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| Version | Date | Description of Revisions |
| 1 | August 30, 2006 | Approved final document. |
| 2 | February 19, 2010 | Modified ‘Related Sections’ |
| 3 | March 22, 2011 | Minor edits |
| 4 | June 26, 2013 | Final Draft – Consolidated Comments Spec Update Project. Incorporation of new Commissioning and Computerized Maintenance Management System Data Requirements Specification cross references. |
| 5 | August 6, 2014 | Changes to reflect renaming of commissioning specification and final review (AV) |
| **6** | **February 4, 2015** | **Finalized Specification – Reference eDOCS #5630506 v8 (AV) and updated standards** |
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NOTE:

This is a CONTROLLED Document. Any documents appearing in paper form are not controlled and should be checked against the on-line file version prior to use.

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**The on-line copy is the current version of the document.**

# GEneral

## Scope

### The Contractor shall furnish and install the Transient Voltage Surge Suppression (TVSS) equipment having the electrical characteristics, ratings and modifications as specified in this Section and as shown on the Contract Drawings. To maximize performance and reliability, the AC surge protection shall be integrated into the electrical distribution equipment such as switchgear, switchboards, panelboards, bus-way and/or motor control centers.

### TVSS shall be part of the MCC or switchgear equipment system unless otherwise specified in the Contract Documents.

## Related Sections

### [Under "Related Sections", identify other Sections that are related to, and/or dependent on, the work results or information specified elsewhere. The list should be limited to Sections with specific information that the reader might expect to find in this Section, but is specified elsewhere. For example, if hardware for aluminum entrances is specified in the aluminum entrance Section, a cross-reference would be appropriate in the finish hardware Section. The purpose of this cross-referencing is for information only, to aid in finding those other requirements—not to define the scope of the Section.

### Cross-referencing here may also be used to coordinate assemblies or systems whose components may span multiple Sections and which must meet certain performance requirements as an assembly or system.

### Contractor is responsible for coordination of the Work. Contractor is responsible for being familiar with and incorporating all required elements of cross-referenced Specifications cited.

### This Section is to be completed/updated during the design development by the Consultant. If it is not applicable to the section for the specific project it may be deleted.]

### [List Sections specifying installation of products supplied but not installed under this Section and indicate specific items.]

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: Execution requirements for ...[item]... specified under this Section.

### [List Sections specifying products installed but not supplied under this Section and indicate specific items.]

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: Product requirements for ...[item]... for installation under this Section.

### [List Sections specifying related requirements.]

### Section [\_\_\_\_\_\_ – \_\_\_\_\_\_\_\_\_\_\_\_]: [Optional short phrase indicating relationship].

### Section 01300 – Submittals

### Section 01425 - Computerized Maintenance Management System Data Requirements

### Section 01430 – Operation and Maintenance Data.

### Section 01810 – Equipment Testing and Facility Commissioning

### Section 16010 – Electrical General Requirements

### [Division 13 – SCADA and Instrumentation - insert applicable specifications]

### Design Guidelines Section 21 - Development and Maintenance of Asset Inventory and Tagging

### Product requirements for [item]... for installation under this Section.

## References

### All TVSS units and its components shall be designed, manufactured and tested in accordance with CSA standards [Consultant to add to subsection 1.3.8 any additional CSA standards that are applicable to the project].

### ANSI/IEEE

#### IEEE STD C62.45-2002 (R2008), IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.

#### IEEE STD C62.41.1-2002 (R2008), IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.

#### IEEE 1100-2005, IEEE Recommended Practice for Powering and Grounding Electronic Equipment . (IEEE Emerald Book)

#### IEEE STD C62.62-2010, IEEE Standard Test Specifications for Surge-Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000V and less) AC Power Circuits.

### UL and ULC

#### UL 1449 (4th Edition R2014), Standard for Surge Protective Devices.

#### UL 1283 (6th edition R2015), Standard for Electromagnetic Interference Filters.

### Ontario Electrical Safety Code, 25th Edition, 2012

### NFPA

#### NFPA 70, National Electrical Code 2014 Edition (NEC), Section 285, Surge-Protective Devices (SPDs) 1000 Volts or Less.

### US Department of Defense

#### MIL-STD-220B 24 January 2000, Test Method Standard - Method of Insertion Loss Measurement.

### NEMA

#### NEMA 250-2014, Enclosures for Electrical Equipment (1000 V Maximum)

#### Type 1 Enclosures

#### Type 3R Enclosures

#### Type 4 Enclosures

#### Type 12 Enclosures

### CSA

#### C22.2 No. 269.2-13, Surge Protective Devices - Type 2 - Permanently Connected.

## Measurement and Payment

*[Choose one of the following payment language provisions that best suits the individual project.*

*If this Section is not specifically referenced by an item in the Bid Form, please use the following language:*

### The work of this Section will not be measured separately for payment. All costs associated with the work of this Section shall be included in the Contract Price.

*OR If this Section is specifically referenced in the Bid Form, use the following language and identify the relevant item in the Bid Form:*

### All costs associated with the work of this Section shall be included in the price(s) for Item No(s). \_\_\_ in the Bid Form.

*If the work of this Section is to be measured and paid for by several different methods, please amend the standard wording given above to reflect the different methods of measurement and payment.*]

## Submittals

### The following items shall be submitted to the Consultant:

#### Verification that the TVSS device complies with the required CSA standards.

#### Actual let through voltage test data in the form of oscillograph results for the ANSI/IEEE C62.41.1-2002 (R2008) Category C3 & C1 (combination wave) and B3 (ringwave) tested in accordance with ANSI/IEEE C62.45-2002 (R2008).

#### Provide spectrum analysis of each unit based on MIL-STD-220A test procedures between 50kHz and 200kHz verifying that the device’s noise attenuation equals or exceeds 50 dB at 100kHz.

#### For retrofit mounting applications, electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

#### Contractor to provide test reports from a recognized independent testing laboratory acceptable to the Consultant verifying that the suppressor components can survive published surge current rating on both a per mode and per phase basis in accordance with IEEE STD C62.41.1-2002. Note that testing on individual modules is not acceptable. The means of connection of the TVSS to the electrical distribution system is indicated on the Contract Documents *[Consultant to ensure the connection means is contained in the Contract Documents and applicable standards are added to this specification section].*

#### Dimensional drawing of each TVSS type, indicating proposed mounting arrangements.

#### Written functional description of the transient protection circuit in terms of components, configuration, design approach, and performance capability in accordance with the applicable standard. *[Consultant to identify relevant standard to this specification related to functional description of the protection circuit].*

#### Provide UL-1449, Fourth Edition data card from the manufacturer showing the Suppressed Voltage Rating (SVR) for the specific catalogue number submitted. *[NOTE: As of September 29, 2009 no manufacturer can produce any listed TVSS or secondary surge arrestor rated 1000V and below per UL 1449 3rd edition. Consultant to provide direction.]*

#### In accordance with NEC Article 285.6, mark the devices with the short circuit current rating. Meet or exceed the available fault current. Provide test data from an independent testing laboratory to demonstrate that the short circuit current rating has been tested on a complete device

#### Submit test report data clearly demonstrating the maximum surge current rating has been tested on a COMPLETE TVSS unit including all necessary fusing/overcurrent protection, thermal disconnects, integral disconnects and monitoring systems.

#### Submit data demonstrating that the TVSS unit, including all overcurrent protection, is fully capable of a minimum repetitive surge current rating of 10,000 ANSI/IEEE C62.41.1-2002 (R2008), Category C3 (10kA) impulses without failure or a change in performance characteristics of more than 10%.

## Submittals for Construction

### The following information shall be submitted for record purposes:

#### Final Contract Drawings showing the exact connection/configuration of the incorporated or retrofitted TVSS system. The Contract Drawings shall reflect all of the devices that were submitted to the Consultant for approval.

## Qualifications

### The Contractor shall ensure that the manufacturer is able to demonstrate that it is capable of responding to service requests from the Consultant or Region within 24-hours of a request for service assistance. The Contractor shall ensure that the field service organization employs fully accredited power system engineer(s) who are able to attend the Site within the 24 hour notice period are capable of performing complete analysis, and coordination studies.

## Delivery, Storage and Handling

### Equipment shall be handled and stored in accordance with the manufacturer’s instructions. One copy of the manufacturer’s instructions shall be included with the equipment at the time of shipment.

## Operation and Maintenance Manuals

### Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

### Submit all other required information as detailed in Design Guideline Section 21 – Development and Maintenance of Asset Inventory and Tagging in an electronic format suitable for upload to the Region’s CMMS (Maximo) in accordance with Section 01430 – Operation and Maintenance Data and Section 01425 - Computerized Maintenance Management System Data Requirements.

# PRODUCTS

## Manufacturers

### TVSS units installed within low voltage distribution equipment shall be provided by the manufacturer of the low voltage distribution equipment in which they are installed.

### Standalone TVSS: [To be identified by the Consultant and approved by Region].

## Voltage Surge Suppression - General

### Electrical Requirements

#### Unit Operating Voltage: Refer to the Drawings for operating voltage and unit configuration.

#### Maximum Continuous Operating Voltage (MCOV): The MCOV shall be greater than 115% of the nominal system operating voltage.

#### The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor for the service entrance and other distribution level. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

#### Protection Modes: For a wye configured system, the device shall have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).

## TVSS Design

### Balanced Suppression Platform: The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV.

### Electrical Noise Filter: Each unit shall include a high – performance EMI/RFI noise rejection filter. Products not able to demonstrate noise attenuation of 50 dB at 100 kHz shall be rejected.

### Extended Range Filter: The surge protective device shall have a High Frequency Extended Range Tracking Filter in each Line to Neutral mode with compliance to UL 1283, 6th edition (R2015) and other applicable standards [*Consultant to list the other applicable standards in detail*]. The filter shall have published high frequency attenuation rating in the attenuation frequencies.

### Internal Connections: No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.

### Standard Monitoring Diagnostics – Each TVSS shall provide integral monitoring options:

#### Each unit shall provide a green/red solid state indicator light on each phase. The absence of a green light and the presence of a red light shall indicate which phase(s) have been damaged.

#### Remote Status Monitor – The TVSS device must include form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state if any of the three phases detect a fault condition.

#### Audible Alarm – The TVSS shall provide an audible alarm with a reset pushbutton that will be activated under any fault condition.

#### Event Counter – The TVSS shall be equipped with a system designed to indicate to the user how many surges, sags, swells and outages have occurred at the location. The event counter triggers each time under each respective category after each significant event occurs.

#### Push to Test – The TVSS shall be equipped with a push-to-test feature, designed to provide users with real time testing of the suppressor’s monitoring and diagnostic system. By depressing the test button, the diagnostic system initiates a self test procedure. If the system is fully operational, the self test will activate all indicator lights.

#### Voltage Monitoring – The TVSS shall display true Root Mean Square (RMS) on the L-N voltage protection mode on Wye configuration and three L-L voltage on delta configuration.

### Overcurrent Protection Fusing: In order to isolate the TVSS under any fault condition, the manufacturer shall provide:

#### Individual Fusing: MOVs shall be individually fused via copper fuse trace. The copper fuse shall allow protection during high surge (kA) events.

#### Thermal Protection: MOVs shall be equipped with Thermal Fuse Spring (TFS) technology which allows disconnection of the suppression component at the overheated stage common during temporary over voltage condition. For small fault currents between 100mA to 30A, or if the occurrence is over a longer period of time, the TFS will disconnect first.

#### All overcurrent protection components shall be tested in accordance with UL 1449 4th edition – Limited Current Test and AIC rating test.

### Minimum Repetitive Surge Current Capability shall be in accordance with the requirements of ANSI/IEEE C62.41.1-2002 (R2008) and ANSI/IEEE C62.45-2002 (R2008).

#### The suppression filter system shall be repetitive surge tested in every mode and it shall satisfy the requirements of ANSI/IEEE C62.41.1-2002 (R2008), and ANSI/IEEE C62.45-2002 (R2008).

## System Application

### The TVSS applications covered under this Section include distribution and branch panel locations, bus plugs, motor control centres (MCC), switchgear, and switchboard assemblies. The TVSS located in the branch panel shall be tested to demonstrate that it is suitable for ANSI/IEEE C62.41.1-2002 (R2008), Category C1 environments.

### Lighting and Distribution Panelboard Requirements

#### The TVSS application covered under this section includes lighting and distribution panelboards. The TVSS units shall be tested to demonstrate suitability for ANSI/IEEE C62.41.1-2002 (R2008) Category C1 environments.

#### The TVSS shall not limit the use of through-feed lugs, sub-feed lugs and sub-feed breaker options.

#### The TVSS shall be installed as indicated in the Contract Documents.

#### The panel board shall be capable of re-energizing upon removal of the TVSS.

#### The TVSS components shall be connected to the panel board bus bar in a way which is recommended by the manufacturer.

#### The TVSS shall be included and mounted within the panel board by the manufacturer of the panel board.

#### The TVSS shall be of the same manufacturer as the panelboard.

#### The complete panelboard including the TVSS shall be CSA and ULC listed.

### Retrofit Installation (externally mounted suppressor): The maximum conductor lead length between breaker and suppressor shall not exceed 14 inches. Comply with the manufacturer’s recommended installation and wiring practices.

### Locate the suppressor on the load side of the main disconnect device, as close as possible to the phase conductors and ground/neutral bar.

### Provide a 30A disconnect. The disconnect device shall be directly integrated to the suppressor and assembly bus using bolted bus bar connections.

### The TVSS shall be integral to switchgear, switchboard, MCC and bus plug as factory standardized design.

### All monitoring diagnostics features shall be visible from the front of the equipment.

## Enclosures

### All enclosed equipment shall have NEMA designation (as indicated on the Contract Drawings) general-purpose enclosures, unless otherwise noted in the Contract Documents. Provide enclosures suitable for locations as indicated on the Contract Drawings and as described below:

#### NEMA 1 enclosures constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts and to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt).

#### NEMA 3R rainproof enclosures intended for outdoor use primarily to provide protection against rain, sleet and damage from external ice formation.

#### NEMA 12 dust-tight enclosures intended for indoor use primarily to provide protection against circulating dust, falling dirt and dripping non-corrosive liquids. (Panelboards only).

#### NEMA 4 watertight stainless steel intended for indoor or outdoor use primarily to provide protection against windblown dust and rain, splashing rain, hose-directed water, and damage from external ice formation. (Side mounted units only)

# EXECUTION

## Factory Testing

### Standard Factory Acceptance Tests (FATs) shall be performed on the equipment under this Section. All tests shall be in accordance with the latest version of the applicable NEMA and CSA standards *[Consultant to list the other applicable standards in detail]*.

## Installation

### The Contractors shall install all equipment in accordance with the manufacturer’s recommendations and the Contract Drawings.

### Perform tests in accordance with Section 16031 – Inspection and Testing and in accordance with Section 01810 – Equipment Testing and Facility Commissioning.

### Inspect primary and secondary connections for tightness and signs of overheating.

### Check fuses for correctness of type and size.

### Check grounding connections.

### Install suppression system immediately next to or on top of service equipment where so approved by the Consultant.

### Install conductors between suppressor and point of attachment to service equipment sized in accordance with the manufacturer’s shop drawings and conductor lengths as short as possible, not to exceed 600 mm unless approved by the Consultant. Provide information from manufacturers who offer an integrated TVSS in the main service entrance equipment clearly showing lead lengths, including the neutral and ground connections.

### Grounding: Bond the suppressor ground to the equipment grounding conductor and service entrance ground.

## Warranty

### The manufacturer shall provide a warranty [insert warranty period and when the warranty period commences; Consultant to ensure the warranty period is determined prior to the tendering process and is clearly incorporated into the Contract Documents] against any TVSS part failure when installed in compliance with the manufacturer’s written instructions and the Ontario Electrical Safety Code.

## Commissioning

### For all commissioning activities on systems where components of this Section are integral to functionality, refer to Section 01810 – Equipment Testing and Facility Commissioning. All inspection and testing activities shall be completed in accordance with the commissioning plan that shall be provided to the Consultant prior to the commencement of commissioning activities.

**END OF SECTION**