

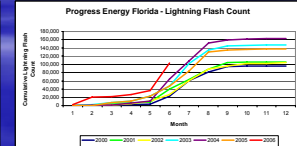
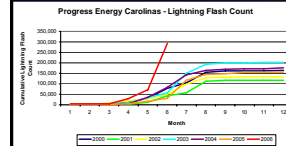
Protecting Poultry Facilities from Lightning & Surges



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North Carolina State University

Summer 2006: NC Overtakes Florida As Lightning Capital of the United States! (At Least Temporarily)

- Duke Power reports approximately 10X typical damage in a season
- Progress Energy Data indicates why



Are There Other Factors?

- Yes, weather is only part of the equation
- Equipment and wiring condition/methods factor heavily as risk factors

Modern Equipment is More Sensitive

Solid State Controllers are Replacing Electro-Mechanical Ones

Many Controllers are connected to modems and PCs



Electrical Systems Have Not Kept Up With Needs of Modern Equipment

- Many wiring installations do not meet the National Electrical Code (NEC)
- Meeting the NEC does not guarantee performance. The NEC does not require lightning and surge protection. The NEC does NOT have a grounding resistance requirement.

What Should We Do?

- Effective protection requires a complete systematic approach
- First insure existing wiring installation is Adequate
- Grounding and Bonding are paramount
- Select and install proper surge protection devices (SPD's)
- Maintain system

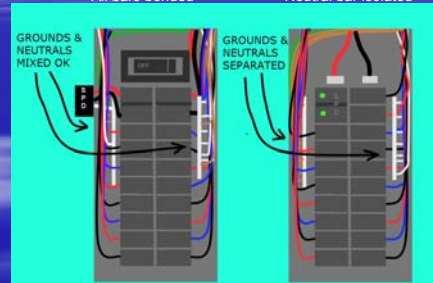
Procedure for Evaluating Existing Wiring System

Check the following and correct as necessary

- Panel and equipment wiring
- Grounding and bonding
- The following slides illustrate what to look for and how to correct

Know the Difference in How Service Panels and Sub Panels are Wired

Service Panel	Sub Panel
Neutral=Ground	Neutral≠Ground
All bars bonded	Neutral bar isolated



Insure Panels and Equipment are Wired Correctly

- No neutral to ground splices downstream of service equipment.



Insure Buildings are Properly Grounded and Bonded

- IEEE states that 90% of lightning damage could be eliminated by proper grounding.
- Grounding is relatively inexpensive
- Easier/Cheaper on new construction

Insure Buildings are Properly Grounded and Bonded

- **All utilities must be at the same ground reference***
- In other words only one grounding **system**
- Multiple **rods** or electrodes are fine, even recommended if bonded together
- * Multiple grounding **systems** are a source of **damage**. This is particularly true with telephone systems

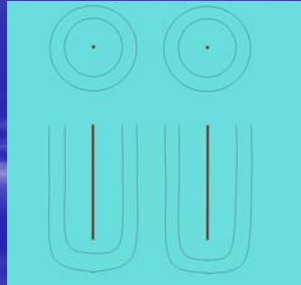
Test Grounding and Improve if Necessary

- Sensitive equipment requires 10 ohms resistance to ground or less, some sources say 5 ohms or less
- A clamp on meter is easy an way to test ground resistance



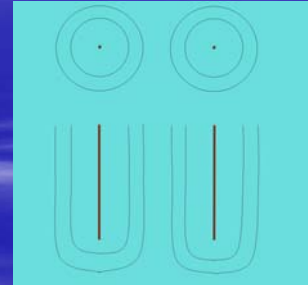
Grounding Electrode

A copper clad ground rod is the most common electrode found on poultry farms. NEC requires an electrode driven to a depth of eight feet if a twenty five ohm or less resistance is achieved and a second eight foot rod driven a distance of six feet from the first if not. I recommend ten to thirty feet deep rods depending on soil conditions.



Grounding Electrode

When multiple rods are driven space them as far apart as they are deep. Closer spacing results in rods "competing" for the same soil to conduct to. The drawing depicts how each rods conducts through cylindrical shells of soil. The goal is to obtain a ground resistance of ten ohms or less.



Deep Driven Rods May be Required to Achieve Adequate Grounding

First Ten Feet

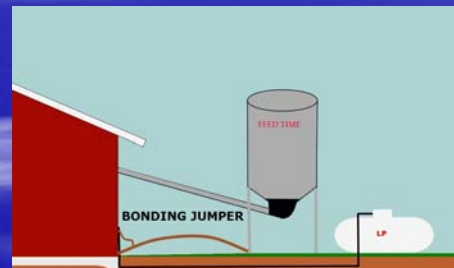


Coupler and Second Ten Feet



Bonding is also Required

- All metallic penetrations to buildings should be bonded to the grounding electrode system

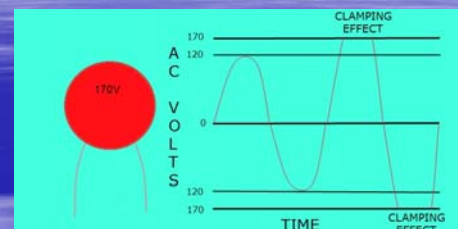


How Does Surge Protection Work?

Surge Protection may include the following

- MOVs
- Silicon Avalanche Diodes
- Gas Tubes
- Reactors
- Capacitors
- Spark Gaps

MOVs are the Most Common Component in SPDs



MOV=METALLIC OXIDE VARISTOR
A DEVICE THAT HAS A HIGH RESISTANCE UNTIL A THRESHOLD VOLTAGE IS REACHED. THEN IT BECOMES A CONDUCTOR AND "CLAMPS" THE VOLTAGE.

Selection and Installation of SPD's

SPD's should be installed as a complete system. Specific SPD's are designed for particular locations (categories) within your electrical system as follows;

Category C - Outside and service entrance

Category B - Feeders and short branch circuits. Examples include sub panels and dedicated circuits for sensitive equipment such as controllers.

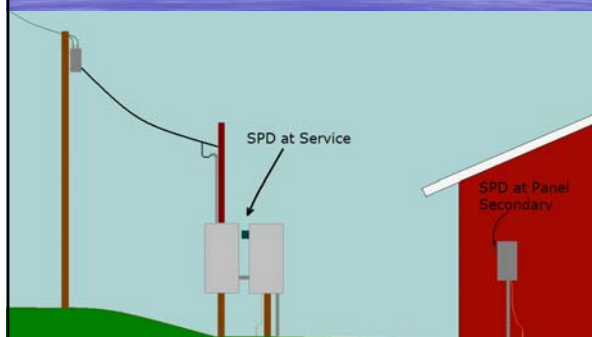
Category A - Outlets and long branch circuits

The Three Categories Provide for Three Levels of System Protection

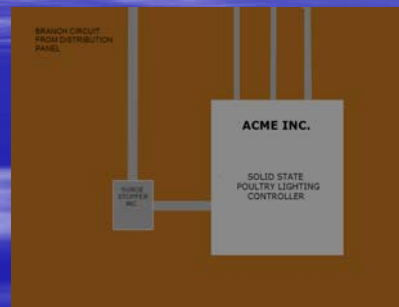
Category C provides the first level of protection. This is a robust (and expensive) piece of equipment. It may be rated for 300,000 amps or more. However it has "let through" voltage that must be handled at the second and third levels. With the brunt of the surge handled the downstream SPDs can hone in on tighter voltage control.

SPD Installation

Three Stage System Provides the Best Protection



Third Stage is at Equipment



INSTALLATION TIPS

Keep SPD Conductors as Short as Possible
Twist Leads to Reduce Impedance
Mount and Connect SPD as Close as Practical to Power Entrance of Panel or Device



Examples

First Stage Protection for Service Entrance



Second Stage Protection for Panels



Third Stage Protection

SPD on equipment, a dedicated circuit or a plug in strip



Don't Forget Phone and Communication Lines



First Hand Experience

Transformer at NCSU Facility

Windings are melted



In Conclusion Lightning Protection is Like Bio-security



All potential pathways must be blocked.
Germs and Lightning only need one entrance
to cause damage

Thanks To

- Wayne Huddleston of Duke Power
- Bruce Watson of Watson Sales
- Jim Yancey of NC OSFM
- Dr Jerry Baughman NCSU BAE

References

- IEEE "Green Book"
- IEEE "Emerald Book"
- NEC Digest Spring 2004 Edition article "Surge Protection Technology, Part I"
- NEC Digest Summer 2004 Edition article "Surge Protection Technology, Part II"
- "Grounding, Bonding, Shielding, and Surge Protection; G Vijayaraghan, Mark Brown, and Malcolm Barnes

Online Resources

- <http://www.aces.edu/dept/poultryventilation/Electrical.php>
- <http://www.lightning.org>
- <http://www.mikeholt.com/technical.php?id=lightning/technicallightningnewslettersmenu>

For Further Information

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Some Surge Protection Manufacturers

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MANUFACTURER		AC POWER	V/D/V
AC Data Systems	www.surgeblox.com	Yes	Yes
Advance Surge Suppressors	www.advanceurgesuppressor.com	Yes	Yes
Advanced Protection Technologies	www.apltvss.com	Yes	Yes
Advanced Resources Intl.	www.surgepure.com	Yes	No
American Power Conversion Corp. (APC)	www.apc.com	Yes	Yes
Asea Brown Boveri (ABB)	www.abb.com	Yes	No
Atlantic Scientific	www.atlantis-scientific.com	Yes	No
Citel, Inc.	www.citelprotection.com	Yes	Yes
Critec / ERICO, Inc.	www.erico.com	Yes	Yes
Current Technology	www.currenttechnology.com	Yes	Yes
Dehn, Inc.	www.dehn-usa.com	Yes	Yes
Ditek	www.ditekcorp.com	Yes	Yes
Eclips	www.eclipspts.com	Yes	Yes
EFI Electronics	www.efinet.com	Yes	No
GE Industrial	www.geindustrial.com	Yes	Yes
Hubbell Wiring Device-Kellems	www.hubbellnet.com	Yes	Yes

Some Surge Protection Manufacturers

Inovative Technology	www.itvss.com	Yes	Yes
Intermatic	www.intermatic.com	Yes	No
Joslyn, Ma	www.joslynmfa.com	Yes	No
LEA International	www.leaintl.com	Yes	Yes
Leviton Mfg	www.leviton.com	Yes	Yes
Liebert Corp	www.liebert.com	Yes	Yes
Lightning Master	www.lightningmaster.com	Yes	Yes
MCG Surge Protection	www.mcgsurge.com	Yes	Yes
Northern Technologies (NTI)	www.northern-tech.com	Yes	Yes
Pass & Seymour/LeGrand	www.passandseymour.com	Yes	No
Siemens	www.sea.siemens.com	Yes	No
Square D/Schneider Electric	www.SquareD.com	Yes	No
Surge Suppression, Inc	www.surgesuppression.com	Yes	Yes
The Wiremold Company	www.wiremold.com	Yes	No
Technology Research Company	www.trcl.net	Yes	No
Transactor Systems	www.transactor.com	Yes	No
Tripp Lite	www.tripplite.com	Yes	No
Tyco Electronics/Raychem	www.tycoelectronics.com	Yes	No
United Power Corp	www.unitedpowercorp.com	Yes	No