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Floriade 2002

By A.J. Both

During a recent trip to the Netherlands I had the opportunity to visit the Floriade (very close to Schiphol Airport near Amsterdam). This exhibit is advertised as the greatest horticultural show of the decade. Ten years in the making, this 65-hectare (163 acre) park showcases a large variety of landscape and garden designs, urban and commercial horticulture, and promotes a sustainable interaction with our environment (Photo 1).

Photo 1. Overview of part of the Floriade.

Photo 2. The Indonesian entry at the Floriade.

Photo 3. Artificial mountain at the Floriade.

Photo 4. Fun with trees at the Floriade.

Many countries are represented through their specially designed horticultural related entries giving the Floriade a distinct international flavor (Photo 2). The Floriade is filled with unique (art) objects (Photos 3 and 4) that relate to various themes of the show. The show continues through October 20 and is open daily from 9:30 am through 7:00 pm (http://www.floriade.nl).

If you happen to travel to the Netherlands in the next few months and have an extra day to spare, I can certainly recommend spending a day at the Floriade! Bring your kids, they will find plenty of entertainment as well.

Greenhouse of the Future

By A.J. Both

One of the exhibits at the Floriade is the Greenhouse of the Future (Photo 5).

Photo 5. Greenhouse of the Future.

This greenhouse incorporates the latest technology developments in the Dutch greenhouse industry. Some of the greenhouse features are:

1) The trusses are positioned underneath the gutters (Photo 6),
2) The bottom of the truss acts as a storage area for the shade curtain,
3) The gutter is strong enough to carry equipment (e.g., for repairs or to wash the glass — see Photo 7),
4) Large glass panes (2.4 by 2.6 m, or approximately 8 by 8.5 feet),
5) The glazing is secured to the structure with rubber seals and clamps for easy repairs,
6) Single continuous ridge ventilation windows that open pneumatically,
7) Insect screening is integrated into the frames of the ventilation windows,
8) Prefabricated or continuously poured concrete foundation to which the posts are bolted, and
9) Optional roof irrigation for additional greenhouse cooling.

Photo 6. Greenhouse roof construction.

Photo 7. Greenhouse roof cleaning apparatus.

A section of the Greenhouse of the Future was covered with newly designed double-layered zigzag polycarbonate panels. These panels were designed and patented by the Dutch research institute IMAG and manufactured by GE Plastics in the Netherlands (Photo 8).

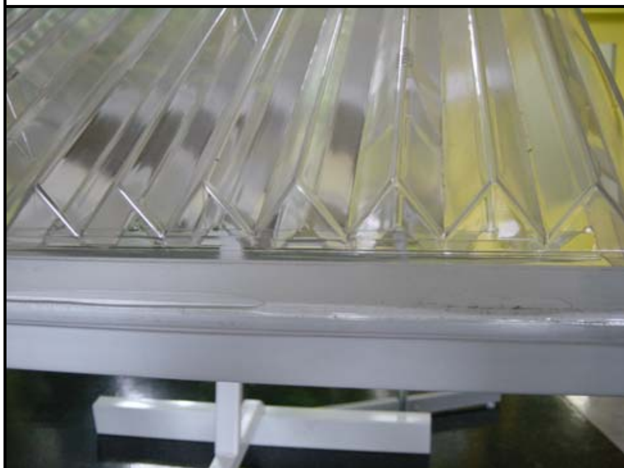

Photo 8. Twin-walled zigzag polycarbonate roofing panels. The triangular shaped ridges have base angles of 48° (84° at the top of the triangles).

Measurements showed that the zigzag panels have a light transmission equal to flat glass panels, help reduce energy consumption by 20% (due to the twin-wall construction), are strong enough to be installed without glazing bars, and (like regular polycarbonate panels) are strong enough to withstand hail storms and are flame resistant. Individual sheets are connected along their sides with simple click-connections allowing for easy installation.

Photo 9 shows the greenhouse roof equipped with zigzag panels. The roof sections near the peak of the greenhouse are moved in a vertical direction in order to increase or decrease the screened ventilation opening area.

Inside the Greenhouse of the Future, a variety of plants (flowering plants such as chrysanthemum, lily, gerbera, and rose and vegetables such as tomato, pepper, cucumber, and lettuce, were grown using a variety of recirculating irrigation systems or directly in the soil (Photo 10). Where appropriate, artificial growing media was used (e.g., for tomato, pepper, and cucumber production).

Photo 9. Greenhouse roof with zigzag panels.

Photo 10. View inside the Greenhouse of the Future.

Many of the greenhouse systems were automated (e.g., the transportation of movable benches to fixed irrigation stations) and a high level of computer control was used to keep everything running smoothly. The very helpful and knowledgeable greenhouse staff gave tours and explained many of the innovative features of this fully functional modern greenhouse structure.

Standby Electric Power Systems

Adapted from Extension Bulletin 1174 (http://www.ces.uga.edu/pubcd/B1174.htm)

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Introduction

It is easy to forget how important a constant supply of electricity is until power is lost due to a storm or other unexpected event. For most greenhouse operations, standby electric power generation is an absolute necessity because electricity is needed to maintain an optimum environment for successful plant production. The loss of power, even for a short period of time, can cause significant problems. A standby power system can be considered as a form of insurance, with the cost of installation and maintenance compared with potential losses as a result of an extended power outage. A properly sized, installed, and maintained standby electric power system can eliminate most of the financial losses and inconveniences resulting from power outages. When considering an emergency standby power system, there is a tendency to cut corners on equipment based on the assumption that the system may never be needed. Equipment that cannot handle the job is little better than none at all. In fact, an undersized, under maintained system may be worse than none at all because it gives a false sense of security. When standby power is needed, it is desperately needed. It must be ready to go at a moment's notice and must be capable of handling the loads applied to it. Equipment required for standby electric power service include: (1) an alternator to produce the alternating current, (2) an engine to power the alternator, and (3) a transfer switch. In addition to the required equipment, a power failure alarm may be desirable where an outage cannot be tolerated for more than a short period of time.

Alternators

There are two types of alternators: direct-connected engine driven and tractor power take-off (PTO) driven. The engine driven units can be started manually or automatically. Small units are generally driven by portable engines and are available in sizes from 1 to 7.5 kW. The alternator must be matched to the type of electrical service (single or three-phase) and voltage. Most common electrical systems are single-phase with dual voltages of 120/240 volts. Some greenhouse operations utilize a combination of single-phase and three-phase power. Generally, one alternator can be selected to provide both types of services. For the frequency (60 Hz) and voltage to be correct, the alternator must operate at the proper speed (usually 3,600 or 1,800 revolutions per minute (RPM). For tractor driven units, a gear box is usually included so that the normal operating speed of the tractor will turn the alternator at the proper speed. Proper voltage is essential for safe operation of electrical equipment, particularly motors. The alternator should be equipped with a voltmeter to make sure the output voltage is within acceptable limits. Alternators must be protected against overload. Factory-installed circuit breakers on the alternator will protect the alternator against damage due to overloads.

Alternators are commonly powered by an internal combustion engine. The engine used to power the alternator must be of the proper size. The engine or tractor should develop at least 2 horsepower for each kilowatt of electric power produced by the alternator. Therefore, an alternator with a continuous rating of 30 kW would require a minimum engine size of 60 horsepower. An alternator operated from the PTO of a tractor has the advantage of lower initial cost and of eliminating the care and maintenance of an additional engine. Using a trailer or 3-point hitch mounting allows the alternator to be mobile. This facilitates the use of e.g., arc welders and/or power tools at any location. A disadvantage of PTO driven alternators is that the tractor powering the alternator will not be available for other uses during a power outage. In addition, due to inconvenience, it is more likely that the standby power unit will not be tested and exercised regularly, which could lead to problems during an emergency. Alternators are designed to operate at a constant fixed speed (RPM); therefore, the tractor must have a tachometer to indicate when the correct speed has been obtained.

A self-contained direct connected engine-driven standby power unit is ready to operate at a moment's notice, provided a scheduled maintenance program is followed. It is important to run these units periodically to make certain the engine will start during an emergency. These units can include automatic starting and an automatic transfer switch for rapid restoration of power.

The choice of the type of engine is important for the greatest efficiency. For alternators up to 15 kilowatts, an air-cooled engine is recommended because of the lower maintenance requirements. Gasoline, LP gas, and diesel-fueled engines are available for powering standby alternators. Generally, it is best to select an engine that uses the fuel type most commonly available at your location.

Transfer Switch

A standby alternator must be connected to the electrical wiring system in a way that will prevent the accidental connection of the alternator to the utility company's power lines. This is a strict requirement of the electrical code and all electrical power suppliers. A so-called double-throw transfer switch is the most common method used to connect the alternator to the wiring system. Such a switch eliminates the danger of feedback onto the main lines and the subsequent endangerment to those working on the lines. It also eliminates the possibility of the alternator being damaged when normal power is restored. The capacity of the transfer switch must be matched to the rating of the service equipment and conductors supplying the normal load, not necessarily to the alternator or emergency load demand. Common capacity sizes for transfer switches are 100, 200, and 400 amperes.

Determining Alternator Size

Several methods are used for determining the proper size alternator for a particular application. Sizing alternators would be easier if electric motors would not draw starting currents of three to five times the running current. The alternator must be capable of supplying these short time high power demands.

Many smaller power generators have two kW ratings. The lower rating is the continuous output. The higher rating, sometimes called "motor starting watts" is the short time overload capacity. Larger units are usually rated for either "intermittent" or "standby" service or for "continuous" or "prime" service. Here, “continuous” service refers to applications where a unit is to be used full time (such as in a remote location where no other source of power is available). Standby or emergency generator sets are sized using intermittent ratings even though they may run for several days at a time in the case of a severe ice storm. This rating has more to do with the expected operating life (in hours) of the machine than with safe short-term operating conditions.

The first factor to consider in sizing an alternator is whether it is manually or automatically started. If the alternator is manually started, and if all potential operators are trained to properly control the loads and bring them on line slowly, the alternator can be sized to operate only essential equipment. Even essential equipment, in some cases, need not all be operated at the same time. If the alternator is automatically started, the assumption must be made that all loads which can be operating at the same time will be operating when the power failure occurs, and thus the alternator must start and run all of these loads simultaneously. In either case, for an expanding greenhouse operation, it is not recommended to size the alternator at the minimum requirement since this may be inadequate when future loads are added.

To size a **manually operated alternator**, list the essential equipment that must operate during an outage. Not all of the essential equipment may need to be operated at the same time. For example, the irrigation system may be delayed, but the ventilation system would operate continuously. For a typical greenhouse operation, there may be two or three sets of equipment that will need to be operated simultaneously. For each set of equipment, determine the total wattage requirement. Next, size the alternator to the largest wattage requirement. The nameplates on most equipment, except motors, will give the wattage requirement. Table 1 lists the approximate starting and running wattages for common motors. To determine the manually started alternator size for a greenhouse operation, follow the following steps:

1. Determine the starting wattage of largest motor. (If there are two or more motors of the same size, list the starting wattage of only one. Include the running wattage of the other motors in step 2)
2. Determine the running wattage of other motors.
3. Determine the nameplate wattage of other equipment.
4. Determine the wattage of any required lights.

Table 1. Approximate Power Requirements for Electric Motors.

Motor Horsepower	Starting Watts	Running Watts
0.17	860	215
0.25	1,500	300
0.33	2,000	400
0.5	2,300	575
0.75	3,350	835
1	4,000	1,000
1.5	5,000	1,500
2	7,500	2,000
3	11,000	3,000
5	15,000	5,000
7.5	21,000	7,000

An **automatically started alternator** must start and operate all loads that might be operating at any given time. Assume that a power outage will occur at the worst possible time, when all loads are running. For this reason, the alternator should be sized by the following procedure:

1. Add up all starting loads that might be on at the same time.
2. Add up all running loads that might be on at the same time.
3. Choose an alternator that will deliver the required starting watts at the "intermittent" or "standby" rating.

This will usually result in a unit much larger than needed to operate the running load, so several steps can be taken to reduce the size depending on the nature of the loads and how much information is known about them. Some motors are easier to start than others. If the code letter of the motor to be started is known, **and if precautions are**

taken to make sure that replacement motors will have the same or better rating, the actual starting load for the motor can be used in place of the table value. Some automatic control systems have the ability to bring the loads up in stages instead of all at once. In this case, the required watts would be calculated by adding the starting watts for the last load added to the running watts for all other loads.

Similarly, more than one automatic transfer switch can be installed in order to bring the loads up in stages. For example, for a greenhouse operation with four separate greenhouse sections, two sections could be placed on each of two switches with the second switch starting a few seconds after the first switch. The cost of the additional switch may be more than offset by a reduction in the required size of the alternator.

Most manufacturers allow a temporary dip in voltage during motor startup. In order to accurately size a unit at minimum size, most manufacturers have software packages available to fine tune requirements for automatic-start units.

Auxiliary Equipment

Standby alternators can be equipped with many optional accessories, depending upon the intended use and kind of alternator selected. A power failure alarm senses the interruption of electrical service and sends out an alarm alerting you of the need for starting the standby alternator, or in the case of an automatic-start unit, the need to check to make sure it is operating properly. Such an alarm system is highly desirable for greenhouse operations. Additional alarm systems could be placed inside each greenhouse to sense temperature changes. Power failures from the utility company are not the only causes of a power outage. For example, a tripped main circuit breaker can turn off all ventilation fans, and this problem will not be corrected by the use of a standby power system.

Direct engine powered standby alternators equipped with electric start would benefit from having an automatic battery charger installed to maintain the battery capacity for immediate use when needed.

The automatic transfer switch can be used with certain self-contained direct engine driven units to provide continuous uninterrupted electrical power. A remote start-stop switch also can be installed on certain units where the direct engine driven alternator is located away from the desired point of control.

Installation

Wiring and equipment must be installed in accordance with the National Electrical Code, local ordinances, and the requirements of the power supplier. Inspection by a local electrical inspector and power supplier is recommended in all cases and required in most. Check with your local power supplier and authority to make sure you understand the requirements before any installation.

The size of electrical wire needed to connect the alternator to the transfer switch depends on the amount of current and the distance the current must be carried. It is desirable to locate the alternator within 25 feet of the transfer switch and preferably within sight. The wire must be sized according to the rating of the main circuit breaker on the alternator. Table 2 can be used as a general guide, but actual size may vary depending on the type of wire insulation. Any attachment plugs must also have a current rating no less than the rated output of the alternator.

Table 2. Guidelines for Wire Selection to Connect an Alternator to a Transfer Switch.

Wattage		Wire Size (AWG)	
115 Volt	**230 Volt**	**Copper**	**Aluminum**
3,450	6,900	10	8
5,750	11,500	6	6
8,050	16,100	4	3
11,500	23,000	3	1
14,375	28,750	1	00
17,250	34,500	0	000

The alternator should be located in a protected atmosphere that is free from excessive dust, wind-blown particles, high temperatures and corrosive fumes. Allowance should be made for a minimum clearance of three feet around the unit for accessibility. Permanently installed, engine-driven alternators should be mounted on a concrete base. Vibration damping pads should be placed between the unit and the concrete base to minimize the transfer of vibration to other equipment. The exhaust gases must be vented to the outside in a way that will not cause a fire hazard where pipes extend through walls.

Tractor-driven alternators are generally stationary or mobile mounted on a trailer or a three-point hitch. If the alternator is to be permanently mounted at one location, the mounting platform must be made of concrete, steel, or heavy-duty wood beams. The surface of the platform must be level so that the alternator mounting base will not allow the alternator to rock. Any alternator rocking or movement could result in damage to the alternator.

For mobile units, the mounting should be of sufficient size and stability to withstand pulling over rough terrain and to withstand torque or turning stresses experienced when full loads are applied. If the alternator is to be mounted on a trailer for maximum portability, the trailer must be a heavy-duty type with a rigid mounting platform suitable to handle the weight of the alternator. A minimum 45-inch wheel-to-wheel distance is required to prevent a trailer-mounted alternator from flipping the trailer over during heavy torque loads when starting motors.

General Wiring Recommendations

- Consult your electric utility for advice on installation and materials (wires, sizes, transfer switch, etc.).
- Consult a licensed electrician or other qualified individual to perform the installation of the alternator and transfer switch.
- All wiring must comply with local electrical codes.
- Weather-protective fittings, couplings and wires should be utilized in the standby alternator installation.
- Install a load-transfer switch between the alternator and load.
- To avoid breakage due to vibration, the load wires (conductors) utilized between the alternator and the transfer switch should be stranded and have sufficiently heavy insulation.
- Each conductor must be connected to the proper location on the alternator.
- Insulate bare ends of ungrounded wires.
- **Alternator must be grounded by utilizing ground lugs provided on the alternator control box.** This is an extremely important step. The alternator will operate without it, but is extremely unsafe.

Safety Considerations

- Gasoline and other fuels always present a hazard of possible explosion or fire.
- The output power voltage generated by this equipment can cause a fatal electric shock.
- Use extreme care when operating in wet conditions. Always check for proper grounding.
- Hot engine parts and moving parts could cause serious injury to the operator.
- The operator must use caution and remain alert when using this unit.
- For installation, wiring, and repairs on standby power equipment, only use qualified personnel.

Operation

Every operator of standby power equipment should be completely familiar with set-up and operating procedures. When a power outage occurs, the procedure for operating a *manual-start* standby power system are as follows:

- Turn off or disconnect all electrical equipment.
- Make all necessary electrical connections including grounding to the standby power unit.
- If a tractor driven unit is used, connect the tractor to the alternator.
- Start the engine and bring the alternator up to the proper speed (1,800 or 3,600 RPM). Refer to the manufacturer's operating manual for voltage-speed adjustments.
- Check the voltmeter. It should register at least 230 volts for 120/240 volt service, or 115 volts for 120 volt service. When the voltage output is correct, the alternator is ready for the load.
- Put the transfer switch in the alternator position.
- Connect the electrical load. Start the largest motor first. Then start each successively smaller motor when the previous one has obtained full operating speed.
- When all of the motors have been started, add any other essential electric load.
- As loads are added, check the voltmeter during operation to make sure the alternator is not being overloaded. The voltage will drop when too much electric load has been connected to the alternator.
- When normal power has been restored, switch off all electrical load, then put the transfer switch in the normal power position.
- Stop the alternator.
- Turn on electrical loads as needed.

Maintenance

The standby power unit should be kept clean and in good running order at all times so that it will be ready for immediate use during an emergency. Alternators should be inspected frequently and kept free of dust, corrosion and moisture.

Tractor-driven alternators should be operated at least once every four months. These units should be operated at the rated speed and under load. The alternator should be covered and stored in a dry protected area. To prevent rusting, a light coating of protective oil or grease should be applied to the alternator PTO input shaft.

Automatic starting engine-powered units should be operated weekly under load and long enough for the engine to obtain normal operating temperature. Fluid levels should be checked each time the unit is operated as with any internal combustion engine. In all cases, the manufacturer's installation, operating, and maintenance manual should be thoroughly studied and followed.

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Lily production at the Floriade.

HORTICULTURAL ENGINEERING

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Upcoming Meetings, Shows, etc.

26th International Horticultural Congress
Toronto, Canada
August 11-17, 2002
http://www.ihc2002.org/ihc2002/cgi.html

New England Greenhouse Conference
Worcester, MA
October 21-23, 2002
http://www.uvm.edu/~pass/greenhouse/negc.html

HortiFair (NTV)
Amsterdam, the Netherlands
November 6-9, 2002
http://www.hortifair.nl

Floriade (once every 10 years)
Near Amsterdam, the Netherlands
April 6-October 20, 2002
http://www.floriade.nl

Greenhouse Engineering Short Course
Rutgers University
January 13-14, 2003
For registration call (732) 932-9271
http://cook.rutgres.edu/~ocpe