

SECTION 23

TRANSIENT VOLTAGE SURGE SUPPRESSORS

23.01 DESCRIPTION

- A. This section describes the materials and installation requirements for transient voltage surge suppressors (TVSS) for the protection of all AC and DC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.
- B. These specifications shall form a part of the Contract Document and shall govern construction work for all buildings to be built or modified for the Board of Water and Sewer Commissioners of the City of Mobile, Alabama. The work covered by this section includes the furnishing of all parts, labor, equipment, appliances and material and performing all operations in connection with the installation of surge suppressors and grounding.
- C. All new construction of buildings, and revision to existing buildings for the Board of Water and Sewer Commissioners of the City of Mobile, Alabama shall include the installation of surge suppressors as follows:
 1. On the power source side of the transfer switch
 2. On the load side of the transfer switch
 3. If the length of wiring between the transfer switch and the motor control center (MCC) is more than 50', install a third surge suppressor at the MCC
 4. If the length of wiring between the transfer switch and a second MCC in the same building is more than 50' in length, install a fourth surge suppressor at the second MCC.
 5. Between the step down transformer and the 3 phase distribution panel for the remote telemetry unit (RTU) used for the Supervisory Control and Data Acquisition Panel (SCADA)
 6. On all 4-20 milliamp analog inputs to and outputs from the RTU panel
 7. On the radio antenna cable between the antenna and the radio for the SCADA system
 8. On the 120 VAC power, and the 24 VDC power to the field mounted electronics for magnetic flow meters

9. On any field mounted breaker, Variable Frequency Drive, Programmable Logic Controller, or instrument that is located in a field location that is likely to be struck by lightning.
10. On low voltage circuits used to start generators after a power failure
11. On all LAN lines, telephone lines, digital data lines and computer highway cables.
12. On the 120 Volt power lines to all computers, remote telemetry units, radios, or programmable logic controllers.

23.02 GENERAL REQUIREMENTS

- A. This standard addresses the installation of surge suppressors on all levels of AC voltage at or below 277/480 VAC and DC voltages at or below 35 volts.
- B. This section shall be used in conjunction with Section 40 entitled "Lightning Protection System" for the application of lightning rods and grounding. To provide full protection requires the installation of lightning rods, grounding, and surge suppressors.
- C. Contractor shall utilize Section 42 entitled "Electrical Material and Methods", for details of enclosures, grounding, and wiring. Section 42 includes specifications for:
 1. General electrical requirements
 2. Raceways, boxes, and fittings
 3. Wire and cable
 4. Low Voltage motor control
 5. Variable frequency drives
 6. Grounding
 7. Lightning protection system

23.03 SCOPE

- A. The General Contractor shall subcontract with a lightning system supplier to install the lightning protection system on the roofs of the buildings and install surge suppressors as specified for each level of power as shown in the specifications. It shall be the responsibility of the supplier to ensure that all equipment to be purchased is

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- completely compatible with the existing hardware.
- B. Upon award of Contract, the system supplier shall be responsible for the following:
1. Visit each existing site, remove the face of the motor control cabinets and panels, and other equipment
 2. Determine the type of connections, number of phases, Delta versus Y arrangement, voltage level, and number or wires to be hooked up.
 3. Specify the actual surge suppressor to be purchased for each site and service.
 4. Coordinate and expedite
 5. delivery of the surge suppressors.
 6. Install and check out the operation of the surge suppressors.
 7. Provide a two year warranty on all parts and labor.
 8. Test the ground at each site to verify that all grounds are common. If they are not common, install equipment as required to make them common.
- C. System supplier shall install a ground wire from each surge suppressor to the common ground for that site. All connections for ground wires to ground rods shall be CAD welded.
- D. All surge suppressors mounted outside buildings shall be NEMA 4 X weatherproof enclosures. All surge suppressors mounted inside buildings shall be in NEMA 12 enclosures.
- E. Surge suppressors to be mounted inside buildings where panels are recessed into a finished wall shall be installed in a recessed area beside the panel, or in the ceiling area above the panel. In such cases, contractor shall be responsible for patching and finishing the wall or ceiling, and painting the area around the new location to match the existing color.
- F. One of the goals of this standard is to provide one single ground point that is common to all electrical equipment at each site. The Contractor shall test the grounding
- for all electrical equipment at existing locations to verify they are common. If they are not, the Contractor shall run # 4 cooper wire between grounds and/or equipment as required to make them common. This may require providing a trench in the ground outside, or providing additional ground rods.
- G. Antenna cables for the SCADA system at lift station and water booster station shall all have an in line surge suppressor. New suppressors shall be installed on the outside of RTU cabinets and include a separate wire for grounding. A #4 bare cooper solid wire shall be installed from the surge suppressor to the nearest ground rod.
- H. Upon completion of any project, there shall be a separate ground rod at each generator and/or fuel tank mounted outside a building. This ground rod shall be attached to the MCC, or power company ground at that site.
- I. Surge suppressors may be mounted inside existing electrical or MCC enclosures where there is adequate space. In such cases where there is inadequate space, the contractor shall be required to purchase a separate enclosure adequate in size to handle suppressors. Separate enclosure will be required for example at the magnetic flow meters and field mount disconnect switches where surge suppressors are specified.
- J. The Contractor shall install surge suppressors at all magnetic flow meter readouts where indicated. The Contractor shall provide a separate box, and install it next to the Flow meter electronics in the field. Install a DIN Rail in the box for mounting the suppressors. Suppressors shall be installed to protect 24 VDC, and 120 VAC at read out, and at field location.
- K. All connections for ground wires to ground rods shall be cad welded as per 4014 of NFPA 780. All grounding media in or on a structure shall be interconnected to provide a common ground potential. This interconnection shall include lightning protection, electrical service, telephone, antenna, MCC, generator, and any other electrical system at each site.

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- L. All surge suppressors shall be installed in close proximity to the equipment to be protected. The Contractor shall keep lead lines as short as possible.

23.04 BRAND SELECTION

The surge suppressor equipment has been pre-selected by the staff of the Board of Water and Sewer Commissioners of the City of Mobile. The brand shall be "Critec" as manufactured or marketed by ERICO or Atlantic Scientific for AC voltages up to and including 208/477 VAC, and Panametrics or Atlantic Scientific for lower voltage and DC applications.

23.05 SUBMITTALS

- A. Submit shop drawings, product data and manufacturer's installation instructions.
- B. The surge suppression submittals shall also include:
 - 1. Dimensional drawing of each suppressor type indicating the following:
 - a. Service Entrance Suppressors
 - (1) Copper bus bars (electrical grade copper 1.5" wide, 0.25" thick)
 - (2) Redundant modules on each phase
 - (3) Replaceable 200,000 AIC fuses on each module
 - b. Subpanel Suppressors
 - Line to neutral, line to ground, and Neutral to ground suppression paths
 - 2. UL 1449 certification (clamp voltage test results)
 - 3. UL 1283 EMI certification

- 4. IEEE C62.41-1991 Category C3 (20KV, 10KA, 8/20 usec. waveform) clamp voltage test results from an independent test lab.

23.06 PRODUCTS

- A. Suppressors shall be listed in accordance with UL 1449, Standard for Safety, Transient Voltage Surge Suppressors and UL 1283, Electromagnetic Interference Filters.
- B. Suppressors shall be independently tested with the category C3 high exposure waveform (20KV, 10KA, 8/20 sec. Waveform) per ANSI/IEEE C62.41 – 1991.
- C. Suppressors shall be constructed using surge current modules (MOV based). Each module shall be fused with user replaceable 200,000 AIC rated fuses. The status of each module shall be visible on the front of the suppressor's enclosure as well as on the module.
- D. For three phases, four wire ground configurations, redundant suppression modules shall provide the following suppression paths: line to ground, and neutral to ground.
- E. Suppressors shall be equipped with an audible alarm which shall actuate when any of the surge current modules has failed. An alarm on/off switch shall be provided to silence the alarm and an alarm push-to-test switch shall be provided to test the alarm. Both switches and audible alarm shall be located on the front cover of the TVSS enclosure.
- F. Suppressors shall meet or exceed the following criteria:
 - 1. Maximum single impulse current rating (L-N): 160,000 amperes per phase (8/20 usec. waveform).

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2. Pulse Lift Test: Capable of protecting against and surviving 5000 ANSI/IEEE C62.41 Category C transients without failure or degradation of UL 1449 clamp voltage by more than 10%.

3. UL 1449 clamping voltage must not exceed the following:

VOLTAGE	L-N	N-G
120/208	400	400
277/480	800	800

4. The Category C3 clamping voltage ANSI/IEEE C.62.41-1991 (20KV-1.2/50us., 10KA-8/20us.) shall not exceed the following:

UL 1449 clamping voltage must not exceed the following:

VOLTAGE	L-N	N-G
120/208	675	675
277/470	1250	1250

5. Minimum impulse withstand 40KA 8/20µs per phase
a. Per NFPA 780.4.18.3.1
b. Rating per NEMA LS-1

- G. The suppressor shall have a response time no greater than five nanoseconds for any of the individual protection modes.

- H. Suppressors shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage, and maximum suppressed voltage per NFPA Table 4.18.4.

- I. Visible indication of proper suppressor connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable.

- J. Terminals shall be provided for all of the necessary power and ground connections. Each terminal shall accommodate wire sizes of #8 to #1 AWG.

- K. Suppressors' manufacturer shall provide certified test data confirming a "fail-short" failure mode.

- L. Suppressors shall be manufactured in the United States. All major components shall also be of American manufacture.

- M. The suppressor shall have a warranty, incorporating unlimited replacements of suppressor modules if they are destroyed by transients during the warranty period.

- N. Suppressors shall be "CRITEC" as manufactured by ERICO or Atlantic Scientific, or approved equal.

- O. High voltage suppressor shall be designed to handle a sustained voltage two times that of its rated voltage and still function. Unit shall provide protection after UL 1449 Ed. 22 X over-voltage test.

23.07 SECONDARY SERVICE SUPPRESSORS FOR DISTRIBUTION PANELS

- A. Suppressors shall be listed in accordance with UL 1449, Standard for Safety, Transient Voltage Surge Suppressors.

- B. For 3 phases, 4 wire plus ground configurations, suppressors shall provide suppression elements between all phase conductors, between each phase conductor and the system neutral and between the neutral conductor and ground, for a total of seven suppression modes.

- C. The suppressor shall provide certified test data confirming a "fail-short" failure mode.

- D. Visible location of proper suppressor connection and operation shall be provided.

- E. Suppressors shall be designed for close couple installation. The mounting position of the suppressor shall permit a straight and short lead length connection between the suppressor and the point of connection to the panel board.

- F. Suppressors shall meet or exceed the following criteria:

- a. Maximum single impulse current rating: 20,000 amperes per phase (8/20 usec.waveform).

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NOTE: If the suppressor utilizes internal fuses, the maximum single impulse current cannot exceed the rating of the fuse, unless pre-approved by the specifying engineer.

- b. Pulse life rating: 3,000 amperes (8/20 usec. Waveform): 500 occurrences.
 - c. Maximum clamping voltage will be listed for a 3KA, 8/20 usec. Current waveform.
- G. Suppressors shall have turn-on and turn-off times of less than one nanosecond.
- H. Suppressors shall be of solid-state components and operate bidirectionally.
- I. Suppressors for secondary service shall be "CRITEC" as manufactured by ERICO, Atlantic Scientific or approved equal.

23.08 LOW VOLTAGE SPPRESSORS

Suppressors for use in lower voltages such as 120 VAC and all DC voltages shall be manufactured by PARAMAX, Atlantic Scientific or approved equal.

23.09 WARRANTY

The suppressor will have a warranty guarantee as follows:

<u>Suppressor</u>	<u>Warranty Period</u>
High Voltage panel suppressor	10 years
Low Voltage series panel suppressor	5 years

END OF SECTION