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Safe Use of Emergency Generators

Paul W. Benson, University of Illinois and LaVerne E. Stetson, USDA-ARS

Introduction

Electric power suppliers cannot guarantee continuity of electrical service. The supply of electric power is usually taken for granted until a power outage occurs. People often do not realize the full importance of electricity. Many outages are caused by storms, equipment failure, accidents to power lines, etc. People rely on electric power to operate their everyday electrical equipment, such as refrigerators, freezers, furnaces, sump pumps, lights, etc. Spoiled food, frozen pipes and flooded basements are just a few of the hazards that may exist with power outages of some duration. In some cases, a consumer may even rely on electricity to operate life-support systems.

A business, such as a livestock farming operation, should have a standby generator to guard against financial losses due to an untimely power failure. The American Society of Agricultural Engineers (ASAE) has a standard for the installation and use of standby power on farms. A residence, however, seldom has a permanently installed standby generator, or even facilities for a standby generator, so when an unexpected power outage occurs, most people do not know what to do for their home. A homeowner may gain access to, or own, a small portable generator with an output in the range of 500 watts to 5000 watts but may not be prepared to use it effectively or safely.

The Illinois Electric Council provides a framework through which the University of Illinois, investor-owned utilities, electric cooperatives and others discuss mutual problems, share information and develop cooperative education programs and research activities designed to promote more effective, efficient and safe use of electric energy by consumers.

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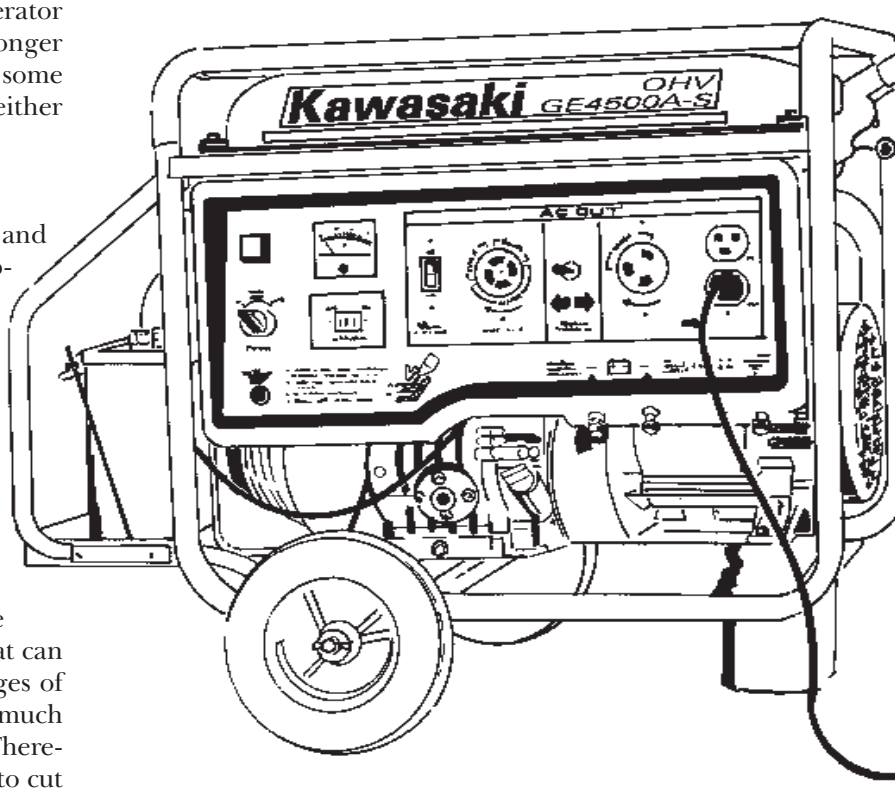
The duration of the power outage can make a difference as to the need for a generator. If power is off for only a short period of time (e.g. 1-3 hrs.), a generator may not be needed. But when power is off for a longer period, the generator may be needed for powering some lights and more than one piece of equipment, either simultaneously or alternately.

Sizing

The generator should have adequate capacity and rating to supply all equipment intended to be operated at one time. Before securing a generator, decide whether you want to power the entire dwelling or operate only the most essential equipment. To figure the generator capacity needed, list lights and equipment that will need to be operated at the same time. Some equipment may not need to be operated at the same time and can be alternately supplied with power after other equipment is shut off. Some equipment should not be operated to reduce the capacity of the generator needed. Determine total wattage required at any one time and buy a generator that can handle this load. Remember when adding wattages of motors, the motors may use about six times as much wattage when starting as compared to running. Therefore, you may want to start motors one at a time to cut down on the total load.



Voltage Specifications

The generator should have available the voltages (V) you will require, i.e. 120V, 240V, 120/240V. You will need 120 V for lights, refrigeration, freezers, sump pumps and most furnaces, while 240V is usually needed for running a well pump and some specialized equipment. A combination of 120V and 240V (120/240V) is needed at a transfer switch to properly operate the service entrance panel.

The transfer switch permits switching the input power to a service entrance panel from either the generator or utility power but keeps generator power from accessing the utility power. Some generators do not have a receptacle outlet that provides both 120V and 240V. Problems occur when using a 240V only generator connected to a service-entrance panel. If the generator does not have a neutral, voltage will vary below or above 120 volts. If this occurs, a dimming or brightening of lights happens when connecting or disconnecting 120V equipment. Equipment with 120V motors could have motor failures with this unstable voltage.

Starting and Exercising

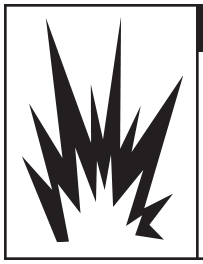
The generator should start readily when it is needed. It may be a manual start with either a rope-pull or battery powered starter, or it could be an automatic start generator. In either ing it against oxidation. If the generator is stored at room temperature or above, the gasoline can oxidize quickly and cause problems in the carburetor. Make sure you have a fresh supply of fuel on hand at all times to run the generator for several days. Be sure to store fuel in a safe place.
Remember never to add fuel to the generator while it is running.

Grounding

Grounding requirements can vary for a generator depending on its installed use. If it is connected to the dwelling's transfer switch, then it should be grounded by a grounding electrode driven in the earth or by bonding the generator's ground to the dwelling's grounding electrode. The frame of a portable generator isn't required to be grounded to the earth if it supplies power only to cord- and plug-connected equipment through receptacles mounted on the generator. The most important fact to consider is that the grounding wire should be provided to the equipment so as to provide a fault path back to the source of power. This will trip an overcurrent device on the generator (if one is provided) and remove the faulted circuit.

Location

The generator should be operated outside of the dwelling to avoid dangerous exhaust fumes and chances for starting a fire. The location for the generator during



⚠ DANGER

- GASOLINE BURNS OR EXPLODES.
- DO NOT REFUEL A HOT OR RUNNING ENGINE.
- CLEAN UP SPILLED FUEL BEFORE STARTING.

operation should be considered carefully so that it is a minimum distance from the largest capacity equipment to be operated and can be protected from the weather. The distance from the equipment to be operated partially determines the size of the conductors needed to supply the power. Increased distances may mean increased size of conductors in the cord. For example, a 120V load of 30 amperes (A) at 9 m (30 ft) from the generator requires No. 10 AWG copper conductors, while this same load 23 m (75 ft) away from the generator requires No. 6 AWG conductors.

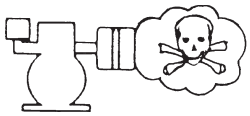
Overload Protection

The generator should be protected from overloads either by its inherent design, or by adding circuit breakers or fuses after purchase. If your generator has no built-in overload protection, you should add protection according to the National Electrical Code (NEC). The conductors in the cord used for carrying current from the generator to the first overcurrent device that you add should not be less than 115 percent of the nameplate current rating of the generator. If the generator has overcurrent protection built-in, then the size of this overcurrent protection is used to size the wires leading from the generator to the transfer switch. For example, if the generator is protected by a 30 A circuit breaker, then the generator power supply cord must be rated to handle 30 A.

Written Procedures

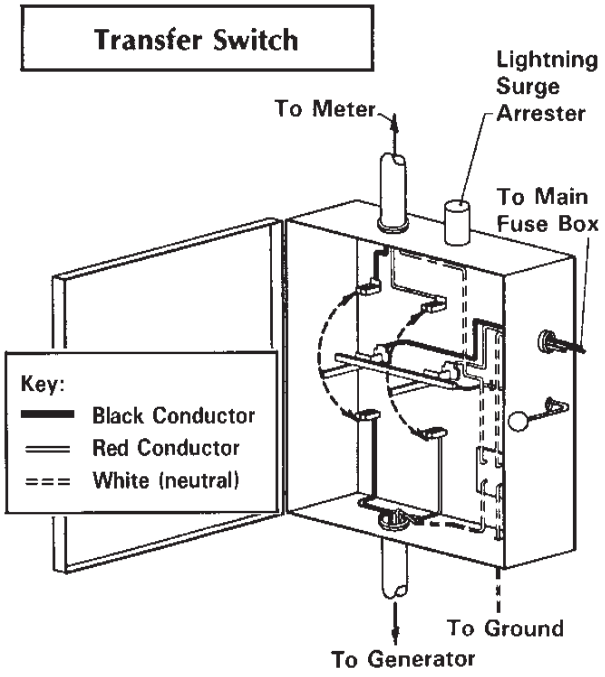
A set of procedures for emergency power should be written and displayed prominently in an area where emergency lighting will allow its use. These procedures should also include the owner's manual for the generator. These instructions will be invaluable if people unfamiliar with the generator will be required to operate it or if a long time occurs between testing or using the generator. Safety for the operators and users of the emergency generating system can't be stressed enough.

⚠ DANGER



ENGINES PRODUCE CARBON MONOZIDE WHICH IS AN ODORLESS DEADLY POISON.

DO NOT OPERATE IN AN ENCLOSED AREA.



Generator Connection Requirements

The generator manufacturer's operator manual should be thoroughly reviewed before attempting to use or install a system. ASAE EP364 has general requirements for installation as well as NEC Article 702.

Transfer Switch

The dwelling should either have a double-pole double-throw transfer switch for connection of a generator or other special provisions to power individual equipment in emergencies. If there is a need to operate the service-entrance panel of a dwelling during an outage, then a transfer switch should be used to disconnect the supply from the power supplier and connect it to the generator. (This is an NEC requirement for permanently installed generators [NEC Article 702]). As stated before, the transfer switch prevents generator current from flowing into the power supplier's lines during an outage. Without this switch, the generator could harm linemen working on the lines when restoring power. The switch also protects the generator from the power supplier's lines when power is restored to the dwelling.

For 120/240V single-phase power, the transfer switch should be a double-pole, double-throw type. The rating of the transfer switch is determined by the load it is to serve. In the case of providing power to the dwelling's service-entrance panel, the rating of the transfer switch should be at least as high as the rating of the service-entrance panel. A way to cut down on the size and cost of the transfer switch needed would be to mount only a smaller transfer switch between the service-entrance panel (in the circuits that are needed during an outage) and the equipment to

⚠ DANGER

FAILURE TO CONNECT GENERATOR PROPERLY TO YOUR ELECTRICAL SYSTEM CAN RESULT IN ENERGIZING UTILITY LINES AND DEATH TO LINEMEN WORKING ON THOSE LINES.

be used. Some generator companies have home standby connection kits (transfer switch, power cord, male receptacle, auxiliary fuel tank, etc.) available for purchase.

Dedicated Circuits

Another low cost option to consider if you decide not to install a transfer switch, is to operate the equipment needed during a power outage by plug- and cord-connections only. For example, a furnace is usually connected with cable to service-entrance box. A licensed electrician could install an electrical device box (containing a receptacle) in the circuit close to the furnace switch and use it for the connection of a cord that would extend to the furnace. When a power outage occurs, you can simply unplug the furnace cord from the house circuit and plug it into the power cord from the generator. You may choose to use a twist-lock attachment plug and receptacle to prevent its accidental disconnection. Make sure the configuration of the furnace attachment plug matches that of the receptacle (connector body) at the end of the generator power cord. Some electrical inspection authorities may not permit this arrangement for some loads.

Extension Cords

A proper extension cord should be available for use with the generator. Be sure to consider size of conductors, type of outer covering, number of conductors, length and flexibility of the cord. This generator power supply cord should be highly flexible cord with copper conductors. For example, a type SO cord could be used because it has an outer covering that is oil resistant, allows extra hard usage and allows it to be used in damp locations. Type SEO and SJEO are also sunlight resistant and remain flexible at cold temperatures. The ampacity ratings for two and three conductor flexible cords can be obtained from NEC Table 400-5(A).

The extension cord should have the proper attachment plug to match the generator receptacle or receptacles. Generator sets are manufactured and de-signed by many different companies. There is no third party certification for generators (such as the Underwriters' Laboratories Inc. [U.L.]). Therefore it is not uncommon to see various configurations used for receptacles on gen-erators of equal wattage size but different brands. Some variations exist because of the specific output voltage and amperage of the generator. Most generators us the National Electrical Manufacturers Association (NEMA) configurations for their receptacles, but same may not. Some generators may have non-locking plug and receptacle combinations. Whichever receptacle configuration your generator has, make sure you have available the proper attachment plug on the proper size and type of power supply cord. A twist-lock plug and receptacle is recommended so they don't vibrate apart while the generator is in use.

If an attachment plug and receptacle are to serve as a disconnecting means for a motor, these devices need to be horsepower rated. For example, a 15 A, 125V, single-phase, 2-pole attachment plug is rated at ½ horsepower. Most attachment plugs and receptacles are not marked with horsepower ratings. However, NEMA and U.L. have determined appropriate horsepower ratings for these unmarked devices, and listings are available.

Widespread Disaster Situation

In the event of a power outage due to a widespread weather disaster, such as tornado or ice storm, situations arise where homes have been without power for several days, or longer. Each one of these disasters brings stories or electrical shocks, fires, damaged equipment and sometimes electrocutions from improper and very unsafe installation and use of standby power. Many people are not prepared for a generator connection as described previously. For example, the power supplier's lines may be down in many locations, stores (including hardware and electrical stores) may be closed and telephone lines could be down. A homeowner buys, rents or borrows a generator to operate some lights, a sump pump and the furnace. A transfer switch was not installed previously and the furnace is not plug- and cord-connected. What can be done in this situation to prevent serious damage to the home or to linemen repairing power lines?

For lighting, use table lamps that are plug- and cord-connected or even a trouble lamp. Power the lamps by directly plugging into the generator when needed. The sump pump may be directly connected by a circuit, but most are plug- and cord-connected which would allow for its operation. The furnace, however, is almost always permanently connected to a circuit. If a licensed electrician can be located, the electrician may choose to connect a cord to the furnace and disconnect the wire to the permanent circuit at the furnace switch.

Summary

The general requirements and recommendations of the procurement of a standby generator have been reviewed, along with the requirements for its installation and connection. An emergency procedure for advice and installation of an emergency generator during widespread disaster situations has also be described.

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