ASCO Power Technologies™

# Source**PacT** Source Isolation Switch Basics

## How Source**PacT**™ Maximizes BESS Value

Life Is On | Schneider Electric

## Introduction

A common perception is that a *Battery Energy Storage System* (BESS) can be used to supply backup power. While true, many power users are unaware that a BESS can only supply backup power if it is isolated from the utility grid. This document reviews the need for isolation, corresponding electrical codes, and benefits of using a purpose-built UL 3008 Listed *Source Isolation Switch* (SIS). It also introduces ASCO's new Source**PacT**™ SIS, and presents use cases that streamline deployment, increase resilience, and maximize return-on-investment for BESS applications.

## Conventional Backup Power Systems

Historically, facilities requiring backup power have most often relied on a transfer switch. This device keeps loads connected to one of two power sources, and transfers loads to the secondary source when power from the primary source is unacceptable or absent. By doing so, transfer switches enable downstream loads to continue to operate until acceptable power returns on the primary power feed. In most applications, the primary and secondary power sources have respectively been utility-supplied electricity and a backup generator. A simple illustration of this arrangement is presented in Figure 1.

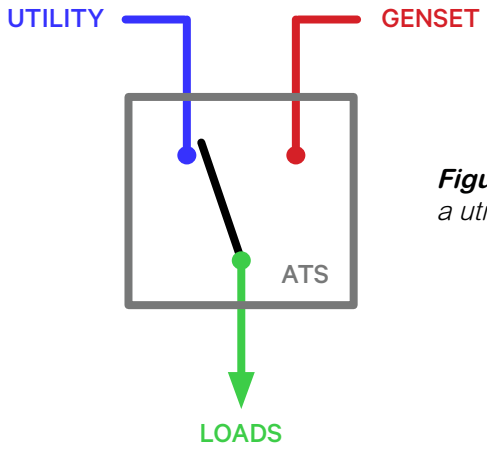


***Figure 1:*** *A conventional facility power distribution system includes a utility feed, a transfer switch, and a generator set.*

Where applications demand greater uptime, *Automatic Transfer Switches* (ATSs) are used. These devices sense the incoming voltage on the primary power source and signal backup gensets to start when primary power is unacceptable or absent. When a genset produces acceptable power, an ATS transfers electrical load to it to minimize or avoid power disruption. When acceptable power returns to the primary feed, the ATS retransfers the load to the primary source. During these operations, an ATS controller may invoke delays to verify the continuity of the outage and/or destination source to avoid unnecessary load transfers. Important takeaways here are that a transfer switch always connects the load to one of the power sources and both power sources are always isolated from each other. For more information about ATS operations, review the ASCO Tech Brief entitled *Basic Automatic Transfer Switch Functions*.

Multiple factors, including the persistence and increase of power outages attributable to severe weather, are accelerating changes in facility power distribution. Factors include continued demand for both cost-effective power and reduced environmental impact from power generation. Consequently, on-site and renewable energy sources are being deployed at end-use facilities to increase the supply, resilience, and sustainability of electrical power. In some jurisdictions, these changes are being codified into laws and regulations. The persistence of outages, especially, from weather-related causes, is described in ASCO Power Technologies' Technical Brief entitled *Power Outages Should be an Expected Operating Condition*. To learn more about emerging trends in power distribution and use, read the ASCO White Paper entitled *Power Source and Load Management in the New Energy Landscape*.

For a summary of a supporting regulatory scheme, see the ASCO Technical Brief entitled *California Title 24 – Building Energy Efficiency Standards*.

To increase the supply, resilience, and sustainability of power, end-use facilities are deploying BESSs to store energy when utility rates are low and discharge this power when utility rates are high. BESSs are also deployed to store power when a cleaner energy source is available, such as an on-site array of photovoltaic panels. This stored energy is later released to meet either facility or utility power demands when other sources are costly or unavailable. By operating in this way, BESSs typically offer benefits that are primarily economic, with corresponding improvements in power resilience and environmental sustainability. For additional reading, review the ASCO Technical Brief entitled *The Emerging Role of Batteries in Facility Power Systems*.

## Temporal Availability of Power from Renewable Sources

To appreciate the benefits that energy storage can deliver to *Prosumers* (facilities with the ability to produce, consume, and control their own energy), it is necessary to understand how the cost of utility power and the availability of *Distributed Energy Resources* (DERs) such as solar panels fluctuate daily. In Figure 2, the load curve shows typical demand throughout a day-long cycle. Load typically peaks in the morning when most people and organizations begin their day, and then peaks even higher in the late afternoon and early evening. The green area in Figure 2 indicates the timing and amount of available solar power, which correlates to diurnal patterns of light and dark skies.

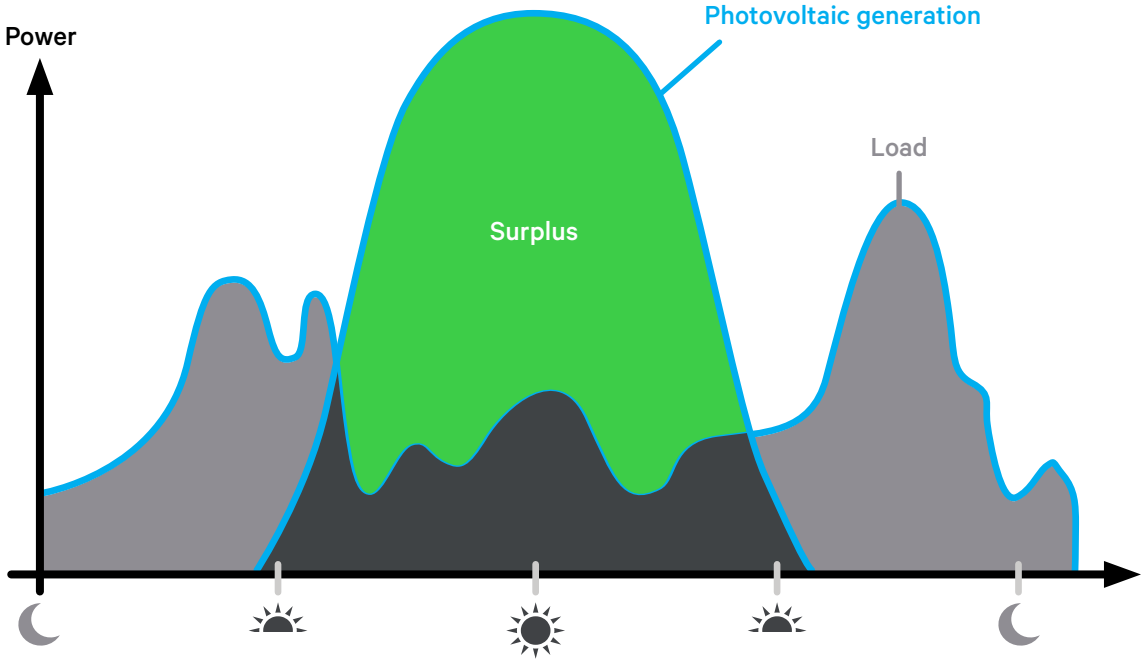


***Figure 2:*** *Conceptual diagram of daily solar power generation peaks at a time of day when power demand is typically low. Storing this surplus power in a BESS makes it available when subsequently needed.*[1]

Notably, the greatest amount of solar power may be available when demand is low. Surplus power can negatively impact both the economical operation of conventional utility power sources as well as the proper operation of utility grids. These trends affect facilities in the following ways:

- Rates for power are highest when public demand is greatest.
- On days of particularly high demand, such as during a summer heat wave, utility grids may not be able to supply all the power required to meet peak demands, compromising availability, reliability, and resilience.
- Relying on conventional utility sources during times when renewables are unavailable negatively impacts overall power sustainability.

[1] *Producing too much solar power? Here's how you can manage the excess.* Schneider Electric. September 12, 2019. https://blog.se.com/infrastructure-and-grid/power-management-metering-monitoring-power-quality/2019/09/12/producing-too-much-solar-power-heres-how-you-can-manage-the-excess/. Viewed February 23, 2024.

## Energy Storage Resolves Supply Differences and Optimizes Costs

The key to resolving discrepancies between power supply and demand is to store power when it is available for later use when it is most needed or most economical to do so. That is one reason BESSs continues to gain interest at both the grid and facility levels. At a facility served by both a utility grid and a solar panel array, the primary elements of a BESS include:

- Batteries that store electrical energy
- A bidirectional inverter that can charge and discharge batteries
- A means for receiving current from the solar array

A facility can install a BESS with or without a generator. Omitting a generator simplifies the system and keeps capital costs low, but power resilience is limited by the reserve capacity of the BESS. Adding a backup genset provides additional resilience for as long as the genset can be fueled. However, without grid isolation, BESSs cannot provide backup power if they remain connected to the utility grid.

## The Need for a Standardized Disconnecting Means

For safety reasons, BESS cannot be simultaneously connected to utility and operate in grid-forming mode. To do so could energize the utility feed during an outage, posing a risk to utility and facility personnel. In addition, if a BESS were to back-feed the grid, it could do so at a high discharge rate that, without other protections, could overtax or overheat its batteries, and overload its inverter.

To safely use a BESS to supply backup or emergency power, an isolating means must be installed between a facility's utility service entrance and its BESS. A conventional transfer switch is unsuited for this purpose because it is expressly designed to remain connected to a power source, and to disallow isolation under any foreseeable circumstance. In addition, it offers an incorrect sequence of operations.

Because a standard solution has not been commercially available, the need for BESS isolation and compliance has impacted BESS stakeholders in the following ways:

- Engineers and Integrators require additional time and incur higher costs to design a compliant solution.
- Engine-Generator Dealers and BESS producers are left without a common solution to serve their customers.
- Contractors must install and test multiple devices in custom solutions for each facility.
- Facility personnel must learn to understand, operate, maintain, and test multiple devices with unique control interfaces.

These challenges make BESS projects more complex, compliance more difficult, and implementation more costly and lengthy. They would be easily resolved if a standardized, UL-listed, single-box, source isolation switch was made available specifically for isolating the grid from BESS equipment. Figure 3 shows how such a device compares to an ATS.

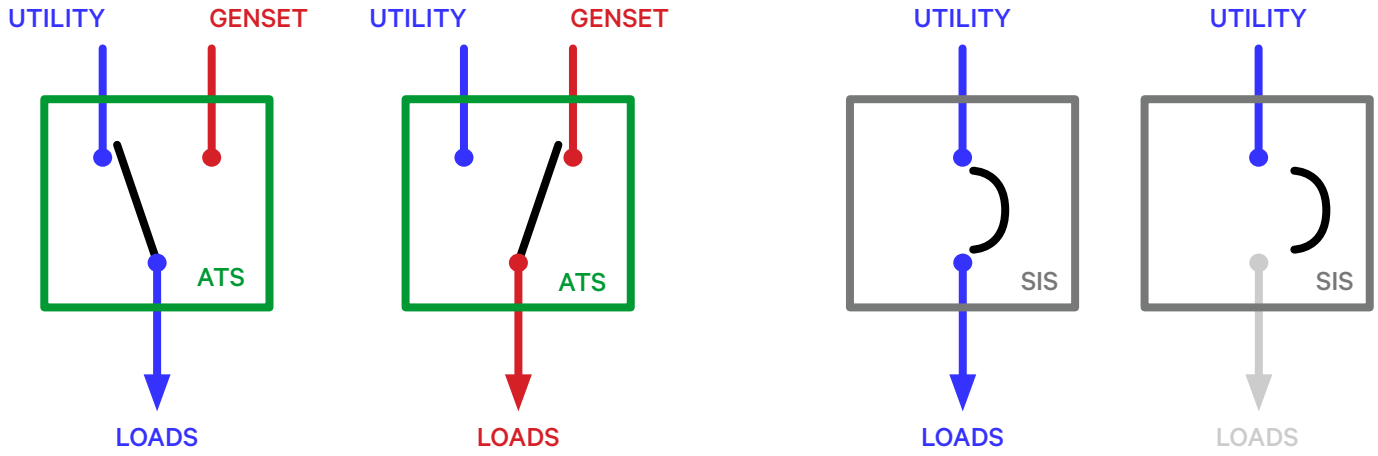


***Figure 3:*** *At left, an ATS always connects a load to one of two power sources. At right, an SIS simply connects or isolates a load, keeping both sources isolated from each other.*

To streamline BESS deployment for applications that include backup power, ASCO Power Technologies has developed Source**PacT**™, a complete source isolation solution in a single enclosure. Source**PacT** puts an advanced controller, an intuitive user interface, and a robust disconnect mechanism in a single enclosure. Listed to UL 3008, Source**PacT** makes an isolation solution simpler and less costly for engineers to specify, contractors to install, and facility personnel to use. It also provides integrators, distributors, dealers, and BESS manufacturers with an off-the-shelf purpose-built solution for meeting the BESS isolation needs of their customers. ASCO's 600 Amp Source**PacT** SIS is shown in Figure 4.


***Figure 4:*** *Source**PacT** is a complete automatic isolation solution.*

## How SourcePacT Works

Source**PacT**™ uses its advanced controller to monitor the voltage of the incoming utility feed and interact with the controls of an inverter serving the BESS output. Under normal utility conditions, Source**PacT's** isolation breaker remains closed on the utility feed and the BESS inverter operates in grid-following mode, providing the economic benefits of energy storage solutions and strategies. When acceptable utility power is no longer present, the following operations occur:

1. The BESS inverter automatically shuts down per IEEE and UL standards.
2. The controller in the Source**PacT** SIS detects the outage.
3. The Source**PacT** Isolation Switch opens.
4. The Source**PacT** controller signals the inverter to switch to grid-forming mode.
5. The BESS supplies power to the facility's essential loads through the inverter.
6. After some time, acceptable power returns on the utility feed.
7. Source**PacT's** controller signals the inverter to switch to grid-following mode after a user-configurable time delay is invoked to ensure the utility source is stable.
8. The inverter momentarily stops supplying power.
9. Source**PacT's** isolation breaker closes to restore utility power to the facility's entire power distribution system.
10. The BESS inverter detects a healthy reference utility power source and resumes grid-following operation.

A conceptual Source**PacT** application is shown in Figure 5.

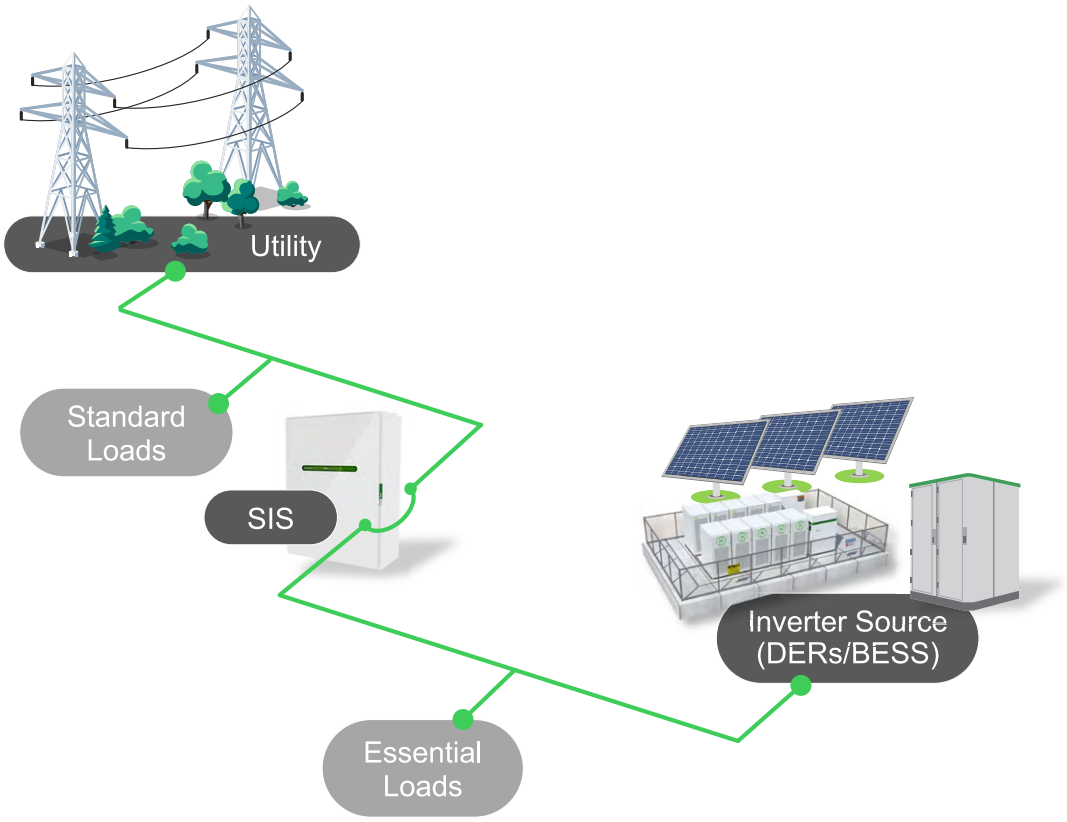


***Figure 5:*** *This diagram shows a Source**PacT** SIS between the utility feed and the facility's BESS and essential loads.*

Source**PacT** works with any inverter that accepts a standard Form-C contact for selecting between grid-forming and grid-following modes. Consequently, it works when bundled with equipment such as the Schneider Electric BESS and with inverters produced by other manufacturers.

## How SourcePacT Enhances Reliability and Safety

When compared to a custom power source isolation solution, Source**PacT**™ promotes reliability and safety in the following ways.

1. Source**PacT** is purpose-built using standard commercial components with a record of reliable service.
2. With Source**PacT**, specifiers do not have to verify the aggregate functionality and adequacy of multiple devices that were not specifically designed, wired, or preprogrammed for the purpose of isolating utility power feeds.
3. Source**PacT** is factory-tested prior to delivery to a worksite. Users receive an entire functioning isolation solution that is simple to install and commission.
4. Source**PacT** is backed by both a warranty and the support of a leading equipment manufacturer with more than a century of backup power experience.
5. Source**PacT** is the industry's first UL 3008 Listed Automatic Interconnection Switch.

### UL 3008 Testing Summary

*UL 3008 - Outline of Investigation for Automatic Interconnection Switches for Emergency Systems* has been specifically developed to assure safety for the source isolation switches needed to streamline BESS deployments for backup power applications. It includes tests for overload and withstand and closing ratings, and for heat rise. Evaluation also involves thousands of operation cycles for endurance testing. Units also undergo review and testing to verify the sequence of operations used in the device. Many of the tests are similar to those used to qualify transfer switches to UL 1008, ensuring equivalent levels of performance and reliability for critical backup power applications.

## Use Cases

The value of Source**PacT**™ is best described by illustrating common use cases for the device. Three are described in the following sections: *Battery Only, Battery and Generator,* and *Battery First.*

### Battery Only

*Battery Only* is the simplest use case for obtaining backup power from a BESS. In this arrangement, a facility is equipped with a BESS and a source isolation switch such as Source**PacT**, but not a generator. A Battery Only power system would provide the resilience of backup power for a duration defined by the amount of load and the energy capacity of the batteries. Consequently, a Battery Only system would typically be used by an organization that can tolerate infrequent power disruption. A Battery Only system is shown in Figure 6.

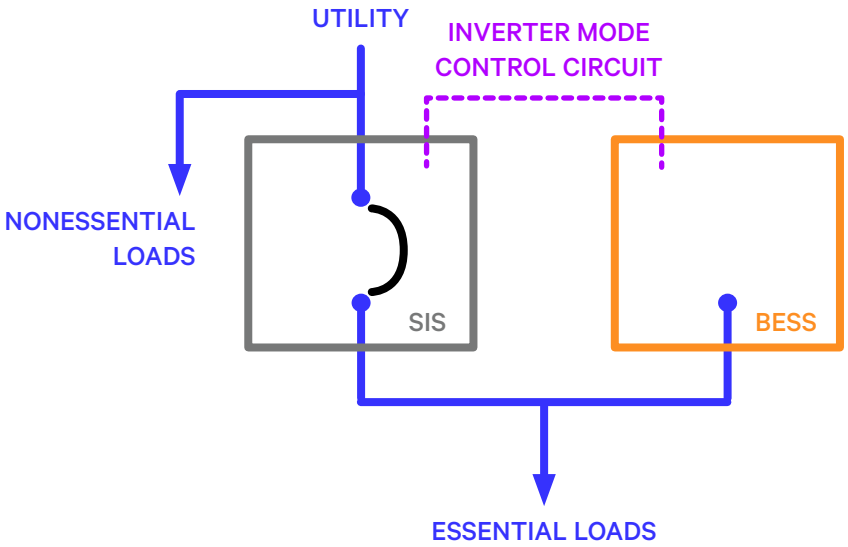


***Figure 6:*** *Here, a Source**PacT** SIS is located between the facility's essential loads and the utility source. In this Battery Only configuration, the available Utility powers all loads, while the BESS can be charged by either a renewable source or the utility feed.*

Figure 6 shows the system connected to the utility power supply through an SIS. In normal operation, the utility supplies all loads. The BESS can be charged by either the utility source or a site's solar array according to prevailing utility rates and available daylight. This enables collection and storage of low-cost power when available from the grid and cost-effective sustainable power from the renewable source during daylight. The stored power can either be used to offset utility use when solar power is unavailable, sold back to the grid during a period of high public demand, or used as backup power when a utility outage occurs.

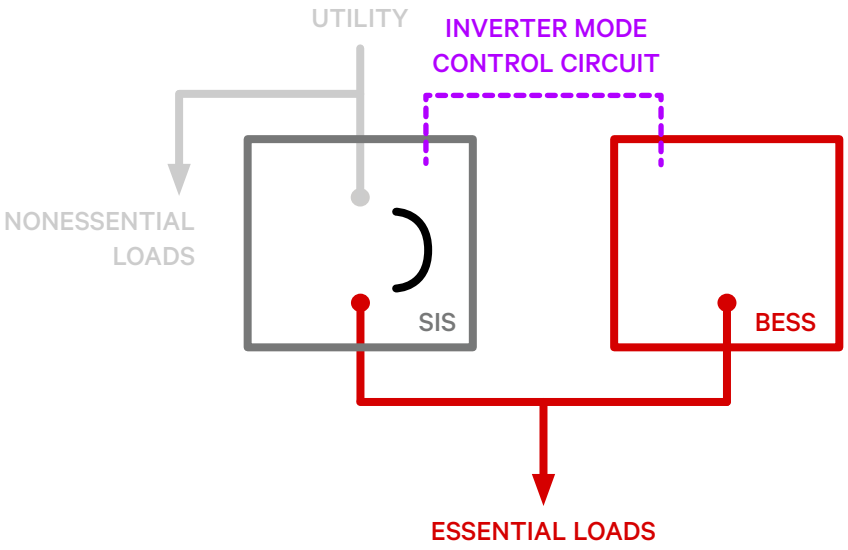


***Figure 7:*** *When utility power is unacceptable or absent, the Source**PacT**™ SIS opens to isolate that source. The SIS controller signals the BESS to send stored energy to the Essential Loads.*

Figure 7 shows the system during a utility outage. In this circumstance, the SIS opens to isolate the grid from the BESS and the Essential Loads. This enables the BESS to supply the Essential Loads with stored power for backup purposes. When acceptable power returns to the utility feed, the SIS closes. With this system, the Nonessential Loads are left unpowered during the outage, and power can be supplied to both upstream and downstream loads. With this configuration, the Essential Loads can be supplied with backup power for a duration defined by the load demand and the capacity of the batteries.

### Battery and Generator

A second use case is *Battery and Generator* together. This arrangement splits the system so that a BESS can supply backup power to one subset of loads and a generator can supply backup power to another set of loads. This option is useful where a facility chooses to (1) backup its most critical loads with a genset and less critical loads with a BESS, or (2) use a BESS to backup essential loads in a new wing of a building. The capital costs increase because a generator must be purchased, integrated, and installed. A *Battery and Generator* arrangement is shown in Figure 8.

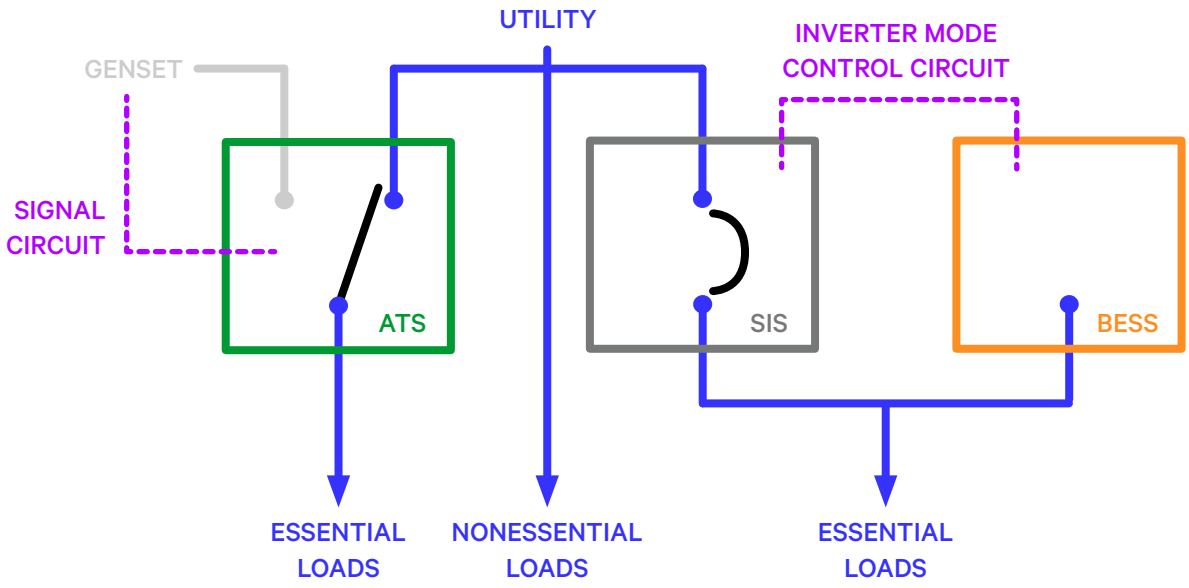


***Figure 8:*** *Here, a facility uses Battery and Generator together to serve distinct Essential Loads. When acceptable utility power is present, it serves the entire electrical distribution system.*

When a utility outage occurs, the SIS opens to isolate the inverter from the utility and the ATS transfers as shown in Figure 9. This action also isolates the two groups of Essential Loads from each other. The Essential Loads powered by the BESS operate until utility power returns or until the BESS is depleted. The Essential Loads powered by the generator operate until acceptable power returns to the utility feed or for as long as the generator can be fueled.

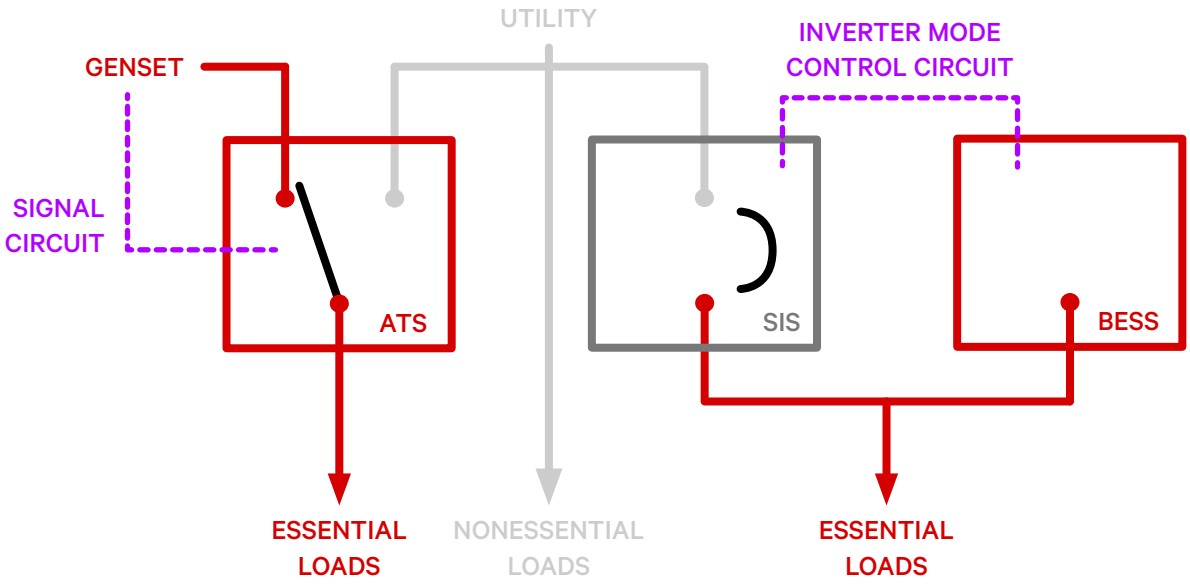


***Figure 9:*** *When a utility outage occurs, the SIS opens, isolating the Utility from the BESS and the two groups of Essential Loads from each other. The genset and the BESS then supply their respective Essential Loads.*

Note that regulated facilities with critical loads and diesel gensets are typically equipped with tankage to supply fuel for multiple days of continuous operation. If a refueling means is available, such systems can potentially run indefinitely without interruption.

While a *Battery and Generator* arrangement provides additional resilience over a *Battery Only* system, it still presents limitations regarding cost-effectiveness, sustainability, and resilience because this system will activate the genset for every qualified utility outage. Since generators are typically more expensive to operate and maintain than other common power sources, this arrangement always incurs the higher cost of operating the genset. Likewise, the genset's internal combustion engine will always emit pollutants to the atmosphere according to the fuel type. This will have a greater environmental impact than the other sources on this system. Whether this is an appropriate solution for a particular application depends on the relative importance of objectives such as capital cost, operating cost, and sustainability.

### Battery First

A *Battery First* configuration maximizes the promise of cost-effective, resilient, and sustainable power by placing the SIS where it will not isolate the BESS from the ATS. Battery First configurations and operating states are shown in Figures 10 through 13.

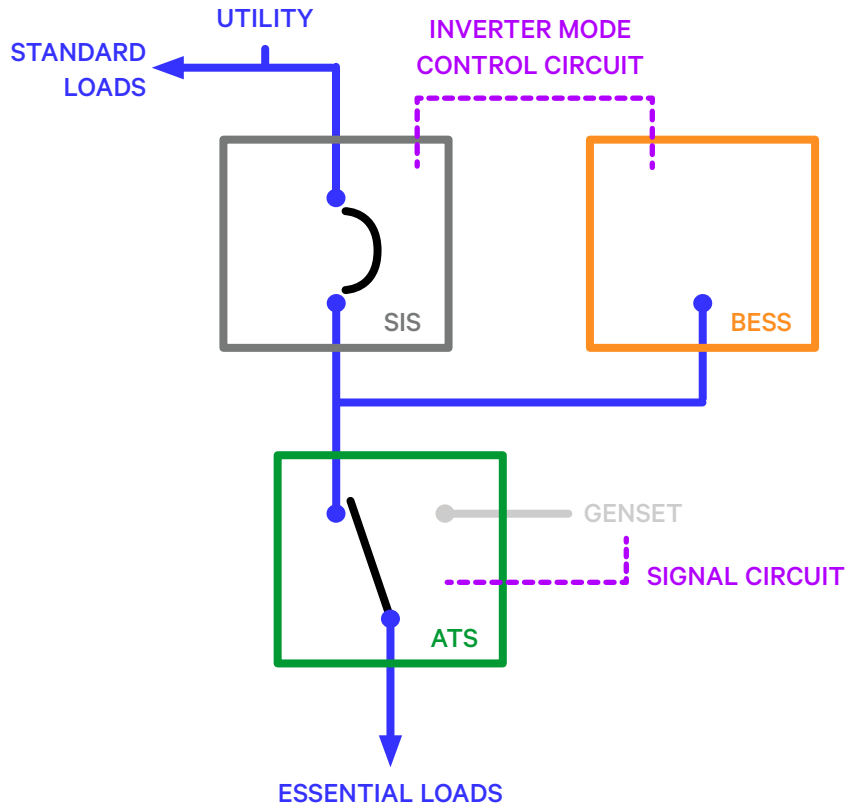


***Figure 10:*** *Here, a facility uses a Battery First configuration. When acceptable utility power is present, it serves the entire electrical distribution system.*

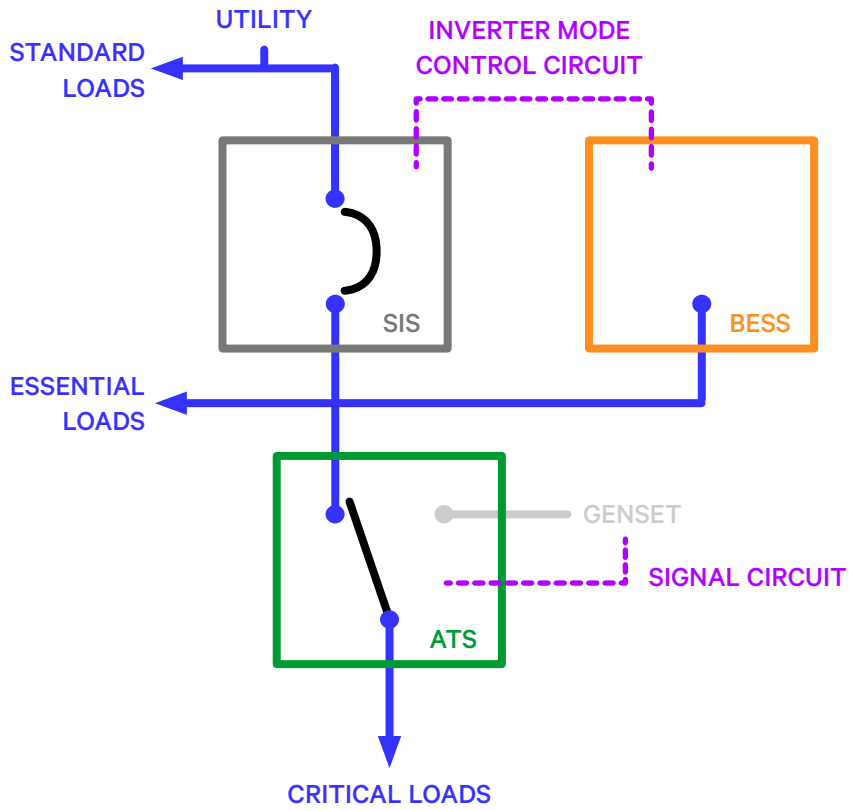


***Figure 11:*** *Here, all essential and critical loads can be supplied by the BESS. For additional resilience, critical loads can be fed by a generator through the ATS.*

When a utility outage occurs, the SIS isolates a portion of the facility from the utility feed. The BESS supplies the normal side of an ATS and its downstream loads for as long as sufficient battery capacity exists. Should the inverter source be depleted, the ATS would detect the outage, then start the generator and transfer loads to it. This sequence maximizes both sustainability and resilience by prioritizing the use of green energy. Providing a genset as a fall-back option extends resilience beyond the battery capacity.

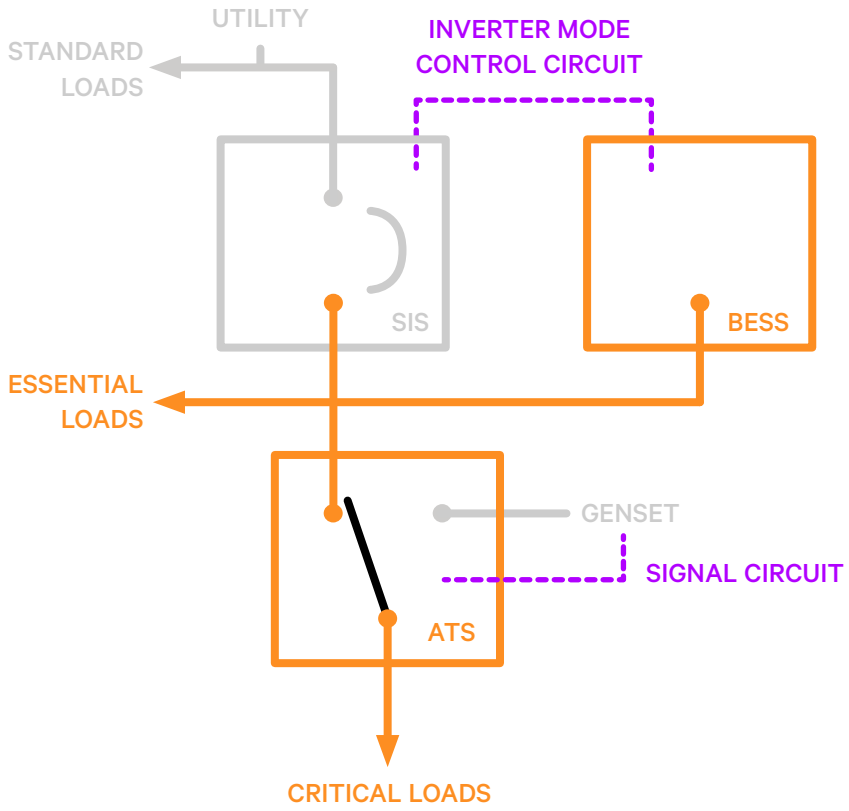


***Figure 12:*** *When a utility outage occurs, the BESS powers all downstream Essential and Critical Loads.*

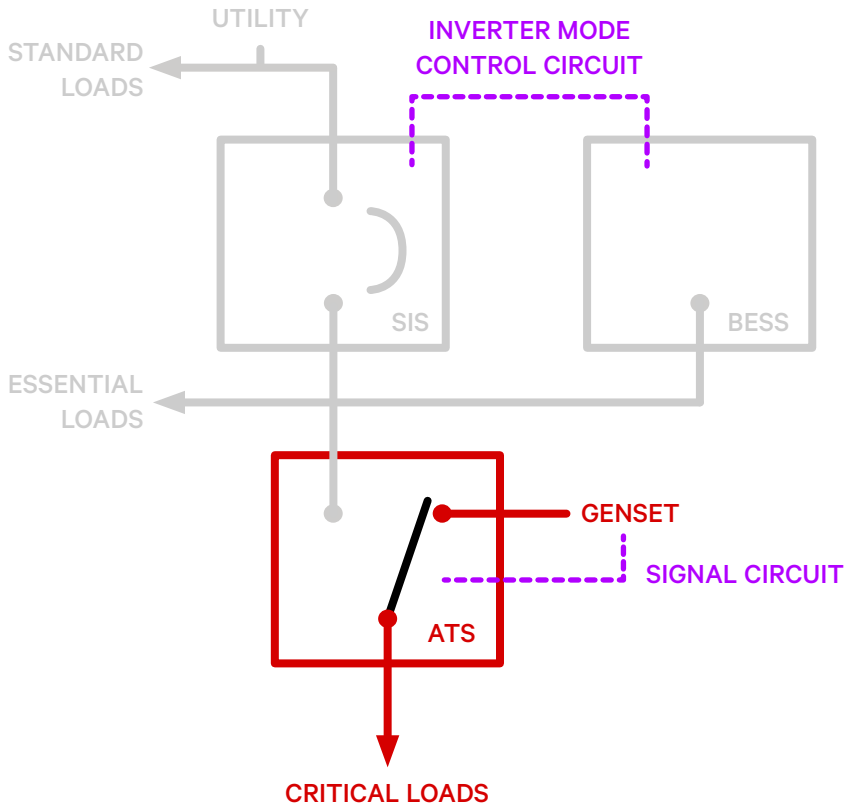


***Figure 13:*** *If the utility outage extends beyond the reserve time afforded by the BESS, the ATS starts the genset and then transfers the facility's critical loads to that source. The generator can power these loads for as long as fuel is available.*

The value of a Battery First solution becomes clearer when considered with the nature of most of the events that demand backup power. The most frequent outages are short-duration events. In most applications, a facility could supply backup power to Essential and Critical Loads for most utility outages on BESS power alone. The cumulative results of providing most of the backup power using the most cost-effective and greenest power source maximizes the economic and sustainability benefits of any BESS application. If an extended outage occurs, there will still be a generator to provide backup power.

## Summary of SourcePacT SIS Benefits

A BESS can only supply backup power if there is a means to isolate it and its Essential Loads from the utility grid. Isolation can now be easily achieved using Source**PacT™**, an SIS that puts an entire isolation control and disconnection solution in a single device listed to UL 3008. Its benefits include:

- *Simplicity:* A single device that streamlines power system design, installation, commissioning, and operation
- *Resilience:* Enables BESS systems to provide backup power
- *Safety:* A UL 3008 Listed and factory-tested product emphasizes safety and longevity
- *Economy:* Enables *Battery First* operation to maximize the value of BESS investment
- *Value:* Modest capital cost maximizes BESS functionality
- *Sustainability:* Enables facilities to use power from their greenest sources first

Source**PacT** can be used in Battery Only BESS systems, together with a generator, or in a Battery First configuration. The most common applications are summarized in Table 1.

| Use Case | Value | Resilience | Sustainability |
|---|---|---|---|
| Battery Only | Energy cost optimized | ✓✓ | ✓✓✓✓✓✓ |
| Battery and Generator | Simple enhancement to existing generator-equipped systems | ✓✓✓✓✓ | ✓✓ |
| Battery First | Prioritizes use of stored energy | ✓✓✓✓✓✓ | ✓✓✓✓✓ |
| **For Comparison** | | | |
| Solar Alone | Energy savings only | ✓ | ✓✓✓✓✓✓✓ |
| Generator Alone | Continuity only | ✓✓✓✓ | ✓ |

*Note: Resilience and Sustainability values are relative for comparison purposes only.*

Source**PacT** enables BESS stakeholders to maximize value in the following ways:

- Engineers and Integrators streamline design and reduce costs to deploy a compliant BESS solution.
- Distributors, Engine-Generator Dealers, and OEM BESS producers gain a standardized, off-the-shelf, BESS isolation solution.
- Contractors gain a single-device solution that is simple to procure, install, and commission.
- Facility personnel gain an automated isolation solution with a single interface that is easy to understand and use.

For more information about Source**PacT** features and specifications, see the brochure and data sheet at https://www.ascopower.com/us/en/products/sourcepact.jsp. For additional information and application support, contact an ASCO Power Technologies representative at 800 800 ASCO or customercare@ascopower.com

## Further Reading

Power community professionals can learn the latest information about backup power and the New Energy Landscape by subscribing to the ASCO Newsletter at https://www.ascopower.com/us/en/about-us/subscribe.jsp. For related reading, review the documents below.

### ASCO Tech Briefs

*Basic Automatic Transfer Switch Functions*

*Power Outages Should be an Expected Operating Condition*

*California Title 24 – Building Energy Efficiency Standards*

*The Emerging Role of Batteries in Facility Power Systems*

*Basic Power Source Synchronization and Paralleling*

### ASCO White Papers

*Power Source and Load Management in the New Energy Landscape*

*Connecting Closed Transition Transfer Switches to Utility Services*


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