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## Applied Poultry Engineering News

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### Preventing Lightning Damage

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Poultry house management and operation has never been more dependent on electronic technology than it is today. Although this new and exciting technology is very useful, the new technology is susceptible to damage from voltage spikes. Lightning is one source of excessive voltage that can damage controllers and other technology. What can be done to protect electronic equipment in poultry houses from lightning damage? The answer depends on the degree of protection desired and cost a grower is willing to accept.

#### **Lightning: Basic Information**

Lightning is a natural phenomenon with amazing properties. A typical lightning strike has:

- a temperature of close to 50,000 F,
- a median current of 18,000 amperes,
- between 250,000 and 1 billion volts.

It is common for lightning to strike power and phone lines and travel 10 miles. Electrical current associated with lightning

can arc (jump) across an air gap from one electrical conductor to another.

#### **Damage to Poultry House Equipment**

There are numerous lines of entry for lightning into a poultry house that lead directly to important and expensive equipment. Besides the main power line, phone lines connected to phone alarm can serve as a path for lightning. There are numerous electrical circuits throughout a poultry house associated with power, control and operation of equipment that can carry current from a lightning strike. These include the standby generator and automatic transfer switch that are connected to the main electrical system.

Each house's main panel box, controller and phone alarm are connected.

Computer and communication lines are very susceptible and are interconnected with the controller and house electrical circuits. Additional problems can result from the large amount of metal comprising the roof and siding, and perhaps roof trusses and

even building framing. A poultry house is an attractive target for lightning.

### **Protection Strategy**

It is very difficult for poultry growers to be completely protected from lightning damage. Lightning is an unpredictable natural phenomenon and there are so many possible entry points in poultry housing that complete protection is probably impossible. The actual lightning protection installed at a farm should be a compromise between informed choices of equipment and its protection benefit with a personal tolerance for risk of damage. In other words, the level of protection must be balanced against cost. Understanding how to evaluate available protection options will lead to a well-informed farm protection plan. Ignoring potential lightning damage and doing nothing will likely be an expensive response.

### **Provide a Proper Ground**

Incorporating a proper ground system for each house is the most basic and cost effective measure for electrical system protection. Without question, it should be included in every poultry house. All equipment in a poultry house should be grounded. A high percentage of poultry house lightning damage could be eliminated by incorporating a proper ground system (Donald et al., 2004).

A ground system provides a route of low electrical resistance to safely dissipate excessive voltage. A ground system consists of a ground electrode (rod), grounding wire and connections. The resistance of a ground system must be less than 25 ohms, but preferably less than 5 ohms if sensitive electronic equipment is to be protected (computers or controllers). A power company engineer, electrical contractor, or extension specialist should be called to check the ground resistance.

It is very important that the correct size and type of ground rod and wire be used in a

ground system. The minimum diameter ground rod allowed by code is 5/8"; however, 3/4" is better. A ground rod is normally 8 to 10 ft. long and driven into the ground close to the main service panel. A driven solid ground rod is preferable to connecting to a water pipe. Proper clamping of the ground wire to a water pipe is more difficult than to a rod. A ground rod is often located in a drip line from the roof where moisture is expected to accumulate. Ground resistance will be lower in moist locations and where soil is dense (clay soil has less resistance than sandy soil).

Grounding wire should be no smaller than 6-gauge copper. If wire runs over 20 ft. occur, then 4-gauge copper should be used. The wire should be protected in conduit along its run. The ground wire must not be cut; it should be continuous. Connections between wires and rods must be carefully produced to minimize resistance to electrical flow. Pipe clamps not rated for outdoor use should not be used; they will corrode and the connection will fail with time. Use acorn clamps manufactured especially for use as ground clamps. Soldered joints will not provide the necessary connection because a strong current surge can melt the solder.

A single point ground should be used as opposed to having several independent ground rods to service individual pieces of equipment. All grounding should be tied to a single ground rod or multiple ground rods properly connected.

An electrical contractor or power company engineer should be consulted to answer questions regarding a ground system. An earlier edition of Applied Poultry Engineer News covering basic electrical grounding is available via the internet ([www.rec.udel.edu](http://www.rec.udel.edu); publications)

### **Incoming Service Protection**

An industrial grade surge protector with a maximum surge current protection of at least 200,000 amps per phase is needed to

protect the main service and transfer switch onto the farm. If the main service and transfer switch are at separate locations, then separate protection is necessary. This device is important not only in preventing damage from voltage surges from lightning, but they also protect against surges from power company transmission problems resulting from switching and equipment failure, and fluctuations in voltage resulting from motors turning on/off. Despite installing quality surge protection, always remember that lightning is a natural phenomenon like a hurricane, tornado, etc. Protection against an enormous direct strike that occurs less than 1% of the time is virtually impossible. Surge protection is a wise investment because it offers protection against over 95% of lightning events and thousands of lower level surges at a cost of about \$1 a day over a 10 year period!

### Phone Line Protection

Phone lines are the most common means of lightning entry into a poultry house. Since phone lines run parallel with power lines, they are open targets for a lightning strike. Electric fields generated by power line surges can induce high voltage in phone lines. Since phone lines are associated with phone alarms and data transmission from controllers, lightning can enter through a phone line and eventually damage the house controller. It is very important to use surge protection equipment on phone lines. Inserting the phone jack into a phone plug on a high quality surge suppression power strip (\$40+) will likely provide minimal protection, but using a device designed to protect low voltage phone lines is a wiser choice.

### Sensor Line Protection

Wiring to sensors and equipment such as fans and heaters is susceptible to lightning strikes and damage. Although lightning does strike this wiring, it seems to occur far less often than it strikes phone and power lines outside the house. One explanation for this might be that the poultry house with its metal roof and siding acts as a Faraday cage: the building may absorb lightning and

conduct it to ground without allowing sensors and equipment to be damaged. Sensors and equipment do receive lightning damage, yet many electrical contractors choose not to add protection at these points because of excessive cost. Protection for these lines costs between \$25 and \$80 per line and each line should receive protection. Considering 9 to 15 fans, 6 to 8 temperature sensors, and 5 to 8 heaters per house, this can quickly become expensive!

### How Surge Protection Works

The basic component of most surge protection devices (SPDs) for high current protection is the metal oxide varistor (MOV). While the name sounds complicated, it has a simple operating method. A MOV is connected between the hot wire and ground wire within an SPD.



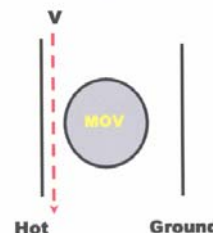
Metal Oxide Varistor (MOV)



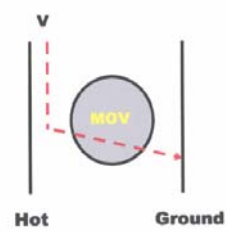
Typical Surge Protector

Electric current flows normally through the MOV until the voltage reaches a certain threshold. Upon reaching this threshold, the MOV diverts excess current to ground. As voltage returns below threshold level, current flow returns to normal through the SPD. The MOV is similar to a pressure relief valve in a steam line.

#### Normal Voltage



#### Voltage Surge



An MOV directs excess voltage to ground.

Not all MOVs are identical; some surge suppression equipment offers a higher degree of protection than others. MOVs are not indestructible. They can only survive high voltage for a very short period of time before they are damaged (burned) and no longer provide protection.

Another typical method of surge suppression involves using a gas discharge tube (GDT). A GDT diverts excess current to ground like a MOV. GDTs use an inert gas as the conductor between the hot and ground lines. When voltage is below a threshold level the gas has high resistance to current flow and current flows normally in the hot wire. When voltage exceeds threshold, the gas conducts excess current away from the hot line to ground, preventing high voltage from damaging components on the hot line. GDTs are used most often with low voltage SPDs that protect data transmission, phone lines etc.

### **Evaluate Surge Suppression Devices**

It is important to become familiar with basic terminology and acceptable characteristics in order to evaluate surge suppression equipment. All surge suppression products should have a UL rating label for transient surge suppression that includes the following terms.

**Clamping Voltage:** This is the voltage that will cause MOVs to divert current to the ground line. The lower the clamping voltage the more protection offered by the equipment. Generally, select products with a clamping voltage less than 400 V.

**Energy Absorption/Dissipation:** This rating is listed on equipment in units of energy known as joules. It is the amount of energy the device can absorb before it fails. As the energy absorption increases, the equipment offers more protection. Equipment with energy absorption less than 600 joules is not very effective.

**Response Time:** Response time refers to how quickly equipment reacts to a voltage surge. High quality equipment should definitely have a response time of less than 5 nanoseconds and ideally a less than one nanosecond. A nanosecond is actually one-billionth of a second!

**Maximum Continuous Operating Voltage (MCOV):** This is the maximum voltage that can be sustained through a SPD without damaging the MOVs.

**Maximum Surge Current:** This is the maximum current that a SPD can operate at without incurring damage.

**Warranty:** Accept nothing less than a warranty of 10 years, preferably 25 years. Many manufacturers of SPDs claim to replace lightning damaged equipment if *they* decide it is the fault of their product. Be wary of companies that offer replacement of equipment damaged by lightning through their \$20 power strip!

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## Location and Priority of Surge Protection Equipment For a Typical Poultry House

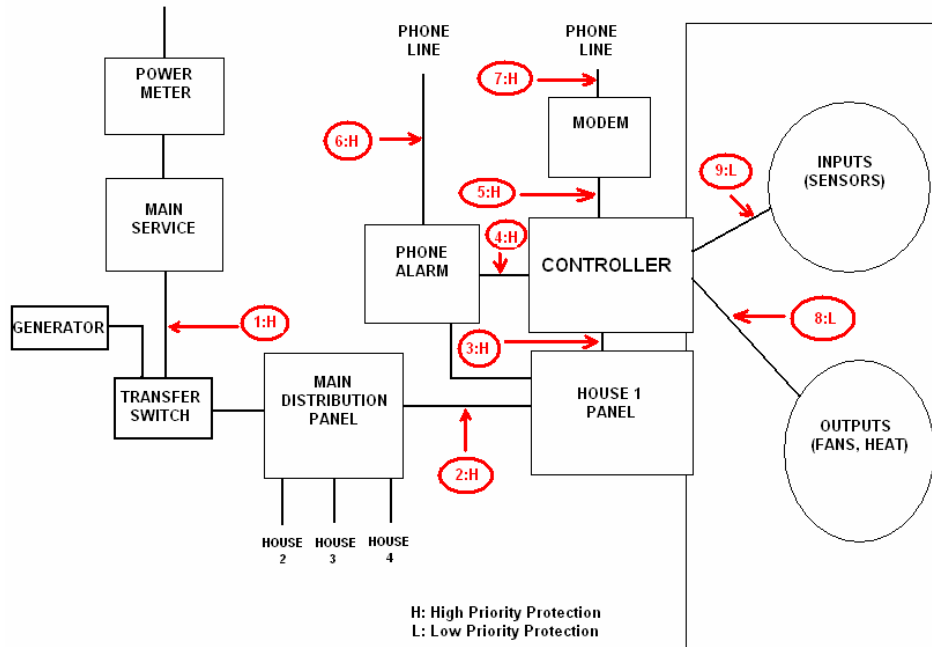


Figure 1. Location and priority of surge suppression equipment for a poultry house.

Table 1. Summary of suggested surge suppression equipment recommended for a poultry house.

Protection Point – Priority	Surge Suppression Equipment	Equipment Protected	Surge Current	Estimated Cost
1 – High	Commercial Service Entrance Surge Protector	Entire house & transfer switch from main power line surges.	200,000A per phase	\$800 to 1000
2 – High	Commercial Sub Panel Surge Protector	Individual house panel boxes from incoming surges.	75,000 A per phase	\$340
3 – High	120/240 V Service Entrance Surge Protector	Controller	125,000 A	\$225
4 – High	Low voltage data/signal surge protector	Underground alarm lines inside poultry house.	20,000 A	\$65
5 – High	Low voltage data/signal surge protector	Communication lines from controller to modem.	20,000 A	\$65
6 – High	Low voltage telephone entry protector	Phone line to phone alarm.	9000 A	\$60 - \$80
7 – High	Low voltage telephone entry protector	Phone line to controller.	9000 A	\$60-\$80
8 – Low	Low voltage data/signal surge protector	Surges from sensor lines.	20,000 A	\$25 - \$80/ line
9 - Low	120/240 V Surge Protector	Surges to/from controller outputs to equipment.		\$50+/line

## Resources for Additional Information

### Books

Cauldwell, R. 2002. ***Wiring a House***. The Taunton Press. Newtown, CT 06470  
Order at: [www.taunton.com/store/pages/070639.asp](http://www.taunton.com/store/pages/070639.asp)

Donald, J. , J. Campbell, G. Simpson, J. Langston and L. Cole. 2004. ***Poultry house construction guidelines***. The Auburn University Poultry Housing and Engineering Program, 215 Tom Corley Bldg., Auburn University, Auburn, AL 36849.

### Surge Suppression Equipment Vendors

Ditek Surge Suppression.  
One DITEK Center  
1720 Starkey Rd  
Largo, FL 33771  
Phone: (800) 753-2345 (toll free)  
Web: [www.ditekcorp.com](http://www.ditekcorp.com)

MCG Surge Protection  
12 Burt Drive  
Deer Park, NY 11720  
Phone: (800) 851-1508  
Web: [my.mcgsurge.com](http://my.mcgsurge.com)

Surge Suppression Incorporated  
109 Melvin St.  
Destin, Florida 32541  
Phone: (888) 987-8877  
Web: [www.surgesuppression.com](http://www.surgesuppression.com)

### Websites

[www.armymars.net/ArmyMARS/Gen-Mil-Info/Resources/Dave-Fiedler/dave5.htm](http://www.armymars.net/ArmyMARS/Gen-Mil-Info/Resources/Dave-Fiedler/dave5.htm)

Interesting website about how the US Army MARS (Military Affiliate Radio System) uses electrical grounding for their Tactical Operations Centers.

Boltek Lightning Detector: [www.boltek.com/ld250.htm](http://www.boltek.com/ld250.htm)  
LD-250 Lightning Detector puts a live lightning map on your computer.

ePanorama.net: [www.epanorama.net/documents/groundloop/why\\_grounding.html](http://www.epanorama.net/documents/groundloop/why_grounding.html)  
Title: "Why Grounding is Used?" -- Information on electrical grounding with valuable links.

Lem Instruments, Inc.: [www.leminstruments.com/grounding\\_tutorial/html/start.shtml](http://www.leminstruments.com/grounding_tutorial/html/start.shtml)  
Ground Resistance Principles, Testing, Techniques & Applications

Vaisala Thunderstorm: [www.lightningstorm.com/](http://www.lightningstorm.com/)  
Free U.S. Lightning Map, U.S. Lightning Detection Network, various interesting features about lightning.