. You're going to fold up everything. You're going to

go inside. At 15 miles an hour, your trash can's going to go blowing down the street. At 20 or 25 miles an hour which is a fraction of the time you're in a wind storm, and we all know what that sounds like when you go inside. And as I understand it this ordinance is to protect people so they can get their sleep.

Okay. Well in a wind storm most people are going to shut the window. Okay. And when you shut the window, number two. Most likely people are going to shut their window in the wintertime which is six to eight months of the year. So we are talking about summertime. Now when you go inside, and we have had many discussions here, many different opinions of background noise, and I've read the letters. One fellow that was putting a diesel tractor outside the window and measuring only a six dB difference from a diesel engine. Okay. And then other data was showing 25 dBA of difference. Okay. So we are going to average 12, 15. Maybe fair. I think I heard the gentleman say five decibels for an open window. Okay. So when you close that window, you're going to get 15 decibels of noise attenuation or masking.

So now when you have -- so number four.

Small wind turbines do not have the low frequency sound and infrasound. They just don't. Nobody has reported any complaints of such. And it's because it doesn't exist. And this is why AWEA 9.1 and SWCC they don't test it because it's not a problem. Okay. They start testing octaves and low frequency sounds in IC61400-11 which was designed to test large wind turbines. They came up with AWEA 9.1 because they knew that small wind turbines could not meet or could not exist with IC61400-11.

CHAIRMAN VOLZ: You're five minutes over your time now. So you can wrap up.

MR. DAY: Okay.

DR. QUIN: It's about done.

MR. DAY: So what I'm saying is that the scenario of a turbine, you go in high wind which makes its sound 16 hours out of the year. The neighbor's going to go inside, close the windows, whether it's wintertime or whether it's just -- the house is going to have 16 dBA of sound attenuation, and the net sound will be less than the three dBA inside as required.

Also that does not take into account any background noise that's going to be happening during that wind storm. And we are recommending --

conclusion; we are recommending 42 dBA at minimum, okay, for night and day. And we are requiring that not be subject to IC61400-11 but AWEA 9.1. And there not be any setback limit in rule 5.100 or 5.700.

We are recommending 1.1 times the top of the blade, and then review it on a case-by-case basis, you know, based on visual impact or whatever during the CPG process.

CHAIRMAN VOLZ: Okay. Thank you. So I think what we would like to do is take our lunch break now, and then when we come back we will have questions for you when we come back.

MR. DAY: Okay, great.

CHAIRMAN VOLZ: So we will come back at 1:35.

(Recess was taken.)

CHAIRMAN VOLZ: We are back from lunch, and we are ready for the next --

MS. CHENEY: Actually questions.

CHAIRMAN VOLZ: -- questions; that's right. So do we have questions?

MS. HOFMANN: For Mr. Day?

MR. DAY: Can I just sum up, if nobody has any questions?

CHAIRMAN VOLZ: I think no. I think we

understood what you were saying --

MR. DAY: Okay.

CHAIRMAN VOLZ: -- pretty well actually. I think it came across very well.

MS. HOFMANN: You already answered my question about NRO and small wind turbines.

MR. LEWIS: Can I ask a question following up with that?

CHAIRMAN VOLZ: Sure.

MR. LEWIS: There was a discussion of NRO with the small turbines, and I just want to ask for clarification. Can most small wind turbines curtail to adjust their sound limit?

MR. DAY: No. Every certified turbine on that list is a fixed-blade turbine. We are working on it. Okay. We are working on better turbines and better technology, but as of today, if you were to go out and buy a turbine, I would say any turbine, I'm not talking about Star Wind Turbines, I'm just saying the small wind turbine industry here you will not find a wind turbine with articulating blades in the small wind category.

MR. LEWIS: So that means that --

MR. DAY: They will not be able to do NRO. In order to do NRO, basically you pitch the

blades and slow the blade down, and therefore reduce the tip speed and reduce the noise.

MS. HOFMANN: Can you stop them?

MR. DAY: Yeah, you can stop them and make zero energy. Sure.

MS. CAMPBELL ANDERSON: But could a homeowner do that on their own?

MR. DAY: It's possible. You just -- it's possible. I mean --

MS. CAMPBELL ANDERSON: Every night turn it --

MR. DAY: You could put a contactor switch on your breaker and turn it off from the grid, and it will shut down. I mean at least ours does. But I can't talk for everybody.

CHAIRMAN VOLZ: It would stop spinning?

MR. DAY: You could -- you know, I can't say. Most turbines have damper load cells, so when they lose the grid, the load bank comes on and replaces the grid but they keep spinning, but mainly protect themselves from over-spinning. Sophisticated wind turbines like Northern Power, Star Wind Turbines, may have an ability to pitch their blades or have a disk brake.

CHAIRMAN VOLZ: But the small ones that

you were talking about --

MR. DAY: The ones on that list they are all -- they do not have NRO capability.

CHAIRMAN VOLZ: If you discontinued them from the grid, they would continue to spin.

MR. DAY: Yes. I think that the Chinese one, the 65 kilowatt, I believe has a disk brake.

CHAIRMAN VOLZ: So you could stop the spinning.

MR. DAY: That could potentially program it to shut down maybe. I'm not exactly sure. I mean it's possible.

MS. CAMPBELL ANDERSON: So you couldn't really have a night and a daytime standard. It would be very difficult.

MR. DAY: Well you could shut down the turbine. I mean --

CHAIRMAN VOLZ: That's my question. Can you really shut it down so that it's not making noise anymore?

MR. DAY: That list of turbines I'm saying no. Northern Power 100 you can.

CHAIRMAN VOLZ: Okay. But you were talking about the category below 100.

MR. DAY: Yeah.

CHAIRMAN VOLZ: That was your presentation.

MR. DAY: That list we gave you off of the SWCC site, none of those turbines you can perform NRO.

CHAIRMAN VOLZ: Okay.

MS. HOFMANN: Well not just NRO, also just stop --

CHAIRMAN VOLZ: Stop them from turning.

MS. HOFMANN: You stop them. They may still turn because the wind is blowing.

MR. DAY: They are not designed to stop. They are designed to protect themselves from over-rotation when the grid goes out. They still spin. They just replace the grid with a dump load.

CHAIRMAN VOLZ: All right. So any other questions? Yes.

MR. AMBROSE: I have a question for you, Dr. On the Texas Wind, you showed a slide of wind noise that you drew a regression line through over grassland.

DR. QUIN: Yeah.

MR. DAY: That was my slide.

MR. AMBROSE: That was your slide.

Were you able to assure that you were not getting wind-on-microphone interference?

MR. DAY: Well I'm not a -- those sites are operated by certified acoustic engineers, okay. They are certified by NREL. Okay, so I expect that those engineers are experts, and I'm sure they can tell the difference between background noise and wind turbine noise.

MR. AMBROSE: No, just wind on microphone is a thing you have to be aware of.

DR. QUIN: It's an issue, I agree. Lots of people have looked at it. I'm sure you read Dave Hessler's paper about it. I've read it too, and it is significant.

MR. DAY: I've seen some of the apparatus they have that kind of cone the microphone.

MR. AMBROSE: You have to protect it, because it is measuring minute variations in barometric pressure.

MR. DAY: Yeah. They do special things. I'm not a sound engineer.

MR. AMBROSE: I just want --

MR. DAY: They do have special efforts to get -- so the data that is on these certified sites is very accurate.

MR. AMBROSE: I'll leave it at that.

MR. DAY: Okay.

CHAIRMAN VOLZ: Any other questions? Okay. So I think we are ready for Resource Systems Group.

MR. DUNCAN: Somebody hit the lights? That's probably good. Thanks. Thank you.

My name is Eddie Duncan, and I'm with RSG. I want to thank the Board for giving us the time to speak today on a number of topics that we prepared hoping that they would be useful to the Board in preparing the draft rule.

I also want to sympathize with the Board that the task at hand is very difficult, and while I sympathize with you, I don't -- well I guess I would just say I don't envy what you have to do with this technical information. But I think it does give the Board the opportunity to do something great in terms of providing clarity to noise rules in the State of Vermont for the average citizen and for developers as well so that they know what to expect. And I appreciate that.

So a brief introduction. My name's Eddie Duncan. I'm a director with RSG. I manage the acoustics practice at RSG. I have been with RSG for

about 13 and-a-half years and practicing acoustics for about 15 years. I'm Board certified through the Institute of Noise Control Engineering, and I'm a member of the Acoustical Society of America.

My education background is in environmental law and policy from Green Mountain College. It's actually a degree in environmental studies with focus on environmental law/policy where I looked specifically at noise policy which was my interest in entering into that.

My other background is in engineering and science with a focus on acoustics. So that's where I get my acoustics background from, and that's from RPI. RSG also has as a whole -- our acoustics team has significant experience in the field of wind turbine acoustics dating back to 1993 when we did work for the Maine land use regulatory commission. Since that time we have studied over 80 different wind turbine projects across the country from Maine to Hawaii, including in the state; Deerfield Wind, Kingdom Wind, Georgia Mountain Community Wind and others that are in development.

We have also conducted research on wind turbine acoustics partly for our own edification and then also other projects for the Massachusetts Clean

Energy Center, and Lawrence Berkeley Laboratory for the U.S. Department of Energy.

Our staff regularly publishes papers, and in fact just two days ago, one of our staff was at the International Wind Turbine Acoustics Conference being held this week in Rotterdam, Netherlands, which is probably where Payam will be calling in from in just a little bit. And then our staff is also co-chair of the technical committee on wind turbine acoustics at the Institute of Noise Control Engineering.

So today I asked for an hour. I suspect it's probably only going to be about 50 minutes. I have five topics that I would like to cover. These are topics that aren't tied by any one theme, but rather topics that I thought would be information that would be helpful to the Board in producing a rule. Those include post-construction compliance measurements where I'll spend a good portion of time. And then also aesthetics and noise annoyance where I'll spend a good bit of time. And then less time, but I will be talking about outdoor to indoor attenuation, noise reduced operation of wind turbines, and then the PSB precedent versus the proposed rule and acoustic context for that.

So the proposed rule in the economic impact statement that's required for making -- creating a new rule, it hypothesizes that the proposed compliance measurements will be cheaper than other alternatives or cost less than other alternatives. And the reason that it proposes that is that it requires monitoring when sound levels from the wind turbine are at its highest, and background sound levels are at its lowest, therefore the line of thought is you don't need to account for background sound levels because you're measuring the sound from wind turbines.

So the new rule does away with background sound level monitoring as opposed to methods that have been used in previous projects in the state and in some other parts around the country. RSG's experience with this is that this methodology does not result in cost savings by not accounting for background sound levels. And in fact, it will not necessarily yield accurate results at all, in some cases it may, and in some cases it may not, but you won't know for sure if it's an accurate measurement or not.

So I plan to present the reasoning behind those two things. So the proposed rule is

very similar to Maine's compliance measurement procedure. It requires the arithmetic average of 12, 10-minute periods. And it takes that number and compares it to the limits in the rule. Those measurements need to be conducted when wind turbine sound is dominant which is probably at night when background sound levels are low. Downwind within 45 degrees of the five closest turbines. Surface measurements -- maximum surface wind speeds need to be six miles per hour or less, surface being defined as ten meters above ground. And hub height wind speeds able to generate maximum turbine power output of plus or minus one decibel. The issue with this is that these conditions, while ideal, and may yield accurate results, require long-term monitoring at most sites in order to actually capture all of these conditions at once, which is required. These are "and" statements not "or" statements.

Also, the standard -- the current proposed rule contemplates installation of temporary 10-meter mast at the site to measure wind speed. Typically this isn't a problem; this can be done. Typically when you're installing a 10-meter mast you're talking about long-term sound level measurements. We are not talking about short-term

sound level measurements. So to the extent the Board or anyone else considers the amount of time needed to monitor to be shorter, it's still a long- term measurement. It's not a few hours of attended monitoring.

So to give an example of this, I would like to present two case studies from the state of Maine. Again, it's very similar to the compliance requirements here in Vermont under the proposed rule. And so in this case we have four monitoring locations, actually we might need to hit the light again, just to see the background -- the map there. So it might be difficult to see, but this is in the state of Maine. There are four compliance monitoring locations. There is one to the east, the west, and then there is two to the south; southeast and southwest. Having four compliance monitoring locations which were selected because this is near the nearest residences, requires that we conduct monitoring in wind regimes from four different directions, and then it also requires all those other things, maximum sound power output above, lower down below. So we had to watch the weather forecast for about nine months in this case, and during those nine months we would go out when it looked like the

weather was -- forecast was promising to capture those events, and we may have captured them or may not have captured them.

We would have to then go back and analyze that data to see did we have enough periods or not. We don't know ahead of time. So over the course of those nine months we monitored over seven periods for a total of 53 days. And in those 53 days of monitoring at two locations, we had seven and eight valid periods. These are 12 10-minute periods that are needed. We had seven and eight 10-minute periods that were valid, and at two locations we had none that were valid that met all of those criteria.

Another example from the state of Maine, this one is more of a better case scenario. We have a sound monitor that was installed really in almost an ideal location to try and capture those requirements for sound monitoring. It was downwind from the predominant wind direction. It was near the wind turbines but also in the direction of the nearest residences, so it was representative of them. And because it was downwind of the predominant wind direction and below the ridge, theoretically we should have less wind at this site, less ground wind speed at this site, because the ridge is blocking

that.

I would add that this monitor is a continuous or permanent monitor installation in the state of Maine. There is a concrete pad and solar power, and it's monitoring all the time. So with doing that, in the first five years of monitoring we had the advantage of it being a continuous system so we could figure out what days were best after the fact. But then even in going in and looking at those days that were best to capture those periods, we had to analyze five days before we could come across 12 periods that were valid. And that's for three years. Two years we had to look at 11 days of data and eight days of data in order to actually find those 12, 10-minute periods that were valid. And even in this scenario, for those 12, 10-minute periods that were valid, we had to go back and filter out bird calls because they were affecting sound levels in some of the 10-minute periods.

So those are just two examples that I hope demonstrate that the proposed conditions can be quite problematic and actually don't result in shorter monitoring. It may, you may get lucky and have the right conditions at a site, but you may not. And it might be difficult to find that location. You

don't know that ahead of time. It still requires significant data analysis, and in the end at some sites it may amount to continuous sound monitoring.

So now I would like to shift over to talking more about the accuracy of this. The rule or the conditions in the rule have the assumption built in that the wind turbines are the only noise source that's aloft at a site. In Vermont that's not the case. We are dealing with hills and mountains that are forested. And so when you have high winds aloft and low winds below, you can have your monitor far away from any tree, but you're still looking at a wall of forest leading up to the higher terrain where the wind turbines are.

And so what you end up actually measuring if you're not accounting for background sound levels is the sound from the wind turbine and the sound from the forest. And it's -- you don't have to have leaves on the forest for the forest to generate noise. If you have high winds aloft, tree moving through trunks and branches can actually be confused quite easily with wind turbine acoustics depending on the conditions at the site. And I have been there at sites before where I have had another acoustical expert from another firm working for

another entity, and we were both looking up at the turbines and listening, and we can't tell based on the high winds whether it's coming from the turbine or whether it's coming from the forest. And it's not until you actually shut the turbines off you're able to actually tell that was mostly the wind turbine or, oh, a good portion of that was from the forest.

So our recommendations to the Board on post-construction compliance monitoring would be to account for background sound levels. I'm not laying out a full detailed way to do that at this point, but I would offer that the turbine shutdown method actually works quite well. It may not be what is favored by the industry because there are power losses when you do that, but there is no cleaner way to look at what the sound level is when the turbines are on, shut them off, and see what the background sound levels are.

The shielding method, this has also been used at some projects in the state. This is where you have a microphone on the opposite side of the building or something like that. If the locations are selected well, it's a good estimate of what the sound levels are like. We have compared the -- that to the turbine shutdown method at specific

sites, and showed that it can actually provide a pretty good estimate at those sites if the selection -- if the locations are selected well.

I would encourage the Board not to consider what we call the proxy method. That is where you have a sound level meter that is far away from the site, and you're saying that that's background sound levels. And at the same time you have another monitor that is close to a project site, and that's measuring operational sound levels. This is something that works well in the midwest where you have a homogeneous landscape that's just farm fields with the same crop and the same wind conditions, so you can go far away from the site and get fairly good background sound level measurements at the same time, but in Vermont it's difficult. We have a heterogenous landscape, and we have mountains and terrain that just affect the background sound levels in all locations. We have streams everywhere that create sound. So it's hard to find a location that's a good proxy background location for projects in the state.

I also believe -- I don't know if he'll talk about it today, but the department has presented at previous workshops before the Board another method

for accounting for background sound levels. And I haven't looked into that method in detail at this point in time. But that may offer another option for the Board to account for background sound levels.

The other two recommendations here are to keep the current instrumentation personnel and calibration requirements in section 707 of the proposed rule. These look pretty good. I think it's good to have those specifications. And then also the -- we would recommend that post-construction monitoring be used to verify the preconstruction model. There has been some questions, and there was questions in previous presentations about the accuracy and the adequacy of the modeling -- standard modeling methodology and predicting sound propagation from wind turbines. That's an easy thing that we can look at. We have projects that are built, and we have projects -- we have models for those projects, and we have monitored data for those projects. And you can do that for all future projects. Compare what the post-construction compliance monitoring says with what the model says it should be, and adjust the model as necessary for any enforcement actions that might be necessary.

Before I go into aesthetics and noise

annoyance, I just wanted to touch on one thing. There was a question earlier from I think someone from the Board about whether or not the monitoring and modeling should take place at one and-a-half meters or four meters since we are talking about compliance monitoring right now. I would propose that modeling be conducted at both one and-a-half meters and four meters. And then post-construction compliance monitoring be conducted at one and-a-half meters to verify the model. So if you know that, then you know that your four meter measurements are probably accurate as well, if your one and-a-half meter measurements are accurate. That's how I would address that.

So I would like to touch on aesthetics now. I don't know if aesthetics has a role in the proposed rule or not. I know it's been brought up at previous workshops. And so I thought it would be something that would be worth discussing in terms of how the acoustics community addresses aesthetics, and noise annoyance, and then why it's also important to consider the acoustical metrics involved in those studies.

So I would first offer to the Board that generally speaking the professional acoustics

community does not talk about aesthetics when they are talking about noise. This is something that we look at in Vermont, and I'll talk about that in a second. But in the acoustic community the closest that we come to those sorts of things is sound quality which is what we use to evaluate whether or not your car door sounds right when you close it. So Ford wants their car door slamming more quality than Chevy does. You know, and so that's something that we look at in terms of acoustics. And that involves some socio -- social surveying to figure that out.

We also talk about natural and cultural sounds as a natural resource. That's something that's a little more similar to aesthetics, but that's done by the National Park Service and in the context of protected areas. So that's not quite the same as the aesthetics that we are talking about here, I think.

Acoustical aesthetics in a rural working landscape are not something that's addressed by the professional acoustic community at large. We do address it here in Vermont though. In Act 250 under criterion one we address noise as air pollution. That's to the extent that it has the potential to be a health impact. But we also address

it in the criterion eight, and that's to the extent that it is a potential aesthetic impact. To be clear, noise is not explicitly mentioned in the statute for Act 250 under criterion eight, but rather there is a long history of case law in addressing noise and acoustics under criterion eight.

CHAIRMAN VOLZ: And not just for wind turbines but for -- in fact not for wind turbines.

MR. DUNCAN: In fact not for wind turbines. This would be for whatever Act 250 is applicable to. Commercial development.

CHAIRMAN VOLZ: Right.

MR. DUNCAN: And it also, I would add, varies from project -- type of project to type of project. So a rock quarry may have different aesthetic impacts or standards than a quickie mart that for some reason had to do an Act 250 permit. Right.

So back in 1985 the Quechee test was developed. I suspect that I'm reviewing a lot of information for people in the room, but I figured I'll just do a very brief overview to the extent that it applies to the topics that I plan to speak about. The Quechee test is a two-part test. It's the framework under which Act 250 looks at aesthetics,

that's both visual aesthetics and noise aesthetics. Although I would point out that the framework was developed by landscape architects for the Environmental Board, not acousticians, but either way it's used to look at acoustical aesthetics in Act 250 today. And it's a two-part test that asks if the project is adverse. To do that you ask whether or not it fits the harmony of the area, whether or not it fits the context of the area. If the project is found to be adverse, you go to the second part of the test. So a project can be found to be adverse and still be permitted. But it cannot be found to be unduly adverse and be permitted.

So the test to be unduly adverse is whether or not it violates a clear written community standard that addresses aesthetics. Does the project offend the sensibilities of the average person. I'll touch -- we are going to highlight that one. And then the last one is has the applicant failed to take generally available mitigation steps. The first question and the third question are fairly easy to answer even in the context of wind turbine acoustics. The second one is a bit trickier. For Act 250 the threshold for does the project offend the sensibilities of the average person, is would the

sound be considered shocking and offensive by the average person. And I would offer to the Board that to the extent that the Board is considering aesthetics in the proposed rule making in its decision-making process, the question of whether or not the daytime limit of 42 dBA and nighttime limit of 35 dBA is necessary to keep the average person from being shocked and offended.

Now I mentioned earlier the acoustics community generally doesn't talk about acoustical aesthetics. What we do talk about is noise annoyance, and I wouldn't necessarily say that noise annoyance and aesthetics are the same thing. But I think that they are similar. Noise annoyance would address aesthetics of an area. So it's worth talking about here. In the field of noise annoyance we have a fairly standardized method for studying this. Even though it's standardized, oftentimes research is different from one paper to another. But we have an ISO standard that involves social surveying methods that asks under certain conditions are you lightly annoyed, moderately annoyed, or highly annoyed. And from those social surveys we also have sound levels associated with that. We are able to develop dose response relationships that say that for sound level

X, some portion of the population that's exposed to sound level X would be considered either lightly annoyed, moderately annoyed or highly annoyed depending on how that those questions were answered.

An example of that that I think the Board has seen in previous filings is the World Health Organization guidelines. They have generalized annoyance ratings for serious annoyance and moderate annoyance for community noise. For daytime and evening they set up a long-term 16-hour average of 55 dBA for a serious annoyance, and a long-term 16-hour average of 50 dBA for moderate annoyance.

I'll add that that study or that paper that came out from the World Health Organization was back in the year 2000, so this predates a lot of more recent research that is typical of wind turbine acoustics, and in fact this is more of a mushing together of mostly transportation sources.

What we do have though are wind turbine specific studies that have been conducted since that time. And primarily we have got three categories of those studies. There is the Swedish and Dutch studies that have been done. These are the Pedersen and Waye papers that you'll often hear referenced.

We also have a Japanese study that has looked at this. And the Health Canada study also has looked at this. The issue with these three studies is that they all use slightly different metrics and different modeling techniques to figure out what the dose response relationship is. So it's difficult to make an apples-to-apples comparison. But one paper does do that. It takes all of those studies, the Swedish and Dutch studies, the Japanese study, and the Canadian study, and it combines those dose response relationships and normalizes them to using the same metric so that we can actually compare them apples to apples. That is, they used the same modeling techniques ISO 9613-2. G equals 0. Four meter high receivers.

These modeling parameters I would point out would yield two decibels lower than what we currently use in Vermont because these modeling parameters used in this paper don't take into account manufacturer uncertainty, so they would be lower. So when we look at this data set, I'll say that in just a second, 43 dBA in this data set is actually what we currently use in Vermont 45 dBA.

CHAIRMAN VOLZ: And the group that did that normalization one of the authors is Mr. Kaliski?

MR. DUNCAN: It is.

CHAIRMAN VOLZ: He's the same person who worked for the Department of Public Service or different?

MR. DUNCAN: No. Mr. Kaliski works at RSG. He's the previous director of the acoustics practice. Still practicing. And this paper was presented at the wind turbine acoustics conference this past week with his normalization.

CHAIRMAN VOLZ: Okay. It's not the same consultant the Department of Public Service used earlier? It was a different spelling?

MR. DUNCAN: No. That's Payam Ashtiani.

CHAIRMAN VOLZ: Sorry. It's confusing.

MR. DUNCAN: So this normalization is not this long-term LDN which we are not even using in the state anyways. It's an hourly LEQ which is what we are currently using in the State of Vermont, and I believe what is similar to what the proposed rule is looking at. And so that's what we are looking at here. On the vertical axis we have the percentage of people who are exposed to noise of a certain level that are highly annoyed. And on the horizontal axis we have actually what those sound levels are that

they are exposed to. So this is our dose response relationship of all of the studies using the same metrics so they are comparable apples to apples.

And what we actually see is fairly good agreement among the Swedish, Dutch and Health Canada studies which results in what we currently use in Vermont, a 45 dBA one-hour maximum resulting in 15 percent of the population being highly annoyed. Under the Japanese study 45 dBA one-hour maximum for what we currently use in Vermont is 15 percent of the population. Highly annoyed.

It's worth noting that these curves are modified and influenced by additional attitudinal variables. So things such as fear, and belief that the noise could be prevented, and personal benefit to a project, perceived importance of a noise source, these are all things that affect someone's potential to be annoyed by noise. I add this here because I think it's important for the Board to note, and I suspect you may have heard this previously, but that is that perceived fairness in the decision-making process is one of the things that have been correlated with noise annoyance. I'm not saying the Board's not fair. I'm just offering that up as a -- that is something that is in the studies that shows

that perceived fairness in the decision making process affects noise annoyance afterwards.

In the Swedish and Dutch studies it was also observed that annoyance occurs primarily when spending time outdoors with activities such as relaxing and barbecuing and things like that.

So with that, I would offer that given that annoyance occurs primarily when people are outdoors, does it even make sense to have a nighttime limit address aesthetics. I'm not saying that the Board was considering aesthetics for the nighttime limit, but that is just a question that I would pose if the Board is considering aesthetics, does it make sense that it would be at nighttime. But rather perhaps a limit -- a lower limit if there is a lower limit by time of day, that that would be applied in the evening, potentially 5 p.m. to 9 p.m. I just throw those numbers out there, the difference from the rest of the period, because that's when people would be outside, enjoying time outside.

I would also offer that given the annoyance research that 45 dBA one-hour maximum results in 10 to 15 percent of the population that's exposed to those levels being highly annoyed, and that under the proposed rule the 35 dBA, 2.5 percent

would be highly annoyed. And under 42 percent -- or 42 dBA six to nine percent would be highly annoyed, I would propose that the current PSB precedent does, in fact, protect against average people -- the average person being shocked and offended per the Act 250 framework, and also that the current -- therefore the current PSB precedent protects against undue adverse impacts on aesthetics. Again, that's per the Act 250 framework.

CHAIRMAN VOLZ: And when you refer to current PSB precedent, you're not referring to the draft rule. You're referring to earlier decisions?

MR. DUNCAN: Yeah. I'm referring to 45 dBA limit exterior one-hour maximum.

CHAIRMAN VOLZ: All right.

MR. DUNCAN: So that's probably at least 50 percent of the talk there. So I think we are doing pretty good on time.

I would like to address outdoor to indoor attenuation. You know, in previous cases there's been an indoor limit. The proposed rule doesn't have that. So to the extent that that has any role in the development of the draft rule, I think it would be good to touch on that.

So the current PSB precedent is based

on 45 dBA outdoors, and that's so that we have 30 dBA indoors. That is assuming that we get a 15 decibel reduction in attenuation with windows partially open. We have two tests though -- that's what the World Health Organization uses in terms of their assumption. We have two tests in Vermont that we can point to though. In Sheffield we have a test that was done that resulted in less than five decibels of attenuation with the windows open. In that case we had large windows that encompassed a good portion of the wall surface area, and the panes were also able to rotate perpendicular to the site so they are essentially more open than a regular window would be.

In Georgia we also had another test that was done, and that test resulted in 15 decibels of attenuation with the windows open with a standard sized window. Those are only two data points.

CHAIRMAN VOLZ: Does Georgia refer to the Georgia wind project here in Vermont?

MR. DUNCAN: Yeah. The Georgia Mountain Wind Farm, Fitzgerald residence. This is information that's been previously submitted to the Board in other cases.

MS. HOFMANN: What is a standard size window?

MR. DUNCAN: A standard size window is I believe two square feet open. Two to three square feet open. So given that those are only two data points, I wanted to take a look at some additional data points that the Board may find useful. There is two studies that were done in the U.K. So it's not exactly the same climate as Vermont, but it's in the northern hemisphere and, you know, they get cold weather too. It might not be exactly the same.

In those studies they saw reductions, a range of reductions, outdoor to indoor with windows open of 7 to 26 decibels. So that's a big range, but they tested a lot of residences. Most of the values in that study were between 10 and 17 decibels in terms of their reduction. What that didn't look at though was the specific wind turbine acoustics spectrum that we see typically from wind turbines.

So what we did at RSG is we took the attenuation values at each frequency from that study, and applied it to a wind turbine spectrum. And in doing so, we found that the worst case attenuation with the windows open from that study was 14 decibels and the best case was 18 decibels. Hayes & McKenzie in 2006 also had another study from the U.K. And in that one, they only tested -- it only offers one

additional data point. They tested one window open compared to a bunch that were closed. In that study they had a 10-decibel reduction with the windows open.

The EPA -- these are not necessarily specific measurements, but the EPA uses a 12-decibel reduction for warm climates and 17 decibel reduction for cold climates with the windows open. And that's assuming, you know, that cold climates will have additional insulation in the outer shell of the building, and that provides some additional acoustical benefit. The FHWA uses a 10-decibel reduction for windows open for all climates. So I just thought it would be helpful to the Board to have multiple data points to look at when they are looking at indoor to outdoor attenuation. So while five dB or less of attenuation is possible, it's one data point that we have currently. Reductions between 10 and 15 are more common, and in some cases attenuation values upwards of 20 or more with windows open is possible. It will just depend on the window size, how they are opened, the bedroom, the orientation to a project, things like that. With the windows closed the attenuation goes up to 25 dB or higher.

So I'm nearing the end. I've got two

more topics here. One is noise reduced operations, and then the context of the current rule with the proposed rule. So noise reduced operations. The proposed rule limits sound levels during the day to 42 dBA and 35 dBA at night. I believe Ms. Anderson had testified earlier from REV that a project is designed to the quietest level, and that's been our experience as well. In the 80 projects that we have worked on across the country, that you have to design to the quietest level because if you can't meet the quietest level, you don't have a project.

So the way -- one of the ways that you are able to, if you have two different standards by time of day, that you're able to actually turn the sound level up or down is using NRO. Most of the sound produced by wind turbines is aerodynamic. It comes from the blades. There is also some sound from mechanical noise in the nacelle. This is, for the most part, in modern turbines has been mitigated. And so we are mostly talking about aerodynamic noise. The NRO is not really affecting mechanical noise in the hub. It's mostly aerodynamic noise.

So when a developer is designing a project, they design to the most stringent limit, and they have some tools to use when they are doing that.

They can look at the actual turbine array and the layout of where they are locating turbines. They can look at the turbine models that they are considering to install which will have varying sound power levels. Generally speaking, those two things are influenced by a number of other factors though including what the wind resource is in the area and project finances.

So the tool that they have to either turn the sound level up or down is NRO. They could also shut down turbines, but oftentimes -- and this is only my experience from speaking with developers, oftentimes that is something when we suggest shutdowns, that is something that is not possible. They have to look at another turbine, or they don't have a project, or something like that. A shutdown is often something that's not desirable. That's not to say it doesn't happen.

When I'm designing a project if it's not meeting a limit, I go through and I say during these conditions this turbine needs to be under this NRO, this NRO, that NRO, and this turbine needs to be shut down. And then they often will decide if they want to shut down that turbine or not or remove that turbine from the project.

So the way NRO works, we talked about this briefly. Essentially the blades are pitched. RPM's go down, but what I do want to touch on is this is a software driven process. This is not someone in a control center flipping a switch that turbine three should be turned down two decibels. It's something that we predict ahead of time. We know that turbine X should be turned down by five decibels or two decibels when winds are from the east, so we can program it so that it varies by time of day, wind direction, wind speed. And these protocols are developed and implemented into the software that's running the actual project.

CHAIRMAN VOLZ: So it happens automatically though?

MR. DUNCAN: It happens automatically. I don't know if there are turbines that are manual, but all of the ones that I'm -- all the projects I'm involved in it's an automatic process.

CHAIRMAN VOLZ: Can it be adjusted over time? In other words, you set it up one day based on the information that you have, and then you discover that in fact it's -- there is still a problem, and so you could then adjust it to -- make adjustments to the way the software dispatches the turbine?

MR. DUNCAN: Yes. It's difficult to adjust it immediately.

CHAIRMAN VOLZ: Right.

MR. DUNCAN: If there is a compliance issue and it's determined that three turbines need some sort of NRO that don't currently have it, that software can be redone, so they do do that.

CHAIRMAN VOLZ: Okay.

MR. DUNCAN: The one exception to that would be that's provided that that turbine has head room in the NRO protocols to do that. So if you're already at maximum NRO, you might not be able to further reduce it.

CHAIRMAN VOLZ: Okay.

MR. DUNCAN: And that's actually what I'm getting to next. There is limits to the usefulness of this function. So NRO typically will get us one to three decibels for per turbine. It is possible to get four. And I know of one manufacturer where we can get five. Only one manufacturer, not just a manufacturer, one model from one manufacturer where we can get five. One to two is most common. One to three is most common. And one to two does result in a moderate power loss. Three to four is possible. But it results in higher power losses

which will start to affect the economics. But it's still not a shutdown.

So the proposed rule there is a seven decibel difference between 42 dBA day and 35 dBA night. So the issue is if NRO is the primary tool that a developer is using to turn the sound level up or down, it's effectively -- the proposal is effectively a 35 dBA nighttime limit and a 39 dBA daytime limit, provided that they are not shutting them down, that they are using NRO as that tool to do it.

So developers have tools to reduce sound emissions from wind turbines, but there are limits to the range of reductions that are achievable. And I would recommend that if the Board is specifying different limits by time of day, that those limits range four decibels or so. If it's not, that's fine. But recognize that if it's more than that four decibels, then there is still an effective limit of those four decibels in the development of a project.

CHAIRMAN VOLZ: So they would build to the low plus maybe up to four above that.

MR. DUNCAN: Yeah.

CHAIRMAN VOLZ: Questions until the end

unless it's clarifying. Okay.

MR. DUNCAN: So that's that section. On to the last section here. And I think we are ahead of time. You can tell me. But --

CHAIRMAN VOLZ: Yes.

MR. DUNCAN: So the PSB precedent and the proposed rule more of an acoustical context for this. From previous testimonies and presentations I haven't talked about health impacts in this study. I'm relying on previous submissions for that, and if we need to, we will submit more information by the deadline. But I would say that from previous submissions on this, the current precedent of 45 dBA one-hour maximum guards against public health impacts. That's the same limit that's used in Kingdom Community Wind, Georgia Community Wind and Deerfield Wind.

I'm only speaking to the projects that RSG has experience with, direct experience with. The proposed rule of 35 dBA nighttime and 42 dBA nighttime goes, I think, beyond public health issues. And so that's partly why I wanted to talk about aesthetics and indoor-outdoor attenuation values and things like that.

The effective limit is lower than

what's proposed. That is, the effective limit is really 35 and 39 or 40 based off of the NRO discussion that we just had. I would offer that the effective limit is actually even lower than those. And the reason for that is that the proposed rule under 705 requires accounting for potential model error in the source emission values for preconstruction modeling. So the actual limits are lower than 35 to 40 depending on what that model error is that we need to take into account.

I haven't prepared to talk in detail about model accuracy today. I know there was some discussion of that earlier in the day. RSG will be submitting some information to the Board addressing comments earlier today about the adequacy and the -- essentially the different parameters used in ISO 9613-2 and what's accurate. What I would offer is that while the standard itself has language in there about accuracy and also about what it's used for, whether or not it's valid for high source or a low source, I would offer that there have been many studies that are wind turbine specific looking at the accuracy and the validation of ISO 9613-2. And RSG is prepared to submit those studies to the Board so that you can review it and see that ISO 9613-2 is

essentially the best tool that we have to use. It's -- we don't have one that's specific to wind turbine noise in the U.S. It's used worldwide, and we have shown it to be accurate if you use the right modeling parameters. So we will provide studies that talk about what those modeling parameters are.

I think the Board is very close to that 0.5 ground attenuation, four meter height, things like that. I think that's all fine, and you'll see that in the submissions that we give to the Board.

So a few closing thoughts. The first is that under the proposed rule, projects like Kingdom Community Wind which have produced over 700 megawatthours of power to the grid would not have been built. I'm not the developer of that project. So I can't say that definitively. But I know from doing the modeling and doing the monitoring at those projects, that it would have been extremely difficult to meet the proposed rule at Kingdom Community Wind, Deerfield Wind, the other projects that have -- currently have a 45 decibel limit applied to them.

I would offer that compliance monitoring must account for background sound levels. From a cost perspective it -- using the Maine methodology, is it any better? And also from an

accuracy method, you have to account for background sound levels. And there is really no clear or more definitive way than shutting down the turbine and seeing what the background sound levels are like.

The current PSB precedent of 45 dBA one-hour maximum does protect against public health impacts, I think, from looking at the research. And also undue adverse impact on aesthetics per the Act 250 framework. That is that the 45 dBA one-hour maximum does not result in the average person being shocked or offended.

And then lastly, if a different limit was needed for aesthetics, I would suggest considering an evening limit between 5 and 9 p.m., if a lower limit was needed by time of day when people may be outside spending time. And that's supported by the research that says a noise happens when people are outside, not in the middle of the night, although people can hike in the middle of the night, but it's not as common of a thing.

And with that, that's all I have in terms of a presentation. I addressed model receiver height question, but I'm happy to take more questions on that. As I mentioned, I'll submit more information on model verification and accuracy.

CHAIRMAN VOLZ: Okay. Do you have questions?

MR. KNAUER: You had one graph I think based on the study that your colleague Mr. Kaliski did about noise annoyance, and there were several lines -- page 21.

MR. DUNCAN: Yes.

MR. KNAUER: And some of the lines referring to outdoors and some to indoors. Was that based on attenuation, or there was actual measurements indoor and outdoor locations?

MR. DUNCAN: That's a great question. And I will get you an answer. I don't know. That's from the Michaud and -- it's from the Health Canada and Swedish and Dutch study. They looked at indoor values as well, but I don't know exactly how they did that. I will look into that and find out.

MR. KNAUER: That will be helpful so the Board can place this into context.

Another question, you opined that using the shutdown method is a preferable method for establishing background. Are you aware of any jurisdictions that use a shutdown method to develop a background and use that as a proxy, say we assume at location X the background is always going to be

whatever is measured using one shutdown period. So that, you know, say we are doing five different compliance testing over the life of a project, you don't have to do the shutdown every time.

MR. DUNCAN: Yeah. I can't point to a specific case, but I believe that that is something that is done in Canada in some jurisdictions. That shutdown period that we are referring to though in that case is usually over a longer term. So it's -- the project is in place and maybe it's preconstruction, I'm not sure, but you're measuring background sound levels over a longer term at the exact locations that you'll be doing compliance monitoring, and then that would fix what the background sound level is.

There are potential issues with that because these projects are installed for years, and background sound levels will change over time as the landscape potentially changes, but I believe that sort of methodology is used in some jurisdictions in Canada.

MS. HOFMANN: Tom, can I ask a follow-up question? One of my questions was about the shutdown method. Assuming the facility is already built, how long are these periods where you have to

shut down the turbines?

MR. DUNCAN: Yeah, we have typically shut down for 20 minutes to a half hour. There is some lag time, so when you're looking at these graphs of when the operation is running, you're seeing -- if you have a low background sound level on high operational sound levels, you'll see the wind turbine sound level, and this slow decline, and then clearly background, and then a slow incline until you get back up to full operation. But typically we recommend 20 to 30 minutes for shutdown period.

MR. KNAUER: I'm all set.

MR. COTTER: Just a clarification question. With respect to -- you had mentioned model uncertainty and accounting for that. And every time I see a reference to uncertainty, whether it's with the model or the manufacturer's rated sound power level, it always says -- I'll just use three decibels in the example -- it always says plus or minus three decibels. And when you account for that in the model, are you always adding three decibels to the output? So in other words, it will always -- probably using the wrong words here -- when you account for uncertainty, you're always increasing the output of the model. You're never going to get a

decrease.

MR. DUNCAN: That's correct, yeah. When we are entering in -- the uncertainty into a model, we are entering in the plus value of whatever the turbine manufacturer has said the uncertainty is. We don't typically enter in the uncertainty of the model itself. That's a separate uncertainty. And the reason for that is that we have done -- and we have conducted research, and we have also reviewed research that says what metrics provide the most accurate results in the model. And we are normally selecting the parameters like G equals 0.5 under certain conditions that are above the -- essentially the best fit curve that's above all the data points. That's usually how we are doing it. So we are already selecting conservative parameters for the model. We don't need to take into account an additional model uncertainty.

MR. COTTER: Okay. Thank you.

MS. HOFMANN: You were talking about in Maine that there is a fixed monitoring location in one of your two examples. I was a little curious about that. You said it was in concrete or something. You made it sound very permanent. And why did they do that?

MR. DUNCAN: Yeah. So this is before a lot of the current rulemaking in the state of Maine or kind of in the midst of all the rulemaking that had happened. And so, you know, the decision from the Board was different from project to project. And on this project, they said let's install a permanent monitor so we can see what the sound levels are like from this thing. And they required it on this one project. It's a permanent sound monitor in the middle of the forest, trees had to be cut down in order to install it there so we have an open yard. So it's not immediately next to trees. And also so that we get sunlight for the batteries because the batteries are run off solar power. And it's not uncommon, but sometimes it does die in the middle of winter, because we will get snow buildup on the solar, and it won't get enough power, and we will have to go out there and fix it. But it's a concrete pad, a 10-meter high mast, and a permanent sound monitor. Expensive thing, but it was required for one project.

MS. HOFMANN: Does it have benefits in terms of the amount -- the amount of data you're getting?

MR. DUNCAN: You know, I think if it

was -- I think if you had multiple continuous monitors, there would be more benefits. But that's one location. And so what we have seen is that it's essentially the same thing as us going out, setting up a long-term monitor for two weeks and analyzing that data except that we have a year's worth of data to analyze.

MS. HOFMANN: Okay. And my last question is you said other states don't look at aesthetics when it comes to sound. You did distinguish between aesthetics and annoyance. Do other states look at annoyance?

MR. DUNCAN: That's a good question. I'm not aware of any regulations that specifically look at annoyance. But oftentimes, and you'll figure this out with writing this rule, you don't put the reason that you set that level necessarily in the rule; right? And so some of the limits from state to state may be based on annoyance without explicitly stating that they are based on annoyance.

MS. HOFMANN: Thank you.

MR. FINK: I had a clarifying question. Towards the beginning of your presentation you made a recommendation that you should modify the preconstruction sound model based on the monitoring

results. And there is some language in the proposed rule that would require that, and I wanted to understand whether your recommendation was simply that we retain that, or whether you had changes that you would recommend to that language.

MR. DUNCAN: I don't recall that language in the proposed rule, so if that's there, I suspect it's covering what my recommendation is. I remember it being recommended by other parties in earlier workshops. And I essentially wanted to second that recommendation from earlier workshops.

MR. FINK: Okay. And if you are interested, you don't have to take a look at it now, but you can address it in your final comments. It's 5.706C of the proposed rule.

MR. DUNCAN: Great. Thank you.

MR. FINK: Turning to the studies you talked about with the dose response relationship for annoyance. I was interested how those studies account for -- or what their setting is in terms of background sound with the understanding that dose response relationship may vary in areas of high or low background sound.

MR. DUNCAN: Yeah. So the sound levels that are presented here are the sound levels

attributable only to the wind turbine development itself. If background sound levels are higher or lower, that may affect annoyance, but most annoyance studies are assuming that there is a dominant source that's causing that annoyance. Specifically how these three sets of tests were done in terms of accounting for background sound levels, I can't speak to today. But I can certainly look that up and provide information on that.

MR. FINK: And so in that vein, I would be interested in knowing whether they are, say, in an environment where a typical background sound level may be in the high 20s, low 30s dBA, or may be in the mid to upper 40s. You know, I could imagine that that may have a significant impact on the degree to which people are annoyed.

So it would be interesting to understand that.

MR. DUNCAN: So that would be what's the background sound levels and the site-specific studies done for these sites. I do know the one study is Health Canada which is a variety of sites across Canada, so the background sounds are going to vary across the study. The curve is based off of all of those sites; right? But I can look into what is

done for the Dutch and the Swedish sites and the Japanese study as well.

MR. FINK: That would be helpful. Thank you. That's all I have.

CHAIRMAN VOLZ: Questions? Yes.

MS. CAMPBELL ANDERSON: Could you go back to when you were talking about the NRO capabilities --

MR. DUNCAN: Yes.

MS. CAMPBELL ANDERSON: -- of the turbines. You said there was only one turbine on the market that could do a four decibel swing shall we say. Is that what you were saying?

MR. DUNCAN: I said there was one that I'm aware of that could do a five decibel swing. I think there are more that can do four, but it's still not entirely common among all manufacturers.

MS. CAMPBELL ANDERSON: Okay. REV would be concerned that if the decibel swing was too loud, that projects would be limited. You would end up forcing use of a turbine that may or may not be suitable for Vermont's environmental conditions and also could -- would likely be -- are these more expensive? The ones that have that larger capability do you know what -- I'll look into that.

MR. DUNCAN: That's not my area.

MS. CAMPBELL ANDERSON: So just -- we will perhaps comment on that, and keep into consideration that if there is only limited individual manufacturers or specific model types that could meet that level of swing, it may be fairly restrictive compared to a two or three-decibel swing.

CHAIRMAN VOLZ: Yes.

MR. DAY: I want to correct my previous statement on NRO for the small turbines. What I meant is what he said. They are not capable of adjusting pitch. I do believe they can shut down. And --

CHAIRMAN VOLZ: So by shut down, you mean stop spinning?

MR. DAY: Yeah. I believe they are small enough that their dump loads will bring them to a stop.

CHAIRMAN VOLZ: Okay.

MR. DAY: Okay. So --

MS. HOFMANN: Thank you.

MR. DAY: I just realized that was wrong.

MS. CHENEY: I was inferring from something that was said earlier that these smaller

ones can actually keep spinning just from the wind the way -- old fashioned ones.

MR. DAY: Some are very, very old and people don't even buy them anymore. So I'm not familiar with those. I know that the Bergey I believe has the dump load, will bring the blades to a halt. I think the Sky Stream will do the same. The only way that they will keep on turning is it's kind of like in -- I think the Bergey kind of folds sideways, so it might turn a little bit. But in general, I think it is possible that you can -- there is a switch which is manual. I believe, you would have to put some sort of program on it, that it will take the grid, take it off the grid, and put the dump load on and bring them to a stop.

Okay. So but they don't have the ability to change RPM.

MR. DUNCAN: I would ask the Board to consider any of the information that I presented in terms -- and in the light of large wind turbines not small wind turbines. I haven't really taken that into account in this information.

CHAIRMAN VOLZ: Mr. Ambrose.

MR. AMBROSE: Yes. Eddie, you showed two Maine sites. Can you identify those sites?

MR. DUNCAN: I may be able to. I'll check. And if I can, I will submit that to the Board. The one site I can say specifically because it's in the public record, the site that has permanent monitoring at it is Spruce Mountain.

MR. AMBROSE: Okay. I've got a number of questions. It's just so difficult, wind turbines have the tightest hold on data sites. I just -- it's amazing. I've worked with all kinds of noise sources in my 40 years, and I've never had such a tight hold on critical information.

I've got a question. You treat daytime noise from a wind turbine the same as nighttime noise. Is there a difference atmospherically between daytime and nighttime?

MR. DUNCAN: Atmospherically the sound level, or excuse me, atmospherically it's not strictly a daytime-nighttime; right? Atmospheric conditions change all the time. So sometimes nighttime will be different. Sometimes daytime will be different. I'm recognizing that the atmosphere is different from time of day.

MR. AMBROSE: Layering thermal inversion. Is it critical? This is why nighttime you hear that distant train is because the cool air

is on the ground, and during the daytime you don't hear that distant train because the cool air is aloft and the sound refracts up into the cooler air.

MR. DUNCAN: Yes. I understand how sound propagation works, and that based on temperature inversion it bends downward and it can also bend upward. I would add that in answering your question, I am not confirming the assertion that we treat daytime different than nighttime. I'm not exactly sure how you're referring to that, but I'm not accepting that assertion.

MR. AMBROSE: Well a wind turbine is a 24-hour noise source. Therefore, the critical time is the 35 dBA at nighttime it has to meet that criteria. And the other is, can you name a nighttime bird call that needs to be removed from the data?

MR. DUNCAN: I would offer that that question is irrelevant and --

MR. AMBROSE: You used it in your data.

MR. DUNCAN: That is false. I did not speak to nighttime bird calls. I spoke to bird calls in general being removed from the data. And specifically the definition from daytime and nighttime includes sunrise and sunset, and the time in which birds are most active in terms of bird call

is sunrise and sunset.

MR. AMBROSE: Okay. ANSI allows for -- American National Standards Institute -- a proxy measurement. Yet you say, no, that's not good. ANSI approach is not relevant for wind turbines.

MR. DUNCAN: Just a clarifying question. By proxy measurement, you're saying that you have a distant monitor measuring background sound levels and a closer monitor measuring operational sound levels. Is that what you mean?

MR. AMBROSE: No. Your noise source is operating. And you need to find a location where that noise source is not audible that's equivalent to it. That's called a proxy location.

MR. DUNCAN: Yes. That's what I was -- wanting clarification as to what you meant. I did not say that it's not adequate for wind turbine acoustics. I did say that it's not adequate for the northeast when you're dealing with heterogenous landscapes and mountainous and hilly terrain. That method works very well in the midwest when you have homogeneous landscapes where you have crops and flat terrain, and you can go two miles down the road, similar traffic patterns, and you're getting similar background sound levels. But that does not work in

the northeast.

MR. AMBROSE: Okay. So you're talking about that. I'll end up asking, is the atmosphere homogeneous at night?

MR. DUNCAN: No.

MR. AMBROSE: Okay. Then you're open to all kinds of errors due to the atmospherics. And you were talking about your model, you've taken your model, and you've compared it to your measurements. When I have done that, we would end up applying a model calibration or correction factor that was added on to measuring uncertainty and the prediction limitations of the model plus or minus three dB. So when you apply the two corrections for measurement uncertainty, and modeling uncertainty out to a thousand meters, that's it, that's all it's good for, where does your calibration correction get applied?

MR. DUNCAN: I'm not sure I understand the question.

MR. AMBROSE: Okay. I predict the sound level out to 500 feet. And it says I'm going to be measuring 48, or it predicts 48 dBA. And I go out and I measure 53. What do I do?

MR. DUNCAN: You get a model that accurately predicts the sound level.

MR. AMBROSE: Wait a minute. Wait a minute.

MR. DUNCAN: It's wrong.

MR. AMBROSE: Models -- I quoted the designer for CADNA who said that plus or minus three dB is the best we can do. That's it. He said we don't know the layer stratification on that. And that's out to a thousand meters and a 30-meter height differential.

This is where Vermont has failed. We have not applied a safety margin because Vermont is beyond the test parameters on flat ground, and we have distances that are greater than the model can predict accurately.

MR. DUNCAN: I would offer that I believe we do have a safety margin considered in the models. That is done through the selection of the parameters that we use in the model. We have looked at studies that look at a variety of distances out from wind farms based off of model data and monitored data, and the reason that those model parameters are set is those are the most conservative assumptions to over predict the actual measured levels from these projects. That is how we do our modeling. In the past if we have done anything differently, it would

be because those model parameters have been dictated to us by governing bodies that say you must use X modeling parameters.

CHAIRMAN VOLZ: Ms. Smith.

MS. SMITH: So who are you representing here today?

MR. DUNCAN: I'm representing RSG.

MS. SMITH: And so you have been working with Renewable Energy Vermont through -- for their presentation through VERA. And you've done the work on Georgia Mountain Wind and Lowell, Kingdom Community Wind, and your firm is engaged in Swanton Wind and Holland Wind. Or I forget, Dairy-Aire Wind. Is that true?

MR. DUNCAN: Yeah. We have a number of clients, and the ones that you mentioned are our clients.

MS. SMITH: So you have an economic interest in assuring that this standard that you're recommending that is the same that we have had stays in place so that your company can do more work.

MR. DUNCAN: Yes. But I would say that if the rule goes through as planned, at least in terms of the limit, and there is no further wind development in Vermont, that the amount of wind work

that we do in Vermont is such a minute part of our business. I'm here mostly because I'm interested in noise policy, that's why I did the master's degree that I did. I'm interested specifically in noise policy, and that it's done well, because it propagates -- Les can attest to this. Let me finish. Bad noise policy will propagate from one location to another as will good policy. But it just propagates everywhere.

So my interest is that I think there are things in the proposed rule that could be fixed and better improved which is why I'm here as RSG.

MS. SMITH: So now I want to ask about NRO mode as it was used at the Kingdom Community Wind Project, because as Chairman Volz just asked, it could be adjusted; right? And that was said during the technical hearings on that project, but when the project actually went into place, and the reports from RSG came in, it all showed that the half dozen turbines next to the Nelsons who were terribly harmed by that project, their health was damaged. None of those were ever in NRO mode, and nothing was ever adjusted. And they complained repeatedly.

And so when we hear that NRO mode can be adjusted, and it was promised it was going to be

adjusted, but every report came in and just said the same thing over and over again, it's hard to understand why NRO mode is being considered. So the other aspect -- thing I wanted to ask you about, you didn't mention the low frequency noise component of this at all, and during those other wind projects Ken Kaliski testified for RSG that infrasound was not a component of wind turbine noise. What is your company's current position on low frequency noise and infrasound as it relates to wind turbines?

MR. DUNCAN: By answering your question, you made a lot of assertions in there, statements, and by answering your question I want to say that I'm not accepting a lot of those assertions. But I will answer the question about low frequency sound and infrasound.

We know from the Massachusetts Clean Energy Center study which I think Howard may have presented a graphic earlier today from that study about infrasound. We know that wind turbines produce infrasound. And so we understand that. Our professional understanding though is that the infrasound that's produced by wind turbines is below audibility thresholds, and it also is significantly lower than so many other infrasound sources

throughout the world and in communities currently today, and people are not complaining about infrasound at those levels from those other sources. Infrasound from wind turbines is significantly less than that.

MS. SMITH: And low frequency noise?

MR. DUNCAN: It's all a spectrum, so do wind turbines produce low frequency noise? Yes. Do we measure it? Yes. Do we model it? Yes.

MS. SMITH: Should it be a component of the rule?

MR. DUNCAN: It is a component of the rule. It's included in the sound propagation modeling that we do. We have to model low frequency noise.

MS. SMITH: For compliance should there be a limit on it?

MR. DUNCAN: If the Board is interested in regulating low frequency noise, then I would recommend that they pick levels from frequency bands by octave bands, and regulate them based off of whatever the current scientific literature is on impacts of those frequency bands.

MS. SMITH: So you would support an LFN standard?

MR. DUNCAN: I don't think it's necessary. No.

MS. SMITH: One last question. You're aware that there are currently and have been dockets at the Board about Georgia Mountain Wind and noise complaints; is that right?

MR. DUNCAN: Yes.

MS. SMITH: Do you consider that a success of your company that this is -- has happened? Or what -- you know, we're kind of here because of RSG's testimony that's been accepted by the Board in Lowell and Georgia Mountain. So when we are trying to come up with something to improve on it, and you're recommending we stay with the same standards, how do you address that? Do you take any responsibility for the problems that have been -- that's brought us here?

MR. DUNCAN: To be clear, I haven't recommended that we stay at the current standards. I have been very explicit about not saying what level we should be at. I think the Board should pick levels that reflect the current state of scientific literature and the values of Vermont. I've stated that from day one when the Board opened up workshops on this. So I'm not recommending that. I'm not

making a recommendation on that front. I've simply made observations that to the extent that they are looking at aesthetics or health impacts, if those are the values that they are trying to protect, then these are the levels that they should consider, or maybe the levels they are considering are too high or too low. That's what I've done in this case.

The question about the success of our firm, how I measure success I think is irrelevant to this. I'm not going to speak specifically to those dockets. I'm here to talk about the current standard for wind turbine acoustics.

MR. AMBROSE: I have one follow up, and going to bring in -- one of my last slides was the Danish has a low frequency noise standard. And since low frequency was talked here, Danish has the standard of summing the 10 hertz to 160 hertz, one third octaves, A-weighted, so you get the penalty of audibility of the ear, and that number is 20. So if you want to comply with the Danish low frequency noise standard, which is -- I recommend, the value is 20. On the --

MS. SMITH: Interior.

MR. AMBROSE: For the low frequency, yes.

MS. SMITH: Indoors.

MR. AMBROSE: Yeah. I won't go indoors. I think it might be an outdoor standard. I'm not sure. But those low frequencies will penetrate and enter a house very easily. And when you see the variability of inside to outside, it depends on the area of the window and the acoustics signature that's outside. You have more high frequencies outside with an open window. You have more attenuation coming through the window than if you have rich in low frequency.

So when you see the variations 26 to 10 or 10 to 26, frequency content of that makes a big difference. And I ended up doing the conservative approach where EPA says transportation at a distance low frequency about five dB entering a room. That's because the sound waves come in through the open window.

Now sound travels three dimensionally, but it comes in through the open window, and it has to fill that room. Now it has the ability to reflect off the walls, and now it's three dimensional again, and there is a six dB reduction, because it's -- there are three axes present. So I think having a low frequency content is good. I still recommend

your 35; you're right on the money.

CHAIRMAN VOLZ: Yes.

MS. WOLFE: If I could just mention the Danish they did impose that limit, that's still in place. They also studied it after it was in place. And they found that the audible sound limit, the dBA limit, was actually the controlling factor, and that low frequency noise has stayed well below the low frequency limit just being governed by the audible limit.

CHAIRMAN VOLZ: Okay. We need to move -- keep moving. Should we go to the department next? I would just note that the resume that we got from Mr. Duncan mentions all of those, his previous work with those entities that you asked him about.

MS. SMITH: Thank you. And Swanton and the ones coming forward too.

CHAIRMAN VOLZ: I don't know if it mentions the ones coming forward, but it mentions all the ones you that mentioned that he did work for.

MS. SMITH: I just wanted to point out --

CHAIRMAN VOLZ: I appreciate your point. I just wanted to make sure that you knew that we had that information. Okay.

MR. KISICKI: Just by way of a very quick introduction, Mr. Ashtiani is on the phone right now, and I just wanted to give a brief introduction. I know we are running a little late, so I'll make it very brief.

The department filed comments, technical comments, on April 27. As part of those comments, Mr. Ashtiani, a retained outside expert from Aercoustics Engineering Limited, submitted a report outlining three major technical issues which will be discussed today. The first one being the proposed rule's lack of a methodology for determining background ambient noise levels. Second, the use of 10-minute measurement intervals as opposed to shorter measurement intervals. And third, the proposed rules requirement that the loudest measurement intervals be used for compliance determinations.

Those three issues will be discussed in Mr. Ashtiani's presentation now, and I think probably the best thing to do is just to turn it over to him right now. He is in Rotterdam, and it's very late there, so I appreciate Mr. Ashtiani joining us at such a late hour. Are you there, Payam?

MR. ASHTIANI: I'm here. Can everybody hear me?

CHAIRMAN VOLZ: If you could speak up a little bit. We will try to turn you up.

MR. ASHTIANI: All right. So let me know at any point if it's difficult to hear me or the call quality drops.

CHAIRMAN VOLZ: It's good right now, so go ahead.

MR. ASHTIANI: All right. So thanks everybody for having me. And thanks for the Board and also the department for making the arrangements for me to be able to call in. It's evening here now. I'm calling through the Internet, and I have slides, so hopefully you guys have slides to look at while I go through a very brief presentation. I understand that we are running a little bit late, so I'll try to keep it short and hopefully allow for more type for questions. Again, interrupt and let me know if there is something that you can't hear.

CHAIRMAN VOLZ: We are all set. We have your slides. Go ahead.

MR. ASHTIANI: Perfect. Okay. So going to slide number two. It's just a quick overview of the topics that I wanted to present to the Board. The main topics -- the main concern really is the lack of provisions for having an

ambient correction to data collected as part of post-construction monitoring. There are other small aspects, but we feel that this is the main issue that can help alleviate a lot of the other portions or aspects of the proposed method.

So for that the topics that I would like to cover are, one, is the nature of ambient sound contamination, specifically transient ambient sounds, and what we will call persistent ambient sounds. And then we go through the effects of different ways of filtering measurement data. Potential for false exceedences and some conclusionary remarks.

Okay. So moving on to the topics. And this kind of follows the submission that we have made. So the first topic is transient noise contamination. Transient noise contamination refers to contamination of sound levels in the context of doing post-construction noise measurements from wind facilities. And the reason I've put this graph up and the slide will become evident pretty soon. But the lines that -- the light blue line and the dark blue line -- I'm not sure if you have color or black and white copies -- but one of them, the darker one, looks like stepped lines and more blocky, whereas the

light blue one would be levels that kind of spike up and down. The X axis is time. So you're going towards the right as time goes by, and the Y axis is the measured sound level at close to a residence in a rural environment not dissimilar to what you would expect in Vermont. And the blue line shows LEQ, so energy equivalent sound levels in one-minute intervals. And the dark blue line is the same overlaid but in 10-minute intervals.

And the purpose of this graph is really to show the effects of what a short-term transient event has on a 10-minute LEQ measurement. Essentially, because LEQ takes the energy average and energy is a logarithmically scaled phenomenon, if you take the overall energy of an interval and the order of magnitude of -- the order of magnitude of contaminating noise is such that even though it can be a relatively short event, it can actually affect the overall level pretty substantially.

And in the proposed rule there is -- there doesn't seem to be a method to individually remove just those parts that, you know, one could assume is contaminated without having to remove the entire 10-minute interval. And so because of the sensitivity of the LEQ, you know, it could be that

you would get a lot of false readings that have some level of contamination from noise levels just because you're looking at things only in a 10-minute interval chunk. And so that's really a point of this graph.

And then the other aspect is that if you are -- if you're analyzing data that is in 10-minutes, it's relatively easy to take -- to find spikes in terms -- in time, and attribute them to contamination from analysis. For example, in about the middle of the graph there is two transient events that are pretty clear to be there even if you look at the 10-minute intervals, presumably you'll be able to exclude that in the analysis. But if you go further down, there are two or three intervals in which you have multiple contaminations, and if you're looking at data in one-minute intervals, you can see these are multiple contaminations, but if you're only looking at data in a 10-minute interval, it would seem as though the level is just constant and higher. So having data not be granular enough or the ability to remove parts of it, can lead to either having to throw out larger amounts of data in post-construction analysis, or leading to contaminated signal being included as part of non -- being assumed to be non contaminated.

If I could go to the next slide. That's slide number four. Now this is some difference between what we call transient ambient sounds to maybe a different category called persistent ambient sounds. The whole point here is there may be some sounds that are not transient in nature and may stick around for awhile or be correlated to some other conditions. And we can separate those categorically from transient ones. A couple of examples of this could be noise from insect activity. That is basically constant. Now this can easily be accounted for by looking at a frequency content and recalculating your spectrum and taking out the effect of insects. So it's definitely achievable technically. It's just not clear if the proposed method would allow for that kind of signal conditioning, I suppose.

And then the other example that I could think about was if you have, especially in Vermont, a ridgeline wind farm condition in which you've got a house in a valley and turbines on top of the ridge as well as a forested area. You could presumably have situations in which the ground level wind speed could be low enough where the microphone is, that it would be a valid measurement from a wind speed perspective

as for the proposed methodology. However, you could have situations where the ambient noise could have a lot of vegetation noise in it that could be propagated from the wind speed at the hill or at the top of the ridge and the amount of vegetation noise that would come from there. It's not a guarantee, but it is a possibility.

And so having the avenue in the method or in the rule to be able to look at sounds like that, and to be able to do that kind of analysis, is probably beneficial. It's not to say that you would always need it, but the approach that we have taken is to assume that this proposed methodology is the law. And you cannot deviate from it from the way it's written. So these are two examples where having the ability to remove contaminating events and account for, or account for the level of contamination that they would present in a signal, would be highly desired.

Going to the next slide. This is now slide number five. It's titled filtering of measurement data. And as I mentioned, here's a real life example of sound measurements taken at a wind farm that is in a rural environment. And in this one ambient levels were able to be quantified by

conducting a shutdown method not dissimilar from what RSG presented. The data points are one-minute intervals, and the lighter one, and again I'm not sure if you have color or if it's black and white, but there are two bands, two horizontal bands of sound levels. And the X axis here is not time, but it's actually ground level wind speed. For it's always important when you look at ambient data to look at that data in the context of the wind speed near the microphone or at least in this case the 10 meter height at the microphone location.

And you know, you can see that you've got the higher band which is the turbine plus ambient measurement scatter, and in the lower band which is just the ambient scatter. And you can see that short-term ambient events, you know, there is plenty of them that would significantly contaminate turbine noise if they were there. And it's not to say that, you know, that they are always there. Just that they are there often enough that there should be some method or ability to either remove them, or if it's not removable, to account for the difference between the on and off conditions so that ambient noise doesn't get counted as facility noise.

Next slide. The other thing we would

get into is the variation in ambient levels. One of the exercises that we undertook in reviewing the proposed methodology and the potential effects of not having an ambient correction, was to look at data sets that we have from Ontario where shutdown method is pretty well required, and look at just analyzing the ambient noise level. So we took three different sites, and we looked at just the ambient levels as compared to the proposed limit of 35 dBA. And so we can see from the first one that the first site on slide six we have only included data where the ground level wind speed has been below three meters a second to be in line with what the proposed methodology here is. And this happens to be a relatively quiet site, and you can see 20 decibels most of the time, but there is sometimes when -- even though the wind speed is very low, the ambient level is between 25 and 35 I would say.

This particular site wouldn't have that much of an issue because presumably when the level does go close to 30 or 35, you would be able to listen to it, identify it, and hopefully exclude it. It indicates that you would be able to assume this is coming from the facility. Again, these measurements are with no facility running. So there is no wind

turbine noise in any of this data.

On the next slide, slide number seven, that's a different site. Again, it's ambient noise. In this case you can see that it's actually a fair portion of the data would have instances of sound levels above 35 dBA. And so if the goal was to look at doing measurements to verify a facility noise of 35 dBA or less, there is a reasonable expectation, I would say, of some contribution from a measured sound level that is actually not in the wind facility but just ambient noise variation.

If you can go to the next slide, that's the last example of the scatter, and again this is another site where sound level's actually very quiet when the wind speed, the ground level wind speed, is less than one meter a second. So it looks like it can go as low as 16 or 17 decibels which is not totally uncommon, and for rural environments anyway. And it does actually start to increase by the time you're at three meters a second, it's gone from 15 to 25.

Now this could be due to local conditions of, you know, the vegetation or, you know, wind speed, wind direction, orientation of other sources. But there is a relationship with wind

speed. But even within that, there are times when the sound level does approach 35 decibels. And, of course, they are contaminating events obviously where the sound level's 50 or 55 decibels.

So the point of showing this information is not to guarantee that sound levels from ambient are always going to be much -- are always going to be low enough that you shouldn't expect any contamination. But it's just to give an idea of where, you know, what things could go wrong if the proposed methodology doesn't have the ability to remove ambient or at least account for ambient in some way.

Going to slide number nine. This is a sample data set. We took the one-minute samples that ambi lows ranging -- it might have been from one of the examples, but they ranged from low levels to mid and high levels. And we actually just took the 10-minute level for one of the nights.

And you can see in the X axis it goes from 2:30 a.m. to about 5 p.m. And the sound levels are tabulated in 10-minute LEQs, and you can see that, I'm sorry, the blue line which is just below 40 decibels, it's actually the average -- the arithmetic average as required by the proposed methodology, it's

about 39 dBA or just about 40, I suppose.

And this is an example that if you are forced to take the top 12, then you're always forced to be looking at the levels that have the most potential for contamination. Again, this data actually doesn't include a wind farm in it. So presumably you would want this data to easily be below 35 or much below 35. And again, this is not to say that, you know, you can't have an option of continuing to measure until the levels do fall below 35, but the difficulty here is if this was mixed with turbine noise, it would be much more complicated to be able to assess how contaminated the measure level is from ambient events.

And so going to the next slide number 10. A very short conclusion that I wanted to make here are there is two real scenarios that I could foresee by rolling out this methodology. And in one scenario you could have measurements that are completed and show levels below 35 dBA with the wind turbines operational. And the result would be that the compliance would be confirmed. And it would be a very defendable conclusion, because even if there was ambient contamination, it would all be still below the limit.

And the other scenario it would be one where say the measured levels showed that the levels are above 35 dBA, say 37. And obviously if the levels are much higher above 35 dBA, then the possibility for contamination is lower. But if they just missed the limit, the result of this kind of analysis would be that non compliance is confirmed, or at least I would presume that's the intended result.

But the comments that I've included, I could see this being challenged in that the sound levels may be argued to include some contribution from ambient levels that would push the overall level above 35, and so if the sound level limit from the -- just the wind turbine facility is 35, and this is the methodology in which measurements are conducted, then practically I could see this running into some challenges, and potentially some, you know, legal or other types of challenges, challenges of the results and of the conclusions.

I think from a practical perspective, measurement periods could also be very long because for the department or for anyone who is intending on conducting these measurements and getting very reliable results, you would have to potentially spend

a long time finding ideal conditions that would both satisfy the data validity requirements so that you could say, for example, that the wind farm is operational, and the wind is downwind, and the background noise level is expected to be very low. It could either take very long, and I'm sure nobody is interested in having post-construction auditing take a really long time.

And so I think that those are things that really should be considered, not just in the context of how measurements are completed, but also in the context of what is the level that you're actually trying to test compliance against. If the sound pressure level limit was something much higher, then I could see this method, although it still might take a long time for you to get the right conditions, but at least I could see the method being much more defendable, because you would look for a time with low background.

All right. So that is my presentation. I figured I would make it hopefully short enough and sweet enough that we could leave time for questions or discussion. Thank you.

CHAIRMAN VOLZ: Thank you. Do we have questions up here?

MR. COTTER: Mr. Ashtiani, this is John Cotter from the Board. I was curious, one of the criticisms in the paper filing that you made had to do with the proposed rule's use of the 12 loudest measurement intervals to obtain the average. And I was curious, does that concern go away if the Board decides to take the approach where background sound is removed from the measurement?

MR. ASHTIANI: I would think that it would be mitigated to a certain extent, because the issue with the 12 loudest is that those are also the 12 most likely to have some contamination. So if there is an ability to quantify what the ambient would be, and if it's not -- yeah, if it's quantified in pretty well the same manner, then that concern would be greatly mitigated.

MR. COTTER: Thank you.

MR. ASHTIANI: The only addition I would put in there then is there should be some level of data quality requirement in that if the signal-to-noise ratio is, for example, three decibels or more, then you can make an assessment. But if the signal-to-noise ratio is much smaller than that, it becomes again more difficult to know if the levels are due to random ambient noise or if they are related to the

wind turbines or at least what component of which is in each.

CHAIRMAN VOLZ: Any other questions?

MS. CHENEY: I have a question. Hi. This is Margaret Cheney on the Board. And you made it very clear that the 10-minute averaging is problematic in that it's more likely to be skewed by those random noise events.

Are you then advocating for the one-minute interval as a preferred substitute?

MR. ASHTIANI: What I would advocate is that if a 10-minute interval is desired, then the ability should be there to salvage parts of the data within 10 minutes, because 10 minutes is an awful lot of time, and there could be a lot of useful noise in there. So if it has to be in 10-minute chunks to have the ability to salvage part of it, or have a minimum part that is okay, and be able to reject the other part, or to take the total amount of minutes or time that was required for 12, 10-minute intervals and make those same amount of time requirement but with one-minute intervals.

MR. KISICKI: If I may build on that very quickly. The Department's draft rule that it submitted in November 16, 2016 contemplated the use

of one-minute measurement intervals as opposed to 10-minute intervals.

MR. FINK: Mr. Ashtiani, this is Kevin Fink with the Board. I wanted to follow up. I think I understand the second part of your answer which was that you were suggesting that essentially you would instead of using say 12, 10-minute intervals, you would use 120, one-minute intervals. The first part of your answer I'm trying to understand. Are you suggesting that you would use some sort of rolling 10-minute structure, or you would exclude an individual one-minute unit in a 10-minute period? Or I'm not sure I understand how you would accomplish that mechanically.

MR. ASHTIANI: So my preference is for the 120, one-minute intervals, easily, because it's a lot cleaner. Because you are just looking at a one-minute interval and representing it as such. The reason I suggested the other method is similar to the ANSI standard where, for example, for an hourly LEQ their requirement is -- it should be at least 30 minutes of uncontaminated data in there, so you could represent it as if it were an hourly LEQ, you could potentially take that same approach here. But, you know, if I had to choose between the two, I would

easily take the one-minute intervals times the total amount of time required to make -- that the data set full enough.

MR. FINK: So your suggestion would be if you had, you know, six or something one-minute intervals within 10 minutes, you could treat it as a valid 10-minute interval for purposes of using or calculating an average?

MR. ASHTIANI: Right.

MR. FINK: If one were to do it that way.

MR. ASHTIANI: Yeah.

MR. FINK: Okay.

CHAIRMAN VOLZ: Any other questions? Okay, so -- yes.

MR. LEWIS: Hi, Mr. Ashtiani. This is Sash Lewis from Dunkiel Saunders. I think you and I are acquainted.

What you said towards the end about the compliance methodology working better with a higher sound limit caught my ear. Is that because in your experience 35 dB is relatively close to ambient levels?

MR. ASHTIANI: Yes. Yeah. That's basically the reason, that if the sound level limit

was higher, the probability of having an ambient contamination increase the uncertainty is much less. So for example, in Maine, where a similar method is used, the sound level limit for nighttime is actually about seven dB higher than what's proposed here.

MR. LEWIS: So --

MR. ASHTIANI: So I could see it --

MR. LEWIS: Sorry. Please finish.

MR. ASHTIANI: Go ahead.

MR. LEWIS: So you also expressed a concern for having an adequate signal-to-noise ratio between turbines only and ambient levels. So I guess my question is, if there is a sound limit that is too close to ordinary ambient levels, is there any compliance methodology where you would not have concerns about signal to noise?

MR. ASHTIANI: Yes. If the levels are always going to be close to ambient, there are a couple of ways. First one is you could do what Europe does in that they measure the sound power level of the turbines, and they rely on the model to tell them what the sound level would be near the residence. And that is specifically to avoid this issue of having not enough signal-to-noise ratio to be able to be precise enough to make an assessment.

The other is what they do sometimes actually in Germany in that they will measure much closer to the turbines or to the facility, and then do the same process by which they would use the model to calculate what it would be at someone's house. But in all those situations they are actually moving away from measuring at the house because of the uncertainty involved in determining what the exact level is.

MR. LEWIS: So is it fair to say that if what Vermont wants to do is determine compliance through direct monitoring rather than through modeling, a level of 35 dBA doesn't set us up for easy compliance determinations in the future?

MR. ASHTIANI: Yes. I would generally agree with that. The difficulty would be finding a time that would be both representative from the turbines being done and generating the amount of power required, but at the same time, having the ambient be quiet enough, and I have to assume that in rural Vermont it's not dissimilar than Ontario in that the sound levels will drop below 35. And you just have to look for those times when kind of all the situations align, and you can be sure that you're not having an ambient contamination.

And so I don't think it would be easy, but not only that, even if it were easy, I think if the level was determined to be non compliant, it could put -- it could set Vermont up to be challenged, and that won't be an easy thing to refute.

MR. LEWIS: Thank you very much. That's all I have.

CHAIRMAN VOLZ: Yes. Go ahead.

MR. AMBROSE: Mr. Ashtiani, my name is Steve Ambrose. And I have a hard time when we had determined compliance by not being present, not listening, not validating the measurement at the measurement time.

Why is there such an aversion to witnessing a measurement as recommended in ANSI 12.9?

MR. ASHTIANI: I would say that it's not -- it's not an aversion as much as it is a desire to have captured the right environment. We started measuring wind turbine noise more than a decade ago now, and that is exactly how we started measuring in that you would look at the forecast, and you would think it's going to be a good day or a good night to quantify the levels, and you drive out there, and you make a measurement, and you try to quantify what the

sound level would be. But it was through experience we found that the times when we would go there are what the acousticians normally hear from the residents is that you should have been here last night or three nights ago or whenever it was really, really bad. So it turned into going from what we thought was the most ideal time to measure to what the complainant thought was more -- most ideal time to measure, or maybe what from a sound impact perspective, what the worst time that needed to be captured.

So it became easier to leave equipment there that was sensitive enough and had the right meteorology to be able to isolate those times and verify them with audio tests, and then over time develop a methodology that actually fairly well limits the analysis to only those times when you should expect the sound level from the turbines to be maximum.

MR. AMBROSE: You mentioned audio tests. What do you mean by that?

MR. ASHTIANI: What I mean is that when we do post-construction measurements basically the standard measurement that we do now includes recording the audio on a continuous basis at the

sampling rate of between eight kilohertz and 25 kilohertz. That's what I mean.

MR. AMBROSE: Okay. But are you using a mannequin, a dual microphone, so that you can get direction?

MR. ASHTIANI: No. What we use is typically an anemometer at the microphone location. So we were not getting like a sound intensity or a sound vector. Just a sound pressure level, but with an audio recording so you could listen to it but also with wind direction and ground level wind speed.

MR. AMBROSE: Right. But you know when people go out and listen, our instruments aren't as good as a human head with two ears and a brain. And the fact I go out there and I hear a sound, I can say well that's coming from that direction, that's where the wind turbine is. Yes, I do hear that wind turbine.

And my feeling is, and I know when wind is interfering with the measurement on the microphone because I monitor the microphone with a head phone. So I can hear the wind-on-microphone impacts where, yeah, that's a bad measurement.

MR. ASHTIANI: I don't doubt that being there is pretty helpful. The problem that we are

trying to overcome is not camping out there for four months and having a reasonable confidence still that the measurements that we are looking at, the overall levels that we are looking at, are predominantly from the facility not from ambient.

I agree though, when you're on site you can make much more observations on location of where the sound is coming from. But I would argue that for the analysis that we have done, we tend to find that when we do filter the data and we look at what's left, it's fairly clear that there is a decent amount of turbine noise in the signal that we ended up with. So you know, it could end up being, you know, last Tuesday at 2 a.m. But if you already have all the data there, you can quantify the overall sound level.

MR. AMBROSE: Because when Rob Rand and I went out and did the Bruce McPherson study, we were empowered to do it in December. And we had to wait until April until we saw the forecast was right for a front to come through the wind turbine site. So we drove four hours to get to the site, did our measurements, and we lived on site for three days and two nights, got our good measurements, and left. And it was a phenomenal experience.

And my feeling is I've always -- when

I'm trying to understand why a neighbor complains, I have to experience what the neighbor is, live as the neighbor. And this is what's bothered me, now that we have these automated instruments we lost that ability. And we have lost the ability to do an outright compliance test. It's always uncertain.

MR. ASHTIANI: Yeah. Again, I don't disagree with that being on site is definitely helpful. It's purely a result of the practicality of having to be at multiple locations at the same time. So, for example, you know, in Ontario or in Alberta, most of the time when post-construction commissioning measurements are required, they are required at multiple locations. And so if there are specific times and specific wind direction where you have to let's say be downwind, it's not going to be downwind from all the residents on the same night usually. And so even for one site out of many, then you would have to basically have a person whose only job is to be at one site because multiple sites will have problems that way.

I mean again, I'm not trying to say that the way you're proposing is inadequate. But the question is, can automated measurements be good enough?

MR. AMBROSE: I say no. But --

MR. KISICKI: I'm sorry.

CHAIRMAN VOLZ: I think we understand.

MS. HOFMANN: I think we understand the conflict here.

CHAIRMAN VOLZ: The pluses and minuses.

MS. CHENEY: We want to leave time for Mr. Blomberg.

MR. AMBROSE: I'm sorry. I apologize to the Board.

CHAIRMAN VOLZ: And we've been doing this for over two hours now since our lunch break. We are going to take a 10-minute break, and then when we come back, we will hear from Mr. Blomberg.

MS. CHENEY: Thank you, Mr. Ashtiani.

CHAIRMAN VOLZ: Yes, thank you.

(Recess was taken.)

CHAIRMAN VOLZ: Go ahead.

MR. BLOMBERG: All right. Thank you very much for accommodating me. I realize the circumstances. Appreciate it.

CHAIRMAN VOLZ: Not a problem.

MR. BLOMBERG: My name is Les Blomberg. I didn't put my resume up there. You've seen it before, and it's in the record already. I want to do

a little thing different. We have been dealing a lot with details, and I want to step back and look at kind of the meta issues. This what I raised at a hearing in the hotel when DPS was presenting. And they weren't able to answer it then, and I think it still remains unanswered. It has to do with enforcement and compliance. So that's basically what I'll be talking about today.

Your rule has -- I would say you could say there is three phases of compliance assessment in your rule. The first phase, or I think it would be really helpful if you keep these three phases in mind as I go through my presentation. The first one is the preconstruction assessment happens in 248. It's usually modeling.

The next one, and much of the discussion in here has focused around the second phase, which is the compliance testing that occurs afterwards.

And the third one is the complaint resolution process. And that is a one-sentence -- one sentence at the very end. It's the very last sentence of your rule basically. And I want to look at basically those last two and how they are operating. And I do this out of my experience of

writing and helping communities write and revise noise regulations. Because where they often fall down is thinking about how this is going to all work out in an enforcement, and what happens when the police officer goes out and tries to do what's written down.

So having said that, there is also two regulatory techniques that you could use in doing this. One is you could require in the 248 process the turbines to meet the noise criteria. And in that case what you're doing is you're regulating the physical properties of the turbines. Turbine already sited there has to meet the criteria, and you do that with modeling. And then in that case your compliance testing, the role of it, is just to make sure your modeling was right. And you have a fairly limited -- hopefully if you do everything right, you have a limited need for your complaint resolution.

The second approach you can take is that you can allow the developer to put in turbines that wouldn't meet it, the criteria, but that they will turn it down at times. This approach involves not regulating the physical properties of the turbines, but regulating the behavior of the operator. And it requires a different set of tools

to do that. And much of my presentation is going to be about the role of the complaint resolution and the compliance testing when you do that, when you try to do it that way.

And just giving an analogy, we can think of enforcing the 65-mile-an-hour speed limit. One way we can do it is we can say you can't build a car that can go faster than 65. If you do that, your work on the highways is pretty much done unless maybe in icy conditions or something. However, if you allow cars that can go over 65, then you need monitoring and you need the highway patrol to enforce it.

And one thing that I want you to note is that you wouldn't just test when you have to regulate behavior, as the car is purchased by the driver, as he pulls off the lot so to speak. That would not be a sufficient test, if you wanted to, you know, see how they are going to behave for the rest of the life of that car, for example. So I'm going to carry this analogy through. Again, as we did this. So you can think of your first technique, your technique number one, as the 65 mile-an-hour car, or the 35 dBA wind turbine.

I take it from reading the rule that

the rule has basically rejected this approach. That it does not use this approach. And I say that for two reasons. One, is because you have a day-night level. So they can build to a higher standard. Unless you require, as people have talked about here, requiring building of the lower ones. But if they can build to the daytime standard, then they do have to turn it down at night. Now you do have to regulate their behavior.

The other thing is just the NRO mode in general that we have talked about here and that Eddie talked about. It's not clear that it's permitted, but it seems to be permitted because in section D -- 5.075D, it says that in there you're required to describe your sound control methods, and as Mr. Duncan mentioned, that is the primary method you can turn them off. You can do other things, but they wouldn't really affect the turbines, like make them smaller, stuff like that, but that would be done ahead of time.

You can't really see this on the screen but in -- on your pieces of paper that is in light green. I put color coding in there because if I'm quoting the proposed rule, that page is in green. And if I'm quoting -- if I'm quoting the protocol

it's kind of in a peach color, and that's what that notation at the bottom right is. And unfortunately, in this light, maybe if you hit the light there, you could see a little bit better the coloring, but it's not showing up on the screen here.

So basically the worst case turbine noise levels will exceed the noise criteria under the rule or can. And therefore, you're in the realm of having to regulate behavior. The problem is I don't think the proposed rule is written to regulate behavior. The post construction -- post-construction monitoring does nothing to regulate the behavior of the operator after that period.

I think I also found a mistake in here. And it's in the fine print. In the rule, the proposed rule, it says that monitoring will take place so many times and they say refer to D. I put D in there. I think it was really referring to C. You might just make note of that. But the whole point of putting D or C in there is that the monitoring is going to happen initially, for a short period of time, and that you are not regulating the behavior. That's kind of like as if you were regulating the technique. One, just relating the properties of it, but the behavior can easily change right after the

monitoring occurs, and you have no way to protect that.

Just as, for example, measuring my speed the day I bought my car doesn't tell you anything about how I'm going to drive it in the next couple years. Maintain it just a little bit. There again I've just circled that mistake.

So this is that last sentence I talked about. It says so what's the complaint resolution process. Remember there was three phases. This is your third phase. Your complaint resolution. And it basically says we are going to use the Public Service Board's protocol. Okay. So I think it's really important that we look carefully at that protocol to see if it will do anything. And so this is in peach on your paper. It's in peach on my screen, but it's not in peach on the monitor unfortunately, so anything in peach I'm quoting the protocol just to help you be clear as to where to look for this stuff.

First thing the department gets a complaint, and they do a desktop analysis. Investigation. A desk level investigation. Not exactly clear what can be done on that, except for to say that you're right, from my desk I can't hear it. I'll come back to that point in a second.

CHAIRMAN VOLZ: You can ask the department -- this is their protocol, not ours.

MR. BLOMBERG: No, I'm not saying --

CHAIRMAN VOLZ: You can ask them what they do to do a desk --

MR. BLOMBERG: No, it says here further.

CHAIRMAN VOLZ: Sorry. I just to want to be clear that people know this protocol isn't one the Board promulgated.

MR. BLOMBERG: It's one the Board is considering adopting, but yes. So the next level is that it can get a case review. Okay. And then in investigating it, they determine if there is a potential, and they can escalate it to the Board.

CHAIRMAN VOLZ: I just want to make something clear which is they promulgated the protocol, they used it. I assume they have been using it for awhile. I don't know how long they have been using it. And we get complaints all the time about other regulatory matters, other utility matters. And it seems to work fine.

MR. BLOMBERG: Right.

CHAIRMAN VOLZ: And so but anyway, I think the reason why there was such a short reference

to this process in our rule is because it's a well-developed process that has lots of cases that have been decided under it, and it has a lot of body to it.

MR. BLOMBERG: Right. I don't doubt it. I think it's got as a general --

CHAIRMAN VOLZ: You understand that -- I just want to make sure everybody in the room understands what you're talking about.

MR. BLOMBERG: Sure. I think as a general procedure, it seems pretty good.

CHAIRMAN VOLZ: Right.

MR. BLOMBERG: I don't think it works with wind turbines. That's where I'm coming to.

CHAIRMAN VOLZ: Keep going then.

MR. BLOMBERG: And this is the essence of it. And the next slide basically during the case review, okay, it can get sent up to the Board, to you guys.

CHAIRMAN VOLZ: Right. But if it isn't sent up to the Board by CAPI, by the department, the complainant can still ask us directly.

MR. BLOMBERG: Right. Exactly.

CHAIRMAN VOLZ: This is just if they want to get the department behind them when they

bring the complaint.

MR. BLOMBERG: Right. So but here's the problem. Here's where I find it most problematic. The field work that would determine if it's in violation or not or potentially in violation or not, can only occur after it's been sent to you according to this -- the protocol. So and that's where I see one of the major problems here, and I'm getting to those. But basically the problem is it's an empirical question whether the noise is in violation of the CPG. And that's investigated by measuring it. And we can only measure it if it gets sent to you.

And let me just go over my presentation. I think it would be better if I go through the problems. So the problems that I see are that the desk-level investigation it doesn't seem relevant because of this empirical nature of the problem. And also that, you know, this complaint was filed at a certain time, it's past, we don't have access to that any more. There is just no way to go back there and hear that.

There is more problems. And I think this could be fixed. I mean the reason I bring these up is because I think you can fix these; right?

There is no objective criteria for the case review. There is no objective criteria for the referral to you. And the field work can't occur until after it's been referred to you. So what is this going to result in?

I see three possible ways this plays out. One is, you know, the DPS could ignore the complaints. You know, just kind of fuddle around and say, yeah, desktop analysis doesn't show that it's -- so whatever.

The other thing is they could use some arbitrary or subjective criteria to determine which ones to forward to you or not. Or if I was DPS Commissioner, I would just send them all to you. Right? Because I don't have any criteria to use, and so I'm just going to make it your problem, because I don't want to deal with this because I can't make any measurements until I send it to you anyways.

And I think that this is a bad situation for you, for the DPS, and for the neighbors. And I think this is a case where all of your interests coincide, that you would like a better procedure for straightening all this stuff out and not have every complaint coming to you.

CHAIRMAN VOLZ: I think -- I mean I

think -- did you talk to the department about this protocol and about these concerns before you put this together?

MR. BLOMBERG: I did. I talked to one of the lawyers there.

CHAIRMAN VOLZ: Okay. Because I mean I think, as I understand the process, I'm not talking about it in the context of windmills and noise. I'm talking about in general when we get complaints from customers about utility behaviors, usually it's a billing dispute, but it can be other things as well. They listen to the complainant, they make a judgment about how much merit there might be. If they think there is enough merit, they might investigate that on their own initially.

MR. BLOMBERG: Right.

CHAIRMAN VOLZ: Then if they think it definitely has some merit, they will file a complaint with us. It's only after the complaint filed with us that they can afford to hire experts, because they are allowed to bill those back to the utility at that point. They can't do that before they file the complaint. So there are reasons why it evolves the way it has. I think they use the same kind of discretion that the prosecutor uses with the police

department. The police bring complaints to them. People call up the prosecutor and complain about behavior, and they look into it on their own. I think it's wrong to say they don't have criteria. Maybe not written down somewhere, but I think they use their judgment and their experience and apply it to the facts of any given situation.

MR. BLOMBERG: Right. That sounds right. That sounds good.

CHAIRMAN VOLZ: Okay.

MR. BLOMBERG: Just don't know how, from the desk, they can figure out whether it's likely -- I mean I call up and say it's loud, it was really loud. It kept me away wake at night.

MS. HOFMANN: Maybe you're suggesting something -- maybe we should cut to the chase.

MR. BLOMBERG: You're right. I am getting there. Solutions.

MS. HOFMANN: That's what I'm looking for.

CHAIRMAN VOLZ: I'm trying to make sure you're trying to solve the right problem. As you were describing it, I'm not sure I agreed with you that was the problem.

MR. BLOMBERG: There is a couple of

problems that I listed there. You might not think it's a problem. But here's one of the things I think is a problem.

Every time we heard one of the presenters talk about this, that the fairness of the process and the -- every time wind turbine noise is in the news, okay, that is bad for renewable energy. Because it just solidifies the idea that a community doesn't want to have anything to do with this. If you want to make renewable energy work, you've got to have a system that can address all this stuff so that it doesn't make the news. Because every time it does, it just sends this one message, you don't want it in your community.

So the two ways to address this are, one, go back to technique one, right? Make sure that you put the stress on the planning process and not the enforcement. Right? To really make sure that anything that's permitted is going to have a real high probability that it will comply. And then compliance testing will confirm that, because remember, I think the key to understanding my concerns is to remember that compliance testing isn't designed to regulate behavior.

And you guys have gotten into the world

of regulating behavior. And I don't know how you can understand the behavior from the desktop. We have got to go back to -- remember we are talking about a behavior and not the operation of the turbines themselves. So that's one solution.

And the other solution is to beef up your compliance testing with something like continuous real-time monitoring and real-time feedback. Because that's how -- we don't do it quite that much on the highways, but it's continuous. There is always a highway patrol out there. They are not always watching you. But you know, that's how we do it when we regulate behavior is we have monitoring out there all the time. Happening all the time. And so those are the two ways to avoid that problem.

Okay. And I can see advantages and disadvantages to both. I think simplest is one, first one. But that doesn't mean you can't do the second one. It's just that you have to design your rule so that it can handle regulating behavior, and I don't think your rule right now regulates behavior.

CHAIRMAN VOLZ: I think one thing I would note, as I understand what you're proposing, number one would be only approve projects with turbines that are certified -- whose certified sound

levels at maximum power output would never exceed the whatever level we decided is the appropriate level.

MR. BLOMBERG: Right.

CHAIRMAN VOLZ: And I think the problem with that approach is that they still might exceed it anyway, and then we still need the other process anyway.

MR. BLOMBERG: No. You need the other process.

CHAIRMAN VOLZ: Because we don't regulate behavior so much, we regulate outcomes.

MR. BLOMBERG: Right. I realize that you still need that. That's one of the reasons why I would always save your NRO modes for when things go wrong instead of using your NRO mode in the development of the whole process; right? Because that can happen. But what happens if you do it the way I describe, the first way -- the way you just described, yes, it can go wrong. Okay. But hopefully the -- if you're not regulating behavior, if they are actually operating at full when -- full capacity when you're doing your compliance testing, you should catch that, and then you can immediately rectify it.

And then I mean if you looked at the

Sheffield, your early rules, your early rules really were, you know, number one here. Okay. I think they were pretty good. I mean you would -- like in one case you had like three decibels from the neighbor at full testing. Another case later on it became five. Stuff like that is an objective criteria that that makes this easier.

Now the problem in the early rules which you resolved in this, is you relied on the self-certification by the developer basically that they were in compliance, and you with your new rules have fixed that. But there are some aspects of the old rules that are very valuable because you did have objective criteria in there that determined if you had -- if you triggered further stuff, and that would really help you guys a lot, because it would give you objective criteria to thin out stuff.

So some of the early rules, like the Sheffield rule, have some good stuff in them like that. I don't think three is the right number.

CHAIRMAN VOLZ: By rule you mean the order that approved the project and had conditions in it?

MR. BLOMBERG: Yes. And the noise monitoring plan that was approved with respect to

those. So you had in that case an objective criteria. And the objective criteria was okay, three is a little close. But what was not as good was just the, you know, giving the developer the ability to pretty much self-certify that they were in compliance. That was where the problem was, and you fixed that one.

And I'd just note that if you do try to do technique two, the monitoring protocol you have in your proposed rule isn't continuous monitoring and won't work for that. So you know, that would have to change, I think, if you tried to really do technique two.

So just to go back to those three phases again. The first phase, the preconstruction phase. That is -- becomes under your new rule irrelevant or very much reduced because the developer will come into your planning process and say we will meet these regulations. Yeah. They can give you modeling, and they can just give you modeling that shows, yeah, we will reduce the level of these things to this level, and it will meet those. So you've really taken -- that's where the stress in my mind ought to be, and the focus ought to be, is you get it right first.

And what these rules that you have there now really don't get it right first. And like I said technique two is okay, but it puts a lot of stress on the compliance monitoring.

CHAIRMAN VOLZ: I'm not sure I agree. I think in 248 cases that would -- if a developer proposed a project that used turbines that were certified way higher in terms of noise than what we are -- than what people -- than what would be consistent with the rule, in the 248 case itself, people would say this is what's going -- this is going to violate the rule and it shouldn't be allowed to be built.

MR. BLOMBERG: Right.

CHAIRMAN VOLZ: So that could be brought up before you get to post construction.

MR. BLOMBERG: Yeah, but people would have to argue it's not part of the rule.

CHAIRMAN VOLZ: But that's -- that problem exists in every project anyway. Is the proposal consistent with --

MR. BLOMBERG: Oh, yeah.

CHAIRMAN VOLZ: -- and in the public good, and why isn't it, because these turbines are going to be too loud. And then the developer will

say the reason I'm using these is for X, Y and Z reasons. Don't worry. I'm going to turn them down. That would be part of the case initially, and it would be taken into account. I'm not sure, but anyway keep going.

MR. BLOMBERG: Okay. The second one is just that the post-construction monitoring, something that we have worried a lot about the details of today, becomes much, much less relevant too. Because when you regulate behavior, that regulates only a snapshot of the behavior. And it's an incredibly small one. And who among us here doesn't take their foot off the gas pedal when they pass the highway patrol? And to think that the utilities won't do the same as what we personally would do ourselves, is to attribute to an entity with a vested interest better motives than you and I can -- better actions than you and I can come up with. So that really is kind of irrelevant.

And all of the burden falls on the complaint resolution. Just drops down to that. And so that's mainly my message is that you're regulating behavior with this rule. This rule is not well designed to regulate behavior. It puts all of the stress in the later parts. That means it's all

coming back to you, over and over and over again.

Like I said, I'm in favor of technique one, but I think that technique two can work. But technique one, do all the work ahead of time, and try to make sure that very little comes back. The less that comes back to you, the better it is for renewable energy.

MS. HOFMANN: To use your analogy of the car technique, one, is you put the speed governor on.

MR. BLOMBERG: Yeah. I don't think we should do that with cars. But that's a regulated utility, and I think we can do that with those things. Although sometimes when I'm driving on the highway, I think we should do that with cars too.

But so those are my main points. I've just got like a couple quick observations too, if I could. One is somebody asked about microphone height four meters, two meters. In some cases it can make a big difference. Really depends on the land, but yes, it makes a difference.

Setbacks, you know, setbacks are the one thing that's constant here. You know, like you're not going to be arguing about it. It's the one thing that's just, you know, like everything goes

wrong at least you've got the setbacks.

Okay. And so I strongly like -- the other thing is, well setbacks are the only clear standard, I've got to say. You've heard so much discussion are we going to get contamination. Are we going to get contamination doing it this way. Maybe we won't. Maybe we will have to do it for five weeks. Maybe we will have to do it for five months. You can do the setback in five minutes.

Second thing, setbacks are really good for getting that participating neighbor going. And getting that -- getting the developer to get the community involved and the neighbors involved. And so they have great value for that. Your rules will not end the renewable energy industry in this state. As I've heard, and I assume he's right, that it wouldn't permit the turbines that are currently at Lowell or Sheffield. Maybe it wouldn't do that. I haven't looked. But I think -- did you tell me that or --

MR. DUNCAN: I said it might.

MR. BLOMBERG: Yeah. But you know, it doesn't mean that it wouldn't permit something of a smaller scale, still utility scale, but maybe a little smaller. What the industry doesn't like about

them is it won't permit the ever increasing biggest turbines to go in everywhere. Okay. And that's very different than saying we can get stuff to fit the scale and size of Vermont.

And finally, with respect to Mr. Duncan's presentation, I had to say something. The -- I don't think you can do -- I think you've caught on to this. I don't think you can do an aesthetic analysis without the background level and looking at the change from the background.

So those are my quick observations about what's happening.

CHAIRMAN VOLZ: Okay. Thanks. Mr. Brabant, you had your hand up?

MR. BRABANT: John Brabant, Vermonters for a Clean Environment. I kind of wanted to clarify from my perspective, what I think Mr. Blomberg is getting at, he did bring up setback. I kind of wrote a note to myself. The chair had discussed a premise wherein the PSB only limited turbine size or design that is certified at a level that does not exceed the noise standard. Instead, it should be evaluated based upon both the turbine sound pressure output maximum and the appropriate setback. You need to look at a project on the whole, the size of the

technology of the turbine, the height, and the setback.

So if you have appropriately scaled the turbine, maximum sound pressure output, certified output, and the turbine height against the setback that you would need to reach compliance at the end of that setback line, then you would get to your first premise, right, Les? That you would have to do less field compliance, end-of-pipe compliance, not only proven to be difficult, if not impossible, as we have seen in the cases that are pending right now, but it's costly to all involved. The neighbors. The regulated community, and you know, state government.

So what I think has brought us here is we have a failed system, and we need to come out of this process with a system that works. I think what you hit upon, Les, might be something that moves us in that direction. It's simple, it's less -- there is less argument to be made, and it's not end of the pipe.

CHAIRMAN VOLZ: Yeah.

MR. DUNCAN: Two brief questions. In case there are questions as a result of your presentation on NRO. One is you talk about essentially the proposed rule regulates behavior

because it allows for the use of NRO. And so the question is that if NRO wasn't used, isn't the Board also regulating behavior of a project operator by making sure that they maintain their equipment so that the physical attributes -- so they are already modifying or regulating behavior; correct?

MR. BLOMBERG: Yeah. I mean you're not -- I mean this isn't, you know, there are certain aspects of the behavior. Like are they maintaining it. Right? Or are they letting it fall apart. So, yeah, there will be aspects of it, but what this rule does in my mind is really shift the focus from regulating the physical properties of the turbines to regulating the behavior of the operator. And I'm not saying that you don't do both already. But it really tips the scales and really goes over to regulating behavior more than regulating the physical properties. You will always have to regulate both -- or well you'll always have to regulate behavior. But that won't be your primary concern, you know. In my mind it shouldn't be your primary concern. That once you get the properties right, you have very little else that you have to regulate behavior wise.

MR. DUNCAN: And the second question is are you aware that with most turbines that even

without acoustical measurements most turbines log operational data that can be used to show it is or is not an NRO after a given time period. So the analogy would be all cars don't have a limiter of 65 miles an hour but rather they have a data logger that's logging the speed of a car that can be requested at any time.

MR. BLOMBERG: That is one approach. And my concern with that approach is that it not fall back into the self-certification process. Because who are you going to get this from? From them. I mean the nice thing about distance, the nice thing about sound pressure level is that you don't get it from the developer. You get it from the environment. Right? The rule or whatever. You know whether setback or the measurement.

And one of the big problems with the image of renewable energy is that the neighbors do not trust the developers. Okay? And so, you know, yes, if you had a mechanism to do that and but still even if you had the mechanism, every time they changed their operations, you would have to go out and measure it again. Right? If they changed their operational protocol, they have changed their behavior, now you've got to go test it again.

And so, yeah, you could come up with, I think, a convoluted way to do that. I think it would again rely on a little bit of self certification. It would also be very complicated because every time they come up with a new operational scheme that they want to try, you're going to have to go out and test it and make sure it's okay. So it's not impossible, but it's not ideal.

MS. CHENEY: So does your concern about basically behavior police lessen or go away if there is not a different day-night standard, and it's just one standard?

MR. BLOMBERG: Well if you just meet the lowest one, yeah. It would.

MS. CHENEY: Not about how high it is. I'm asking if it's just one.

MR. BLOMBERG: Yeah. If there was just one, as long as you also didn't allow NRO modes to meet that. The second you allow an NRO mode, the second you allow an NRO mode to meet your criteria, then you've already done that. So it's both the day-night and the use of NRO modes.

And so I would recommend not using NRO modes to meet the criteria. You save them for when they don't, by some, you know, unusual hopefully

occurrence. And I think you should meet the lower, you know, the night level. Yeah. That's what I would do.

MS. CHENEY: Thank you.

MR. COTTER: I was curious, Mr. Blomberg, if the Board -- I'm sure you're aware that the Board in the past has looked at modeling for turbines out of a concern for is it possible for these turbines to meet a particular standard. If the Board were to determine that NRO mode should not be accounted for in the modeling, how much would that or how far would that go to shift the balance of from what you called technique two over to technique one?

MR. BLOMBERG: A long ways. I think you just identified it. There are two main things that are shifting it that way. One is NRO mode, two is the day-night levels. So yeah, it would get you halfway there.

MR. COTTER: Okay. Thank you.

MR. KNAUER: I have a question in terms of assuming we are in world one or technique one, where we are really trying to regulate the operation and the technical aspects of a project. How does compliance monitoring look in that world? Are we doing sound power level testing, you know, up near

the turbines every once in a while, or are we still doing it at residences?

MR. BLOMBERG: Well, no. I think compliance testing probably looks like what you're imagining. I agree with Mr. Ashtiani that in a lot of places I think it makes sense to move closer to the turbines, make the measurements there, and use modeling to go the distance away from it. So you might, you know, use something like that. But I would -- I think it looks -- I think your compliance testing is right. It's just that it's not designed to regulate behavior. It's designed to regulate the physical properties. And so you know, although I've got to say, you know, I have some problems with it too, and it's all in my previous testimony, so I don't want to even -- you guys have accepted what I said, and you've rejected some of what I said. And I don't think I'm going to change your mind on that so --

CHAIRMAN VOLZ: Ms. Smith.

MS. SMITH: I'm really glad that Mr. Blomberg brought up the compliance and complaint part of the rule. Sitting around this room are a number of people who are potential neighbors of wind projects. And if I have one goal in success with

this rule, is that they are not put in the position of enforcement which is what's happened. And so my default position, if we can't come up with a decent standard, is continuous sound monitoring.

I want to make the distinction between the continuous sound monitoring and Mr. Duncan talked about that's going on in Maine which you put out the suitcase and you gather bags of data, and then you look at it after the fact. The real-time monitoring is totally technically possible now. You have it up on the computer screen in real time, and you have the SCADA data there and the weather data. And you have a trigger that when it hits the standard, then you can go and watch and see what's going on. It has audio and video. Each one of these pieces of equipment costs about $25,000. The best equipment comes from Germany. This is a really, really small amount of money in the grand scheme of how much money is being made on these wind turbines.

And that enables someone to do the monitoring only looking at when there are exceedences. For the majority of the time you don't look at it. You don't need to gather and analyze all of these suitcases of data. You have a great example of how not to do continuous sound monitoring with the

rule of one-year continuous sound monitoring which is just absurd. You put a microphone in the bush, sometimes the background monitor is higher than the main monitor.

The neighbors right now are in a position where when there is a problem it's in the middle of the night, they are supposed to make a phone call or send an E-mail. So you have to turn on your phone. That's disrupting your sleep. And then there is days before anyone is going to respond. And what's in this rule allows for that process to continue where first you go to the department, then it comes back. And the fact is that people need sleep at night.

One of the goals I have had for years is just give the neighbors a phone number so if they are awake at night, and they can make a phone call to the operator and say turn it down. It's too loud. That's when it's the problem.

If you go outside and can't enjoy being in your garden on a Saturday afternoon because the wind turbines are too loud, there needs to be some mechanism where you can look at what's going on and analyze it for a real-time perspective.

So I want out of this room on this

subject. I've spent so much time. I've devoted years of my life to addressing this subject, and it's very painful because people are being hurt. I don't want to see more people hurt, so that's what I'm asking you to do is put something in place that takes the neighbors out of the role of being the enforcement monitors and puts a standard in place that is genuinely protective so people have the right to their peaceful enjoyment of their properties and their health.

And really what we need to be doing here is setting a good standard and coming up with the speed limit and the enforcement so that we can assure that things are being complied with in a real time manner and not days and months and years after the fact.

CHAIRMAN VOLZ: Any other questions? Yes.

MR. DUNCAN: I just had one question. Following the same logic of not allowing NRO to be used. Would you then also extend that to say don't allow developers to use shutdowns to regulate noise?

MR. BLOMBERG: Yeah. That would be another. Yeah, I probably should have said that too, but I think you're right that that would be another

example of behavior.

MR. DUNCAN: Okay.

MR. BLOMBERG: I think that that becomes the fallback like NRO when your modeling was wrong.

CHAIRMAN VOLZ: I'm sorry. What becomes the fallback?

MR. BLOMBERG: Shutting down at certain times, and NRO mode becomes your cushion to deal with any problems after the fact if, you know, through the 248 process and the modeling it just didn't match the environmental conditions for some reason.

CHAIRMAN VOLZ: Any other questions for Mr. Blomberg? Okay. Just want to thank everyone for coming out today. I thought it was really interesting.

Just want to remind you that the final written comments are due on May 11. And so if you get those in, that will be really helpful. Thank you.

(Whereupon, the proceeding was adjourned at 4:35 p.m.)

C E R T I F I C A T E

I, Kim U. Sears, do hereby certify that I recorded by stenographic means the Workshop re: Rule 5.700, at the Susan M. Hudson Hearing Room, People's United Bank Building, 112 State Street, Montpelier, Vermont, on May 4, 2017, beginning at 9:30 a.m.

I further certify that the foregoing testimony was taken by me stenographically and thereafter reduced to typewriting and the foregoing 248 pages are a transcript of the stenograph notes taken by me of the evidence and the proceedings to the best of my ability.

I further certify that I am not related to any of the parties thereto or their counsel, and I am in no way interested in the outcome of said cause.

Dated at Williston, Vermont, this 4th day of May, 2017.