

Auxiliary Power Units For Greenhouse Operations ¹

Ray A. Bucklin and Richard W. Henley²

An unpredictable power outage can lead to production losses and damage to valuable greenhouse plant material. Successful operation of a greenhouse water well requires the availability of electricity at all times. In the winter, electrical power is needed to run heater fans and controls; in the summer, electricity is needed to operate ventilation fans and to keep double-layered, film-covered houses inflated. An auxiliary power unit can provide insurance against losses or brown outs. A standby power system consists of a generator, an engine or tractor to power the generator, and a transfer switch.

Selection of Unit

It is not always necessary to provide standby power for all greenhouse electrical equipment. The largest users of power are often the water well pump and the ventilation fans. The generator power capacity should be about three times that of the wattage of the largest motor that is to be started, or at least two kilowatts of generator capacity for each brake horsepower as shown on the nameplate of the electrical motors.

When selecting a generator, determine the essential equipment that must be operated at the same time, and calculate the power needed to start and operate that equipment. If short stoppages of some equipment can be tolerated, a smaller generator can be used.

The current needed to run a motor is given on the nameplate attached to the motor, but the starting amperage will

be from two to seven times this amount. More than one motor can be operated at once, but they should not all be started simultaneously. Start the largest or most heavily loaded one first.

Generators are rated in terms of kilowatts. You can get an estimate of the amperes that a generator will produce by dividing power in watts by voltage. At 230 volts, a generator of 5 kilowatts will produce 21.7 amperes. (See Equation 1)

$$\frac{5000 \text{ watts}}{230 \text{ volts}} = 21.7 \text{ amps}$$

Equation 1.

The amps rating should also be given on the generator nameplate.

Table 1 gives the starting power requirements of single-phase electric motors. Three-phase motors have lower starting power requirements, so generators supplying power to three-phase motors can be sized to meet the running requirements alone. Follow manufacturers' recommendations to select the appropriate generator for your combination of voltages and single- and three-phase equipment.

Type of Units

The generator may be powered by a stationary engine or by the power take off (PTO) unit of a tractor. Automatic switching systems will require their own power unit.

1. This document is AE63, one of a series of the Department of Agricultural and Biological Engineering, UF/IFAS Extension. Original publication date June 1993. Revised July 2002. Reviewed December 2017. Visit the EDIS website at <http://edis.ifas.ufl.edu>.

2. Ray A. Bucklin, associate professor, Department of Agricultural and Biological Engineering; and Richard W. Henley, professor, Department of Environmental Horticulture; UF/IFAS Extension, Gainesville, FL 32611.

The Institute of Food and Agricultural Sciences (IFAS) is an Equal Opportunity Institution authorized to provide research, educational information and other services only to individuals and institutions that function with non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, marital status, national origin, political opinions or affiliations. For more information on obtaining other UF/IFAS Extension publications, contact your county's UF/IFAS Extension office.

U.S. Department of Agriculture, UF/IFAS Extension Service, University of Florida, IFAS, Florida A & M University Cooperative Extension Program, and Boards of County Commissioners Cooperating. Nick T. Place, dean for UF/IFAS Extension.

Manual switching systems can be PTO driven or use stationary power plants. If the generator is PTO driven, the tractor must produce two horsepower for each kilowatt of electric power produced by the generator. The use of PTO power reduces the amount of money invested in a system, and the tractor can be used for other greenhouse operations when not being used to drive the generator. Remember, it does take time to hook the tractor to the generator. However if a tractor is not running properly, it is often easier and faster to change tractors than it is to repair or replace a disabled stationary engine.

Gasoline, liquid propane (LP) gas, and diesel engines are available to power these units. LP fuels generally burn cleaner than gasoline. This promotes longer engine life and reduces frequency of service. Gasoline tends to form a varnish in the system during storage, which may make starting difficult. Except for very large engines, diesel units cost more initially than gasoline engines of comparable capacity. However, operating and maintenance costs are lower for diesel engines. A typical standby power unit is shown in Figure 1.

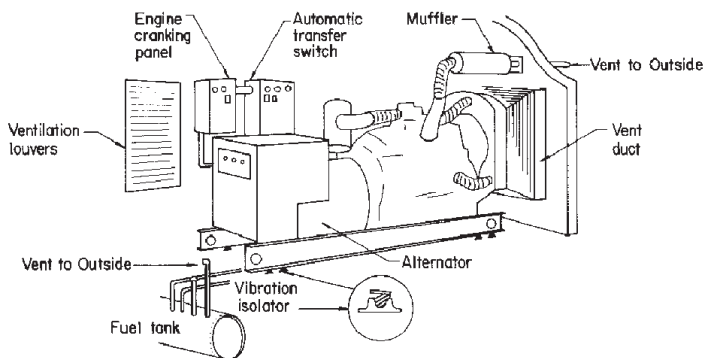


Figure 1. Stationary standby power unit.

The switching mechanism can be either manual or automatic. Automatic switches restore power in a minimum amount of time when power fails, but are expensive. If personnel are readily available to start the generator, a manually controlled system is more economical. Manual switching also makes it possible to use a smaller generator because the operation of equipment should be regulated so that only essential equipment is drawing power.

A standby power system should be completely automatic if critical operations cannot be without power for more than a short time. The generator must have the capacity to handle the starting current of all motors at once. This problem can be eliminated by controlling some motors with time delay relays. They can be set to turn on the motors in sequence to minimize the initial load starting requirements. The cost of this sequencing equipment should be compared to the savings resulting from the reduction in generator size.

Motor Protection

Protect all motors with thermally operated switches that break the circuit if the motor draws too much current. The same type of fuse should be built into the generator.

Installation

When selecting a location for the generator, several factors should be considered.

- Protection from the weather.
- Location near the main service entrance from the power line to minimize wire usage.
- Whether it is to be used on all circuits or only those that supply essential equipment.

Permanently installed, engine-driven electric generators should be mounted on a concrete base. Pads that damp vibrations should be placed between the engine mount and the concrete base to minimize the transfer of vibration to other equipment. If PTO power is used, a location must be selected where the tractor can easily be lined up. Size the wire based on the amount of current carried and the length of the wire. Follow National Electric Code (NEC) guidance when selecting wire sizes and transfer switches.

Use a double-pole/double-throw switch that is approved by NEC to transfer the load to the generator. This type of switch protects service men working on the line from shock, and protects against damage to the generator if the generator is connected to a power line. It is best to employ a professional electrician to wire an auxiliary power unit and transfer switches into your electrical system.

Venting Exhaust Fumes

Engines running on fossil fuels give off exhaust fumes that can damage plant materials and can be poisonous to personnel. If you use a tractor inside a building, use flexible tubing to vent the exhaust gases outside. The exhaust vent from either stationary engines or tractors must be located so that fumes cannot gain entry to the plant growing areas. Make sure that sparks from the exhaust cannot ignite flammable materials.

Operation of Manual Units

Follow manufacturers' recommendations when starting manually-operated standby units. When starting manual units, always turn off or disconnect all electrical loads before starting the unit.

Engage the transfer switch and gradually increase the load on the generator. Start large electric motors first because of their large starting requirements. When commercial power is restored, reduce the loads and return the transfer switch to the normal position. Do not stop the standby unit suddenly; allow the unit to stop freely, because sudden stops can damage the unit.

Care and Maintenance

Auxiliary generating equipment must be properly maintained for satisfactory operation. The generator should be started at least once a month to check for proper operation and recharge starting batteries. Operate the engine long enough to reach normal operating temperature. Oil should be changed and bearings lubricated on a regular basis.

The generator and power plant should be protected from the weather. Also protect equipment from mice and from birds building nests when the generator is idle; a 1/4-inch mesh over ventilating openings is recommended. Avoid lightning damage by grounding the frame of the generator. If the unit is belt driven, frequently check the belts for wear or rot, and use belt guards to prevent accidents. Check the condition of all electrical insulation and test automatic switching units once a week to make sure the unit will start when needed. Do not let fuel stand in unused storage tanks for long periods of times, because undesirable deposits may form.

Alarms

Provide alarms or devices that notify the greenhouse operator at home when power is interrupted. Check the operation of alarms frequently to make sure that personnel will be made aware that power has been lost during an outage. Make sure that alarms monitor all three phases of a three-phase system.

Conclusion

By selecting the proper auxiliary generator, insurance can be provided against loss and damage caused by power outages. This can be done by determining the critical equipment and the amount of power it takes to start the equipment. Install a double-pole/double-throw switch sized to handle the maximum current that will flow through the circuit when connected to the system. Install a generator that has a thermal overload device and has a power rating large enough to handle the critical items that must be used simultaneously. Make sure the system is large enough to provide power to equipment added in the future. Use proper venting techniques with exhaust fumes. Provide

fail-safe alarm systems. Obtain the services of a professional electrician to wire your auxiliary power unit into your power system and make sure that your installation meets the requirements of the National Electric Code.

Sources and Equipment

The following companies supply auxiliary power equipment. These addresses are provided as a convenience and are not recommended over those not mentioned. Check with local electrical wholesalers for transfer switches.

Ag. Tronic, Inc.
364 Airport Rd.
Kearny, NE 68847
(308) 237-2181

Cummings Engine Co., Inc.
Box 3005
Columbus, IN 47202
(812) 377-5000

BFG Supply Co.
14500 Kinsman Rd.
Burton, OH 44021
(216) 834-1883

DMT Generator Corp.
W229 N2494 Hwy 164
Wauksha, WI 53186
(414) 549-0014

Biotherm Eng.
P.O. Box 6007
Petaluma, CA 94953
(707) 763-4444

Dayton Elec. Mfg. Co.
5959 Howard St.
Chicago, IL 60648
(312) 647-0124

Clinton Engines Corp.
Clark & Maple Sts.
Magnoketa, IA 52060
(319) 652-2411

Deere & Co.
John Deere Rd.
Moline, IL 61265
(309) 752-8000

Cropking Inc.
P.O. Box 310
Medina, OH 44250
(216) 725-5656

Empire Generator Corp.
Box 399
Germantown, WI 53022
(414) 255-2700

Empire Mach. Co.
P.O. Box 2985
Phoenix, AZ 85062
(602) 898-4856

Equip. Div. Hale Fire Pump Co.
700 Spring Mill Ave.
Conshohocken, PA 19428
(215) 825-6300

Fermont Division
Dynamic Corp of Am
141 North Ave.
Bridgeport, CT 06606
(203) 366-5211

Kato Engineering
P.O. Box 47
Mankato, MN 56001
(506) 625-4011

Generac Corp.
P.O. Box 8
Waukesha, WI 53187
(414) 544-4811

Katolight Corp.
3201 3rd Ave. N.
Mankato, MN 56001
(507) 625-7973

Kohler Co.
44 High Street
Kohler, WI 33044
(414) 457-4441

W.W. Grainger, Inc.
5959 W. Howard St.
Chicago, IL 60648
(312) 638-0536

Griffin Greenhouse Supplies
1619 Main St.
Tewksbury, MA 01876
(617) 851-4346

The Lima Electric Co.
A Sub. of Condec Corp.
200 E. Chapman Rd.
Lima, OH 45802
(612) 574-5000

Griffin Greenhouse Supplies
6 Interstate Ave
Albany, NY 12205
(518) 489-8419

McCalif Grower Supplies
2215 Ringwood Ave.
San Jose, CA 95131
(408) 946-5773

McCulloch Crop Div.
P.O. Box 92180
Los Angeles, CA 90009
(213) 827-7111

Marathon Electric
100 E. Randolph St.
P.O. Box 1407
Wausan, WI 54401
(715) 675-3311

Medalist Industries
P.O. Box 3008
Oshkosh, WI 54901
(414) 231-4100

Mercantile Mfg. Co.
P.O. Box 895
314 Dennis Dr.
Minden, LA 71055
(318) 377-0844

W.H. Milikowski Inc.
45 Chestnut Hill
Stafford Springs, CT 06076
(203) 684-5811

Miller Electric
P.O. Box 1079
Appleton, WI 54912
(414) 734-9821

Milwaukee Electric Tool Corp.
13135 W. Lisbon Rd.
Brookfield, WI 53005
(414) 781-3600

Onan/Div of Onan Corp.
1400 73rd Ave., NE
Minneapolis, MN 55432
(612) 574-5000

Pacific Scientific
4301 Kisuwakee St.
Rockford, IL 61109
(815) 966-3600

Pincor Power Prod.
11600 King St.
Franklin Park, IL 60131
(312) 455-3456

Power Products Div.
American Honda Motor Co.,Inc.
P.O. Box 50
Gardena, CA 90247

E.E. Richter & Son
6598 Hollis St.
Emeryville, CA 92608
(414) 658-1100

Scott/Div of Ardox. Corp
P.O. Box 286
Cedarburg, WI 53012
(414) 377-7000

Shindaiwa
11985 SW Herman Rd.
Sherwood, OR 97140
(503) 692-3070

Sola
1717 Busse Rd.
Elk Grove, IL 60007
(312) 439-2800
Spurgeon Supp. Co. Inc.
Rt. 2 Box 315
Maryville, TN 37801
(615) 983-1716

T & J Mfg. Inc.
102 W. 5th Ave.
Oshkosh, WI 54902
(414) 231-8217

Tanaka
22121 Crystal Creek Blvd SE
Bothell, WA 98021
(800) 426-7912

Vertee Ind. Ltd.
Box 840
Vermillion AB
Canada 4MO
(403) 853-2901

Westinghouse Electric
496 Laguardia M
Box 141
New York, NY 10012
(800) 821-7700

Winco
7850 Metro Parkway
Minneapolis, MN 55420
(612) 829-1933

Winpower Corp.
1207 First Ave., East
Newton, IA 50208
(515) 792-1301

Table 1. Electrical power requirements of single-phase 120V and 240V electric motors.

Motor power (horsepower)	Split phase starting (watts)	Capacitive starting (watts)	Running (watts)
1/6	860	---	215
1/4	1500	1200	300
1/3	2000	1600	400
1/2	2300	2300	575
3/4	3350	3345	835
1	4000	4000	1000
1 1/2	5000	6000	1500
2	7500	8000	2000
3	11000	12000	3000
5	15000	18000	4500
7 1/2	21000	28000	7000