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Small Wind Turbine Application of the SEL-547

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INTRODUCTION

The idea of small, widely distributed power generation has been talked about and implemented on a limited scale since the 1970s energy crisis. Since then, advances in technology and reliability have contributed to the large number of wind turbines installed in the last few years. Looking into the future, carbon limits, government incentives, and the decreasing cost of wind turbine technology will all contribute to the increased installation of distributed wind energy systems.

The SEL-547 Distributed Generator Interconnection Relay is a key system component that allows wind turbines to be connected to the electric utility grid. Since its introduction in 2002, the SEL-547 has been installed in hundreds of wind energy installations all over North America.

WHY USE A GENERATOR INTERCONNECTION RELAY?

Connecting a basic load to the grid is a very simple process. All that is required is a service conductor from the electric utility transformer, a service entrance, an electric meter, and a circuit breaker. This simplicity is possible because the load will never produce its own voltage or current. If anything goes wrong with the load, the circuit breaker will separate the load from the utility grid before it can damage the grid equipment or interfere with its proper operation.

Now let us introduce an electrical generation source onto the electric utility power grid. Unlike the case of the simple load, it is no longer safe to close the breaker at will. To do so could cause catastrophic damage to the generator if it was not electrically synchronized to the grid. To prevent this from happening, a protective relay is used that only allows the breaker to close if the generator is synchronized to the grid and is producing the proper voltage.

Once the generator is connected to the grid, there are other conditions that could require the breaker to be opened. One example is “anti-islanding” protection. If there is a power outage on the grid, it is important that the generator be disconnected from the grid by opening the breaker. This is a safety precaution to protect the electric utility line crews from encountering an unexpected voltage on a disconnected line, among other issues.

A simple circuit breaker, like that used with a common service entrance, cannot provide these necessary protection features. The SEL-547 provides all of these protection functions and more.

GRID INTERCONNECTION STANDARDS

The electric utility and/or state public utilities commission usually has published interconnection standards for distributed generation. These standards specify protective relay requirements. A distributed generation installation must meet these requirements if it will ever be connected to the grid.

Often, these local interconnection standards require that the system comply with the recommendations of IEEE 1547-2003, *Standard for Interconnecting Distributed Resources with Electric Power Systems*. The SEL-547 provides IEEE 1547-compliant protection.

AN EXAMPLE APPLICATION OF THE SEL-547

The SEL-547 has been successfully applied to small-scale wind generation installations all over the United States and Canada. Figure 1 shows one such installation at Hyannis Country Garden on Cape Cod. This net-metered installation allows power to flow in either direction. During windy conditions, the grid-connected turbine provides more power than needed by the garden store. In such circumstances, electric power is exported from the wind turbine to the power grid. In light wind conditions, the garden store supplements the wind turbine power with electric utility power.

In this application, the SEL-547 protects both the generator and the electric grid by opening the breaker if an adverse condition occurs. Examples include over-/undervoltage or over-/underfrequency conditions due to local system islanding or a system-wide voltage/frequency disturbance.

The SEL-547 accomplishes this by monitoring the system voltages and one of the phase currents, as shown in Figure 2. If the SEL-547 detects an abnormal voltage or frequency condition, it sends a trip signal to the breaker, thereby isolating the generator from the electric grid.

Once the generator has disconnected from the grid, the SEL-547 will not allow the generator to reconnect unless it detects that the utility supply and generator are within normal bounds (voltage, frequency, phase angle). This protects both the generator and the grid from damage caused by a nonsynchronized close.

Figure 1 Hyannis Country Garden Wind Turbine

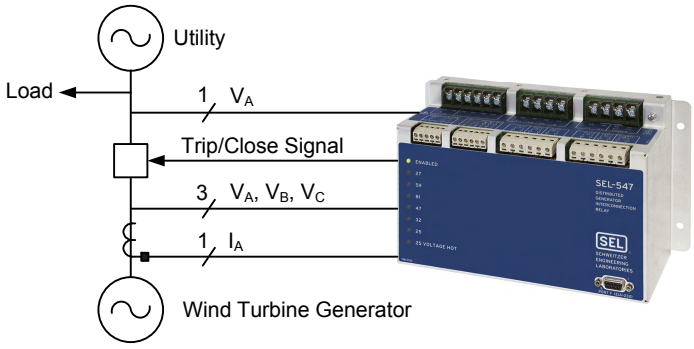

Figure 2 Typical SEL-547 Connections for a Net-Metered Distributed Generation Application

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