Best Practices

Small Wind Turbines and the NEC: Code Issues

BY **MICK SAGRILLO with technical review by Roy Butler, Four Winds Renewable Energy**

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There are a couple of National Electric Code (NEC) stipulations that seem to perennially trip up installers of small wind systems. These include wire and circuit breaker size as well as ampacity calculations for the infrastructure components.

Dedicated Circuits and Breakers

The NEC stipulates in article 705.12D(1) that the grid interface for a wind system, whether a utility-tied inverter or an induction-system controller, be connected to a dedicated circuit breaker, and wired through its own raceways. A dedicated circuit breaker allows for the segregation of the wind system from all of the other loads in the circuit breaker box that serves the residence, farm or business. Isolating the wind system from other loads or generating sources assures that it can be serviced or repaired independently of other electrical wiring and devices, protecting the service person from possible shock hazards.

The ampacity rating (that is, the current-carrying capacity) of wiring and circuit breakers assumes that the loads served by these devices are intermittent. In residential, business or farm applications this is usually true. A light or refrigerator is very likely only a portion of what the wiring or overcurrent protection for those appliances can accommodate. In addition, they are not continuous loads, but cycle on and off periodically.

While wind turbines also cycle on and off over time depending on the wind speed, they are capable of pumping maximum current into the main circuit breaker panel for hours, or even days, at a time. That situation is not unusual during winter storms in most of the United States. The NEC therefore considers current ratings for wind turbines and their inverters to be continuous ratings.

To resolve potential undersizing of conductors or overcurrent devices, the NEC specifies in article 694.8 that conductors and overcurrent devices be sized to carry not less than 125 percent of maximum current output of the wind turbine and the maximum continuous output current of the inverter, what installers call the 125 percent rule. Some people use the inverse stipulated in other NEC articles: Unless specifically rated for 100 percent duty, conductors and overcurrent devices can only be used at 80 percent of their rated capacity.

Distribution Panel Constraints

One of the biggest surprises that confronts a wind installer occurs during the electrical inspection when it is discovered that the circuit breaker box is undersized for the electric supplies feeding it. A typical scenario is as follows:

An installer checks the main circuit breaker panel feeding the property where a wind system is to be installed, and finds a 200-amp (A) service with slots available for extra circuit breakers. The system to be installed is rated at 10 kilowatts(kW) and requires a 70-A circuit breaker. Per the NEC, this breaker is installed at the bottom of the buss, opposite the main breaker. The installer wires the system following the manufacturer's electrical diagram, but is flagged by the electrical inspector who refuses to approve the installation. What happened?

In this case, the problem is the circuit breaker panel fed by two generating sources. The main breaker for this panel is 200 A. Article 705.12D(2) allows up to 120 percent of the electrical panel nameplate buss-bar rating for back-feeding in residential applications. So a 200-A main panel allows for up to a 40-A back-feed breaker, for a total of 240 input amps. However, in this case, the back-feed circuit breaker is 70 amps, which is why it failed inspection.

There are several ways to connect the wind system so that it meets the code requirements. One way would be to downgrade the main circuit breaker to accommodate the wind turbine breaker rating on the buss. Replacing the 200-A main breaker with a 150-A main breaker provides an additional 50 amps to add to the original 40 amps. The total capacity available for interconnecting the wind system is now 90 amps and the 70-A breaker now complies with the Article 705.12D 120 percent rule.

However, sometimes this solution is not possible. If the owner wished to install a 20-kW wind system, the inverter circuit breaker would need to be in the range of 175 A. To satisfy the 120 percent rule, the main breaker would need to be downsized to only 65 A (240 A-175 A). Such a main breaker clearly would not suffice (nor does it exist) for a breaker panel loaded down with circuit breakers.

One alternative would be to upgrade the main breaker panel and electrical service to 320 A or 400 A, but that would be a considerable expense. Another alternative might be to install a separate electrical service just for the wind system, but only if permitted by the utility. Some utilities frown on dedicated electrical services that are not loads but only supply parallel generators like a wind turbine.

A better alternative might be to install a "line side tap" on the customer side of the utility meter, or a double-lug utility meter base, one that has lugs for more than one set of wires. Such options are often used in situations where a property has more than one building, each with its own circuit breaker box but collectively served by one utility meter. In this case, wiring from the wind turbine would need to feed all the way back to the utility meter, an added expense, but far less costly than upgrading the entire breaker box and service to a higher-amp capacity.

Lesson: It's a great idea to know the local codes during the planning phase of a wind installation. **ST**