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SUBJECT 497E

OUTLINE OF INVESTIGATION

FOR

PROTECTORS FOR ANTENNA LEAD-IN CONDUCTORS

Issue No. 4

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Summary of Topics

This is the Fourth issue of the Outline of Investigation for Protectors for Antenna Lead-In Conductors, Subject 497E, which covers devices that are used to limit surges on the cable that connects the antenna to the receiver/transmitter electronics and are connected between the conductors and the grounded shield or other ground connection.

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INTRODUCTION

1 Scope

1.1 This Outline of Investigation covers protectors for antenna lead-in conductors. These devices are used to limit surges on the cable that connects the antenna to the receiver/transmitter electronics and are connected between the conductors and the grounded shield or other ground connection. Typical applications include antenna installations for radio and television receiving equipment, amateur radio transmitting and receiving equipment, cellular telephone towers and WiMax or WiFi wireless networks.

1.2 As covered by these requirements, protectors for antenna lead-in conductors typically consists of air gap arresters, gas tube arresters, solid-state arresters or quarter-wave stub type devices, or combinations of these devices. Other technologies are not excluded. They may or may not contain additional components such as inductors or blocking capacitors. These protectors are intended to protect equipment, wiring, and personnel at the premises against the effects of excessive potentials and currents on the conductors caused by lightning.

1.3 These devices operate to divert a surge current to earth, and control the residual voltage (also known as let-through voltage) to a suitable level. Once the surge current has subsided, the device automatically returns normal operation and reset to a state ready to receive the next surge. Residual voltage limits or their suitability to minimize damage to connected equipment is not within the scope of these requirements.

1.4 These protectors are investigated for their maximum discharge current (I_{max}) capability using an 8/20 current waveform. This is the maximum impulse current the protector can withstand, including after environmental conditioning, without affecting its surge limiting capability or creating a risk of fire, fragmentation or electrical shock.

1.5 This Outline does not cover the following:

- a) Lightning protective devices for the protection of secondary distribution wiring systems and equipment.
- b) Antenna discharge units for radio and television receiving appliances that are covered by the Standard for Antenna-Discharge Units, UL 452.
- c) Lightning conductor and air terminals for connection of lightning rods for building protection.
- d) Protectors for fire alarm signaling circuits that are covered by the Standard for Protectors for Data Communications and Fire-Alarm Circuits, UL 497B.
- e) Equipment covered by the Standard for Secondary Protectors for Communications Circuits, UL 497A.
- f) Equipment covered by the Standard for Surge Protective Devices, UL 1449.
- g) Equipment covered by the Standard for Protectors for Paired-Conductor Communications Circuits, UL 497.
- h) Equipment covered by the Standard for Protectors for Coaxial Communications Circuits, UL 497C.
- i) DC blocking connectors or components that do not have lightning protection as their primary function.

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- j) Applications where follow-on currents may occur, such as installations where communications wiring is routed on shared facilities with electrical distribution systems.

1.6 Special installation methods are required for equipment connected to wire-line communication facilities serving high-voltage electric power stations operating at greater than 1 kV. These requirements do not cover the equipment or devices used in the design of such installations. Special system design requirements, such as those covered by Recommended Practice for the Protection of Wire-Line Communication Facilities Serving Electric Power Locations, IEEE 487, shall be followed to reduce the risks associated with wire-line communication facilities serving such power stations.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this Outline shall comply with the requirements for that component.

2.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this outline or
- b) Is superseded by a requirement in this outline.

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

3.2 Unless otherwise indicated, all voltage and current values specified in this outline are root-mean-square (rms).

4 Undated References

4.1 Any undated reference to a code or standard appearing in the requirements of this outline shall be interpreted as referring to the latest edition of that code or standard.

5 Glossary

5.1 For the purpose of this outline the following definitions apply.

5.2 COMBINATION WAVEFORM GENERATOR – A surge generator with a 2-ohm internal impedance producing a 1.2/50 μ s open circuit voltage and an 8/20 short-circuit current waveshape.

5.3 DIRECT CURRENT (DC) BREAKDOWN VOLTAGE – The voltage at which an arrester changes from non-conduction to conduction when the DC potential is increased at a rate not greater than 2000 Volts per second.

5.4 INDOOR USE (CONTROLLED ENVIRONMENT) – Installation of equipment in an area where the atmosphere is artificially controlled. For the purpose of this Outline, indoor ambient is limited to a temperature of 0 – 30°C. Limits for corrosion concentrations are defined in the test program. Rain does not occur.

5.5 LIGHTNING IMPULSE CURRENT (I_{imp}) – See Maximum Discharge Current, 5.6.

5.6 MAXIMUM DISCHARGE CURRENT (I_{max}) – The maximum instantaneous value of the current through the protector having an 8/20 waveshape. From the Standard for the Installation of Lightning Protection Systems, NFPA 780. Other common terms for “maximum discharge current” include but are not limited to:

- a) Lightning current carrying capability;
- b) Lightning impulse current (I_{imp}) [see Lightning Protection Components (LPC) Part 3: Requirements for isolating spark gaps, EN 50164-3];
- c) Impulse discharge current;
- d) Withstand current;
- e) Surge discharge current;
- f) Surge current capability;
- g) Discharge current;
- h) Maximum impulse discharge;
- i) Surge current;
- j) Peak pulse current; and
- k) Maximum transient.

5.7 NOMINAL DISCHARGE CURRENT (I_n) – Peak value of 8/20 μ s current waveform selected by the manufacturer for which a protector remains functional after 15 surges. From the Standard for the Installation of Lighting Protection Systems, NFPA 780.

5.8 OUTDOOR USE (UNCONTROLLED ENVIRONMENT) – An area subjected to the natural environmental conditions which make-up the ambient and moisture extremes of this plant. For the purpose of consistency, the ambient and moisture extremes are defined in the various tests of this Outline.

5.9 PROTECTOR – A device intended to prevent damage to a circuit or system when abnormally high voltages occur.

CONSTRUCTION

6 General

6.1 A protector for antenna lead-in conductors shall be constructed to withstand, without damage, its intended installation and use and shall comply with the applicable performance requirements specified in Sections 11 – 27.

6.2 A protector shall not have provision for adjustment of its surge limiting components. For dc shorting type protectors, it is permissible for the operating pass-through frequency to be adjustable as long as it remains beyond normal lightning frequencies, typically above 10 MHz.

6.3 An uninsulated live part shall be secured to an insulated mounting surface so that it is prevented from turning or shifting in position, when such motion is capable of resulting in a reduction of spacings.

6.4 A protector assembly shall be protected against fouling by dust or other material capable of affecting intended operation.

6.5 A current-carrying part shall be silver, copper, copper-alloy, or any non-corrosive metal that complies with the test current requirements of this Outline.

7 Enclosures

7.1 General

7.1.1 An enclosure shall have the strength and rigidity to resist total or partial collapse with attendant reduction of spacings, loosening or displacement of parts, or other conditions that impair the operation of the device and increase the risk of fire, electric shock, or injury to persons.

7.1.2 Enclosures for individual components, outer enclosures, and combinations of the two are considered in determining compliance with 7.1.1.

7.1.3 Protector enclosures shall have provision for mounting. For installations utilizing hard-line coaxial cable, it is acceptable to use the cable connections as the mounting means.

7.1.4 A protector intended for outdoor use shall be provided with a water-resistant cover or enclosure that is resistant to corrosion and the effects of UV radiation.

7.2 Sheet metal

7.2.1 See Sheet metal, Section 5.2 of the Standard for Protectors for Coaxial Communications Circuits, UL 497C.

7.3 Nonmetallic

7.3.1 An enclosure of nonmetallic material for a protector shall have the mechanical strength and durability intended for the application and be formed so that it covers all uninsulated non-grounded current-carrying parts. Nonmetallic enclosures shall employ material rated 5VA or shall comply with the 127 mm (5 inch) flame test of the Standard for Polymeric Material – Use in Electrical Equipment Evaluations, UL 746C.

8 Protection Against Corrosion

8.1 See Protection Against Corrosion – General, Section 6.1 of the Standard for Protectors for Coaxial Communications Circuits, UL 497C.

9 Wiring Connections

9.1 Coaxial connections

9.1.1 A coaxial type protector shall be provided with a threaded receptacle which accepts the mating connector of a coaxial cable to which it is intended to be connected.

9.2 Grounding

9.2.1 A protector shall be provided with a method of grounding consisting of at least one of the following:

- a) A field wiring terminal;
- b) An attached grounding lead or strap of a minimum of 12 AWG (3.3 mm²) copper, or equivalent;
- c) A tab with a through hole, a tapped hole, or a threaded stud for mounting the protector to a grounded metal panel; or
- d) A threaded bulkhead with mounting hardware, for fastening the protector through a hole in a grounded panel.

9.2.2 The shield of a coaxial cable shall not be used as the main grounding connections for the protector.

9.2.3 A protector field wiring terminal shall have provision for connecting at least one grounding conductor not smaller than 12 AWG (3.3 mm²). A three- to six-cable protector shall have provision for connecting at least one grounding conductor not smaller than 10 AWG (5.3 mm²). Protectors intended for connecting more than six circuits shall have provision for connecting at least one grounding conductor not smaller than 6 AWG (13.3 mm²). All protector ground terminals shall be capable of connecting a minimum 14 AWG (2.1 mm²) wire.