

VIDEO FAQ - TRANSCRIPT

ANSWERS FOR THE ENGINEERING/CONSTRUCTION MANAGER

1. Will a wind turbine affect power quality?

The wind turbines we use are permanent-magnet direct-drive (PMDD) turbines. The actual power coming directly off the generator is extremely poor quality; it's not even grid-matched for frequency. To fix that, we have to do full power conversion. That means we go from AC to DC and back to AC with a rectifier and an inverter. The end result is that we put out near perfect power quality as part of the design of this turbine. The turbine is able to deliver both leading and lagging reactive power and it's able to deliver extremely high power quality that is better than almost anything you'd get off of any normal distribution grid.

2. How do you control voltage?

The way the wind turbines work is that they operate on the grid voltage. They follow the grid voltage up or down inside the allowable specifications we have for boundaries where we go into a trip or a shutdown. So the voltage isn't manipulated by us; we follow the existing grid voltage.

3. Where will you tie into my plant?

We like to tie in at primary voltage. Typically, that's 12,470 V or 34,500 V. We like to tie in at the most isolated point you have away from the plant. We prefer to be right next to the substation or right next to the service feed. The reason we do that is that it keeps our electrical systems completely outside of your plants, which makes it easier for installation, easier for operation, and it also just physically keeps us away from the part where you have the most congestion. If we do our job right and find the right point, you almost never know we're there other than an additional utility pole or an additional underground cable tie into your main distribution system.

4. What protective equipment do you have in place?

The turbines themselves have their own protection equipment that's certified to UL508. They're designed to detect and operate on grids by themselves. That, however, isn't enough for us, so at each site we have a Padmount Switchgear that is an SF6 enclosed gear. It's the same type of stuff they use in distribution and transmission systems. That gear is controlled by an SEL-351A or 351 protective relay that is a grid-level protective relay. It's the same type of grids used by substations and state-of-the-art transmission



facilities around the country. Those systems are designed to protect against loss of phase, anti-islanding, high voltage, low voltage, frequency issues, or anything else. The level of protection we have is the highest level of protection currently available on the market.

5. Will you cause harmonic problems?

No, we don't cause harmonic problems. Because it's a full conversion turbine, and because we have a Delta grounded Wye transformer in line, we have a huge amount of third order harmonic filtering already. And then with the power quality systems we have as part of that fully synthetic power through the inverter, we're able to avoid that problem entirely. We *will* sometimes match the existing harmonics that are in the system. We don't make it better without doing something additional, but we also don't make it worse. If you already have a harmonic problem, we will survive that harmonic problem – not add or contribute to it, and function in the environment you currently have.

6. Will you cause power factor problems?

No, the turbines don't cause power factor problems. Because we have full conversion, we're able to actually make the power factor whatever we'd like. We're able to either do a leading or lagging power factor at your discretion at a fixed, static setting of up to 0.95 leading or 0.95 lagging. We can also generate at unity. We have the option to do any or all of those based on your needs.

7. What do the turbines do in a fault or grid outage?

The turbines interconnect under IEEE 1547 as a design standard. That standard is designed to allow a distributed-generation system to safely interface with the grid. It does a lot of good things in that it standardizes the way we interconnect with the grid. It does create some very high-precision safety requirements that we have to follow. So, our turbines are designed to detect any anomaly that potentially means the grid is in trouble: a voltage spike, a voltage dip, a frequency spike, a frequency dip. Also, we detect for any sort of islanding, a loss of phase, a phase to ground fault, a loss of all three phases, so that we don't put power back on the grid in the event that there's a system problem.

The end result is that when a fault happens, we detect and (depending on the fault) trip in as little as three cycles. That's three sixtieths of a second. So we're able to detect and isolate in a fraction of a second. In most cases we trip in five to six cycles. In some extreme cases where it's a minor issue that we have a longer time setting on, that can be up to a second. But it all is tied to the severity of the cycle.



8. If the grid is down, will the turbines still be powering my plant?

It's theoretically possible that we could adapt the system so that it can provide power in the event that it lost grid. The problem is the interconnect standard that we operate under doesn't allow us to do that. On top of that, the real problem is we don't know if it's going to be windy that day. We could spend a whole bunch of money to try to build a system that would automatically isolate from the grid at a sufficient level of isolation to then allow the wind turbines to generate privately without matching the grid signal. The problem doing that is we don't guarantee there's wind on that day. So while it is technically possible, it's not financially advantageous for us to design a system that way.

9. What is the interconnection process with the utility?

In the state of Ohio, utilities are required to use IEEE 1547, which is the international standard for distributed-generation interconnection, as their sole guideline for determining technical feasibility and safety of a project. We've helped several utilities write their own standards for how to interpret and permit underneath that standard. We turn in a detailed application to the utility that gives them everything they need to understand the turbine and to model the turbine. They go through an internal review process where their engineering team inserts that into their computer model of the grid and they determine that it is or is not safe based on the current grid function.

In addition to that, they also determine if additional protection or controls are needed and they determine that we've met IEEE 1547. Typically, that process takes about a week of actual engineering time from the utility. Typically, it takes 6 to 12 weeks to get that actual week done. But the entire process is handled by us and we have a standardized package at this point that we've used with all of the major utilities in the state of Ohio.

10. Why don't you put your cable in conduit?

We always get asked, "why don't you put your cable in conduit?" A lot of building engineers, for some reason years ago, decided they wanted to put cable in conduit. At the high voltage scale, provided you aren't worried about surface loading, you aren't underneath your main truck drive, it is far more advantageous to have that cable be directly buried. The reason is in the event that there's a fault or a problem with that cable at any point over the next 20 years, or somebody accidentally hits that cable, which they would do just as likely in conduit, we're able to immediately locate and then dig with normal equipment and then do a splice right where the fault is.

We can take out 20 or 30 feet of cable and do a repair and be back online far quicker than pulling all the cable through that conduit or trying to repair that conduit and then pull



all the cable through it. The downtime for a typical fault when there's an issue where it's been struck, or some other failure has resulted, for direct burial cable is between 4 and 8 hours to be back in service. The downtime for that exact same situation if it's in conduit is typically 1 to 2 days if not more, depending on lead time for the actual cable if you don't have enough to replace the entire conduit run.

All our systems are designed with direct burial cable unless we have a very compelling reason not to because it's by far the most reliable way for us to operate a power system. We have never seen any data, including in the hundreds and thousands of miles of wind turbine collection lines we've been part of both as One Energy and in our past experiences, that shows conduit cable is any more reliable than direct burial cable for these types of applications.

11. What voltage do the turbines produce power at?

The turbines produce power that's somewhere between 400 and 700 volts at the generator. Once that goes through the rectifier and the inverter, it leaves the turbine at a grid-synchronous 600 volts. That 600 volts is then stepped up at the Padmount transformer to either 12,470 V, 34,500 V, or some other voltage that your plant distribution system operates at. Then the entire rest of our collection system and switching system operates at that higher voltage.

12. What voltage does the collection system operate at?

The collection system operates at whatever voltage it needs to match your system. We've done stuff as low as 4,160 V, we've done stuff as high as 34,500 V. In theory we can go as high as 69 kV, although most plants don't operate at that voltage.

13. Can we access the meter ourselves?

For security reasons, you can't directly access the meter without us. We can get you electronic access to that meter so you can inspect the records any time you would like, and we can do that both automated or by providing you copies of the actual metered data. We'll also provide you copies of the third-party reports that verify the meter settings are correct.

14. Do the turbines produce AC or DC power?

The turbines produce AC power. But in order to clean it, i.e. to fully make it ready to go back on the grid, they have to rectify it which means it goes from AC to DC and then back to AC. So while the power is produced at AC, it does go through an AC/DC/AC conversion process.



15. Do the turbines get hit by lightning?

Just about every tall thing eventually gets hit by lightning. The turbines are designed to take a direct lightning strike. We have the highest level of lightning protection available on the turbines. It doesn't mean they are perfect. From time to time we will have lightning events that end up causing computer problems or something else in the turbine that result in parts having to be repaired, but it's very infrequent. I think in the 75 turbine-years of operation currently, we may have had one event where that's actually been the case.

The turbines are very well grounded. There is something on the order of 600 feet of copper ground cable at the base of the turbine, six or more ground rods, an entire system bonding all those to the turbine as well as tying it into the collection system ground, tying it into the utility ground, and having multiple surge arrestors. We operate under the assumption that the turbines are going to be hit by lightning and we designed them to operate through that.

16. How often are the turbines serviced?

The regular service interval for these turbines is twice a year. There is an off-six-months minor service and an every-year major service. From a practical point of view, minor issues pop up throughout the year and typically those issues are addressed once or twice a quarter. Almost everything outside of that is able to be handled remotely by the remote operation center.

17. Where are the spare parts?

Depending on the size of the spare parts, most of them are kept in Findlay. Right now in Findlay, Ohio we have, and the turbine manufacturer's office has, an inventory of all normal consumables. That's spare IGBTs, yaw motors, all the small parts. We also right now stock large turbine parts in Findlay. In addition to that, Goldwind America has a stockpile of large components. That's the generators, the hubs, the spare blade sets in Shady Oaks, Illinois. So, there are parts available both immediately local to the site in Northwest Ohio, and then there are backup parts available in Illinois.

18. How long will the construction process take?

The realistic timeframe depends greatly on permitting and some of the preliminary land activity that goes along with projects from time to time. Otherwise, we are working on creating more of a manufacturing-based construction process and less of an order-as-needed process, which should decrease the time greatly from about six months; we're working to about three months.



19. Who are your subcontractors?

Currently, One Energy uses subcontractors for two main activities: for rebar installation and for overhead installation (and some odds and ends on some of our jobs, which are not normal to wind-turbine-erection activities). We use Westwind Reinforcing for our rebar installations and we use an overhead contractor generally by area; we've used some local contractors to Findlay, Marion, and some of our other locations. For the overhead, we go through a normal vetting process. Otherwise, all of the labor we use is self-performed by our One Energy crew.

20. Can we veto your subcontractors?

If there's anything on our projects that you feel strongly about or would like to be a part of, you are absolutely, 100 percent our number-one customer. If there is a subcontractor you prefer we use, or you prefer we do not use, let us know. We are more than able to have a conversation about it.

21. Who controls the design?

Ultimately, One Energy controls the design of each of these turbine projects. We rely on engineers and third-party expertise for certain aspects of the design: structural, foundation, as well as tower design. And we don't manufacture our own turbines, so we rely on our suppliers for that type of design. But each of our individual Wind Campus[®] designs is ultimately controlled by One Energy.

22. Can we review or modify the design?

Absolutely. We are very happy to review all our designs with our customers. We understand that no two customers are alike and just as no two customers are alike, no two plants are identical often times as well. So, we know each project is going to be [designed on] a case-by-case basis, where we make sure that our design fits our customer's needs. We're happy to review that. Modifications to our design often times again are case-by-case. We're always striving to innovate and improve our design. We are moving to a systematized, standardized process and structure for our construction crew, but we're happy to have that conversation and discussion, especially if it helps our customer or improves our design.

23. Do we get weekly updates?

All our customers receive weekly updates from the project manager. Those are sent based on what day or time of the week a customer would prefer to have those. If you've got a crucial meeting on Fridays, let us know – we'll make sure we get that to you prior to that. That will be both a forward-looking and a look-back. What was accomplished the



previous week, what will be accomplished in the week leading up, and what is currently in process in that current week.

Our customers have access to mywindproject.com. That allows them to understand exactly what the state is; there's going to be photo updates as well as bits of information. Hopefully a lot of that information will already be conveyed to our customers through weekly updates through the project manager, but for folks who aren't receiving that update, mywindproject.com is an excellent resource.

24. How much work do you self-perform?

We are very proud of the fact that we are self-performing most of the work. We can go from a green-field site and turn it into a fully commissioned set of turbines pretty much on our own. There are certain aspects of the job that we leave to folks who are a little more efficient and understand; things such as rebar installation – we leave that to a third party, overhead electric work we leave to a third party. We're capable of doing these things, we just find it more reliable, more efficient, to outsource that to a third-party contractor.

Self-performing includes going to a green-field site, building our own roads, digging our own foundations and excavating, pouring our own concrete, and taking care of all the necessary civil, mechanical, and electrical completion. So, we will operate the cranes, stack out the towers, and go from a site that had nothing there to a fully commissioned set of turbines up and running and generating electricity for our customers.

25. Can we review your quality documentation throughout the project?

Absolutely. We'd be happy to share our quality documentation with our customers. Safety and quality are our top two priorities at One Energy, especially on the construction team. We have a documented quality plan which we're happy to walk through step-by-step with our customers to ensure we're meeting their needs and mitigating any hazards on site. So, if you talk to your project manager, they'd be happy to answer any specific questions as well as show you that documentation.

26. Who's in charge of the project?

We try to make these projects as easy as possible for our customers. We try to take almost all the load and put it on our shoulders. We *are* in charge of the projects and we like to see through all the problems, all the issues – everything from start to finish, we like to keep on our plate. If there's something a customer or a representative would like to be a part of, we are very open to including you in all those conversations.



Generally, we give you one point of contact. For a customer we'll give one point of contact to the projects – generally that is a project manager. It has in the past been Jereme (the CEO and General Manager) for certain items, but you should have one point of contact for the projects where you should be able to get almost all your information.

27. What is the organizational chart for the project?

At One Energy, responsibility falls on all our people, especially on the construction site in ensuring that safety and quality are our top two priorities. But we do have an organizational hierarchy. Your project manager is typically the controller of the site that makes sure everything is moving, making sure workflow is coordinated, and ensuring that the process and project are being installed safely and correctly.

We also have field engineers, technicians, and technician trainers who all report through the project managers to ensure that onsite workflow and field installations are happening in a safe and high-quality manner. So, on any given time on a job site you would expect to interact with project managers, field engineers, technicians, and trainers who are developing and training our technicians. Primarily our customers are going to have a primary point of contact that's going to be the project manager.

28. What security do you have?

When it comes to security, we understand we're dealing with some very high-risk items – when you're talking of the weight of the equipment, when you're talking about the nature of the electricity we're generating. So, we ensure we think about security from two aspects. There's the physical aspect, where we're ensuring that we have locks and cameras, and we're warding off intruders with security patrol cars and fencing as needed. And then there's also cyber security where we ensure that we have all the necessary firewalls and networking and protocols to ensure that only we have the safe remote access to our sites.

So, it's really two-fold and it gets far deeper into the weeds. And if you have questions, always ask your project manager because they'd be happy to dive into details with you.

29. What do we need to do to support the project?

Items that we need from you in order to proceed with our projects: certain things in the plant, as-builts (drawings) from the plant, getting points around the plant to include in our drawings and to help with our engineering process are necessary to complete this. Other than that, certain activities when we complete our tie-in to the facility are necessary to share information for. In addition to that, basically any time we are on your property to do any sort of install is when we really need input – and for the initial planning process. Otherwise we do handle all the construction.



30. Do you need a plant shut-down?

When we do the interconnects, we do not necessarily need a plant shut-down. Most plants require or ask that we do a plant shut-down because otherwise we're doing an interconnect hot (or live), which most people try to veer away from. It's not out of the question; we've done it before – we just want to dot our I's and cross our T's when we're selecting vendors, and we want to make sure we're taking every precaution necessary to take that step. Otherwise, for plant shut-downs, we normally will try to gear our shut-downs with your shut-downs if that's a requirement. Thanksgiving, Fourth of July, Christmas – we work on the holidays. We work around your schedule. We are here for you.