KENICK

SURGE PROTECTION FOR CHURCHES

Church facilities can experience significant challenges as thunder storms pass through the area. This article is designed to assist churches in protecting their critical infrastructure from transient surge damage.

Where we cannot make absolute guarantees, we have found that implementation of recommendations contained in this document will go far in significantly reducing or eliminating future damage issues.

OVERALL:

Most areas of the country experience increased thunder storm activity during transition seasons (Spring-Summer Summer-Fall).

Areas of the southeast (including Florida) can experience longer term almost daily storms between May and September. Other areas of the north experience ice storms and "thunder snow" storms which can wreak havoc on electrical power systems.

With these thunder storms come an increase in transient surge events (lightning strikes) occurring at or near church facilities.

While electric utilities take significant steps to protect their distribution system, utility customers can benefit greatly by checking internal wiring at their facilities and by installing additional surge protection devices at electrical panels and at high value electronics.

Recommendations in this summary are designed around protecting a medium to large church facility. Feel free to call or email with specific questions relating to your church.

SAFETY:

Several of our recommendations will require removing electrical panel covers to inspect interior wiring. It is very important that all safety measures are followed during inspection and or installation of recommended surge protection devices.

Where all power supply voltages can be dangerous, if your church facility has 277/480 Volt electric power, severe arc flash burns can occur when working within these panels. Special precautions must be followed to avoid severe injury or death.

For all panel inspections and/or work, safety measures **must include securing a licensed and qualified electrical contractor** (not a church volunteer) that makes use of all required safety protection devices (gloves, face shields, protected clothing and related equipment).

Where applicable, the **contractor must be familiar with working on 277/480 Volt three phase equipment with complete knowledge of additional safety steps required for this voltage.**

We strongly recommend that the contractor deenergize and lock electrical panels and control equipment prior to carrying out inspections or installation of surge protection.

We also recommend additional labeling of electrical panels for people to "Keep Out" unless they are certified to safely work inside these panels.

UNDERSTANDING SINGLE PHASE VS. THREE PHASE ELECTRICAL SERVICE

Small churches may have single phase (a.k.a. split phase) electric service from their local electric utility. Power is supplied via two energized conductors and a neutral.

Medium to large churches typically have three phase electric service. This type of electric service has three energized conductors and a neutral.

During routine utility distribution line maintenance (blown fuse links, car versus pole or local storm events) you may experience a "loss of phase" event where one of the three incoming electrical "phases" from the utility feed to your church facility becomes deenergized.

If your church has three phase electric service, additional steps need to be carried out to protect against a loss of phase event.

During a loss of phase event, it is important that all three-phase pumps, motors and air conditioning compressors immediately turn off until the lost phase is re-energized.

Any three-phase equipment that attempts to continue to run during a loss of phase event, can be damaged or destroyed.

Recommendation: All three phase pumps, motors and HVAC/refrigeration compressors should have a "loss of phase" protection module that turns off the device during a "loss of phase" event.

Your electrical contractor should inspect each three-phase device to verify that all have "loss of phase" protection modules installed and operational.

Additional Note: Time Delay Upon Restart

HVAC and refrigeration compressors should have an additional protection module that we will call "time delay upon restart". This device will delay restart of HVAC and refrigeration compressors for 3 to 5 minutes, allowing time for the high-pressure refrigerant gas to bleed down and allow for an easy restart following power interruptions.

We strongly recommend that you have your electrician (or qualified refrigeration technician) check to make sure that time-delays are installed and operational.

VARIABLE SPEED DRIVES:

Newer church facilities may make use of variable speed (frequency) drives for their domestic water or HVAC systems.

If your church has variable speed/variable frequency drive units, you may want to further protect these devices by contacting the equipment manufacturer to see if they offer a "ride through kit".

This "kit" includes inductive chokes that are installed at the power feed to the drive to allow it to "ride through" momentary power interruptions without blowing a drive fuse or module.

Based upon what you learn from the manufacturer, if a ride through kit is not installed, but available, we recommend that you install "ride through kits" on all variable speed drive motors and compressors.

Side Note: If you have VF drives but are not having any problems or issues (or you don't have VF drives) congratulations, one less item to worry about!

BATTERY BACK-UP SYSTEMS:

On occasion, utility customers will experience a brief (several second) interruption of power. These blinks, or momentary power interruptions can occur during thunder storms or on a clear day with the sun shining brightly.

Blinks are caused by a device called a recloser which is an automatic resetting circuit breaker. Reclosers will operate during electrical system disturbances such as car vs. pole, tree branch into line, lightning strike on line and other system events.

Where power blinks are somewhat harmless, they can quickly reach "nuisance stage" if they significantly disrupt operations at your church facility.

We offer the following suggestions:

1. Install a medium to large battery back-up system at your main computer/ server. The battery back-up should be carefully sized to provide a minimum of 5 to 10 minutes of back-up power. (This provides time to save critical files and shut down computer equipment during an extended power interruption.)
2. Install smaller battery back-up units at less critical (but still important) computer support equipment located away from the main computer/server.
3. Consider a battery back-up system for your audio/visual equipment control console/ TV's to maintain their operation should the outage occur during a church service.
4. Be sure to test these back-up units monthly and replace internal batteries every 2 years.

GROUNDING:

Having proper grounding at your church facility is very important. However, quite often, many electricians will recommend driving additional ground rods at the electric meter (or individual pieces of church equipment) in their attempt to solve a problem.

Driving additional ground rods to improve a facility ground is rarely the best approach to resolving power and surge related issues.

We offer the following recommendations relating to grounding of your church facilities:

Main Electrical Power Feed:

Article 250 and related articles of the National Electric Code (NEC) state that a ground rod should be driven and should have a ground resistance of 25 ohms or less. If not 25 ohms, the code states that a second ground rod should be driven 6 feet away and bonded together with #4 copper wire. After driving and connecting the second ground rod, there is no additional need to measure or achieve 25-ohm rating.

Recommendations:

1. Ask your qualified electrician to visually inspect to verify existence of grounding system at the main electrical service entrance (where your electric meter is located). You may find that driven ground rods are covered by concrete. If this is the case, you might have the electrician use a clamp-on ground tester to verify existence of the ground.

   Otherwise, a visual inspection noting a ground conductor (or conduit) from metering system to "earth" is sufficient. We want to avoid driving of additional ground rods ,which may lower the resistance sufficiently to allow your church location to become the "system ground" for the entire area. In other words, if your ground resistance is the lowest in the neighborhood, it could draw surge currents to your facility which is certainly "not good" as storms approach.

2. Visually inspect the soil around the driven ground rods at the electrical power feed to your facility to make sure that it is "dry". We have found several occasions where a leaking hose bib or AC condensate drain creates a "swampy ground". This damp ground often creates the lowest ground resistance in the area and until falling rain balances all area grounds, the impacts on your facility from this issue can be significant.

3. Verify that all "utilities" entering the property (power, cable, telephone, etc.) are bonded together (i.e. single point ground). Cable and telephone service grounds should be bonded to the ground conductor that extends from the meter enclosure to the ground rods. This can usually be verified by visual inspection. There should not be separate ground rods for these or other utility systems. .

4. Ground any metal fencing on the property at the corners that are farthest away from the church building. The goal is to provide a path for any transient surge energy to dissipate from the fence to earth ground rather than jump over to facility equipment.

5. Carefully inspect the church steeple and note whether there is an air terminal (lightning rod) at its highest point. Much to everyone's surprise, we often find that the lightning rod is "there" but not properly grounded. There should not be separate ground rods for these or other utility systems.

In visiting a church that kept losing their AV system, we climbed up and found the braided ground conductor from the steeple lightning rod not connected. It was hanging loosely but touching the metal building structure. Arcing and burn marks indicated that this may have been the cause of their problems (and later confirmed).

ELECTRICAL PANEL INSPECTION:

A critical part of the electrical power feed to a customer facility is the "one-time" bonding of the neutral and ground conductors. This bond typically takes place at the service entrance (meter enclosure) and creates a zero-volt reference between the neutral (operating current) and safety ground (ground rods).

If additional neutral/ground bonds are made inside electrical panels at your church facility, this will create opportunities for neutral (operating current) to also flow on safety ground conductors.

In addition, these extra bonds can create additional risk of damage as transient surge energy ricochets and loops its way around your electrical panels seeking the easiest path to earth ground.

We recommend the following for each electrical panel:

1. Ask your electrical contractor to carefully inspect each electrical panel (and sub-panels) to confirm that:
    a. All bare copper ground wires are connected to the same terminal block which should be bonded directly to the circuit breaker panel enclosure at each panel.
    b. All white neutral wires (other than white conductors connected to double or three pole breakers) should be bonded to the same neutral terminal block; however, in sub-panels this terminal block MUST "float" (i.e. not be bonded to electrical panel enclosure).

Why is this important?

If grounds and neutrals are mixed, together, or neutrals not mixed but the neutral terminal block is bonded to the circuit breaker panel, you risk having operating current(s) traveling on both the neutral and safety ground conductors. This can cause touch voltage issues and can further increase risk of damage to appliances and electronic devices during a transient surge event

If mixing of neutrals/grounds are found, this should be corrected prior to installation of surge protection.

2. We recommend that appropriate labeling be added, warning employees to **"Keep Out"** of energized panels.
3. Make sure that all coaxial cable (internet) and telephone demarcations are bonded at the electrical service entrance.

    The coaxial feed should connect through a grounding block that has screw (Type F) connectors and a terminal to allow for connection to the electrical ground. It would be wise to change this unit out for a connector that has built-in surge protection. Also, telephone demarcations (small grey or medium green box) should be bonded to the electrical ground.

SURGE PROTECTION:

Installation of surge protection at your church facilities will help provide a path for transient surge energy to quickly pass to earth ground, rather than find a path to ground through facility equipment or controls. We offer the following recommendations..

1. During inspection of electrical panels to verify proper neutral/ground float/bond, please have your electrical contractor check and document phase to phase and phase to neutral voltage for each panel. It is very important that they confirm actual voltages in order to determine specific surge protection needs.

Voltage options would be:

Voltage	Phase Reading	A-B	B-C	C-A	A-N	B-N	C-N
120/208Y		208	208	208	120	120	120
120/240D	(High leg Delta)	240	240	240	120	208	120
277/480Y		480	480	480	277	277	277

NOTE: Voltages can vary by plus or minus 5%. If voltages are higher (or lower) or if one leg measures zero, please STOP. Do not proceed.

Feel free to call with questions specific to your facility. The surge protector that you select must be of the proper voltage.

2. Once you confirm panel voltages, please create a list of electrical panels, and note their voltages using the identifiers above and based upon this list:
    a. Install an appropriate hard-wire surge protector at each circuit breaker panel.
    b. Install an appropriate hard-wire surge protector at the circuit breaker providing power to outdoor/parking lot lighting.
    c. Install an appropriate hard-wire surge protector at the circuit breaker providing power to outdoor street signs.
    d. Install additional hard-wire surge protectors at any circuit breaker that provides power to any other equipment located outside of the main church building.
    e. Carry out an audit of 120-volt single phase duplex receptacles, including their location and what equipment is served. Based upon this list, carefully review the value and potential sensitivity of the connected device to determine if it qualifies for additional surge protection. Install a high quality multi-stage surge protector at all critical duplex 120-volt receptacles.
    f. Secure a quality plug-in surge protector with telephone and/or cable surge protection modules for the point where cable and/or telephone lines enter the building.

We look forward to working with you as you review your church facility to help protect it from transient surge damage events.

ABOUT KENICK, INC.

KENICK, Inc. has been providing surge protection products and solutions to the electric utility industry for over 32 years. Their manufacturing facility includes a state-of-the-art research laboratory, allowing them to test surge protection products to see how they respond to small, medium, large and “oh my gosh… what was that!!” transient surge events.

ABOUT THE AUTHOR

Peter Jackson has been responding to the needs of electric utility clients and their customers for over 25 years. His knowledge and expertise in mitigating transient surge damage events has been gained through hundreds of field reviews and their successful outcomes.

Questions?

Please contact us if you have questions about this article or a particular issue that you need help with.
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