Information Sheet # 114

Residential Standby Applications Using Battery Power

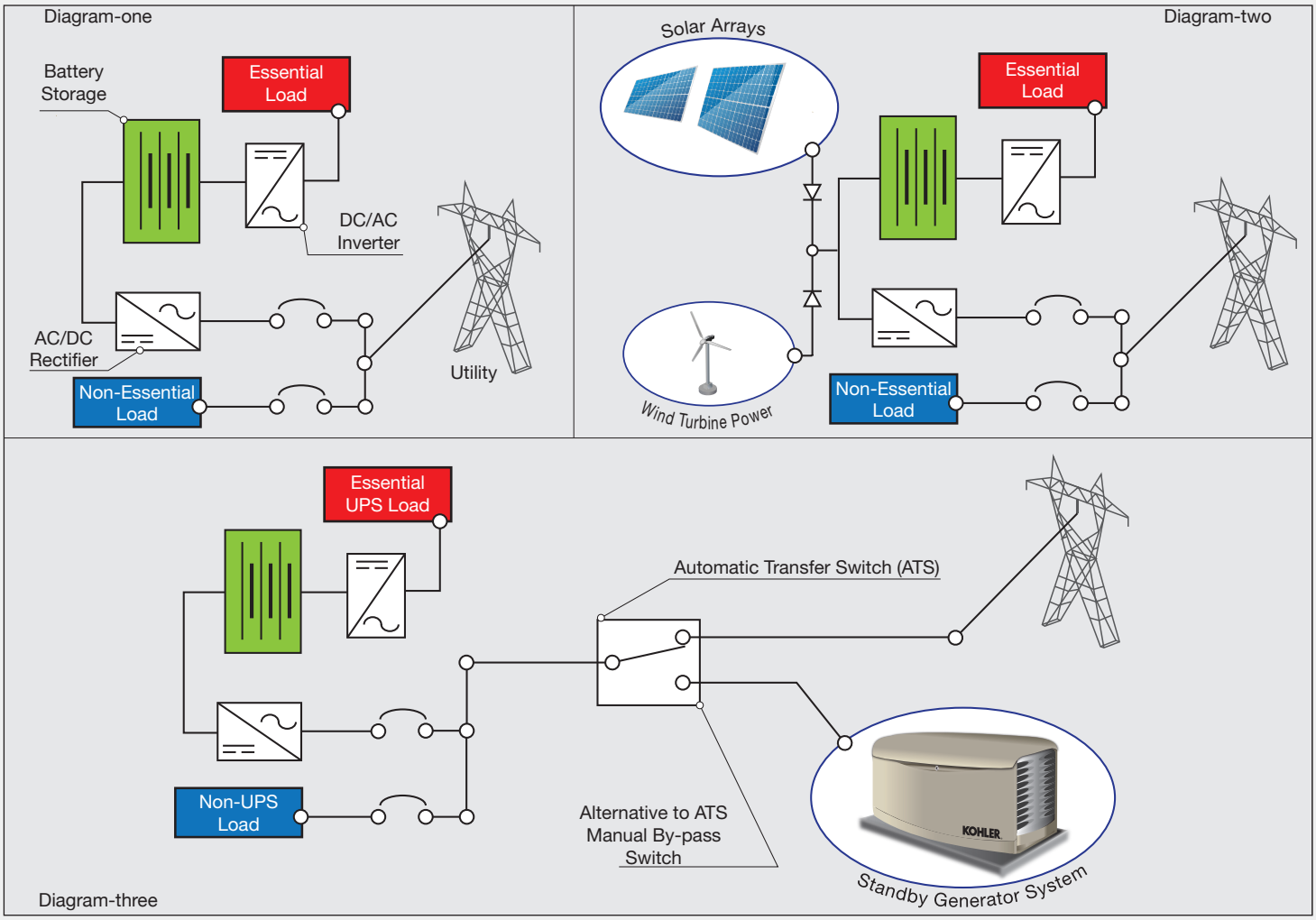
Your Reliable Guide for Power Solutions

1.0 Introduction:

Most residential homes are connected to the utility grid for their source of electric power. Our increasing reliance on electricity and growing intolerance for any interruption in power to our residence has greatly increased the demand for residential standby power systems. A recent driver for more power security is the increased number of people working from home during the 2020 COVID-19 pandemic. In the past, when a homeowner considered backup power to the utility supply, an engine driven generator using diesel or gaseous fuel was considered. However, advances in battery technology, digital control, and switching systems, have accelerated the use of battery banks as a backup power source.

This Information Sheet discusses battery backup power for residential applications, the technology, options, and the role an engine driven generator set system provides should the power outage be longer than the stored battery energy could supply.

Sample Configurations for Battery Backup Power Systems for Residential Use



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The installation information provided in this information sheet is informational in nature only and should not be considered the advice of a properly licensed and qualified electrician or used in place of a detailed review of the applicable National Electric Codes, NFPA 99/110 and local codes. Specific questions about how this information may affect any particular situation should be addressed to a licensed and qualified engineer and/or electrician.

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2.0 Batteries Provide a UPS Power Solution: Since the start of the nineteenth century, connected utility power to our homes has been Alternating Current, or commonly known as AC power. AC power is when the current delivered is in a sine wave through a 360 degree cycle where half the wave is positive and the second half is negative. This was determined to be the most efficient method of distributing power over large distances without losing a significant percentage of the power in transmission lines. AC power can use transformer coils to step-up the usual residential voltages of 120/220 volts to hundreds of thousands of volts that are distributed through overhead lines from city to city and power station to city with only a small drop in current delivered at the other end when the transformers step down to 120/220 volts.

Batteries however, produce their power with direct current, given as DC voltage. In this case the current flow does not alternate, but only flows in one direction. While it is not efficient to transport DC current over large distances, advances in electronic controls can take advantage of a battery's ability to deliver DC current providing the home owner with the following:

2.1 Uninterrupted Power Source (UPS) - Digital UPS systems already use batteries to provide uninterrupted power when the AC power input is changed between normal and standby power sources. Battery DC power is fed through an inverter. An inverter, through digital switching, converts the battery DC current to the same AC current of the utility power connected to the residence.

When the residence is being supplied power from the utility, the batteries are maintained in a fully charged condition by a rectifier that converted current from AC to DC. When part or all of the residential load is connected to the inverter, that is in turn connected to the battery, should the utility power go off line, the power is immediately supplied from the reserve battery power and the home owner experiences no interruption of the power. A true uninterrupted power supply. ***See diagram one.***

2.2 Prioritizing Loads Requiring UPS - When selecting a battery backup system, the user will have the option of having all their connected load supplied through a UPS system, or just the elements of the connected load such as home internet and security systems. The supplier of the battery backup system will discuss the costs and benefits of batteries sized to supply all of the load connected to the utility, as an opposed to just priority loads.

3.0 Selecting Battery Size - Batteries are rated in ampere-hour capacity. This means how much current can the battery provide to a connected load for a period of 1-hour. Various discussions will be held to determine what the home owner requires as regards backup power including:

3.1 Length of Power Outage to be Covered - Records are maintained of utility interruptions for most areas of the United States. In some areas power outages are infrequent, but can be for a considerable amount of time and in other areas an overloaded utility system is experiencing frequent power outages. An audit of power outages in the given area is made and recommendations will be made to determine the users tolerance level for power outages. The higher the tolerance of power interruption the smaller the battery required, the longer the battery has to supply power increases calculated ampere-hour capacity, battery size, and cost.

3.2 Location of User - Weather is one of the primary reasons for utility outages. Does the user live in an area prone to ice storms, thunders storms, hurricanes, flooding or severe winters? Also, is the user in an area where the utility company frequently cuts power due to an overloaded network?

3.3 Are there Other Power Sources - More users are moving to microgrid systems. Microgrids are not dependent on the traditional utility supply, having power from large power stations supplying millions of users. They can have several different connected loads such as solar or wind power. If the main power is interrupted can the user's power be supplied by any of the other power sources of a microgrid system? ***See diagram two.***

It may be calculated the battery capacity can be reduced because of other connected power supplies in a microgrid system.

3.4 Is a Standby Engine Driven Generator System Connected - Traditionally homeowners or small businesses have relied on engine driven generator systems either powered by a gaseous fuel (natural gas or propane) or diesel fuel for standby power when the utility goes off-line. The user may determine the battery back-up is sufficient to provide UPS power while the generator runs up to speed.

4.0 Using Battery Power to Off-Set Peak Utility Charges - Many areas of the US have utilities that are fully utilized from the connected loads of their residential and commercial customers. It is common for utility companies to charge their customers varying rates for their electrical consumption through the day. The more customers they can get to switch their main electrical demand to times when the utility is not fully loaded the less susceptible the system is to brownouts or rolling outages. To do this they encourage more electrical use by consumers when demand is low by offering lower charges.

Users that have installed a battery backup system can arrange to switch over to battery power when the utility tariff rate is high, and then recharge the batteries when the rate is lower. An electrical contractor can install a manual bi-pass switch to switch the residence's connected load from the utility to the battery bank during high tariff periods.

5.0 Using a Standby Generator System in Conjunction with Battery Back-up - When located in an area prone to extensive power outages and no additional power sources such as wind and solar power are connected, the user should consider the advantages of a residential standby generator system.

5.1 Sizing the Generator - In areas prone to extended power outages it is more viable to install a standby generator system. The generator can be sized to power all or just priority loads when the battery back-up power is exhausted. This reduces the size of battery back-up ampere hour capacity, but still retains the UPS facility of battery systems and the capacity for the battery to supply the residence's electrical load for most short duration outages.

The generator should be sized to power the defined loads and recharge the batteries.

5.2 Connecting the Generator - Home owners have two options for connecting the household load to the generator from the utility.

Option-1 Manual By-pass Switch: A manual switch installed by an authorized electrical contractor is connected between the utility input and the generator. During a power outage the generator would be started and when ready the load would be manually switched from the utility to the generator, and when the utility returns the load would be switched back to the utility and the generator switched off.

Option-2 Automatic Transfer Switch (ATS): An automatic transfer switch installed by an authorized electrical contractor is connected between the utility input and the generator. During a power outage the load would be automatically switched from the utility to the generator, and when the utility returns the load would be switched back to the utility and the generator switched off. In both options the UPS feature of the battery system would be retained. ***See diagram three.***