Overcoming Wind Siting Challenges II: Radar
April 15, 2015

Coordinator: Welcome and thank you for standing by. At this time, all participants are on a listen only mode. Today's call is being recorded. If you have any objections please disconnect at this time. I would now like to turn the call over to Mr. Patrick Gilman. Thank you, sir. You may begin.

Patrick Gilman: Thank you. Good afternoon everyone. My name is Patrick Gilman. I'm the Wind Market Acceleration and Deployment Lead for the U.S. Department of Energy's Wind Energy Program. I also have the pleasure of leading this series of webinars through our WINDExchange Program.

Today we're continuing an ongoing three part series, talking about overcoming wind siting challenges. And specifically, we'll be covering challenges. And specifically, we'll be covering challenges countered when wind interacts with radar systems.

Before we get started, one quick plug, our last webinar in February was about siting challenges having to do with wildlife.

We made a major announcement associated with - with our efforts to overcome those issues yesterday, $1.75 million in funding to advance technologies that will help reduce the impact of wind facilities on (FATS).

If you'd like to know more about that, I'd encourage you to visit our website at www.wind.energy.gov and click on the news tab. So, next slide, we've also made, in the last couple of months, another major announcement that relates to all of the work that we do at the Department of Energy.

We released a landmark report, the Wind Vision, that looks at the feasibility or the implications of reaching a high penetration wind scenario in the U.S. electricity market. Next slide.

And that scenario looks at what happens if the United States can reach 10% wind energy by 2020, 20% wind energy by 2030 and 35% of wind energy by 2050, compared against a business as usual scenario.

And, you know, while this study isn't a projection of the future, it does allow us - it's a really powerful tool for us to look at the benefits, costs and challenges associated with a future in which wind energy and other sources of renewable energy, play an increasingly important part of our electricity sector.

And next slide. I think the major findings - one of the major findings of this study beyond the fact that there's no technical - fundamental technical barriers associated with achieving those high deployment levels, is that there are some real major benefits associated with the greater deployment of wind energy in the United States.

In terms of system costs - wind energy - the wind vision scenario - 10% by 2020, again and 20% by 2030 and 35% by 2050, requires some major system cost savings. So that is 3% savings over a baseline scenario.

Another major benefit - a major benefit in terms of greenhouse gas emissions avoided; air criteria air pollutants avoided with consequent public health effects; and something I don't think we talk enough about, a huge amount of water saved in the electricity sector, versus other sources of generation.

You see additional impacts below - lots of jobs; tax revenue. I think direct your attention to the bottom right hand corner of the slide here. There are also some real challenges associated with - with that.

We understand that deploying wind energy brings with it impacts on other things that we care about as a country - wildlife; impacts on other human uses of land; and in this case, impacts on national security and public safety radar missions.

We know that wind energy when deployed within the line of site of these radar facilities, can have significant effects on their performance and in some cases, has degraded that performance.

So what we're talking about today, next slide, is really about the efforts that we are undertaking at the DOE and in the interagency community, to take a look at how we can overcome the challenges associated with - with wind's impact on radar.

How do we maximize the coexistence of wind energy in the future with impacted radar systems?

As we see from the wind vision results, if we want to achieve the benefits of that - of that scenario, we have a lot of work to do, to ensure that wind can go in - a lot more wind can go in a lot more places, without unacceptable impacts to those radar missions.

And that's what our two presenters today are going to be talking about in their presentations. So they're going to be giving it sort of in a tag team style so I'll introduce them both now.

First up we'll have Bill Van Houten who is the Deputy Director of the U.S. Department of Defense's Siting Clearinghouse, which is located in the Office of the Secretary of Defense.

Bill has an undergraduate degree from Carnegie Mellon, a law degree from William and Mary and a Master's degree from the Harvard Kennedy School and the Industrial College of the Armed Forces.

And I am grateful to say that among his many other duties, he has time to work on this important challenge for - for wind energy development going forward.

And our second presenter will be Jason Biddle. Jason Biddle is a technology lead for our wind energy and radar work at Lincoln Laboratory, associated with Massachusetts Institute of Technology.

Jason has degrees in Computer Science from Penn State and in Computational Systems Optimization from the Massachusetts Institute of Technology. At the end of our presentations today, we'll have a question and answer period. I'd encourage you to ask lots of questions.

During the presentations you can ask questions by submitting them - you see the question and answer box at the top of your webinar screen. Type in your question in that box and click Ask. I will be moderating those questions and delivering them to the appropriate presenters. Next slide please.

And just as a reminder, we do this webinar series every other month. The third Wednesday of every other month - 3:00 pm eastern. In our next session in June, we'll be talking the third in this issue of the series of webinars around siting challenges.

Talking specifically about public acceptance and land use effects of wind energy development. And then in August, we'll be doing a deep dive on the wind vision study that I mentioned earlier.

So without further ado, I'd like to turn it over to Bill Van Houten who's going to be talking about the work that he and I and others, are engaged in, in wind turbine radar interference mitigation. So Bill, over to you.

Bill Van Houten: All right. Thank you very much for that introduction Patrick. So Patrick has already outlined for you where DOD is in the scheme of things, as a potential barrier to the deployment of wind. And I just want to say upfront, that DOD takes this very seriously.

We have a - we operate actually under a statute that was passed in fiscal year '11 by the Congress. And the Congress actually told us that we are - we are to try to ensure a more robust grid and also attempt to - to support deployment of renewable resources, concurrent with protecting military missions.

So while we will occasionally object to a project, we try very hard to work on mitigation solutions, either by moving turbines or other physical methods.

Or we've got this research and development program in the works in order to try to find technological workarounds both for the short run and for the longer run. So - and I also wanted to add one other thing.

Patrick discussed the military concern here with respect to radar because that's largely what we worked with the Department of Energy on, as well as the other interagency partners. But there is another dimension to this as well which is the turbines can act as a physical obstruction as well.

So if you're putting up 500 foot to all wind turbines in the vicinity of something, you know, like a bombing range or something else, where we're doing low altitude flights, the obstruction issue can become an issue. And as turbines increase in height and size that problem will - will also increase.

On the radar side, the problem we face with the - with the further deployment of wind energy, is that the more turbines you have concentrated in an - in an area, the more difficult it is for the radar to take care of the two problems which the wind turbines present to it.

And first of all, the - the turbines basically at the tip speed, are traveling quite - quite fast. So the radar picks it up as a - as a moving object. And so what you end up is clutter, because it is perceiving those - those tips as additional aircraft.

And it - because the radar is busy worrying about that, it decreases the probability of detection of the system. So - so that essentially is what the problem is. Next slide please.

So over the course of - of the next 15 minutes or so, I'm going to - I'm going to tell you about what we've been - we've been doing on the program. First I'm going to tell you about the interagency field test and evaluation program that we just completed six months to a year ago.

This has now been followed up by something called the WTRIM which is the wind turbine radar interference working group, which is an interagency group which is going - which is building off of the interagency field test and evaluation program which is more narrowly focused.

And then I'm going to tell you a little bit about the (pilot) mitigation initiative that we - we are just starting where we're looking to partner with the industry in order to come up with better solutions. And part of that as well, is to just gather a better set of data upon which to - to work better solutions.

And so that will be followed - I'm really interested in industry feedback on this. We got some very good feedback when we presented this at the (OWEA) siting conference about a month ago. We're going to also lay this out at the National Conference during May.

(OWEA) does, you know, back the - the effort because they back technological solutions more generally. And - and then I'm going to be followed by Jason Biddle of MIT Lincoln Labs, who is going to - going to talk about the mitigation solutions from a more technical point of view.

And then we'll follow that with questions. So questions will be dealt with at the end. Next slide please, which is now slide 3.

So field tests and evaluation programs - so the idea here was while there was anecdotal evidence that wind turbines degraded radar, we didn't't' have what we consider to be sufficient studies that - that could back that claim up. So the IFTNE actually examined three different radars.

Two of them were long range radars which were different types and the third was a terminal radar to see what the degradation issue was. And in fact the studies pretty conclusively showed that the radars were degraded.

And then we had - before we started this we had gone out to industry, and asked for possible mitigation solutions. And we then whittled those down to a shorter list of mitigation solutions.

And we tested those and we came to the conclusion that what we call an (INFIL) radar which it's a radar of a shorter range than something like a long range radar, so something like 20, 30, 40 miles radius, is - is - is something that we can use as a short term strategy to fill the gaps caused by the turbines.

And I guess as an aside I should also tell you that we do have voluntary contribution authority from - from industries. So we look to have industry come in and basically try to make the government whole for what it's losing.

And if you're wondering, so what's the clearinghouse's authority to objects to a project? We get involved in this, in two different ways.

One is the (NIPA) process which any of you who - who listened to the first of this series of webinars, would - would, you know, understand comes into play through the - through the wildlife side. But it also comes into play on the mission - the military mission side.

So it's just a similar process. And then we are also covered under a provision of FAA statute which is the obstruction evaluation process, which FAA runs. So that's the two ways that we come into this. And if we - if we have a concern with a project we will ask FAA to determine a project to hazard.

And then if - and then the - the third piece of the IFTNE, getting back to the slide, was to collect data. And we used that - we use those data sets now to further build our mitigation capabilities. Next slide please. So as I said, we have the three flight campaigns - mitigation technologies.

And basically, conclusively show that there was in fact, a problem. Some of the solutions were positive. I will say we further built on that since we're, you know, we're also examining what happens if you want to replace the - an entire radar that currently exists.

So let's say, replace a long range radar which is obviously a more expensive solution we're looking at. And we're also looking at things like improving algorithms. So go into the - the existing radars and improve the algorithms so that they do a better job filtering out the wind turbine interference.

And then the last thing on this slide deals with (T-Spear) which is something which DOE is leading in terms of - it's a modeling and simulation tool that will eventually, you know, hopefully be rolled out for industry to use as a way of figuring out whether if they put a project in that particular place there's likely to be a problem with military radars.

So that's something that's under development. And frankly, we're looking at modeling and simulation tools more broadly as well. Next slide please, which should be slide 5. So with the results completed from the IFTNE program, then the issue is what next?

So we actually came up with a more formal structure. The DOD, DOE, FAA and NOAA entered into a memorandum of agreement several months ago, basically to joint research - jointly funded research to try to come up with technical solutions to the - the wind turbine problem.

And you can see from this slide, that we have both long and short run goals under this MOU. You might ask yourself, you know, why those particular parties? Well in short, DOD has the military mission issue. The Department of Energy is the proponent for wind.

FAA has - has a mission to keep the national air space safe and used efficiently. And NOAA's involved in this because NOAA's got weather radars which in the next - the next generation of weather radars is - could very well also have a terminal radar piece to it.

So basically kill two birds with one stone through that effort. And then the slide also mentions DHS because DHS also has a mission in terms of protecting the borders. DHS - DHS is not one of the co-signatories of the MOU.

But we do work with DHS and integrated their concerns into what we are doing. Next slide please. So other things that the WTRIM working group is also doing. The first thing on here which is the - the (RISP), is we're developing a database of who's doing what.

Because when we first got into this several years ago, you know, you might have the Air Force research lab doing something and - and the Navy research lab doing something and something else being done, you know, by a civilian agency. And nobody was talking to one another.

So one of our - one of our challenges was to put a list together of who's doing what, so it's not duplicative and we can all try to march towards the same goal efficiently. The next thing on here is the ANC modeling and simulation. So I - I briefly said something about (T-Spears).

And we also have several internal models within the government that are used by organizations such as NORAD. We're improving those models. And then the third thing on here is the PMP initiative which is what I'm going to talk about next and so actually why don't we just go to slide 7 on this?

So in short, we're already, you know, we're already engaged with industry so that if we have a particular project site where industry wants to - to build a wind farm and - and it's going to interfere with military mission, we enter into mitigation discussions with industry.

And sometimes those mitigation discussions will result in what we would call a curtailment agreement so that certain - for certain periods for a certain number of hours, they will shut the turbines off.

Generally we use that if we're in a test range situation. Because it needs a - it needs a very quiet environment to do testing.

The other - the other case we've got is where it's - where we work to mitigate the effect of the turbines themselves, through some kind of technology, generally to supplement what we've lost in the national radar system. And this is more with that - with the PMP initiative, it's about.

So the idea is that as long as we're engaged already in these discussions with industry, to mitigate, it makes sense to take it the next step so that once the system is deployed, work out some kind of an agreement, whereby we're going to collect data on the mitigation solution so that we can do a better job in the future.

And, you know, it is true that while we, you know, we'll run tests or we'll do a flight campaign for something like two weeks and we'll fly a variety of aircraft against - against, you know, an area where there are a number of turbines and then there is a radar.

And see how - how the radar is degraded and how the solution will improve the radar. That's only for a very short period of time. So the PMP initiative would allow us to gather data over differing whether conditions, over a protracted period of time, looking at probably a wider variety of aircraft.

So this is something we're very interested in. We don't think in the end, it's going to cost industry very much in terms of us being able to gather data off of a system that they were already providing voluntary contributions in order to put in.

So it seems - it seems basically to be win/win both for the government and for the industry as a whole, as a way of collecting better data. Next slide please. And I think the next slide just makes some of the points I just - I just made.

Now I will say this slide is a little bit off and I probably want to change it because we're looking, you know, we're looking at a number of mitigation solutions. But we are not going to have an approved list of mitigation solutions.

Because I don't want to - not just I, but we, the government, do not want to come into a situation where we appear to be anti-competitive. So the idea here is that, you know, we're going to work on improving our performance specifications in terms of what we're looking at.

We'll then probably run some kind of a competition and come up - and come up with - with possible solution sets.

Now the pluses of the PMP program, if you're - if you're a manufacturer of technology and you're going to have that technology fielded, you're going to be able to have data collected over a protracted period of time, which you can then use to better make the - the case that your mitigation solution is effective.

And then for future competitions, you're going to have better past performance data which you can use to win - win the next competition.

So it's not just, you know, we would really like not only to get developers involved in this, but we're very interested in getting the technology producers involved in this.

And with - with that said, I'm going to turn this over to Jason Biddle of MIT, who is going to talk more specifically, about the technical pieces of the things I just discussed. So over to you Jason.

Jason Biddle: Thank you very much Bill and good afternoon to the participants on the line. So in the next ten minutes I hope to provide you all with a high level overview of the wind turbine impacts on radar systems and Bill covered a lot of this but I'll provide a little bit more technical detail.

Go over the IFTNE program and the key technical outputs from that. And then conclude with a summary of our ongoing mitigation R&D efforts in this area. So we're on slide now, the Impacts of Wind Turbines on Radars.

So for those of you who aren't familiar with radar systems, they're good at picking up fast moving metal objects. And wind turbines are certainly those, namely the tips, which as Bill alluded to, can have very high tip speeds.

So these have an impact on deployed radar systems, not only in the immediate vicinity of the turbine, but they can also span kind of multiple radar coverage cells in and around both individual turbines as well as wind farms as a whole.

And so as Bill had mentioned, these decrease the ability of the radar to detect aircraft over top of the wind farms.

They produce false alarms which the radar can interpret as aircraft, which leads to a concern for both flight safety and that - the case of FAA as well as homeland, air security and defense for DHS and the Department of Defense. Next slide please.

So in response to known and expected impacts on these existing radars, industry had been working on a number of mitigations which were developed and proposed prior to and at the start of the IFTNE program. On the left, these are mitigations for turbines and farms themselves.

So reducing the radar cross section of the - the wind turbine blades by removing some of the reflective elements, as well as changing the geometry or placement of individual turbines within a farm to perhaps reduce the overall impact based on the radar's line of sight.

The middle here, we have replacement options or augmentation options. So at the top this would be replacing some of these older legacy radar systems across the country, with newer, more modern and capable radars.

And on the bottom, the augmentation or (infil) radars, have lower coverage areas but are designed to just fill the immediate gap posed by a particular farm or set of turbines. And then on the right you have options for the existing systems themselves.

So on the top we have upgrades to those legacy systems. You know, whether it's better signal processing hardware or improved software algorithms, to leverage the existing infrastructure to mitigate the impact of the turbines.

And then at the bottom, when you look at kind of the mission as a whole or a regional coverage to fuse the outputs from multiple radars in a way where you can reduce the impact to an individual radar by perhaps leveraging the feed from a nearby radar where the turbines are not within line of site.

Next chart please. So the (inner) agency field test and evaluation program which Bill covered, was designed to characterize the impact on existing radars as well as look at these proposed mitigation options. So this was a two year program from 2012 to 2014.

The mitigations that we tested included radar upgrades, replacement radars and augmentations or (infil) radars. The key outcomes here were really the data products. So a thorough assessment of the impact on existing systems as opposed to the anecdotal evidence that have been gathered to date.

An assessment of those - of those mitigation concepts from industry. And then a third key product was the capture of data for future research and development.

So this is data from the legacy radar systems or existing radar systems as well as for some of those new mitigations, so that we could look at perhaps new ways of processing data or other approaches. And I'll talk about that in a few slides. Next slide please.

So the flight campaigns that Bill had mentioned - depicted on the left are the two long range radars that we looked at. So one in the Midwest and one down in Texas. So these radars have about a 200, 250 mile air surveillance coverage area.

And then on the right is a terminal radar which has a short or about 50 mile coverage area. But as you can see, based on the map where the coloring indicates turbine density, these are existing radars that are in close proximity to large wind farms and impacted by wind turbines.

So these were kind of hot button radars for us to look at for IFTNE. Next slide please. So on slide 13, these are plots taken from the IFTNE industry report. So this is a publicly available report.

And there's a link at the bottom of the slide, for those that are interested in more detail on these plots and the technical findings of the program as a whole. So to walk you through this, the plots on the left and right are just for two different classes of aircraft.

On the left is general aviation or kind of your typical small Cessna type aircraft and (GLengine). And on the right is larger business jet sized aircraft.

So focusing say on the plot on the left, the vertical access is - or the whole - or yeah, the vertical axis is probability of detection and the horizontal axis is probability of false alarm. The three different lines and colors here are for those three different radars depicted on the previous slide.

And then the symbol themselves, the diamond shape indicates performance of the radar in the areas clear from wind turbines. So you can consider this the baseline performance. And the circular dots are the performance in and around wind farms.

So for those who aren't familiar with this type of plot, you want to be towards the upper left. So a high probability of detection, a low probability of false alarm. And for the - the radars and their baseline performance, the dots on the left side are good.

And then moving to their performance over top of wind turbines, you can see a significant reduction in their ability to detect aircraft as well as a significant increase in the number of false alarms that are generated when there are no aircraft over top of the wind turbines.

And so here that degradation and performance brings the radars to an unacceptable level of performance, both on the left for, you know, general aviation, single propeller aircraft as well as for the larger business get sized aircraft.

So across these three campaigns and the many flight hours, we were able to collect enough data to definitively say that for these three radars that were looked at that wind turbines do affect their performance significantly. Next chart please.

So on slide number 14, these are similar plots as on the last chart. The difference here is that we've added in the industry and mitigations that were tested. So those were indicated by the - the colors here. So now the - the blue indicates the existing radars which are the same as last chart.

The red indicates the augmentation or short range (infil) radars that were tested. The green indicates the radar upgrade and the black indicates a replacement radar. And so it's a busy plot.

But the key takeaway here is that for many of the mitigations tested they are bringing you up towards that top left corner where you want to be in terms of restoring performance to acceptable levels of detection as well as lower levels of - of false alarms.

Based on, you know, the - the extensive testing, although many of these radars more performance to the upper left, we didn't find that there was a single solution necessarily that was the best fit across all scenarios.

And given the short nature of the ITNE, you know, the findings weren't enough to say that in the long term that a particular solution was best. And so that's really where the pilot mitigation program that Bill mentioned, comes into play.

That we want to take the promising technologies that were tested and identified through the IFTNE campaign, and really mature and vet them for, you know, longer term deployment. Next chart please.

So on slide number 15, this is just a depiction of how some of these mitigation technologies are able to - to get, you know, to restore performance or to do well in the face of wind turbines. And so, in general, for radars, the way they do this is by improving their resolution.

So essentially shrinking down the spatial area that would be affected by the wind turbine. And you can do that in a number of dimensions. On the left is range. So this is kind of, you know, the space in between the turbines. In the middle is Doppler resolution.

So based on how fast the aircraft is moving with respect to the turbine or the radar - and as well as the - the turbine with respect to the radar. You can potentially discriminate and aircraft from a wind turbine based on their relative speeds.

And that, on the right, is altitude resolution. So for the radars that have multiple beams and elevation, if you have an aircraft flying sufficiently high above the turbines, you can perhaps keep it in a separate beam from the wind turbines which are going to be at a lower elevation with respect to the radar.

So these are the different dimensions that you have to (unintelligible) in order to decrease the impact of the radar and maintain good detection performance of aircraft over top of the terms. Next chart please.

And so I'll wrap up with a quick discussion of our ongoing mitigation research and development efforts. So we're looking at upgrades for the existing radars based on the data that we collected from IFTNE. And the concepts here include what we call multi-beamed turbine (nulling).

So for the existing radars that have multiple elevation beams, leveraging those beams in order to essentially cancel out the turbines at low elevation, while maintaining the ability to detect aircraft that are sufficiently above the turbines.

As well as improving the range resolution for existing radars, introducing kind of more space in between the turbines so that you can detect the aircraft as they - they transit between them. So these are all - these are all byproducts of that R&D data that came out of the IFTNE effort.

In the middle we're also looking at commanding control or automation systems. For those that aren't familiar, these systems fuse the - the data from multiple radars. They also include trackers to - to essentially, you know, fill in the gaps potentially over top of turbines.

This was an area that we didn't have a chance to look at through the IFTNE campaign but we're looking at it now to see kind of the mission level impact.

We know thoroughly what the local impact is and now the question is how well do the trackers and other capabilities inside of these systems, deal with the decrease in detection performance and increased false alarms from wind turbines.

And can we develop new fusion or tracking algorithms to help out on the system side? And finally, on the right, we're looking towards the future.

So we want to take the - the technical lessons learned from IFTNE and the ongoing WTRIM efforts, and fold those into the requirements for acquisition systems for, you know, modern and future systems within both the DOD and FAA, now that are just starting out so that they include the capability to deal with wind turbines.

And that, you know, ten, 15, 20 years from now, we're not back at square one, trying to fill them in with augmentation radars, that they have a native capability to deal with wind turbines no matter where they are or how many. And with that, next slide.

I'll turn things back over to Patrick to wrap up, and for moderation.

Patrick Gilman: Thanks Jason. And thank you also to Bill for - for your presentation. I'm a lucky guy in that I get to work with these guys on a daily basis. And there are a lot of really interesting and cool work going on that - that I think you heard a little bit about.

I'd encourage you to reach out to either one of us if you have further questions if you can't or don't have time to address on this webinar.

In addition, I would encourage you to check out our Web site, www.Wind.Energy.gov under the research and development environmental siting and R&D, we have the IFTNE report that Jason was speaking from in his slides, as well as another - a number of other resources related to this topic. So with that, we have a number of questions.

Most of which appear to be for Bill, surprisingly. So Bill...

Patrick Gilman: So first up for Bill, we have you mentioned make whole payments by the wind industry to DOD. And can you explain under what conditions you would require such payments and roughly how you might determine the amount required?

Bill Van Houten: That's an excellent question. So all right, so this goes to the idea that - that when the Congress gave us our fiscal year '11 statute it - there's a provision in there that talks about voluntary contributions from industry. So we have the ability to collect contributions from industry.

Basically we look at this almost as a - as a polluter pays kind of a thing. So if you're dealing with a polluter and they've degraded - they've degraded an ecosystem, you collect enough funds to basically bring you back to where you were originally and make you whole as in make you even.

So when we try to use the principle, the idea is not - is not to go and buy a system that's better than the performance that we originally had. The idea is to get us back to where we were. So I'm making the point that this is not some - the concept is not to try to extort money from industries.

So what we're looking at is what's the performance of the radar before the farm versus what's the performance after radar after the farm would be put in place? And of course the tricky thing in this is that - is that because we have the ability to make it more difficult to build a project before it goes up.

We have to - we have to use modeling and simulation in order to - to figure out what the degradation is going to be. And then put a mitigation agreement in place before - before the project is actually built. So it's, you know, it's basically all, you know, we had to perform an analysis.

And then frankly then there's an amount of risk on each side because the developer is - is basically betting that the analysis that's being done is not having - having them pay more than they should in order to make us whole.

And the government in turn, is taking the risk and I would say a significant risk, in terms of clearing a project, to be built based on its modeling and simulation efforts and its best estimates as to what the mitigation technology is going to cost.

So maybe that's not as specific as the answer as you're looking at. But the bottom line on this, is that - is that we do everything on a case by case basis. We have an idea of what we're trying - what we're trying to protect.

Frankly there are so many variables in terms of - of topography and different kinds of radars and even different kinds of turbines and how they all interact, that we don't just run a - we don't just run, you know, a model and then say we're done with it. We actually look at various scenarios.

And then - and then it's also not just enough to have an impact. We also have to determine whether or not the impact is - is an unreasonable risk to national security, which is the standard in the statute.

So we're looking at is the - is the degradation so significant that - that basically DOD cannot take the risk with it? And then we - we have a mitigation solution that will bring us back.

Now having said all that, one of the problems we have under voluntary contributions is that, you know, typically this presupposes that we're going to be dealing with a single developer on a single project. And we're going - and we're going to be putting a solution in to make us whole.

The problem is that there are clearly going to be parts of this country where you have larger concentrations of turbines that you probably don't want multiple short range radars and, you know, put in and then - and then multiple feeds from this feeding into one larger picture.

In fact the better solution would be to - to upgrade the larger - the larger let's say long range, radar either through an algorithm or through a replacement. And because the costs on that tend to be larger, you probably want to get a group of developers in - on that.

And so we've got to figure out what kind of an arrangement where we come in that multiple developers will benefit through - through a payment.

Because obviously no developer is going to want to contribute to - nobody wants to be first in line to make the contribution to make the government whole so that a bunch of their competitors can then come in and piggyback off of that and not pay anything.

So we're still - we're still struggling with how to make this work. And frankly, we're - we're talking to what we among others, as to how we might - might make this work. And it's something I'm going to bring up at the siting conference in May. And that would be my answer.

Patrick Gilman: Thank you Bill. We have a couple of other questions for Bill but I'll hold on those for a second so we get some time for Jason as well. And I think Bill, you may have something to contribute to these as well.

So first, Jason is there any information out there on whether the proposed mitigations that - that we're talking about on this webinar, are being used currently in Europe?

Jason Biddle: So yeah, while I can't identify specific mitigations from the IFTNE, I think we can say at a high level, that some of the mitigations that were tested as part of IFTNE, are currently being tested or are deployed elsewhere, both internationally as well as domestically.

So while unfortunately, I can't go into specifics, due to the nondisclosure agreements that we signed with these companies and some of the proprietary information, I can say that for some of those mitigations they are continuing to deploy and develop them.

And Bill, I don't know if you have anything to add there.

Bill Van Houten: Well I'll just - I'll just add while also being respectful of agreements that we've entered into. So there are a number of the shorter range mitigation solutions, the (infil)s that are being examined.

And then there is also a long range radar that has been tested and I think probably needs further testing as well, that's deployed in Europe.

Patrick Gilman: Great. Thank you both. Again, back to Bill, a couple of questions on - on timing associated with going through the clearinghouse process.

First, a couple of things regarding the - just to both of these questions is that there's - there are some challenges that industry has experienced in terms of the timing of - of their applications going through the setting clearinghouse process.

And what are you, DOE, doing to implement a way to get through those - to get through those backlogs and deal with projects in a more consistent and I guess more - a faster way?

Bill Van Houten: Okay. Now that you've directed the question to me, I could have sworn a piece of that you said, what is DOE doing to make sure they're...

Patrick Gilman: DOD.

Bill Van Houten: ...(unintelligible) faster. Okay, so - so the Defense Department in its external context with industry, operates under a rule, which became final in December of 2013 which spells out the timeframes under which we're supposed to be performing work.

Now having - and I think I need to say, just as an aside that - that we're approving something like 97% of projects that come in, in the door, go out approved within something like two months. I mean it's - and so then you're left with 3%.

And most of those get whittled down and frankly, at this point, right now we have 15 active mitigation response teams looking at specific projects, trying to find a mitigation solution. And out of the - the large number of things we review, that's a relatively small number.

But I understand the industry frustration that some of these seem to drag on and on as we come up with a - with a - with a technical solution. I'm not quite sure how beyond that answer to give you an answer. Because again, I mean each one of these goes through a specific issue.

Now I will say since generally I'm not involved with those mitigation response teams, if somebody who is on the line has - they may very well have a specific issue with a specific project, I'm happy for them to write me and - and discuss with me what their question is.

And I can - I can run that specific question down.

Patrick Gilman: Great. Thank you Bill. For Jason, and Bill you again, may have some things to say about this. Based on - based on our experience from the field evaluations, what can you infer about radar impact and the trend towards taller turbines, larger rotors and greater spacing in between turbines?

But it - which is to say the turbine area is larger. Each turbine is - or the farm - the wind farms are larger but the density in those wind farms is smaller.

Bill Van Houten: Jason, why don't you start with that?

Jason Biddle: Sure. So with regard to kind of taller turbines, you know, bigger blades - based on what we found from IFTNE given kind of the current sizes that even if - even if they were to get larger, so looking towards, you know, larger onshore or say offshore turbines, while they would certainly have a stronger signal with the radar, we don't expect it to be - to be significantly worse than it already is.

So essentially the big problem when it comes to turbines from radar is that you're not just detecting the tip speed of the very (SAS) part of the turbine. You're detecting the whole blade as it's turning, which is a Doppler signature or a velocity signature that spans lots of different bins.

And that cumulatively has a - has a large impact on the radars. And so if you were to get, you know, it really comes down to the size of the farm as a whole and how many cells are affected that for some of the older radars there is a concern about overloading them.

But there you have to get to - to very, very large farm sizes compared to - to what exists today. So I would say that for individual turbines getting larger, I don't think it's a problem that the mitigation that we're looking at today wouldn't be able to overcome.

Patrick Gilman: Bill, anything to add there?

Bill Van Houten: I - no. The only thing I would - I would - I would ask Jason as part of that question, was what happens if you space these larger turbines further apart? Does that - does that impact or change the impact on the military radar?

Jason Biddle: So just - if you space them further apart, if the overall farm size is staying the same then it wouldn't have a larger impact. It may actually be a benefit when you consider some of the proposed mitigations like improving the range resolution of existing radars.

Because then you have more space in between the turbines to detect them, even though the individual cell or cells that they're occupying are higher in return that they're getting back that then you buy yourself some more cells in between them to be able to detect them. So there is a trade at play there.

Bill Van Houten: Right. Now I will say, just as an aside, so - so here's a case where the - the taller, larger turbine while it might not have a radar, bigger radar impact, it's going to have a bigger obstruction impact.

So that could, you know, it could be a bigger issue when you - you're dealing with - with low altitude NTRs or something. So there could possibly be an impact there. the other impact is that, you know, DOE's come up with their - their revised wind resource maps.

And so they're assuming technologies are going to improve and you're going to be able to build taller turbines. So to date, most of our wind turbine issues have been in the western United States.

But as turbines become more efficient and taller, it's going to open up broader swaths of the country to potential conflict.

Jason Biddle: And I guess the one final point to add on this topic is with them getting taller, I guess one consideration would be for, you know, turbines today if they're not within - a particular farm is not within the line of sight of a radar, if it's, you know, a couple of hundred feet taller that could put you in an area where now you're impacting a radar which previously couldn't see a given area for say, you know, lower elevation turbine.

So that would be one consideration for taller.

Patrick Gilman: Great. Thank you both. And I know that we're - we're doing quite a bit of work in conjunction with the White House and FAA and others on - on the issues that are posed by taller turbines. So I would say stay tuned for a lot more on - on that topic.

A question about the availability on data - regarding radars, one of the listeners works on an energy zone mapping tool which generates suitability maps for setting wind turbines and other power generation. They have greater locations and many types of deciding factors to avoid.

But have had difficulty finding spatial data for some systems and sources indicating that distances that are problematic or not are inconsistent.

So Bill, do you have spatial data - are there spatial data available for all of the types of radar systems that might be at issue here, or specific - and/or specific guidance on how close wind turbines could be from those radar types?

Bill Van Houten: If you're looking for some kind of a metric that would tell you specifically if you're - if you're X distance away from Y radar, you're going to be safe. I doubt we're going - well generally, that's not going to be possible. And even the maps that we're currently working on are not to that level of specificity.

So however, before I give a flat out no to this, this is probably something I would be interested in having the questioner follow up with me through email.

Patrick Gilman: Great. And I bet we can make that information available. It should be on the presentation. I will say that we have a couple more minutes for questions. So please continue submitting them if you have any further ones. Bill's and my email is now back up on the screen.

So take that down and feel free to follow up with - with us on any of that. I am at least happy to stay on the line if we don't have any more questions.

But in - if there are none, in closing I would just say thank you very much again to our speakers, Bill Van Houten and Jason Biddle from DOD Siting Clearinghouse and MIT Lincoln Labs respectively.

We're going to be hosting a side event at the Wind Power Conference that the American Wind Energy Association is hosting down in Orlando in May.

If you are attending that conference, I'd encourage you to attend and hear further updates on where we're going particularly with respect to the pilot mitigation initiative.

And I also encourage you to visit our websites, www.wind.energy.gov and www.wind.energy.gov/windexchange for more information on the topics that we covered during today's webinar. And I would encourage you to reach out to Bill or I for any further questions around what we covered today.

And to stay tuned for future webinars in the series. As we said, we'll be covering land use and public acceptance impacts to wind energy, in June. So seeing no further questions, I guess we'll close.

Coordinator: This concludes today's conference. Thank you for participating. You may disconnect at this time.