UL 1449-3rd Edition
Effects on Lightning Protection Systems

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The effective date of compliance for the 3rd Edition of UL 1449, "Standard for Safety for Surge Protective Devices" has been with us for just over a year. This paper will serve as a refresher in describing some of the key changes to the UL 1449 3rd Edition standard and will attempt to describe how they impact the installation requirements for lightning protection systems for electrical distribution systems under 1000 volts.

KEY CHANGES in UL 1449 – 3rd Edition

The UL 1449 3rd Edition was published in September 29, 2006 with the manufacturing compliance effective date required by September 29, 2009. The five key changes are as follows:

1. UL 1449 becomes an ANSI standard

The 3rd Edition is an approved American National Standard for Safety for Surge Protective Devices and designated as ANSI/UL 1449-2006 (3rd Edition). This standard strengthens conformity of testing among various manufacturers, which provides the consumer with better comparative results. The previous edition did not have such designation and primarily relied on ANSI/IEEE C62.41.2 and ANSI/IEEE C62.45 standards as reference guidelines for UL performance and safety testing.

2. TVSS is named SPD and combined with secondary surge arresters

Surge Protective Devices (SPD) has replaced the terminology of Transient Voltage Surge Suppressor (TVSS). The SPDs are also combined with secondary surge arrestors for devices on circuits 1000 volts or less. The SPD and surge arrestors are now certified under the same ANSI/UL 1449-2006 (3rd Edition) standard.

3. New Device Designations

The surge environment, as defined by ANSI/IEEE Standard C62.41.1, is comprised of location categories that can be described (in simplified terms) as Category C – High Exposure, Category B – Medium Exposure and Category A – Low Exposure. Manufacturers of SPDs will generally recommend their products for use at these various locations, primarily based on the surge current withstand capability of the SPD design. ANSI/UL 1449-2006 (3rd Edition) has now introduced SPD "Type" ratings that define the specific locations where an SPD is allowed to be installed based on product design, safety and performance testing. All SPDs intended for use on systems of less than 1000v are now required to be evaluated and listed as one of the following SPD types:

Type 1: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt-hour meter socket enclosures and intended to be installed without an external overcurrent protective device. (ANSI/IEEE C62.41 - Category C)

Type 2: Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device; including SPDs located at the branch panel. (ANSI/IEEE C62.41 – Categories B and C)

Type 3: Point of utilization SPDs, installed at a minimum conductor length of 30 feet from the electrical service panel to the point of utilization, for example cord connected, direct plug-in, receptacle type and SPDs installed at the utilization equipment being protected. The distance (30 feet) is exclusive of conductors provided with or used to attach SPDs. (ANSI/IEEE C62.41 - Category A - Example: Surge Outlet strips)

Note: Type 1, 2 and 3 Component Assemblies consists of a Type 4 component assembly that has been tested and approved for use in Type 1, 2 or 3 locations. (Example: Integrally mounted SPDs that are to be factory installed within UL Listed electrical panels or gear.)

Type 4: Component Assemblies, consisting of one or more Type 5 components together with internal or external short circuit protection or a means of complying with the limited current test of UL1449 3rd Edition, section 39.4.

Type 5: Discrete component surge suppressors, such as metal oxide varistors MOVs that may be mounted on a printed circuit board, connected by leads or provided within an enclosure with mounting means and wiring terminations.

Note: Type 1 and Type 2 devices will be the only designations that will be further discussed in this paper since they are primarily the types of SPDs which are permanently connected to an electrical distribution system under 1000 volts.

4. Clamping Voltage Testing Changes (Surge Impulse Test)

Previously old impulse tests were performed with a surge waveform of 6kV/500A to obtain Suppressed Voltage Ratings (SVR). Presently the new 3rd Edition impulse test is performed with a surge waveform of 6kV/3,000A to obtain Voltage Protection Ratings (VPR). One should notice that there is six times more surge energy present in testing for the revised 3rd Edition standard. This results in higher clamping voltages therefore VPR values will be numerically higher than former SVR values.

5. New Nominal Discharge Current Test (I_n)

This is a new SPD test where the device must remain fully operational after being subjected to a total of 15 impulses, one minute apart. Some consider this to be the "stress test" for SPDs to measure its durability in the electrical system. It is performed in combination with the surge impulse test above. A 10% deviation in VPR during these tests would result in failure. The value of the nominal discharge current (I_n) impulse value is selected by the manufacture and can vary from 10kA to 20kA for Type 1 devices and 3kA, 5kA, 10kA or 20kA for Type 2 devices. The actual nominal discharge current level achieved by the device must be marked on the label of the device as (I_n). Some manufacturers have selected to consolidate the nominal discharge current (I_n) rating for a majority of their Type 1 and Type 2 devices to the highest value of 20 kA (I_n). The SPDs and secondary surge arresters 20kA nominal discharge current (I_n) rating is a critical requirement in lightning protection systems (LPS) installation standards.

These five key changes to the ANSI/UL 1449-2006 (3rd Edition) set the stage for other codes and standards to be revised as well to align with the new publication.

Alignment of National Electrical Code Articles

Previous editions of the NEC had separate articles for surge arresters (Article 280) and transient voltage surge suppressors (TVSS) units (Article 285). The surge arresters were considered line-side devices and the TVSS was the load-side device. Under the 2008 National Electrical Code (NEC) the Articles 280 and 285 were revised to align with the ANSI/UL 1449-2006 (3rd Edition).

Article 280

Prior editions of the NEC Article 280 had addressed surge arresters installed on circuits both less than and over 1000 volts. Since low voltage surge arresters are now certified with surge protective devices under ANSI/UL 1449-2006 (3rd Edition) their requirements were moved from Article 280 to Article 285 in the 2008 NEC. The low voltage surge arresters are considered a Type 1 SPD under Article 285. Now Article 280 concentrates only on addressing the surge arresters installed on wiring systems over 1000 volts.

Article 285

This 2008 NEC article combines surge arresters with transient voltage surge suppressors into one category called surge protective devices (SPDs) installed on wiring systems operating at 1000 volts or less. This change is discussed earlier in the KEY CHANGES in UL 1449 – 3rd Edition item No. 2 above. Article 285 also utilizes the new "Type" designations for Types 1, 2 and 3 devices as defined in the ANSI/UL 1449-2006 (3rd Edition) that is discussed in item No. 3 of the "Key Changes" above.

LIGHTNING PROTECTION SYSTEMS (LPS) SURGE PROTECTION REQUIREMENTS

Lightning protection systems (LPS) do not prevent lightning strikes from occurring but rather they provide a means of controlling the lightning strike. This is performed by the installation of a low resistance path for the lightning strike to flow to ground along with devices to protect electrical distribution equipment and sensitive electronic equipment. A lightning protection system (LPS) is comprised of air terminals, down conductors, ground rods, connectors, etc. for the low resistance path to ground in conjunction with surge protection devices (SPDs) for the equipment protection, all of which shall be properly installed in accordance with the NFPA 780 and UL 96A. The NFPA 780 and UL 96A are national standards on installation requirements for lightning protection systems (LPS). Compliance to these standards is key for insurance purposes and in obtaining a code compliant or a UL Master Label certified lightning protection system (LPS).

These standards have called for surge suppression devices to be installed on electric and telephone service entrances and on radio and television antenna lead-ins as part of the LPS since 1992 if not earlier. A recent review of the NFPA 780-2008 mandates that surge protection devices (SPDs) shall be installed at all power service entrances. The UL 96A (circa 2007) further defines the requirement that the SPDs shall be installed on each electric service entrance on the line or load side of the service equipment overcurrent protection device. Additionally, UL 96A references the National Electrical Code (NEC) Article 285 – Type 1 and Type 2 surge protection devices when describing the surge protection locations at the service entrance. This terminology clearly aligns with the changes made in the ANSI/UL 1449-2006 (3rd Edition) discussed earlier.

A critical requirement introduced by the ANSI/UL 1449-2006 (3rd Edition) is the new nominal discharge current (I_n) test rating values. NFPA 780-2008 incorporates this new testing by requiring the installation of surge protection devices (SPDs) at the service entrance to have a nominal discharge current rating of least 20kA (8/20 us) per phase. UL 96A also requires for both Type 1 and Type 2 surge protection devices (SPDs) to be rated for 20kA or more nominal discharge current (I_n) to

be considered suitable for lightning protection systems (LPS). Such compliant devices are found in UL's certification directories under the new UL category code (VZCA) for wall mounted devices and UL category code (VZCA2) for factory installed only integral surge protection devices.

Previously the UL 1449 2nd Edition standard compliant devices were listed under the UL category code (OWHX) for secondary surge arresters and UL category code (XUHT) for transient voltage surge suppressors. The UL category codes (OWHX) and (XUHT) were withdrawn on September 29, 2009 with the manufacture effective compliance of ANSI/UL 1449-2006 (3rd Edition). Although these categories were withdrawn, UL did accept these previously listed products to be utilized until supplies are depleted to meet full compliance of UL 96A for a lightning protection system Master Label Certificate. Information on these two UL category codes is no longer available in the UL Certification Directory but evidence of the UL Mark on the device indicates these units were previously listed products. The (XUHT) transient voltage surge suppressors would have an additional mark on the unit stating that it is "Suitable for LPS" or "TVSS/Arrester".

DESIGN CONSIDERATIONS FOR LIGHTNING PROTECTION SYSTEM (LPS)

The need for installing a lightning protection system on a project will vary due to risk factors. Some of these risk factors include project location, frequency of thunderstorms, building construction, type of building occupancy, and type of equipment within the building. These risks will establish the insurance rates for the building and its contents. A LPS can provide insurance rate cost savings by providing a means of controlling the lightning strike and eliminating the chance of fire caused by a lightning strike. Once the need for a lightning protection system is decided it should also be determined whether a code compliant or a UL Master Label certified lightning protection system is required. A code compliant LPS is one where the installer simply certifies that the lightning protection system complies with the national standards. A UL Master Label certified LPS is one where upon completion of the system the UL listed LPS installer submits the certification application. The LPS will be assigned a UL field representative who inspects the installation. Upon correction of any variances found and passing UL inspection the UL listed LPS installer can forward the UL Master Label certificate to the building owner and posts the certificate on UL's web site. The UL Master Label certificate provides proof that the LPS is in compliance with NFPA 780 and/or UL 96A national standards and must be renewed every five years.

Regardless of whether a code compliant or a UL Master Label certified lightning protection system is chosen the electrical designer should ensure that the LPS only be designed and installed by experienced qualified designers and installers that are UL listed. The installer should utilize UL listed lightning protection system components for installation in accordance with the NFPA 780 and UL 96A national standards. The electrical designer should also ensure that the appropriate Type 1 or Type 2 surge protection device SPD with a minimum 20kA nominal discharge current (I_n) rating be installed at all electrical service entrances in accordance with the national codes. Additional SPD devices should be installed downstream of the electrical service entrance to provide optimum sensitive equipment surge protection to further enhance a lightning protection system.