NGMA Helpful Hints

Electrical Systems & The Greenhouse

How does electricity work?
Electricity moves through wires, pushed along by a force called potential. Electric potential is measured in units of volts. The voltage forcing electricity through the power wiring comes from a utility company's generating plant. Large wires are needed to carry large currents. Electricity faces resistance to its flow through a wire, and in fact, resistance is the electrical term for the force that works against the free-flow of electricity. Resistance is measured in units called ohms.Electricity, voltage and current all work together to form power, which is measured by watts.

What is voltage drop?
In a greenhouse, equipment can easily be hundreds of feet from the circuit breaker panel that feeds it power. Wires have resistance and resistance works against voltage. This effect is called voltage drop and relates directly to the efficiency of the equipment we connect with electrical wiring. Voltage drop also has another effect: the voltage doesn't just disappear, it gets converted into heat that is wasted, even though you pay for it on your utility bill.

How do I eliminate voltage drop?
While there's no way to completely eliminate voltage drops and other inefficiencies, you can minimize them by working with a design engineer who is familiar with greenhouses. A design engineer will provide an electrical system that meets your requirements for safety, efficiency, adequacy, convenience, and spare capacity. You'll need to coordinate both the design and installation phases of your electrical system with your local electric utility as only they can tell you if they can provide the type of system you require with the capacity you need.

What are the most important things to consider when creating an electrical greenhouse system?
Demand that all work be done in accordance with the National Electric Code and local codes. List all equipment requiring electricity. Have a design engineer prepare a load schedule, main service and branch layout, power diagrams, wiring layout, and control diagrams.

What is a load schedule?
This is an inventory of all the electrical equipment in your project. The total electrical demand of this equipment determines the size of electrical service you'll require.

What is the main service and branch panel board layout?
This shows the location and size of your service entrance components and any additional circuit breaker panels you will need. The service entrance is where the wires from the electric utility enter your property and include a large switch or circuit breaker that can disconnect your entire premises from the electrical grid.

What are one-line power diagrams?
These diagrams show how your equipment will be assigned to individual circuit breakers and breaker panels. These plans show the number and the sizes of the wires that will carry power to your equipment.

What is a conduit and wiring layout?
This diagram shows where conduits will be routed, the sizes of the conduits, and the number and sizes of the wires that will be run into the conduit.

What are control diagrams and schematics?
These plans show the interface between control devices and the equipment they control.

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Where should I locate my main service?
The location of your main service entrance must be coordinated with your electric utility. A central location minimizes wire lengths and reduces both the costs of voltage drop and of the wire itself. A centrally located main service is your most efficient and economical alternative.

What type of power system should I purchase?
One-phase systems are commonly used in houses and small businesses. Three phase systems are used in schools, medium to large businesses, and industrial plants. Though three-phase power is not available everywhere there are technical advantages that should be considered. Do not be afraid to go for high voltage. The higher voltages mean the voltage drops are less significant. Because power is the product of volts and amps, a higher voltage means we can deliver the same total power while using fewer amps. The practical benefit of reduced amperage is reduced wire size.

What are the advantages to three-phase power?
Three-phase motors are less expensive than single-phase motors for motors of one horsepower or larger. Also, they are mechanically and electrically simpler than single-phase motors. A three-phase system can use smaller wires and conduits than a single-phase system — and are more reliable.

Do I need a standby generator?
Because a greenhouse can lose and gain heat so rapidly, it is critically dependent on a constant supply of power for its heating and cooling systems. Because a power outage of more than a few minutes can mean the loss of your livelihood, you must consider a standby generator when you plan your electrical system.

What is an automatic transfer system?
Automatic transfer systems are available which start the generator, allow the engine to warm up and the generator to come to full power, and then connect the generator to your greenhouse equipment. When utility power returns, these systems reverse the process, and shut down the generator.

How do voltage drops affect crop lighting?
Voltage drops have a disproportionate affect on the light output of incandescent lamps. If the electrical system delivers a voltage below the rated operating voltage of the lamps, they cannot deliver the intended amount of light. The light loss can be significant and is often undetectable to the human eye.
What are the benefits of high-efficiency motors?
Though high-efficiency motors cost more than standard motors, the energy savings they offer easily outweigh the cost difference. A one-horse power, high-efficiency motor can pay for the cost difference in only four months of typical greenhouse use. A high-efficiency motor is built using more copper wire and iron than a standard motor and it runs cooler than a standard motor.

What is a ground-fault circuit interrupter?
A ground-fault circuit interrupter, or GFCI, is a safety device that protects people from possible electric shock hazards. A typical GFCI is built into an electrical outlet to kill the power once an electrical fault is detected. The National Electrical Code (NEC), which regulates electrical wiring, has begun to require ground-fault circuit interrupters in more and more locations; particularly in damp locations in contact with the earth or concrete.

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