Application Note - SolarEdge Inverter Generator Compatibility with Energy Hub + Backup Interface (BUI)

Contents

Version History

- Version 1.0 (Jul 2022) - Initial release

Introduction

Energy-generation systems (such as PV inverters) connected to the grid may consist of several types of energy-generating sources. In some cases, when grid power is disconnected, PV inverters should operate in parallel with other voltage sources, such as generators. In this document, “generator” is used as a general term for such sources. When inverters operate concurrently with generators, they may be subjected to voltage and frequency fluctuations that exceed trip limits, which are preset according to regional grid connection requirements.

To support the simultaneous or dynamic operation of the inverter with a generator, the inverter extends its voltage and frequency operating range once it receives a signal that the grid is unavailable, and the Backup Interface (BUI) islands the generation sources (“Backup mode”). Once the BUI has isolated the generation system from the grid, the relay that isolates the gas generator from the grid will close. **The gas generator will never be able to run in parallel with the grid.**

When grid power is restored, the gas generator relay opens, the inverter automatically reverts to its default country setting, which includes the original voltage and frequency operating range, and the Backup Interface closes the grid connection relay.

This document describes how to configure SolarEdge inverters for operation with a gas generator.

Supported SolarEdge products

- The BUI is required for generator functionality, BI-Exxx or BI-Nxxxx, w/firmware version 1.0.35 and up
- Single Phase Energy Hub inverter with CPU Version 4.15.199 and up

System requirements for generators connected to the backup panel

When generators are connected to the backup panel, it is usually a result of a pre-existing backup system. Remember, the generator is required to be isolated from the grid while operating. This can be done through a small, selected loads panel, interlock kit (Photo 1), or manual transfer switch that will **NOT** allow the generator to feed the grid, or the energy storage system. The only drawback to the connection method is the generator will not be able to charge the batteries. This generator connection method is considered an auxiliary backup system for the new PV + storage system.

Figure 1

- Pull start or portable generators:
  - The generator must be able to provide 240vac to the backup loads panel
  - While the generator is operating, it must be in open air, and a minimum of 20 ft. from the home
- Permanent or pad-mounted generators with a manual transfer:
  - The generator must be able to provide 240vac to the backup loads panel
  - While the generator is operating, it must be in open air, and a minimum of 20 ft. from the home

Functionality

One or multiple transfer switches can be used to incorporate generators into the backup system. Depending on the mode of operation, the generator may operate independently or in conjunction with the energy storage system.

Generators with pull start capability and temporary connection:

- This system setup is reserved for small, portable generators or pad-mounted generators that lack a 2-wire start/stop capability. The typical operation of this style of system is to use solar and stored energy or the generator. In this application, the generator works independently of the energy storage system, which consists of an Energy Hub inverter(s), PV array, compatible battery, BUI, generator interconnection device and a generator.

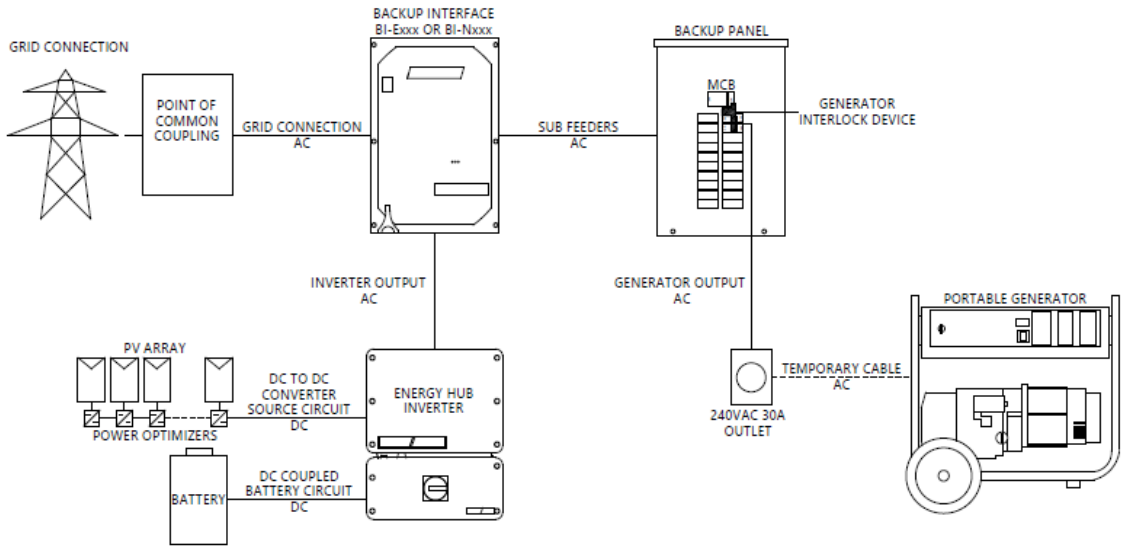

Figure 2: Generator with manual start and/or manual transfer capability connected to the BUI

If the generator is a standby generator with a manual transfer switch, it can be connected in the same manner, using an interlock device, or by connecting a manual transfer switch to the backed-up loads panel. These generators are usually pad-mounted and need to be run independently of the inverter(s). The main circuit breaker in the backup panel must isolate the loads and the PV generation system.

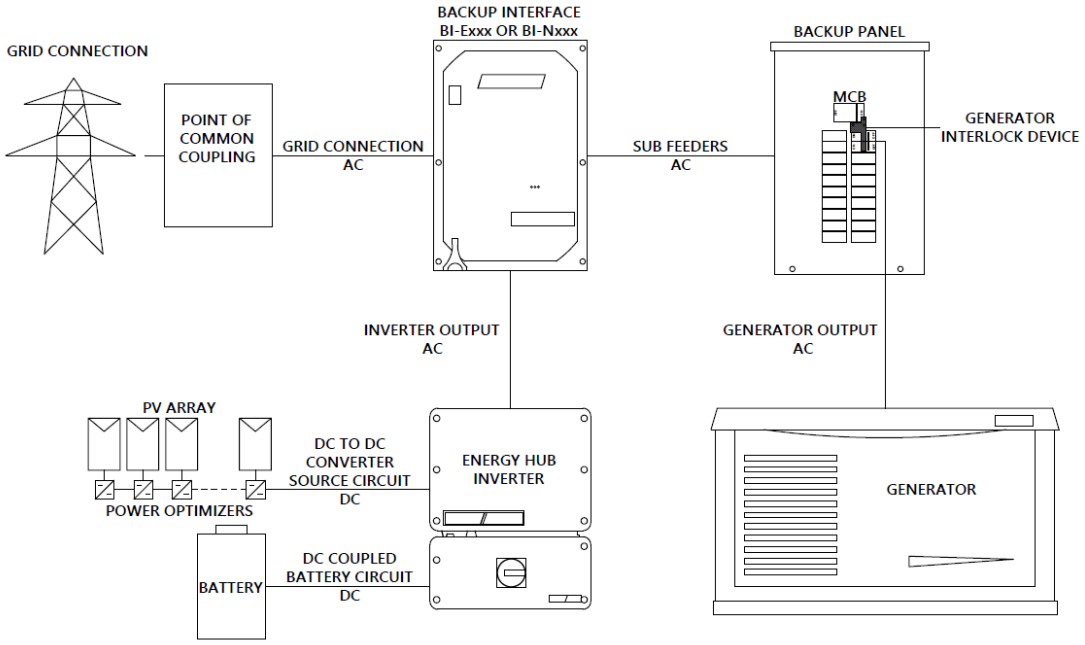

Figure 3: System requirements when connected to an interlock device or manual transfer switch on the load side of the BUI

In this system setup, the generator is electrically isolated from the grid, using a 3rd party relay or transfer switch that is normally open when connected to the grid. When the grid power goes down, the BUI will isolate the home loads and backup system from the grid. The generator will need to be programmed with a 10-second delay start. The required component for this system is an Energy Hub inverter(s), PV array, compatible battery, BUI, 3rd party auto transfer switch, and a generator. The inverter will be isolated from the generator while the generator is operating, and the generator will not be able to charge the batteries.

Pad-mounted generator with "auto-start" capability

The BUI is the primary backup control, and the generator is secondary. Generators with existing or new automatic transfer switches can be used with the BUI and Energy Hub inverter to supply backup power to the home after the batteries have been depleted.

In this system setup, the generator is electrically isolated from the grid using an external ATS (Automatic Transfer Switch) with a voltage sensor. When the grid power goes down, the BUI will isolate the home energy storage system that provides power to the backup panel. If the batteries deplete, the generator's transfer switch will detect the loss of voltage and will start the generator. With this method, the generator will be electrically isolated from the Energy Hub inverter and cannot be used to charge the batteries—it will only provide backup power to the home loads.

A key step in running the generator in this mode is to delay the automatic generator start by 10 seconds. This will ensure that the generator does not start while inverters are operating. See the illustration below (Figure 4).

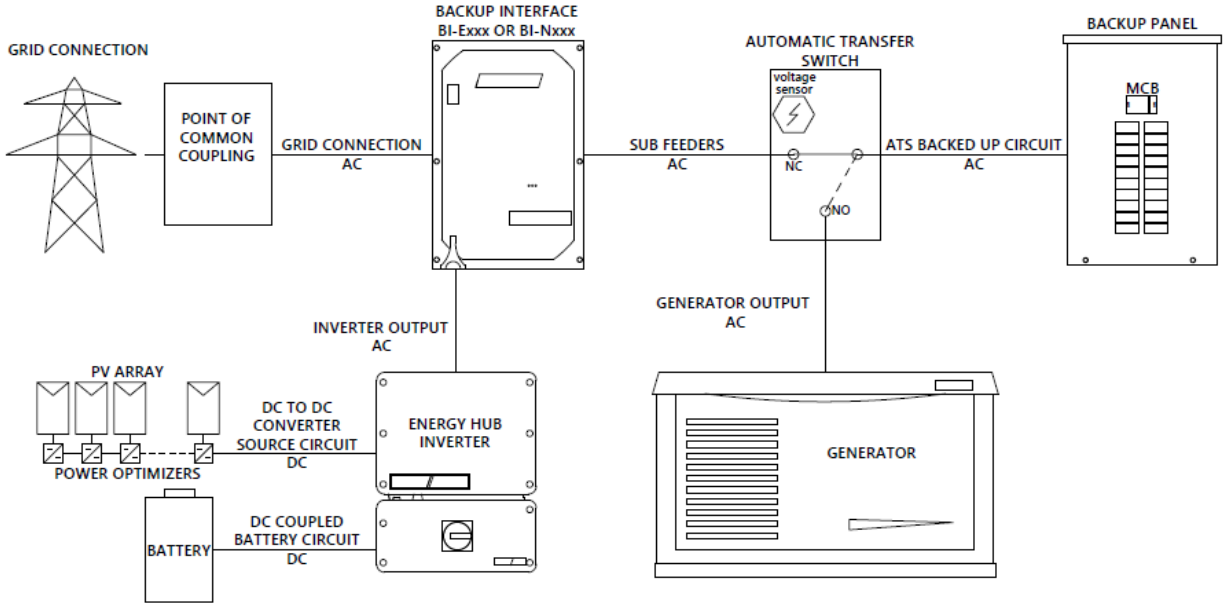

Figure 4

Operational behaviors

This section describes how all the above system configurations will behave during a grid outage. Generators connected to the backed-up loads panel with manual transfer switches, or interlock devices. As soon as the grid goes down, the BUI will isolate from the grid, while the PV + storage system provides power to the backed-up loads. Here, the generator is on standby. Figure 4 indicates the flow of power in this state.

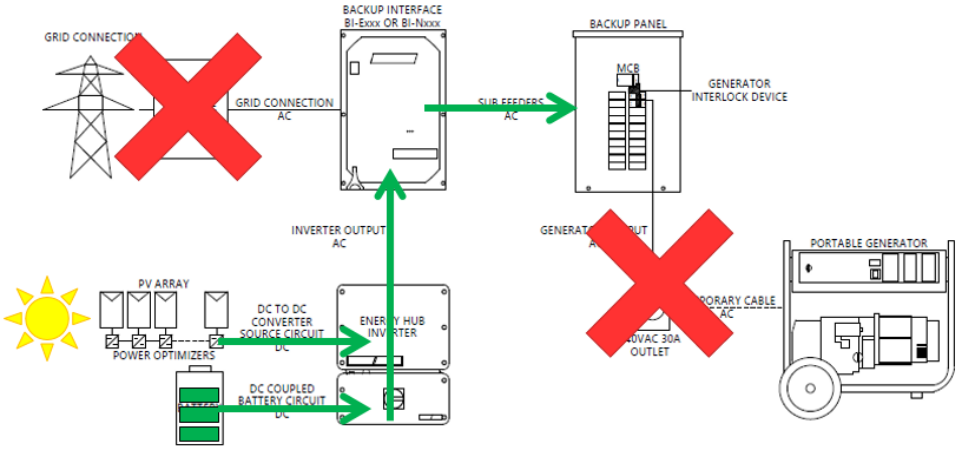

Figure 5

Once the batteries have been depleted, and there is no PV production, the system operator will turn on the generator. The first step is to turn off the main breaker to the backed-up loads panel, move the interlock device, and turn on the breaker to the generator. The generator interlock will isolate the generator from the inverter. Figure 5 indicates the flow of power in this state.

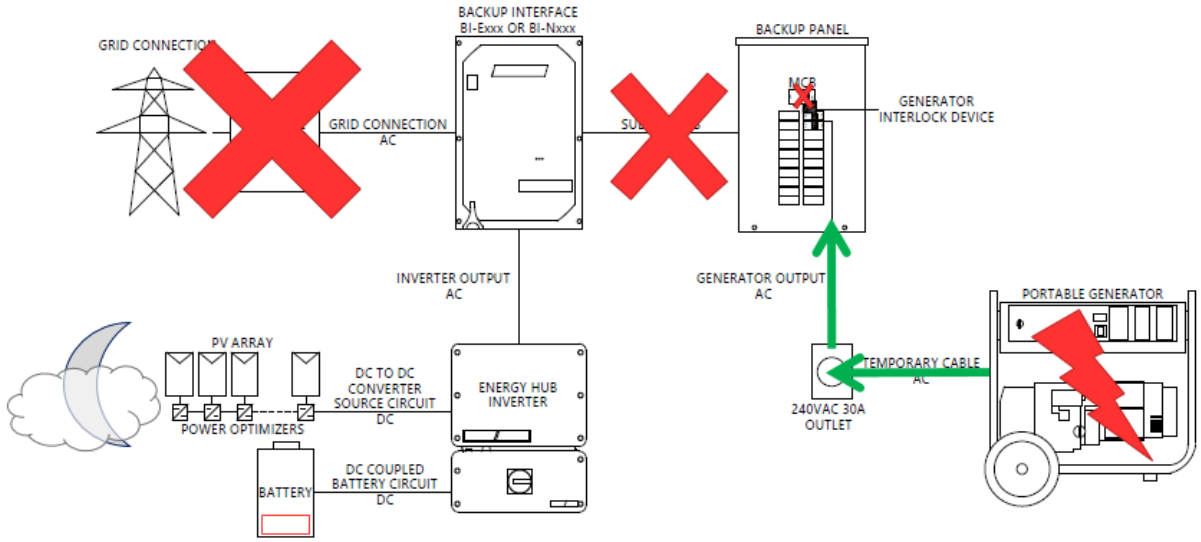

Figure 6

When PV production resumes, the batteries will start to charge. The system operator will have to turn off the generator to provide backup power from the sun. The generator interlock must be switched manually by the user, which will isolate the generator from the inverter. Figures 7 and 8 indicate the flow of power in these states.

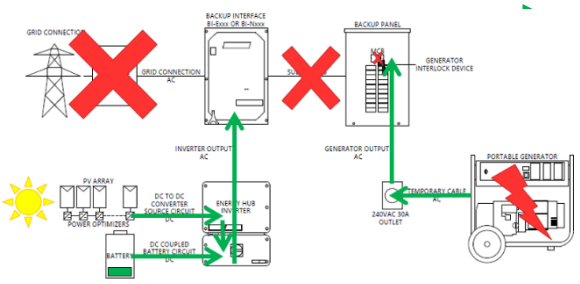

Figure 7

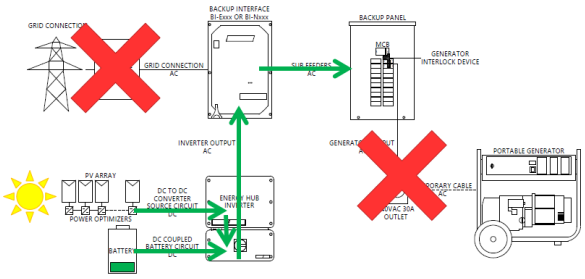

Figure 8

Generators connected to a 3rd party transfer switch on the supply side of the BUI

As soon as the grid goes down, the generator becomes the primary source of backup power, and the PV + storage (BUI) becomes secondary. The 3rd part auto transfer switch will isolate from the grid and provide power to the backed-up loads. The BUI will recognize this as "Grid" energy. The PV + storage system needs to be programmed for "Net Zero Export." The PV + storage system will provide power to the backed-up loads, and the generator will remain on until the grid is restored. See Figure 8 for system power flow.

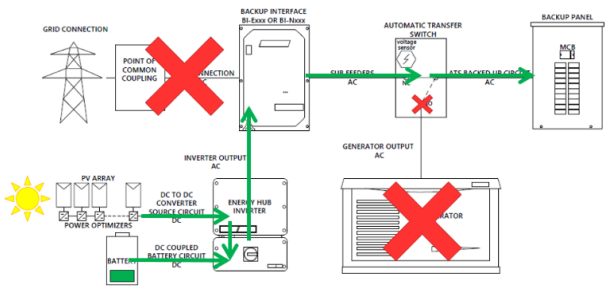

Figure 9

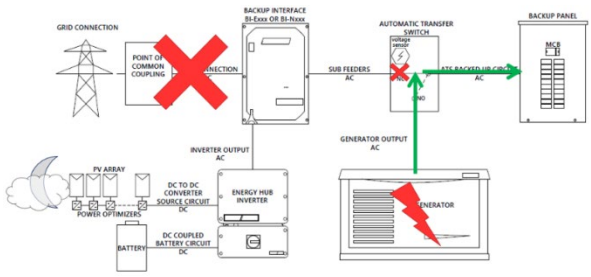

Figure 10

When the PV power and the batteries have been depleted, the inverter will go to sleep, and the generator will provide backup power. The generator will be able to charge the batteries if “AC Grid Charge” has been enabled. Once there is sufficient energy to power the home loads, the inverter will resume production. The generator's auto transfer switch will isolate the generator and the backup system once the grid has been restored.

Operational instructions

This section will instruct the system operator on how to control the generator and the energy storage system for each of the scenarios listed above. The system operator will need intimate knowledge of the location of breakers, disconnects, and power controls for the energy storage system, the generator, and any other auxiliary devices.

Generators connected to the backed-up loads panel with manual transfer switches or interlock devices

Portable generators – which usually offer wider frequency ranges and are always 10kW or less.

Steps to take when a grid outage occurs, and the BUI has transitioned to backup mode:

1. Allow the energy storage system to operate for as long as possible using PV energy to charge the batteries and power the home loads
2. Lock the Main Disconnect/Main Breaker into the open/off position, once the batteries have been depleted, and the energy storage system is no longer supplying energy to the backed-up loads

NOTE
The main disconnect will vary from system to system

3. Use the generator’s interlock device, or manual transfer switch, to isolate the generator from the BUI
4. Start the generator per the manufacturer's instructions
5. Plug the generator into the pre-installed receptacle
6. Allow the generator to provide backup power to the loads
7. Optional: when the batteries have sufficient charge, first turn off the generator, and then move the interlock device back to normal operation
8. When the grid is restored, ensure the generator is off
9. Remove any locks, and turn on the Main Disconnect

Standby generators – which usually provide better frequency ranges and are usually greater than 10kW.

Steps to take when a grid outage occurs, and the BUI has transitioned to backup mode:

1. Allow the energy storage system to operate, if possible, using PV energy to charge the batteries and power the home loads
2. Lock the Main Disconnect/Main Breaker into the open/off position, once the batteries have been depleted, and the energy storage system is no longer supplying energy to the backed-up loads

NOTE
The main disconnect will vary from system to system

3. Use the generator’s interlock device, or manual transfer switch, to isolate the generator from the BUI
4. Start the generator per the manufacturer's instructions
5. Allow the generator to provide backup power to the loads
6. Optional: when the batteries have sufficient charge, turn off the generator and move the interlock device back into normal operation
7. When the grid is restored, ensure the generator is off
8. Remove any locks, and turn on the Main Disconnect

Generators connected to a 3rd party transfer switch on the load side of the BUI

NOTE
Portable generators are not usually used in this application

Standby generator connected to the load side of the backup Interface with "Auto Start" functionality

NOTE
In this case the generator should be pre-programmed for a 10-second delay start

Steps to take when a grid outage occurs, and the BUI has transitioned to backup mode:

1. Allow the energy storage system to operate, if possible, using PV energy to charge the batteries and power the home loads
2. Once the batteries have been depleted, and the energy storage system is no longer supplying energy to the backed-up loads, lock the Main Disconnect/Main Breaker into the open/off position
3. The generator's Auto Transfer Switch will isolate the generator from the BUI
4. The generator will Auto Start and allow the generator to provide backup power to the loads
5. When the PV + storage system has sufficient energy to resume production, the Auto Transfer Switch will automatically isolate the generator from the backed-up loads
6. When the grid is restored, the system will automatically resume default programming

Safety and maintenance

It is important to note that generators are noisy, have high operational costs, and require routine maintenance. Follow the generator manufacturer's instructions for monthly or yearly maintenance. The SolarEdge BUI and Energy Hub inverters were designed and built to be maintenance-free. However, it is recommended that the backup system is tested yearly to ensure functionality and operational behaviors. While this document does cover the most common generator applications, there are other system setups that are not supported and could result in damaged equipment and voided warranties.