Wind Turbine Dump and Diversion Loads: What They Do and How to Choose the Right System

We get a lot of questions about why dump loads must be used on wind turbines and how to figure out the proper dump load(s) that's required for a particular system. The first part of this article will explain why dump loads are used on wind turbines and the second part of this article will explain in detail how to determine what dump loads will work for your particular system.

So, let's get started!

First of all, please take note that the term "diversion load" and "dump load" are interchangeable.

Why is a dump or diversion load necessary?

Wind turbines are designed to be under a load when operating. For a wind turbine, the load is almost always an electrical load which is drawing electricity from the wind turbine's generator. The two most common loads for a wind turbine are (1) a battery bank and (2) an electrical grid. Although this is most likely well known to many of you reading this article, it is very important to understand that an electrical load (i.e. battery bank or the electric grid) keeps a wind turbine in its designed operating range.

To really drive home this point, let's consider as an analogy using a hand drill on a piece of wood. For our analogy, the hand drill is the wind turbine and the wood is the electrical load. If the hand drill is turned to its highest power setting and allowed to spin in free air, it will probably spin at about 700 rpm. This is the "no load" situation because the drill is not doing any work. Now, if we use the hand drill on its highest power setting to start to drill a hole in the wood, what is going to happen? The rpm of the hand drill will obviously slow down a lot compared to when it was spinning in free air. This is because the drill now has to work hard to make the hole in the wood. This is the "loaded" situation. Now, a drill is designed to operate under "no load" but a wind turbine is not.

If a wind turbine operates under no load in high wind conditions, it can self destruct. In high winds and no load the wind turbine blades can spin so fast that the blades can come ripping off or, at the very least, put intense stresses and strains on the wind turbine components which will cause them to wear out very quickly. Or, in other words, a wind turbine operates safely and properly when it is under a load.
How is the dump load used in a wind turbine system?

As stated previously, wind turbines are generally used to charge battery banks or feed an electrical grid. Both of these applications required dump loads but let's examine the battery bank application in more detail.

A wind turbine will continue to charge a battery a bank until the battery bank is fully charged. For a 12 volt battery bank, this is approximately 14 volts (The exact fully charged voltage of a 12 volt battery bank depends on the type of batteries being used). Once the battery bank is fully charged, it is necessary that the wind turbine stop charging the battery bank as overcharging batteries is very bad for several reasons (i.e. battery destruction, risk of explosion, etc.) But, wait there is a problem! We have to keep the wind turbine under an electrical load! To accomplish this task a diversion load charge controller is used.

In the simplest terms, a diversion load charge controller is a voltage sensor switch. The charge controller constantly monitors the voltage of the battery bank. In the case of a 12 volt battery bank, when the voltage level reaches approximately 14 volts, the charge controller senses this and disconnects the wind turbine from the battery bank. Now, we said that a diversion load charge controller is a voltage sensor switch. So, a diversion load charge controller is not only capable of disconnecting the wind turbine from the battery bank, it is also capable of switching the wind turbine's connection to the diversion load! And this is exactly what the diversion load charge controller does which keeps the wind turbine under a constant electrical load.

Once the battery bank's voltage drops a little (approximately 13.6 volts for a 12 volt battery bank), the charge controller senses this and switches the wind turbine back to charging the battery bank. This cycle is repeated as

necessary which keeps the battery bank from overcharging and the wind turbine always under load.

How do I figure out how many dump loads I need?

Now, to figure out how to appropriately size you dump load system, you need to ask yourself to simple questions: (1)What is the voltage of my system (12 volt battery bank, 48 volt battery bank, 200 volts?)? (2) How many amps will your wind turbine produce at maximum power? Once you know this information, you are ready to move on to the next phase.

In these next steps, we have to do some math and use Ohm's Law. Instead of speaking in generalities, let's use a real example. Our example will use our Windtura 500 wind turbine charging a 24 volt battery bank.

Step 1: What is the voltage of my system?
Answer: 24 volt battery bank

Step 2: How many amps does my Windtura 500 make at maximum power?
Answer: 26 amps (We know this by looking at the published power curve of the Windtura 500)

Step 3: The dump load system needs to be capable of dumping the maximum power of the wind turbine being used. Ohm's law states that: Power = Volt x Amps. The voltage of the system is the battery bank voltage (We are going to use 29 volts which is roughly the voltage of a fully charged 24 volt battery bank). The amps is the current produced by the Windtura 500 at maximum power (26 amps).

Power = Volt x Amps = (29 volts x 26 amps) = 754 Watts

Step 4: We need a dump load that can dump at least 754 Watts. We're going to use our 24 volt dump load resistors [1] in this example. These resistors have an internal resistance rating of 2.9 ohms. Knowing that these resistors are 2.9 ohms, we need to figure out how much power this resistor will consume?

Step 5: Calculating the power consumed by a 2.9 ohm resistor:
Use Ohm's law equation: Voltage = Current x Resistance and using simple algebra we arrive at the following equation:
Current = (Voltage)/(Resistance) = (Battery bank voltage)/(Resistor's resistance) = (29 volts)/(2.9 Ohms) = 10 amps

Well, now we know at 29 volts (battery bank voltage) 10 amps of current will be used by one of these resistors. How much power is the resistor consuming?

Easy, we know:

Power = Volt x Amps = (Battery bank voltage) x (amps through resistor) = (29 volts) x (10 amps) = 290 Watts

Therefore, 290 Watts will flow through one of our WindyNation 24 volt dump load resistors. Important: At this stage, you need to make certain the dump load you are using is rated to handle 290 Watts at continuous duty or there could be a very dangerous fire hazard. The WindyNation 24 volt dump loads can handle up to 320 Watts continuously so they will work fine for this application.

Step 6: Setting up a 290 Watt dump load resistor to dump at least 754 Watts:
If you go back and read Step 3, it says that our dump load system needs to be capable of dumping at least 754 Watts. How do we do this using a 290 Watt dump load resistor? Well, that's easy! If we wire multiple 290 Watt dump load resistors in parallel, the dump load Wattage is cumulative. Therefore, we have this very simple equation:

Total Watts our dump load system needs to consume = (290 Watts) x (# of 2.9 Ohm resistors we need wired in parallel)
754 Watts = (290 Watts) x (# of 2.9 Ohm resistors we need wired in parallel)

And use simple algebra to solve:

(# of 2.9 Ohm resistors we need wired in parallel) = 2.6

Well, our resistors only come in whole units so we cannot use 2.6 resistors. We have to round up as we need AT LEAST 754 Watts. Therefore, we need to wire three of the WindyNation 2.9 Ohm resistors in parallel. That will give us 870 Watts of dump load capacity. Now, we have appropriately set-up a dump load system for the particular wind turbine and battery bank used in this example. You can apply the same thought process above (Steps 1-6) for any wind turbine system.

We hope this article helped you understand why dump loads are necessary for wind turbines and how to figure out how to set-up a dump load for your particular system.

In addition to this article, we strongly suggest you join our FREE Community Forums [2]. Register and post your questions and gain important insights from our community of DIYers!

- Charge Controller [3]
- Dump Load [4]

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