



# NRG #40C Webinar

December 2, 2008, 11:00 a.m.-12:00 p.m. EST (USA)

<b>Barton Merle-Smith:</b>	<p>I'm joined today by Larry Jacobs, our Senior Marketing Engineer and Owen Clay, our Director of Engineering. Today's format will be similar to many wind industry seminars and consist of a presentation by Larry and Owen, with a follow-up period for questions and answers.</p> <p>Just one note too, if your connection is bad or becomes bad, hang up and reestablish using the same credentials and this ought to clear up any issues you should have. Similarly, if your video fails, then you can reestablish using the credentials provided.</p> <p>We are reviewing all incoming questions, so please note if you have some sort of technical issue by typing in a question. You can type in questions in the chat area on the right hand side of the screen and we will see those.</p> <p>While this forum is an opportunity for us to share information with you, it is also an opportunity for you to ask us questions and tell us how you feel. And we encourage you to send us questions at any time during the Webinar. We are going to compile them at the end and address as many as we can while on the air. Realizing that we cannot get to all of them and you will want additional information, we encourage you to visit our Technical Support Forum on our website at <a href="http://www.nrgsystems.com">www.nrgsystems.com</a>. There we will post the presentation by Owen and Lawrence Jacobs within 24 hours and we will also post questions and answers. We will continue to use this Webinar format and will likely pass on additional important information in the future in the same way.</p> <p>So without further ado, I'm going to turn the microphone over to Larry and begin today's presentation.</p>
<b>Lawrence Jacobs:</b>	<p>Thanks Barton. Welcome to everyone who has joined us today. We appreciate you taking the time over the next hour to learn more on the #40C update and to get some valuable information. For some who have had the opportunity to attend past workshops or seminars, some of this information is familiar. The purpose of this Webinar today is to reach out to as many industry folks as possible and to also relay information and provide a vehicle for you to check back with us to get updates. In today's Webinar we'll walk through the chronology of where we are today and how we got here. I'll ask Owen to go over the problem definition and we'll discuss some findings, touch on the current status of where we are today, and provide some next steps both for ourselves NRG and for those for you as the product consumer and user. As Barton said, we will be having a question and answer session at the end up to the allotted time and we will post all questions and answers on our Technical Forum.</p> <p>So if we look at the chronology of events, back in February 2007, we were notified by a customer of a report of what they referred to as sensor dragging and in comparing two sensors at the same level, they noticed that they were not matching and one sensor was under reporting the wind speed. At that time we requested the return of sensors to NRG Systems and we did review the data and acknowledge that there was certainly something going on with the data. But as the manufacturing of the sensor, we reacted to the product itself and asked for it to be returned so that we could diagnose, inspect, and trouble shoot. In November of 2007, we received those sensors from the field and began our in-depth analysis. A lot of time was spent on this; a lot of Engineering digging deep into the intricacies of the sensor and the components. In early 2008 we were finally able to identify a process problem with the epoxy process, whereby the cylindrical magnet that it is epoxy-ed [<i>sic</i>] to the shaft that spins inside the sensor and the process used to attach the magnet to the shaft had run away. There was an overflow of epoxy on some sensors and this overflow would interfere with the bearing and certainly could cause a slowdown in the sensor. We sited that process and corrected it. In May 2008 we issued Technical Support Bulletin 008 to explain details behind identifying and correcting that process and the sensors that were shipped after that. Then in July of 2008, we started to look at data ourselves from our test towers as well as some customers starting to analyze data from sensors that were built using this new epoxy process. By looking at the data, it was clear that the epoxy on the shaft was not the root cause of this new scattering in the data with these sensors that had been manufactured using this new process. And the conclusions that we identified in Technical Support Bulletin 008 were not valid. We had continued at that time and expanded an in-depth Engineering investigation into the sensor. And for the next few weeks really got into trying to understand every integral part and component of the sensor. In September of 2008, we identified a vibratory mode as the mechanism for sensor dragging. And in September of 2008, Owen Clay, our Director of Engineering, gave a presentation at an AWEA workshop (some of you who are here today were probably at that) to talk about the details behind the vibratory mode. At that time, we established a round-table of industry experts to really help us to review and validate our processes and our results, number one, and number two, to have a good forum on data analysis and to help develop a methodology to account for this added uncertainty that would be present with sensors that have a slow down. At that time we continued to ship sensors based on information that we had which was that the data was still usable. We fully understood the magnitude of the slow down and that it was a bounded magnitude that not all sensors were</p>



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	<p>affected. Customers were reporting no sensors were affected while some were reporting quite a significant amount so we felt we just didn't have enough information to justify stopping shipment and disrupting the flow of capacity to the industry.</p> <p>So that brings us from identifying a manufacturing process with the epoxy and the magnet shaft assembly up to present day and identifying a vibratory mode. At this point, I'm going to ask Owen to get a little bit more into the details of the actual problem definition and how to account for it and what does it look like in the data.</p>
<b>Owen Clay</b>	<p>Thank you, Larry. So I will talk a little bit in more detail about the scatter and what it looks like in data plots of 10 minute averages. In order to see this problem of course you need a pair of sensors and what you do is compare the 10 minute averages of two sensors that are in the same wind, meaning at the same height, and the wind direction is such that they should both be seeing the same wind. The scatter that occurs when there is a problem with one sensor is one slows down, so you get 10 minute averages that do not have a difference of zero; it is something greater than zero. One side note, we found that this problem, as we look at lots of data from a number of you and looking at your historical data and field data, is that it is pretty well isolated in sensors manufactured since 2006 and later, through 2008.</p> <p>One characteristic of the vibratory mode is it is a mode that the sensor gets into where it loses energy and slows down. It slows down pretty consistently between .3 and .6 meters per second. And it actually slows down a little bit more at lower wind speeds. So at 5 meters per second it slows down a little bit more than at 10 meters per second; maybe a tenth of a meter per second difference. The sensor preferentially gets into this slow down mode when the wind speed is in the range of 5 to 12 meters per second and can stay in this mode for long periods; for hours. It can also stay there for shorter periods of time and can go in and out in a period of seconds. The variable is how much time it will stay in that mode. But again it can be as much as a 10 minute average. As the wind speed increases, the sensor actually goes out of the mode above 15 meters per second and considerably less at 12 meters per second. Below 5 meters per second it often it drops out of the mode. Another important characteristic is that newly manufactured sensors do not exhibit a vibratory mode. It is only after two weeks plus on a tower in the field that, if the sensor is going to exhibit this mode, it is only after that amount of time that it does actually exhibit it.</p> <p>So now on this next slide I'm going to point out in a scatter plot what a sensor pair, both normal and two versions of dragging sensor pairs look like. Now this pair is wind speed difference between two sensors on the y-axis versus wind speed direction. It's important when looking at data for this kind of thing, when you want 2 sensors to be agreeing, that you are looking at sensors in directions that are not affected by tower shadowing or other terrain feature shadowing. And in this case, starting with the bottom of these three plots, if you can see this arrow, looking say between 100 and 200 degrees in direction. Every dot on the plot is each anemometer's average wind speed for 10 minutes, one subtracted from the other, that's what each data point is. So if you look at that area, it's pretty much a straight line along zero just like you'd expect a normal pair of sensors. There is some variation but it's fairly tightly grouped and that is normal scatter. If you then look at the middle plot, you'll see that that same normal scatter is a significant part of the plot, but there is also a large sort of "claw" that comes out above again in the 100 to 200 (degree) range you see significant scatter in a .4 to .5 meter per second difference. And that is one sensor slowing down that is creating that. And then, looking at the top plot, again you see the dominant central bar of data that looks normal, but now you've got scatter somewhat evenly distributed above and below that and that reflects that some of the time, one sensor is slowing down and for some time, the other sensor is slowing down. So all possible combinations are shown in this slide of wind speed difference versus wind direction.</p> <p>The next slide is also wind speed difference versus direction. The difference is, in previous slides the colors of dots really didn't signify anything. In this case the red dots are a sensor pair where both sensors were manufactured in 2003 whereas the blue dots show two sensors that were manufactured in 2008. And looking first at the red dots, you see again in the regions where you'd expect zero difference, if you look at the red between 200 and 300 degrees or between 45 and 135 degrees, the red is behaving normally. Whereas, particularly on the right side, where the wind is dominantly from this region here, you see scatter primarily above but also below where one of the 2008 sensors is considerably dragging here.</p> <p>The third slide here of these plots is similar to the first, except now we're looking at wind speed ratios rather than differences. It's important to acknowledge that, because a lot of people look at ratios, although differences gives you the more true error that you might get from this, the ratios are visually interesting and when you are looking at a lot of data it may be useful. You see a slightly different kind of pattern. And again, with these three plots, the</p>



## NRG #40C Webinar

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bottom is where both sensors are behaving normally; there is no significant difference between them. And you can see, even in this bottom one, there is a slight taper as you go from low wind speed to high wind speed, because small differences at low wind speed are a larger ratios difference than small differences at high wind speed. That's just the nature of ratios. If you look at the middle plot, you see on the top an arrowhead shape or a spike that comes off. And that reflects, like the first slide is this series, one sensor slowing down or dragging. And then in the top one you see both sides of the arrowhead nicely shaped and you get both of them dragging some of the time. Let me point that the x-axis here, unlike the other two plots, is not wind direction but wind speed. And this supports what I said earlier, which is that this phenomenon, the vibratory mode and the consequential slow down, is happening preferentially in wind speeds of 5 to 10 meters per second. A little bit you see above 10 but not much at all above 12 and it actually reduces at 4 and below. And the shape of this curve up here, of the arrowhead, is partly due to the ratio – that the same difference will look bigger at a smaller wind speed. But also partly due to the fact that less of the vibratory mode is occurring at higher wind speeds until you actually get up here and they go away. The next slide that I've got up here is switching from looking at the field data, looking at wind speed 10 minute averages over months in your field data.

There is another approach to understanding and identifying if your sensor has a problem and that is looking at post-deployment calibrations. So the sensor comes back and it is recalibrated and we look for two primary things. We look for a change in the offset of the transfer function. The transfer function is what is highlighted here and the offset is the last term here in the transfer function. And in this case, I believe this sensor's initial calibration was about .36 and it's moved up to .7 and it's about a .34 meter per second increase and we have a threshold of greater than .1 meters per second, which indicates a problem. So this is a significant offset increase and it is indicating a problem. The other thing we look at in very small print here is the standard error from the calibration procedure. You are looking at many data points and you compute standard error and if that number is greater than .12, as it is here, that's another indication of a problem. For those of you who are not familiar with these calibration sheets, this is kind of a slice out of a calibration sheet with the calibrations for the #40C's done at [Otech Engineering](#). And this is a typical slice of what one of those calibration reports look like. This is actually a slice from a particular sensor that was recalibrated and did have the vibratory mode.

This next slide is switching from characteristics you might see in the field or in a post-calibration to our laboratory testing that we are doing here. This is a plot of a pair of sensors on a tower, I believe at 40 meters. So let's look at the top plot. That is 10 minutes with time along the x-axis and wind speed along the y-axis. The red trace is an anemometer that is performing normally and the white trace is an anemometer that gets into the vibratory mode. And if you look at about 2 minutes into these 10 minutes, if you can see my arrow, the traces diverge. The red and the white had been tracking each other nicely until that point. The sensor with the white trace gets into the vibratory mode and it slows down relative to the other sensor and for the rest of the 10 minutes that is occurring. If you look down at the bottom right, that dial indicator at minus .33 meters per second shows the average difference between the measured speeds of the two sensors. So that is a .33 meter per second offset due to this vibratory mode for the sensor that slows down. So that is showing the slow down. The other part of this slide that is very important is the other two charts. In the one on the left you can see the large red spike. This is a plot of 3-axis vibration energy as a function of frequency and the left hand graph is for the spectrum of the sensor that is in the vibratory mode (the one that is in the white trace above). You see at a certain frequency a very large spike. And if you look at the other plot to the right, which probably looks blank to you, is of the normal sensor and there is no such spike. In both of them you see at a different frequency a couple of spikes or small registers of energy, which are for a normal sensor and they appear in both. But for the sensor that gets into the vibratory mode, this red spike is a characteristic of its vibration and that is what correlates to the slow down. So this is data from a tower field test in a good windy site and we have the same set up in our lab set up with our wind tunnel and we see the same results, the same signatures. When we induce the vibratory mode in a sensor that is able to get into a vibratory mode, this is what it looks like – the signature on the left and a similar slow down. And when there is a sensor that does not get into the vibratory mode, it looks like the one on the right.

So I'm now going to hand the microphone back to Larry.



# NRG #40C Webinar

December 2, 2008, 11:00 a.m.-12:00 p.m. EST (USA)

<b>Lawrence Jacobs</b>	<p>Great, thanks Owen. That was a good explanation taking us through the problem definition and bringing us up to the current status. And I'd just like to reiterate that, at this point, the vibratory mode has been identified as the mechanism of sensor dragging, which was a very big breakthrough in our understanding the sensor operation and performance. And it's also important to note that we did consult with outside experts to understand the physics of the vibratory mode. Outside experts both outside of NRG, but also not only within the industry but also within universities to really get a handle on understanding the physics behind it. We have recently identified a root cause of this vibratory mode and my understanding is we are able to make modifications to the sensor and have made some prototypes addressing root cause and very soon we will be underway with a field testing of these sensors to validate modifications made. And it is at that point that, when we get more information, we'll talk about next steps and be able to share additional information with the industry.</p> <p>So the next steps for NRG Systems are: We continue to work with our roundtable of experts. As I mentioned they are very important in helping us validate and verify and also to help us with in-depth analysis. We continue to focus our Engineering efforts on the validation of these sensor modifications; building them up, getting them out in the field, flying them, and looking at the data as it comes back. And again, once the sensor modifications are validated, we will communicate details on what you should do next. We will communicate details in many ways, through email much like you got an invitation to this Webinar, and we will be posting updates on our Technical Support Forum, with a link right <a href="#">there</a>, where you can get the answers to the questions, as well as the presentation you are looking at today. The plan is to also host another Webinar to serve as a follow-up to this, as we finish up our validation process. And then the ultimate would be the publishing of a detailed white paper relaying both the scope of this issue with the #40C and equally important is the methodology used in solving this, which we think is important to share with the industry.</p> <p>Recommendations that we have for the wind analysis and measurement community is certainly first to continue to analyze your data and perform quality checks as usual. The data is very powerful and is going to tell you what is going on and allow you to make decisions on how to analyze and perform those quality checks. We do understand that the sensor drag issue on some of these sensors does add additional uncertainty caused by the sensor drag and that this uncertainty is not trivial and that it should be accounted for in your data analysis. As I've said in presentations that I've given at workshops and seminars, that it is always important to consult an expert. Someone who is quite adept at analyzing data and who does that for a living and is used to looking at a lot of data because the data does tell you the story. And as always, contact NRG Technical Support with additional questions. You can do that again through the website where our <a href="#">Technical Forum</a> is a very good resource.</p> <p>At this point we will end the presentation portion of the Webinar and turn our focus to the questions that have been asked, which Barton Merle-Smith will be moderating.</p>
<b>Barton Merle-Smith</b>	Thank you Larry. Thank you Owen. We have a lot of questions that are coming in now and, as I said before, we won't be able to get to every single one of them, but we will follow-up and post the questions and the answers on our website.
<b>Barton: Question 1</b>	Owen, I'd like to start with you. We have quite a few questions coming in about data and how do I interpret my data. Do I scrap my existing data? How do I manipulate my data? What does NRG recommend doing to ensure reliable and accurate wind measurement data right now?
<b>Owen: Answer</b>	First, as Larry said, it's important always to analyze your data, to do quality checks, and to scrutinize your data. So all of you continue to do that. And when you see evidence of a dragging sensor problem, and you have done your best with your experts to mitigate that with whatever methods you are using, it's important that you then take into account the additional uncertainty that the dragging sensor is introducing into this tower's assessment program. It should of course be put into the context of the other uncertainties, which you always consider. There is already some uncertainty that you already assign to sensors, as well as to reference MCP methods, modeling, tower configuration, long-term variability, and a variety of other things that you do consider. So put the whole thing together. Yes, take it into account and proceed ahead. We don't recommend any wholesale changes to your equipment. To reiterate, we continue to recommend installing sensor pairs at each level, which allows the kind of quality checks and minimizing of uncertainty that we are talking about here.
<b>Barton: Question 2</b>	Thank you. Ok, Larry I'm going to have you take this one and it has to do with shipping of sensors and essentially why has NRG continued to ship sensors that were possibly affected by this?



# NRG #40C Webinar

December 2, 2008, 11:00 a.m.-12:00 p.m. EST (USA)

<b>Larry: Answer</b>	<p>Thank you Barton.</p> <p>The first thing to keep in mind is that up until 6 to 8 weeks ago, we really had not identified any problem with the sensor itself and considering all the work that we had done, there is no smoking gun that we could uncover that said this new-found sensor dragging was due to the sensor. So at that time we really had nothing to report. We continued to investigate the sensor itself, in looking at other things like the boom, sensor interaction, and looking at it from a system point of view as well as the sensor itself. But we hadn't exhausted all of the detailed analysis. Again this time we are pulling in outside industry experts and university experts to help us understand the physics behind it. We wanted to make sure we fully exhausted all possibly issues with the sensor, but up to this point had nothing to report.</p> <p>Secondly, in talking to customers and looking at the data coming from them, the data was still usable. Yes, there is additional uncertainty associated with it, but that uncertainty can be accounted for. We don't want to trivialize the amount of effort that goes into doing data analysis of any kind. The recent presentation made at a conference showed that when you look at the data and you take the worst case and look at the end results and end numbers that you look for in doing any wind data assessment project, the annual production number margin wasn't ever really that significant. But the amount of work it took to get to that point, we understand, is not trivial.</p> <p>Third point to be made is that not all sensors exhibited dragging. While we had some customers that reported no incidences, we did have others that reported higher frequencies of the incident. So that, coupled with the other points made, meant that we couldn't justify it. And also it's important to understand that there are many variables that contribute to uncertainty in wind measurement as you stack them up. Long-term reference being one, MCP methods, modeling, and even how the tower is configured as well as long-term things like variability and the site environment itself – all of these stack up as the bigger uncertainty tolerances. We understand that the anemometers are a small piece, but certainly a piece, of the uncertainty tolerances and this additional uncertainty could be accounted for and kept in perspective when you look at the whole picture. And also the idea that there is certainly a capacity issue. There was a demand and we wanted to make sure that we didn't have a huge capacity outage in the industry at that time. Again, factoring all of the points made, it meant that a sensor could still be used.</p>
<b>Barton: Question 3</b>	<p>Ok Owen, we have several questions that are around the subject of, if NRG can make a sensor go bad in the test lab, why not test all of sensors before they leave NRG and is there some sort of a screen to test for bad sensors? Maybe you could address that.</p>
<b>Owen: Answer</b>	<p>Yes. What we can do in the test lab is take any sensor and determine whether it is a sensor that can get into the vibratory mode or not at this time. So if it can't at this time, then it won't be a dragging sensor. And if it can, then it possibly will be a dragging sensor. The problem is that new manufactured sensors take two weeks or more, as I think Lawrence Jacobs mentioned, of field service, before they will exhibit the vibratory mode and slow down. So it is only in time that they reveal themselves, which is why we cannot do a screen as part of an inspection process on new manufactured sensors.</p>
<b>Barton: Question 4</b>	<p>Ok, thank you. We also have some additional questions as to what should we do? Should we be sending sensors in for recalibration? Should we go out and replace all of our sensors? What should we do now? And I think I'll take that one myself.</p>
<b>Barton: Answer</b>	<p>NRG really values all of our customers and the users of our products. And it's really an issue of trust. You need to be able to trust our products as you deploy and use them. And you need to be able to trust us as a company and that we deliver products that work. And this trust is not something that we take lightly. If the past, when we've had issues with one our products, and we have, we have done the right thing in dealing with the solution. Some of you have experienced this with us in the past. This issue really is no different in that respect, it's just a lot more complicated. And in order for us to have a comprehensive program that deals with all of your concerns as our customers and users of our products, we need to complete the field validation of the revision of the sensors first. Once that validation is complete, then we'll be able to introduce a program as we've done in the past that enables you, our customers, a program to replace sensors as needed and in the most effective and efficient way as is possible. We realize this is tough and it is complicated and we will have a solution and a program ready to go once these sensors are validated in the field.</p>
<b>Barton: Question 5</b>	<p>Owen, I would like to ask you to talk a little bit about the vibratory mode. You talked a little bit about the onset of it and perhaps you could explain the time it takes for the onset of the vibratory mode. What happens if two anemometers go into the vibratory mode? How do you detect that and what kind of a test is there that we can do as a customer?</p>



# NRG #40C Webinar

December 2, 2008, 11:00 a.m.-12:00 p.m. EST (USA)

<p><b>Owen: Answer</b></p>	<p>Let me start with the second question first. If both sensors in the pair go into the vibratory mode, how can we see that and how can we understand that that's happening? If they are both in the vibratory mode and have a similar slow down continuously, so all of the 10 minute averages for both sensors continuously slow down by say .4 meters per second, you will not be able to tell that. In fact, the sensors tend to go in and out of the vibratory mode. If both sensors in a pair have the tendency and the ability to go into the vibratory mode, it will more likely look like the slides that I showed where there were two that had 3 plots each. The top plots were where both sensors were bad and you see scatter both above and below the line and that is the signature of both sensors having scatter.</p> <p>The first question that Barton relayed was how does the sensor get into the vibratory mode? What is the time period and what is the mechanism? What we've found, and this is just based on the evidence that we've received and sensor data primarily from customers in the field, is that some pairs exhibit this scatter as soon as two weeks. None have we seen sooner than that. Partly that has to do with having enough data to look at. If a sensor is going to exhibit dragging and scatter, the longest it's taken from anything we've seen to exhibit that is 26 weeks. So somewhere between 2 and 26 weeks. But we believe there is a priority or a tendency for that to occur within the 2 to 6 week range. The mechanism of how that occurs is something that we'll share at a later time. There may be a number of questions about just what is the vibratory mode? How is this occurring? What parts are making this happen and what parts might you be [sic] changing to fix it? We want to get our test and validation program further along to really finalize and get really good, solid backup data on what's happening and the success of any design changes we have before we share those details. When we've got lots of not just lab data, but sufficient field data behind us, then we'll share more details on the mechanism and more details on design changes.</p>
<p><b>Barton: Question 6</b></p>	<p>Larry, let's go back to shipping anemometers and one question is why were new anemometers shipped when calibration offsets were known to be greater than default offset values?</p>
<p><b>Larry: Answer</b></p>	<p>That question might come about because of some confusion with the section of the calibration report that Owen addressed in the presentation. Let me first answer this by saying that all anemometers that are shipped are calibrated and pass the criteria for calibration. What was shown in the presentation was an anemometer that had been in the field for a while, had been known to show some slow down, and when that anemometer was post-calibrated, or calibrated again after being in the field, the higher offset and higher standard error were shown to be the case. And again this is one mechanism used to identify.....and those parameters are what is used to identify this.</p>
<p><b>Barton: Question 7</b></p>	<p>Ok, thank you. Owen, we had one of our listeners send in a question and there appears to be some confusion on what you had stated about being able to see two sensors going into vibratory mode and maybe you could address that person's question. He says, "He said that you won't be able to see the two sensors going into vibratory mode, but then you said you can. Please explain which is correct."</p>
<p><b>Owen: Answer</b></p>	<p>The answer is yes, you can see it based on typical data. So the plots that we showed in the slide presentation are typical data where you can see that. What I spoke to, to make sure that I was fully disclosing in a sense, is that if you had an extreme case where both sensors were all of the time in the vibratory mode (that's not a case we've seen, but if there was such a case) then you couldn't tell the difference.</p>
<p><b>Barton: Question 8</b></p>	<p>Ok thanks. Larry, I would like one just a quick follow-up on your last question and it appeared to, towards the end of your answer, break up a little bit. So maybe you could just repeat the last part there. And then go from there into a question regarding the percentage of expected sensors and maybe you could address what you think is the affected percentage of sensors is.</p>
<p><b>Larry: Answer</b></p>	<p>Sure. To summarize the answer to the last question, all new anemometers shipped to NRG are calibrated past the criteria for calibration and are shipped here with offset slopes and standard errors being within the limits of that criteria. So the calibration report that we were looking at in the presentation was of a sensor that had been in the field for some time.</p> <p>And then the other question is, "What is the percentage of sensors affected?" And this is based on a population in talking with some customers who report no incidences and some who report very high. Based on all of the data that we've looked at and all of the sensors we've looked at, it's somewhere between 20% and 30%. We've had it reported as high as 100% by some customers. So we can only base that on looking at the entire population of sensors and our best estimate is it is somewhere in that range.</p>
<p><b>Barton: Question 9</b></p>	<p>Owen we have several questions that are around our experiments and testing and how long we anticipate this validation of the revision of the sensor to take, which of course translates to how soon will we be shipping new sensors? And some of these we can address and some we can't right now, because we don't know the answers to them all, but perhaps you could take a stab at the parts that we can answer.</p>



# NRG #40C Webinar

December 2, 2008, 11:00 a.m.-12:00 p.m. EST (USA)

<b>Owen: Answer</b>	Yes. I hesitate to give specific timelines on getting to a conclusion of shipping a revised sensor. But let me talk about a couple of parts of that process to get there. One is that prototypes of revised sensors and we think at least 50 pairs will need to be out on towers for one to two months before we have sufficient data to ourselves make final conclusions. And by the way we're partnering with some very experienced users among you to facilitate that. There needs to be consensus that the sensors are performing up to pre-2006 standards before we'll move ahead. There is a little bit of time on either side of that which is needed to complete the Engineering activities we're doing right now and then ramp up activities on the other end.
<b>Barton: Question 10</b>	Thanks Owen. We are beginning to run down on time, but we have some more questions that we can answer pretty quickly I think. Larry, this is a dual question. "What if I don't have sensors mounted in pairs and what role do booms play in the occurrence of the #40 slowdown?"
<b>Larry: Answer</b>	<p>Ok to look at the "What if I don't have sensors mounted in pairs?" question first: Typically, most towers have at least one level of sensors mounted in pairs, but for those instances where towers have sensors mounted one per level, it has been shown that you can account for drag in the data in that type of orientation. The amount of analysis needed to do that is not trivial and, as with any data analysis project, should be left to the experts who truly understand data analysis and statistics. I have talked to those who have looked at single sets of sensors and not pairs and have been able to identify this. But it is best left to those who handle and analyze data for a living. The more data you look at, the more of an expert you become, and it's something that NRG has always said to leave up to the experts for sure.</p> <p>And then the second question: "What role do booms play in the occurrence?" We are quite aware that (and look at this as a complete system) you have boom to sensor interaction and sensor to tower interaction. You've got cable to tower interaction as well as the logger at the base. And all of this creates a system that, as we mentioned before, adds to the uncertainty tolerances that stack up in a complete project. As far as the boom interaction goes, yes there can be some occurrence of a boom causing a vibration, but when we look at this particular issue as it relates to our sensor, we are looking at the sensor as being the sole contributor and making the modifications and testing of those modifications to eliminate that. So, although it has been mentioned in the past, we have focused our efforts primarily on the sensor and feel fairly confident that we've identified issues in the sensor. Again, always look at the complete system. It's important to understand the mounting of booms and the mounting of sensors to booms and the orientation of those booms in any complete project.</p>
<b>Barton: Question 11</b>	I have another question about the magnitude of any cost increase per sensor for a revised sensor.
<b>Barton: Answer</b>	We don't plan to have any cost increase for the revised sensor at this time.
<b>Barton: Question 12</b>	Owen, there is another question here: "Does the problem vary with wind speed and how big of a variance is there - does it seem to be a big deal?"
<b>Owen: Answer</b>	<p>As I described a little bit, the problem does vary with wind speed. It is preferential for lower wind speeds. A dragging sensor will tend to be more in that mode at 6 meters per second and less in that mode at 10 meters per second and much less at 14 or above or not at all at 14 or above. So just based on getting into the mode, much less of the time at higher wind speeds and more of the time at lower wind speeds, although as I said there is a drop off at about 4 meters per second, where it drops off too. And that's also not so relevant, because that data is not useful anyway really. So the slowdown will be less of an overall affect on the total annual wind speed average because it selectively prefers lower wind speeds.</p> <p>The other piece of it is when it's in the vibratory mode and slowing down - it also slows down less at higher wind speeds than it does at lower wind speeds. So this is a small effect. It may be, if it slowed down at 6 meters per second .4 meters per second and it slowed down at 10 meters per second .3 meters per second, you'd have a slightly lesser effect also at higher wind speeds. So that just reinforces the first, more dominant part of that. So yes, that is something that, in looking at your uncertainty, you can take advantage of the fact that there is more uncertainty due to this at 6 and 8 meters per second than there is above that. And that I think can be helpful.</p>
<b>Barton</b>	<p>Thank you very much.</p> <p>Well, we are essentially out of time now and we want to thank everyone for joining us. I want to thank Owen and Larry for their work here. The questions that have been asked here today are excellent questions and we really thank you for all of them. We will get to all of them and we will post answers to them on our Technical Support Forum on our website. Additionally, one of the things that we have here is we do know who has asked the</p>



## NRG #40C Webinar

December 2, 2008, 11:00 a.m.-12:00 p.m. EST (USA)

questions and we can address some of them personally and answer them that way as well. They all will be answered and we will post answers as quickly as we can. This presentation will be posted within 24 hours on our website as well.

We thank you all for joining us and we look forward to sharing additional information with you as it becomes available and thank you once again. We are now going off air.