ULTIMATE SERVICE ASSOCIATES
A NORTH AMERICAN SITE SERVICES CO.

The ultimate solution for maintaining your nationwide generator network

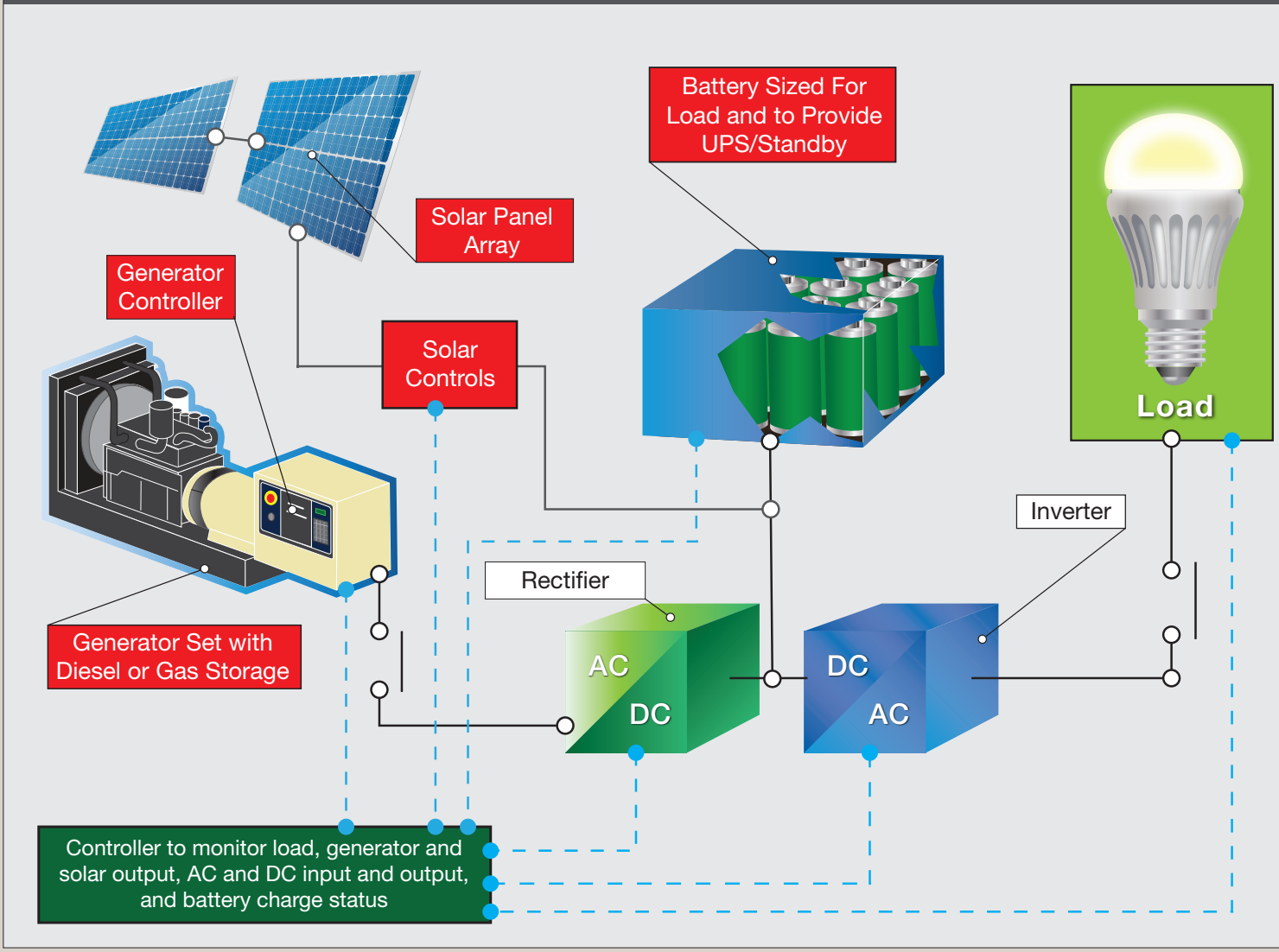
Hybrid Generator Systems - More Efficiency and Greater Sustainability

1.0 Introduction:

As users, local authorities, and regulatory bodies move towards sustainable energy solutions, alternative solutions for power generation (for both prime and standby applications) have been developed. The hybrid solution was first adopted in large numbers by automotive manufacturers. Their hybrid solution was to use the vehicle motor in combination with batteries with drive to the wheels from electric motors as opposed to the traditional engine drivetrain system. With the wide acceptance of hybrid power solutions, some manufacturers and power system designers are now applying hybrid power solutions to the generator set industry and applications.

This information sheet discusses the advantages of adopting a hybrid energy solution for your power needs, how these systems operate, and how they can be applied to a wide range of power system applications.

Figure 1 **Prime Power Hybrid Generator System Using a Combination of Solar and Fuel Energy Sources**



To fulfill our commitment to be the leading network service provider in the Power Generation Industry, the USA, Inc. team maintains up-to-date technology and information standards on Power Industry changes, regulations and trends. As a service, our **Information Sheets** are circulated on a regular basis, to existing and potential Power Customers to maintain awareness of changes and developments in engineering standards, electrical codes, and technology impacting the Power Generation Industry.

2.0 Definition of a Hybrid Energy System:

A Hybrid Energy System is where the energy to drive the equipment to be powered is derived from more than one energy source. Hybrid Energy Systems have been around for many years, but they were first introduced to the general public when the automotive industry offered hybrid powered vehicles. Hybrid cars power the car using an engine generator system to provide electricity to the electric motors driving the wheels with a battery system incorporated that allows the engine to shut down when there is sufficient battery power available to drive the wheels. While defined as hybrid power, they are not a true Hybrid Energy System, because the fuel in the tank is always the single source of energy. Whereas when referring to hybrid power in generator systems, the following occurs:

2.1 Hybrid Dual Energy Supply/Source – A traditional engine-driven generator system utilizes an internal combustion engine fueled by a fossil fuel such as diesel, natural gas, or LPG. The engine is connected to an alternator which is turned to generate electrical current. In this case it is a single fuel/energy source system. In a hybrid system, we introduce an additional energy source. This source in hybrid generator systems is frequently renewable energy, most frequently wind, and solar. Therefore, a hybrid generator system has two distinct energy sources for powering the connected load.

2.2 Other Dual Fuel Systems – Some generator systems have dual sources of fuel. For example, some rental generators can be switched between natural gas to LPG, and some larger engine systems can switch from diesel to a gas mixture. But these systems are not the latest concept of what a hybrid generator system is.

3.0 How a Hybrid Energy System Operates:

In a true hybrid system, the sources of energy are switched as load demand fluctuates. The switching is seamless with no perception at the load side that the source of energy has changed. If a renewable energy supply, such as wind and solar is operating in a hybrid system using a diesel generator set, it is connected as follows:

3.1 Connecting Hybrid Dual Energy Sources – The generator power is connected to a bus bar. Some or all of the load is fed from the bus bar via a connected rectifier and inverter system, with a battery back also connected to provide storage and Uninterrupted Power System (UPS). See ***Figure 1***.

3.2 Selecting the Energy Source – The load applied to the Hybrid Power System dictates the energy sources in a normal state condition. Should one of the sources go offline then the remaining energy source would be the default selection provided it had the capacity to manage the load. In a Hybrid System, the renewable fuel source is used to supply the average load with the engine-driven component switching online when demand exceeds the average.

An analogy to this could be a Hybrid vehicle, when cruising down the road, a period of less power demand, the electric motors on the wheels are powered by the battery. However, when more power is required to accelerate or climb hills, the engine generator system kicks in to provide the extra power.

4.0 Advantage of a Hybrid Energy System:

As for highway vehicles, the demand and technology for hybrid systems has been driven by emission regulatory bodies and the trend towards systems having a lower carbon footprint. However, even as environmental concerns have driven the technology to reduce emissions, the technology developed to meet reduced emissions also provides some additional benefits. When considering a Hybrid Generator System, the following benefits of such a system are:

4.1 Lower Emissions – Some states, such as California, have very stringent exhaust emission standards and regulate total carbon emissions over a given period. If an engine-driven system is connected to a hybrid system with renewable energy such as wind and solar as the alternative energy source, the benefit is the engine generator (the regulated exhaust emission component) only runs when full load is required. Most generator applications only require full load when connected items such as motors are switched on; the average load demand is well below peak load demand. When the renewable energy component is supplying the load carbon emissions are zero, thus reducing total emissions over a given period.

4.2 More Efficient Use of Carbon Fuel Components – The engine driving a generator system is designed to have optimum fuel efficiency when operating at its rated power. Look at an engine data sheets and they indicate pounds of fuel per bhp goes down as the load increases. When the engine component only runs when it is loaded above 75% full load, the system will have much greater fuel efficiency.

4.3 UPS Component – As shown in ***figure 1,*** the connection of the energy sources through rectifiers and output through inverters connected over a battery backup, provides a UPS system. In a traditional standby engine driven generator system, the load is connected via an automatic transfer switch (ATS). When the primary power supply goes offline there is a few second delay without power as the generator runs up to speed. With the UPS component, the batteries or renewable energy seamless supply power as the engine system runs up to speed. In a hybrid system the batteries would be sized to provide the power required by the load while the generator runs up to speed.

4.4 Generator Sizing – Frequently the generator must be sized to meet application loads that have high peak demand for short periods; this results in high redundant capacity. By sizing the batteries, see figure 1, to manage the peak loads, there is the possibility to select a lower rated generator system. The generator will maintain the batteries are charged for peak demand.

5.0 Applications Suitable for Hybrid Energy Systems:

A hybrid generator system benefits applications that wish to enhance energy efficiency, have long periods of minimal daily load, and 24-hour load requirements with zero tolerance for a power outage. Typical applications include:

- Remote application in rural areas situated far from the utility supply.
- Rental power where the peak load demand is only used for short periods.
- Noise abatement restricts the continuous use of engine-driven power systems.
- Applications requiring full UPS.
- Applications where fuel replenishment is restrictive and high fuel efficiency is a requirement.

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