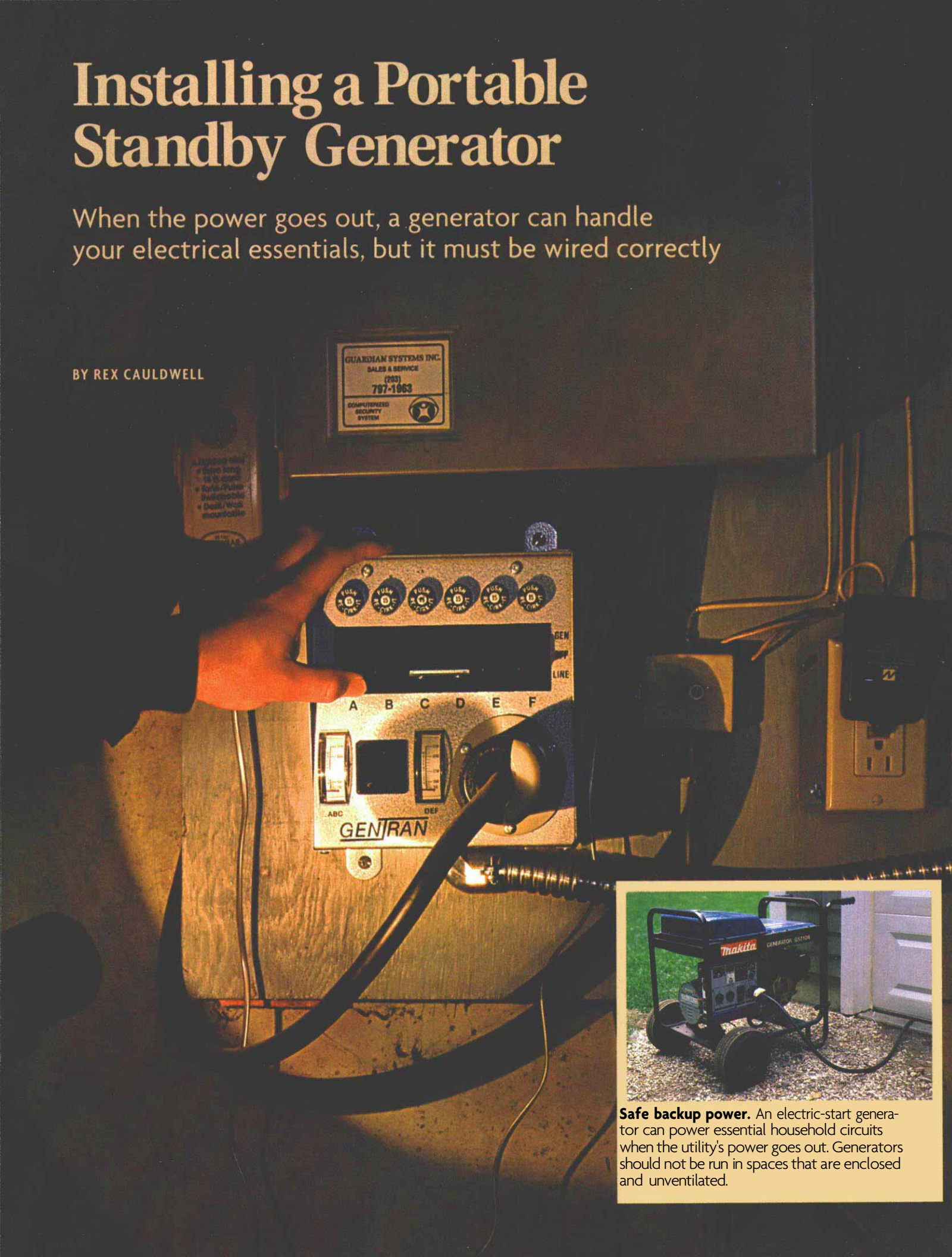
Installing a Portable Standby Generator

When the power goes out, a generator can handle your electrical essentials, but it must be wired correctly

BY REX CAULDWELL



Safe backup power. An electric-start generator can power essential household circuits when the utility's power goes out. Generators should not be run in spaces that are enclosed and unventilated.

Sick and tired of hearing about the Y2K problem? Electricians have it worse, believe me. I've been deluged this year with telephone calls and e-mail from people worried that computer problems will lead to power outages as clocks roll over to 2000. In the past, extended power outages created by storms or utility overloads have been enough to make a portable standby generator look appealing. Now the incentive is even stronger.

Even if the Y2K problem *fizzles,* having your own generator system can be a blessing. A midsize gasoline-powered device can provide power to essential appliances, such as a freezer, refrigerator, lights and water pump. I designed circuits in my electrical system so that a portable generator could run everything I need during a power outage. Your wiring plan may not allow you to do that. But by sizing your generator correctly and by wiring your service panel to accept this alternate source of electricity, power outages might not be a problem. In fact, I rather enjoy them now.

If a generator can make life easier, it can also he dangerous. Thanks to faulty information doled out by expert neighbors, hardware stores and even some generator manufacturers, I've seen many improper installations. When wired incorrectly, a generator can route electricity through your grounding system and put voltage on utility-transmission lines. That dims power over the local area and can electrocute utility linemen. Carbon-monoxide fumes produced by the engine can be extremely dangerous. Installing a standby generator properly isn't necessarily cheap. An electric-start, 5000w generator can cost more than $2,000, and a switch for your service panel costs at least another $350. But if you're going to do it, make sure the job gets done right.

Buy a generator with an output of at least 4500w

Generators come in all shapes and sizes. Those that start automatically and provide massive amounts of power sell for $10,000 or more, making them too expensive for the average homeowner. More realistic are manual-start units, fired up by the owner after the power has gone out. Very small generators—in the 1500w output range—are light in weight. But they will run only light loads and are meant to be used for small appliances, one or two at a time, through an extension cord.

To power household circuits, choose a generator with a higher output, or wattage (inset photo, facing page). A generator comes with two listings, surge and run. A salesman may try to hype his generator by giving you only the surge wattage, which lasts only a few seconds, as a reference. You must be concerned with both surge and run outputs. A large surge wattage is important because it allows one or more motors or compressors to start at the same time. But you can't use the surge rating as a reference to the total wattage that can be continuously used. Typically, surge ratings are 200w to 500w higher than continuous-run ratings.

You could determine what size generator you need by figuring the number of appliances, receptacles and lights that you absolutely must have and totaling their wattage. But rather than add up every small appliance, it's easier just to buy a generator with an output of at least 4500w or, even better, 6000w. My 5900w generator runs a freezer, fridge, lights, stereo-TV-satellite, water pump, computer, electric garage-door opener and microwave all at the same time.

Some appliances need a lot of power. It takes a 3500w generator to start a $^{3}/_{4}$-hp submersible water pump. A typical electric water heater requires 4500w, although replacing standard heating elements with 3500w (or smaller) elements will help. It takes longer for the water to get hot, but it does get just as hot.

Low-cost generators typically have a standard 120v ground-fault receptacle to provide power. Midpower generators add a 240v plug, which looks like a standard receptacle

USE A THREE-POSITION SWITCH

This switch is not legal. A switch with only two positions does not meet code and, more important, is potentially lethal.

This switch is legal. A double-throw switch safely handles power from the utility's grid or from a standby generator.

Look for a four-slot receptacle. Power to a special switch at the main service panel is provided through the receptacle on the far right. Its four slots are designed for a twist-lock plug and feed a four-conductor cable. This circuit will provide both 120v and 240v.

Photos facing page: Scott Gibson

with the two slots going sideways instead of straight up and down. They may also have a three-slot twist-lock receptacle supplying 120v. If the generator is intended to supply an entire house with power, the generator must have a round, female twist-lock receptacle with four slots (bottom photo, p. 99). To provide power to the house, you will have to make a special extension cord. It should have a four-conductor twist lock on each end, male on one end and female on the other, and it should use four-conductor cable.

Look for an easy-starting engine

Most low-cost to medium-cost generators come with engines just like the ones you'll find on economy lawn mowers. And they start just as hard. A number of manufacturers use Honda engines on better-quality machines. They are easy to start, even if they've been ignored for a year. When ease of starting is important, that's the engine I prefer.

You either will buy a generator with an electric start or wish you had. Hand-pull, or recoil, starts have a habit of not starting when you want them to due to long periods of inactivity (I'm told the Honda engines are an exception). With an electric-start generator, it's a good idea to start your generator once or twice a year just to be sure the battery is properly charged.

Generators are heavy and noisy. If your generator isn't already on wheels, you should consider making a two- or four-wheel dolly so that you can move it around easily. Because of noise and exhaust, a generator normally is exiled to an outside shed or the garage. Some manufacturers provide silencers and outside exhaust kits for their generators. Because of the dangers from exhaust gases, I don't think it's a good idea to run a generator in the garage (sidebar below). Nor should one be operated near doors and windows.

Wiring a generator into your household electric system

Wiring a generator normally requires a licensed electrician. If you do the work, remember the job involves working inside the main service panel, and possibly with the service-entrance conductor. If work is to be done in the service panel, be sure to cut all power at the main. If work is done between the service panel and the meter base, you will have to call your electric utility to get the meter pulled, and you may need a permit.

No matter what you may have been told, it is illegal to hook a generator directly into household wiring via a dryer or stove receptacle. This process is called back-feeding, and such connections are against all electric codes and are extremely dangerous to utility workers. A generator must be installed through a special switch called a double-pole double throw. This device can be a large single switch (photo top right, p. 99) or a box containing a number of individual switches. Even if the box looks official, unless it is a double-throw, three-position switch (with on-off-on settings), it does not meet code, and it is dangerous (photo top left, p. 99).

In the past, the standard legal way to connect a generator to the house was to install a double-throw switch box between the meter base and the main service panel. But this system no longer meets code: You are not allowed to cut into the line between the meter base and the service panel.

Another alternative is to put all the circuits you want to feed from the generator into a separate panel that is fed by a double-pole, double-throw switch. In one position, power comes from the service panel. In the opposite position, circuits are disconnected from the main service panel and are fed by a generator. But this method, which is expensive in terms of labor and materials, is not a logical way to go if the house is built already.

The easiest route is to use a manual transfer switch at the main panel

A manual transfer switch is the easiest way to hook up a generator. I use a Gen/Tran switch (Gen/Tran Corp., 88 Mansell Court, Roswell, GA 30076; 888-436-8726; www.gen-tran.com). Another brand, which I have not used, is the EmerGen Switch (Connecticut Electric Switch Mfg. Co., 19 W. 11th St., Anderson, IN 46016; 765-608-5230; www.connecticut-electric.com). Whether the house is under construction or already built, installation is simple because no coordination is necessary with the utility.

The switch is installed next to the main circuit panel and wired directly into it (photos facing page). When the power goes out, your generator is connected to the switch via a cable that you make yourself. You will need a four-conductor cable ending in a female twist-lock plug at the switch end. The other end will be whatever is needed to plug into the generator—the best choice is a male four-conductor twist-lock plug. The cable should be made of 10-ga. wire, but it can be 12 ga. for short runs and lower current.

The pigtail from the Gen/Tran, consisting of pairs of red and black conductors, is fed through a service-panel knockout. The large neutral (white) wire from the switch is connected to the neutral bus of the service panel. Each pair of red and black conductors is coded by letter. To wire a circuit into the Gen/Tran, remove the hot (black) wire from the breaker and splice it onto a black wire from the Gen/Tran (photo bottom left, facing page). The red wire with the same letter code is inserted into the breaker (photo bottom right, facing page). Power will now flow out of the breaker, into the Gen/Tran and then to the branch circuit. In case of utility power failure, the Gen/Tran switch is thrown to the "Gen" position, which disconnects the load from the breaker and connects it to the generator.

When you design the system, it's a good idea to place a light bulb next to the main service-panel box on a circuit that is always powered by the utility. When you see that light on, you know power has been restored, and your generator can be turned off. □

Rex Cauldwell is a master electrician and plumber in Copper Hill, Virginia. Photos by the author, except where noted.

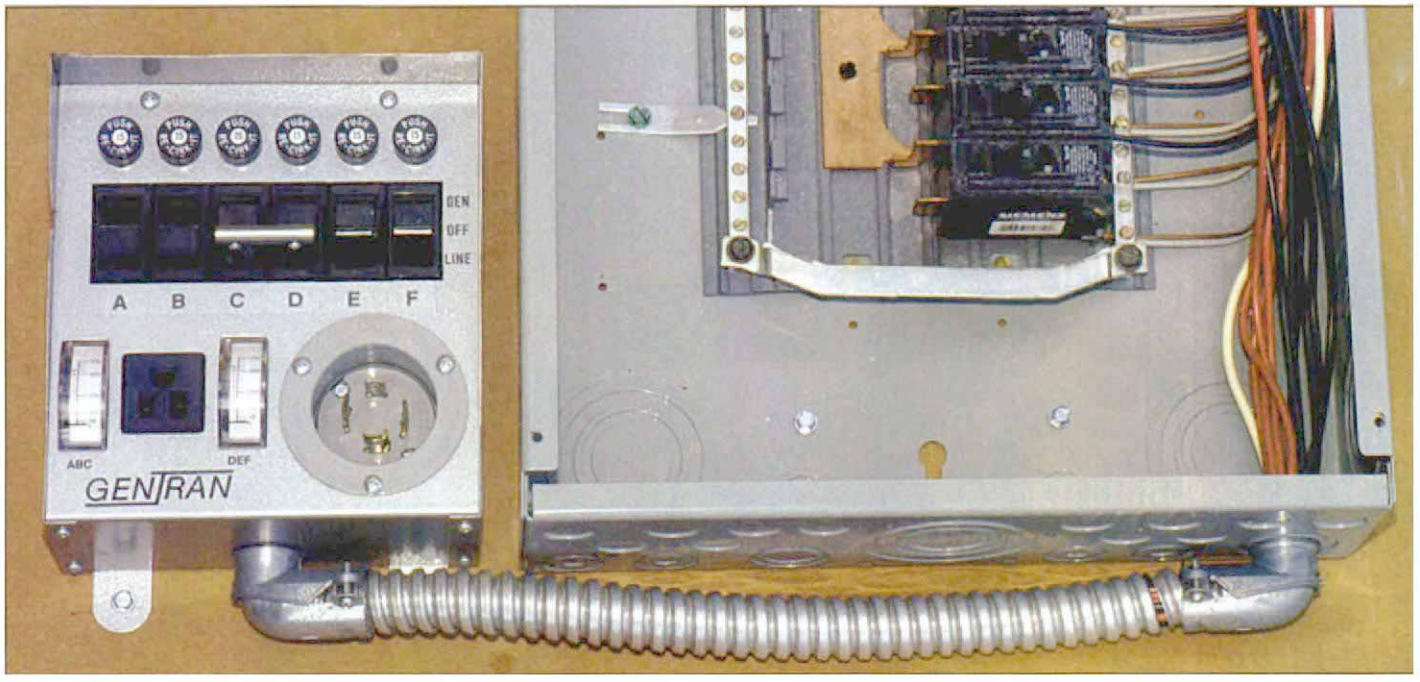
Exhaust fumes can kill

by Scott Gibson

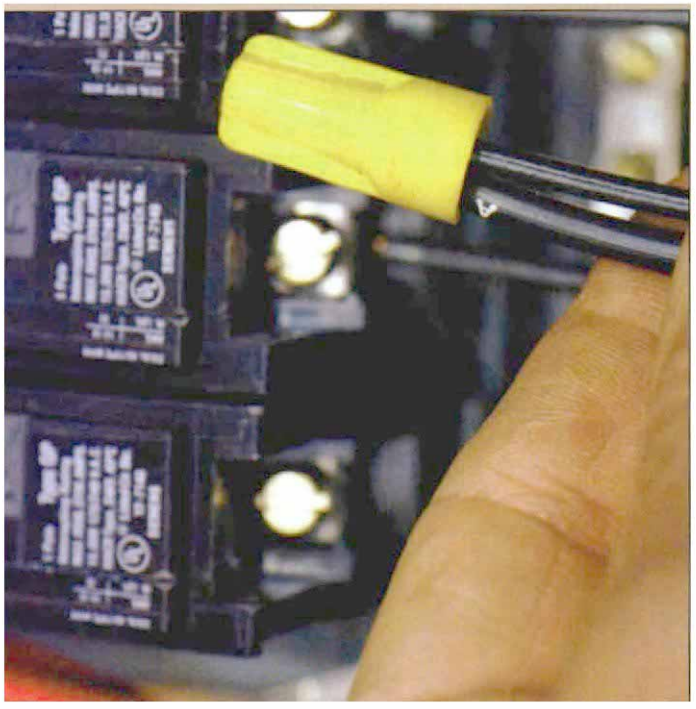
Wayne Kondor was a timber-framer who lived in Vermont with his wife and two daughters. A few weeks before Christmas 1996, heavy snow took down power lines to their house. To keep his family warm, Wayne went to the garage attached to the house and started a standby generator. According to a friend, he was careful to open the garage door a few feet for ventilation. Then the family went to bed. Sometime during the night, the door between the garage and house apparently blew open, creating a draft that carried exhaust gases into the house. Wayne woke up, smelled the fumes and went to investigate. He apparently was overcome by carbon monoxide, and on the way back into the house, he collapsed and died. His wife and children survived. Wayne's funeral took place in a timber-frame church he had built.—Scott *Gibson is a senior editor at* **Fine Homebuilding.**

WIRING A MANUAL TRANSFER SWITCH

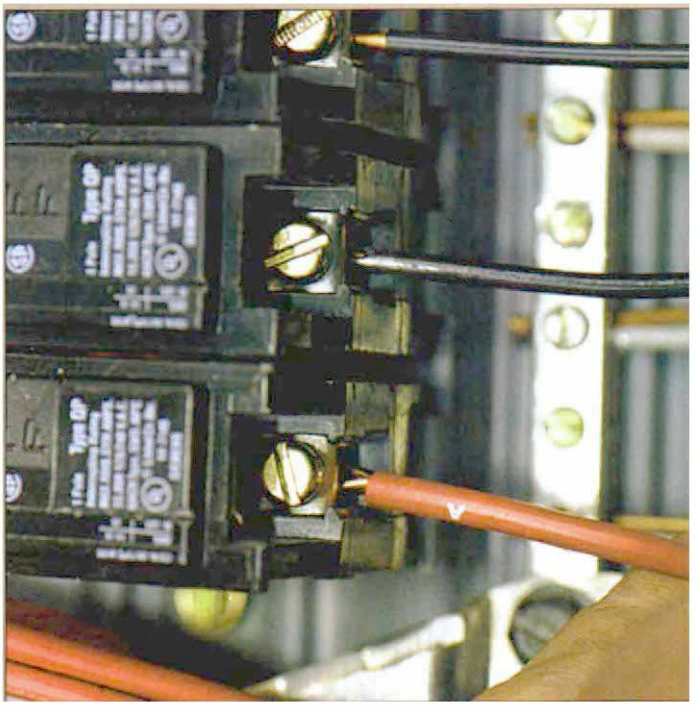
When utility power fails, a manual transfer switch (below) safely routes power from a portable generator to selected branch circuits in the main service panel. Lettered switches on this Gen/Tran control four 120v circuits and one 240v branch circuit



Wiring a transfer switch is simple. Pairs of black and red conductors, plus a white neutral, run through a knockout into the main service panel, where they are connected to household circuits (photos below). During a power failure, a generator supplies power through a cable that plugs into the right side of the Gen/Tran.



Remove the hot conductor to the breaker. After the pigtail from the Gen/Tran switch has been fed into the main service panel, the hot (black) conductor on a selected circuit is removed from the breaker. It is spliced onto a black wire from the Gen/Tran.



The red conductor goes into the breaker. The red wire from the Gen/Tran with the same letter code is plugged into the breaker to replace the black conductor from the branch circuit. When the lights go out, the generator is plugged into the Gen/Tran, and the switch is moved to the "Gen" position.