

Application Note:

Generator Compatibility with the Redback Smart Hybrid

General Comments

Fuel powered engine-generators use gasoline/petrol, diesel, natural gas or LPG/propane to make AC electricity. They are a useful for providing high amounts of power for short periods of time. If operated for extended periods, generators incur significant fuel, maintenance, repair and replacement costs. By combining a generator with an inverter/battery system and solar panels, it is possible to provide reliable power for extended outage back-up or off-grid applications with minimal generator fuel/maintenance/repair/replacement costs.

Types of Generators

Generators can be divided into three basic types.

1. Capacitor excited (sometimes referred to as “automatic”)
2. Electronically regulated (sometimes referred to as “microprocessor controlled”)
3. Inverter-Generators (sometime referred to as “variable speed”)

Capacitive excited generators do not provide stable enough voltage regulation for use with the Redback Smart Hybrid inverter system. They also can cause damage to the loads or the inverter when loads are removed from the generator as the output voltage can over-shoot due to the lack of active voltage regulation. These types of generators are suitable for running loads such as tools and pumps, etc. and are usually the lowest cost types of generators.

Electronically regulated generators provide much better voltage and frequency regulation – often as tight as +/- 1%. They also do not have significant voltage overshoot when large loads are disconnected. These types of generators are suitable for use with more sensitive loads such as electronics and inverters. These types of generators are more expensive.

Inverter-Generators produce a very clean and well regulated AC grid waveform through a built-in inverter from high voltage DC produced by the engine driven generator. Because the AC waveform is produced by the inverter, the AC output frequency is extremely stable and the engine is able to operate at variable speeds depending on the amount of loads connected. This reduces noise and fuel consumption while extending engine life. These type of generators are ideal for use with inverter/battery systems but are usually the most expensive to purchase but have lower operating costs and longer life. They also are more commonly available in smaller kW capacities which are not ideal for use with the Redback Smart Hybrid inverter system. Higher power versions are available from companies like Honda, Onan and Kohler.

Recommended Generator kW Capacity Rating

Generators are typically rated optimistically – the datasheet’s kW rating does not take into account the effects of high temperatures, altitude and poor fuel quality or the engine being slightly out-of-tune. They also do not usually include a “safety margin” into the design to ensure reliability and proper operation.

It is recommended that generators be derated at least 20% from the data plate values for this reason. If the generator is running at high altitudes (over 1000 meters) or if alternate fuels are used (such as natural gas) additional deratings may be necessary. If a generator is referred to as a “prime power” generator, then usually these deratings will be already included in the ratings.

The Redback Smart Hybrid includes a built-in AC transfer switch which can allow for up to 40 amps / 9.6 kW of power to be used for both the backed-up AC loads as well as the for powering the built-in battery charger. Because of this, the smallest recommended generator size is 8 kW for when the system will power only limited AC loads (such as 2.3 kW / 10 amps at 230 VAC) or 10 kW if the AC loads connected are more significant (such as 4.6 kW / 20 amps at 230 VAC) If there are large loads such as well pumps or air conditioners being powered by the generator, then a larger kW capacity generator is highly recommended.

Generator Auto Starting

There is no “standard” for how a generator start system works or is wired. Techniques vary between manufacturers and even amongst similar models from the same manufacturer.

Generator start systems can be divided into two types:

1. Two-wire generator start system
2. Three (or more) wire generator start systems

Many generators says they include connections for a “remote start”. This does not mean it is suitable for automatic starting and unattended operation.

The only type of start system which is recommended for use with Redback Smart Hybrid systems is “two-wire” type start systems. With this type of system, a single switch or relay connects the two wires and the generator starts. When the switch or relay opens, the generator stops.

Multi-wired generator starts systems require additional switches or relays for control of the engine starter, glow plugs, fuel solenoids etc. If the generator requires these types of controls, it is possible to connect a conversion device which then allows the generator to be started with a single switch or relay. Redback recommends the use of generator start controllers from a company called “Atkinson Electronics” located in Salt Lake City, Utah USA.

www.atkinsonelectronics.com

Some generators also require the addition of an AC load contactor to allow the generator to initially warm-up and then cool down before the generator’s engine is shut off. This typically is required on larger diesel powered generators. Including a load control contactor can also improve the quality of the transition when the loads are being switched from the generator to the inverter. The contactor provides a “clean break” transition which is easy for the inverter to respond to. If a load contactor is not used, the AC voltage waveform of the generator tends to jump around as the engine spins down which can result in noticeable transitions from the generator to the inverter system. The Atkinson generator start controllers allow for the addition of a load contactor.