ULTIMATE SERVICE ASSOCIATES
A NORTH AMERICAN SITE SERVICES CO.

The ultimate solution for maintaining your nationwide generator network

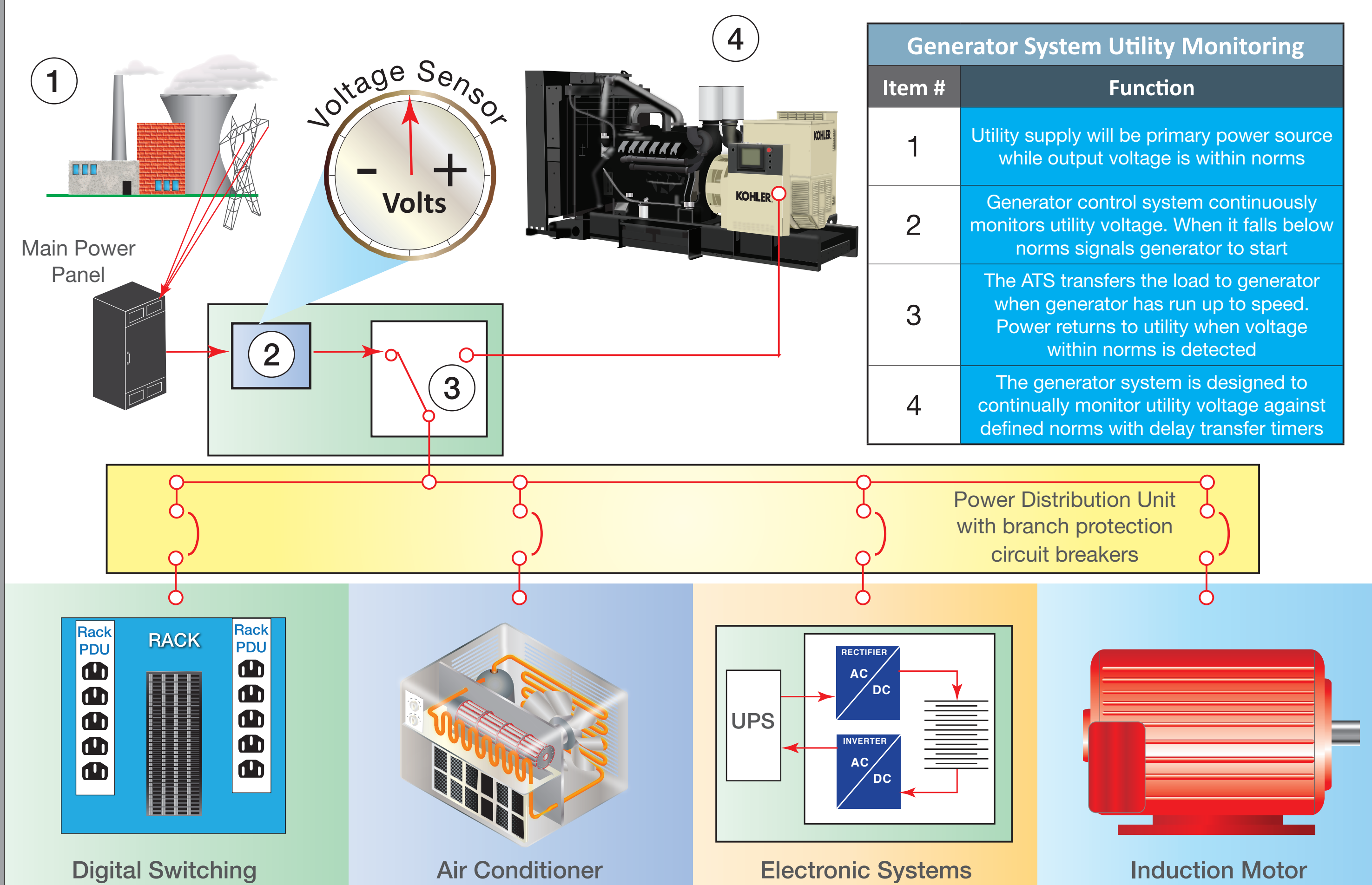
Generator System Backup Managing Brownouts

1.0 Introduction:

Primarily when considering the requirement for a backup generator system, users are looking to protect themselves from a total power outage when the utility system goes off-line. A complete power outage is referred to as a "Blackout", but there is another equally damaging scenario to connected electrical equipment termed "Brownout". A brownout is different than a blackout. In a brownout, the voltage provided by the power supply drops below its standard value, but the electric service is not interrupted completely. A brownout is defined as a period of reduced voltage of electrically utility power, particularly in periods of high demand on the utility supply that results in reduced illumination.

This information discusses why brownouts occur, the damaging effect on different types of connected loads, and why it is just as important to install a standby generator system to protect against brownouts as blackouts.

Figure 1 Standby Generator System Sensing & Protecting Loads During Brownouts



Generator System Utility Monitoring

Item #	Function
1	Utility supply will be primary power source while output voltage is within norms
2	Generator control system continuously monitors utility voltage. When it falls below norms signals generator to start
3	The ATS transfers the load to generator when generator has run up to speed. Power returns to utility when voltage within norms is detected
4	The generator system is designed to continually monitor utility voltage against defined norms with delay transfer timers

Typical connected loads that can be adversely effected when the utility voltage falls below defined norms.

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 What Causes Brownouts:

Brownouts can be created intentionally by the utility power supply to manage a load reduction in an emergency and to avoid going to a full blackout. The power company tries to avoid brownouts due to the potential adverse effects on various connected loads.

More frequently brownouts are unintentional due to unforeseen loads on the utility supply, for example:

2.1 Unusually High Power Demand – Very high ambients in the summer will cause much greater loads as air-conditioners run continuous with the sum average of all connected utility customers above the capacity of the utility supply. Similarly, very cold winters result in total connected heater devices placing an above average power demand.

2.2 Parts of the Utility System Going Off-Line – Utility companies have multiple sources of power generation, and various ways to route power to their customers. The utility usually supplies power below full capacity of all the power generation centers feeding the supply, for example the utility, or grid system, may only be loaded to 80% of capacity with surplus power available to meet seasonal variations. However, should part of the system go off-line a greater load is placed on the remaining power supply. Failure of power capacity could be maintenance planned shutdowns, unplanned failures, and switching issues.

2.3 Distribution Grid Network – An electrical grid supply routes power to users through a complex network with the grid having connections to numerous power supplies; coal, gas, nuclear, hydro, renewable, etc. The grid system is designed to switch power to users from various supply sources. Should one supply go off-line the power to connected customers will be automatically fed from another source. When there are issues with the grid supply; lighting strikes on transformers, wind damage, switching system issues, etc., the remaining grid can end up being overloaded.

3.0 Is a Brownout Worse Than a Blackout:

A blackout is a total loss of power, that in itself is an issue because all connected loads will lose power and shut down. Many installations connected to the utility are life and economically critical, that is why applicable regulations mandate the use of standby power for critical installations. However, a total interruption in power does not usually damage connected equipment.

A brownout is a reduction in power, not a shutdown in power. The load being supplied remains connected but is now being fed electrical power at a lower voltage than it was designed to operate at. This reduced voltage can have an adverse effect on numerous connected loads. Therefore, if the connected load is not life and/or economically critical, brownout could be more damaging to users than a blackout.

About 40% of customers each year experience lower voltage supply issues when connected to the grid supply.

4.0 Connected Loads That Can Be Adversely Effected by Brownouts:

Utility customers have an extensive list of connected loads that react in different ways when the supply voltage drops below normal. A high percentage of connected loads, for example; electric heaters, incandescent lamps will lose functionality, loss of heat, but will not be damaged by reduced voltage. However, the following electrically equipment can be damaged:

4.1 Commutated Electric Motors – These motors will run at reduced speed or reduced torque which will not affect all motors. However, when the motor is fully loaded it could draw more current at lower speeds. If the motor does not have sufficient cooling it could burn out.

4.2 Induction Motors – These motors will draw more current as the voltage decreases, which can lead to overheating and burnout. If a high percentage of a customer's load on the grid is electric motors a reduction in the voltage supplied may not reduce overall load and result in damage to the connected load.

4.3 Electronic DC Circuits – A reduced rectified AC supply can result in reduced direct current. A linear direct current regulated supply will maintain the DC output voltage provided the brownout does not drop the input voltage below the drop out voltage for the regulator.

4.4 Digital Controls – Brownouts can cause unexpected results in systems using digital control circuits. Reduced voltages can bring control signals below the threshold at which logic circuits can reliably detect which state is being represented. When the voltage returns to normal the logic controls may return to an incorrect state.

5.0 How Standby Generator Systems Manage Brownouts:

If a utility customer becomes aware of reduced voltage on the grid supply they have the option to switch off loads that are adversely effected by reduced input voltage. The risk during a brownout is that it may be detected too late and switching off power to equipment is not the optimum solution. While a generator system can be started and have the load manually switched by a bypass isolator switch to the generator when it runs up to speed, the preferred solution is to monitor the utility voltage and switch power to the standby generator automatically. Automatic switching adopts the following process, see *figure 1*:

5.1 Automatic Transfer Switch (ATS) – In addition to an ATS's primary role in transferring the load to the standby generator when the utility goes off line, it also has the generator take over the load when the utility voltage falls below preset norms.

5.2 Generator Control Module – The generator controls are designed to constantly monitor the status of the utility power input and generator output. Monitoring of utility includes:

- Voltage - each phase if three-phase system
- Current
- Frequency

5.3 Monitoring Brownout Conditions – When a blackout occurs the generator will be signaled to start, run up to speed, and take over the connected load via the ATS. The monitoring system will also signal the generator to take over the load when it detects the utility power voltage has dropped to the defined definition of a brownout.

5.4 Delay Transfer Timers – Timers are built into the monitoring system to avoid transfer to the generator and return to the utility when there is only a momentary drop below voltage norms. This avoids too much switching when there are just transient conditions. Adjustable presets are built in by the generator system designer.

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