PART 1 - GENERAL

1.1 SUMMARY

This specification includes requirements for a high energy, dual-listed, surge arrester and transient voltage surge suppressor (TVSS) electronic filtering system used to protect AC electrical distribution from the effects of lightning, utility switching events, temporary over voltages (TOV), and impulses generated internally within a facility.

1.2 RELATED DOCUMENTS

The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

- ANSI/IEEE C62.1 and C62.11
- Canadian Standards (CUL)
- Federal Information Processing Standards Publication 94 (FIPS PUB 94)
- National Electrical Manufacturers Association (NEMA LS1-1992 Guidelines)
- National Fire Protection Association (NFPA 70 [NEC], 75 and 78)
- Underwriters Laboratories (UL 96, 198, 248-1, 489, 1283 and 1449-Second Edition)

1.3 SUBMITTALS

A. Product Data: Provide complete product data detailing manufacturer’s model number, specifications, features and options. Substitute/alternate products require pre-approval, and shall only be considered if the Attachment 1 TVSS Submittal Compliance Form is fully completed and submitted at least fourteen (14) days prior to bid date.

B. Test Data: Certified documentation shall be provided of the product’s UL 1449 Second Edition listing, clamping values (to include ratings with internal disconnects, if applicable), surge current fuse testing, independent test lab single pulse surge current capacity testing, and minimum repetitive surge current capacity testing.

C. Shop Drawings: Provide electrical and mechanical drawings that include detail on unit dimensions, weights, field connections and mounting provisions.

D. Installation, Operation and Maintenance Manuals: Provide one copy of the installation, start-up, operation and maintenance data for each unit supplied.
E. ACCEPTABLE MANUFACTURER

These specifications detail performance requirements for a selenium-enhanced suppression system manufactured by Current Technology. Substitute, value-engineered or alternate products shall meet all performance and reliability aspects of this specification. The surge suppression and noise filtering unit shall be as follows:

Service Entrance Location: Current Technology Model # SL2-150 – or approved equal.
Panelboard Locations: Current Technology Model #TG100 – or approved equal.

1.4 SUBSTITUTION PRE-APPROVAL PROCEDURES

Manufacturers requesting approval of their products shall identify the full model number and submit product data, specifications and complete the Attachment 1 TVSS Submittal Compliance Form at least fourteen (14) days prior to the bid date.

1.5 WARRANTY

The manufacturer shall provide a fifteen (15) year limited warranty from the date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer’s installation, operation and maintenance instructions.

1.6 LOCAL SERVICE SUPPORT

A dedicated support organization shall be located within 150 miles of the project location, and shall have experience supporting at least twenty other projects of similar complexity within the last three years. Personnel shall perform a start-up service to verify correct installation of the filters, perform transient voltage tests for reliability and performance using appropriate surge generating test equipment, and respond on-site to investigate user concerns.

PART 2 - PRODUCTS

2.1 HIGH PERFORMANCE SUPPRESSION SYSTEM

The suppression system shall incorporate a hybrid design of selenium cells (for service entrance location only), metal oxide varistor (MOV) arrays and filtering capacitors. These components shall optimally share surge currents to ensure maximum performance and long-term reliability. The system shall not utilize gas tubes, spark gaps, silicon avalanche diodes, or other components that might short or crowbar the line, thus leading to power interruption.

2.2 UL DUAL LISTED - SURGE ARRESTER and SURGE SUPPRESSOR

The system shall be UL listed as category XUHT (UL 1449 Second Edition, manufactured after February 2007) and CUL approved as a transient voltage surge suppressor (TVSS), as well as UL listed as category OWHX (UL96) as a secondary surge arrester, and UL listed as category FOKY (UL 1283) as an electromagnetic interference filter.
2.3 UNIT OPERATING VOLTAGE

The operating voltage and configuration shall be 277/480 grounded wye for service entrance location and 120/208 Volt grounded wye for panelboard locations.

2.4 MAXIMUM CONTINUOUS OPERATING VOLTAGE (MCOV)

The MCOV shall be greater than 115 percent (%) of nominal voltage, but no greater than 130 percent (%). Test and evaluation shall be as outlined in NEMA LS1-1992, paragraphs 2.2.6 and 3.6.

2.5 PROTECTION MODES

Per the definitions in NEMA LS 1-1992, paragraph 2.2.7, all modes shall be protected (e.g., line-to-line, line-to-neutral, line-to-ground and neutral-to-ground).

2.6 RATED SINGLE PULSE SURGE CURRENT CAPACITY

Calculations for single pulse surge current capacity shall use the component manufacturer’s individual component rating multiplied by the respective number of per mode components. Documentation shall be provided with submittals on the Attachment 1 TVSS Submittal Compliance Form. Component manufacturer’s ratings shall be derived using the ANSI/IEEE C62.41-1991 Category C1 8 X 20 µsec, 3000A current waveform. The per mode single pulse surge current rating shall be calculated based upon the component manufacturer’s catalog rating for each device. The minimum rated single pulse surge current capacity per mode shall be as follows:

<table>
<thead>
<tr>
<th>Location</th>
<th>L-N</th>
<th>L-G</th>
<th>N-G</th>
<th>L-L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Entrance</td>
<td>150,000</td>
<td>150,000</td>
<td>150,000</td>
<td>150,000</td>
</tr>
<tr>
<td>Panelboards</td>
<td>100,000</td>
<td>100,000</td>
<td>100,000</td>
<td>100,000</td>
</tr>
</tbody>
</table>

2.7 TESTED SINGLE PULSE SURGE CURRENT CAPACITY

The suppression filter system shall be single pulse surge current tested in all modes at rated surge currents by an industry-recognized independent test laboratory. Units with surge current capacities of 200,000 amps or less shall be tested as a unit, not individual modules. Due to industry test equipment limitations, units with surge current capacities greater than 200,000 amps shall be tested as a unit to 200,000 amps; and certified for surge current ratings above 200,000 amps by testing individual components or sub-assemblies within a mode. Units that sustain any component or overcurrent device failure or degradation are unacceptable.

2.8 MINIMUM REPETITIVE SURGE CURRENT CAPACITY

Per ANSI/IEEE C62.41 and ANSI/IEEE C62.45-1992, every mode of the suppression filter system shall be designed to survive multiple Category C3, 20 KV, 10 KA impulses. Test documentation shall detail the unit’s ability to survive the following number of
events (at one minute intervals) without any performance degradation.

| Repetitive Surge Current Capacity - Number of Impulses |
|---------------------------------|-----|-----|-----|-----|
| Locations                      | L-L | L-N | L-G | N-G |
| Service Entrance               | >12,000 | >12,000 | >12,000 | >12,000 |
| Panelboards                    | >4500 | >4500 | >4500 | >4500 |

2.9 SWELL VOLTAGE RATING

For service entrance locations only, suppression components shall be capable of withstanding continuous overvoltage events (swells). Based on a source impedance of 0.7 Ohms, the unit shall withstand an overvoltage of 200 percent (above RMS nominal voltage) for at least 60 cycles, without component failure (including fuses).

2.10 HIGH FREQUENCY EXTENDED RANGE FILTER

EMI-RFI noise rejection/attenuation (per NEMA LS-1-1992 and MIL-STD-E220A 50 ohm insertion loss methodology) shall be as follows:

<table>
<thead>
<tr>
<th>Attenuation Frequency</th>
<th>50 KHz</th>
<th>100 KHz</th>
<th>1 MHZ</th>
<th>10 MHZ</th>
<th>100 MHZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss (dB)</td>
<td>50</td>
<td>41</td>
<td>31</td>
<td>35</td>
<td>53</td>
</tr>
</tbody>
</table>

For installations that install multiple downstream filters, the filters shall be coordinated to provide minimum noise rejection/attenuation as follows:

<table>
<thead>
<tr>
<th>Attenuation Frequency</th>
<th>50 KHz</th>
<th>100 KHz</th>
<th>1 MHZ</th>
<th>10 MHZ</th>
<th>100 MHZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss (dB)</td>
<td>85</td>
<td>83</td>
<td>68</td>
<td>67</td>
<td>84</td>
</tr>
</tbody>
</table>

NOTE: Insertion loss data shall be based on a minimum of 100 feet of #4 AWG conductor between filters.

2.11 SUPPRESSION VOLTAGE RATING

In compliance with procedures outlined in NEMA LS 1-1992, paragraphs 2.2.10 and 3.10, the maximum suppression voltage rating (with integral fused disconnect) shall be as follows:

<table>
<thead>
<tr>
<th>System Voltage</th>
<th>Mode</th>
<th>6KV/500A Comb Wave</th>
<th>B3 Ringwave</th>
<th>B3/C1 Comb. Wave</th>
<th>C3 Comb. Wave</th>
</tr>
</thead>
<tbody>
<tr>
<td>120/208</td>
<td>L-N</td>
<td>325</td>
<td>350</td>
<td>425</td>
<td>725</td>
</tr>
<tr>
<td></td>
<td>L-G</td>
<td>325</td>
<td>425</td>
<td>500</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>N-G</td>
<td>325</td>
<td>375</td>
<td>475</td>
<td>750</td>
</tr>
<tr>
<td></td>
<td>L-L</td>
<td>625</td>
<td>475</td>
<td>825</td>
<td>1200</td>
</tr>
<tr>
<td>277/480</td>
<td>L-N</td>
<td>725</td>
<td>575</td>
<td>850</td>
<td>1150</td>
</tr>
<tr>
<td></td>
<td>L-G</td>
<td>750</td>
<td>875</td>
<td>850</td>
<td>1175</td>
</tr>
<tr>
<td></td>
<td>N-G</td>
<td>700</td>
<td>700</td>
<td>900</td>
<td>1200</td>
</tr>
<tr>
<td></td>
<td>L-L</td>
<td>1375</td>
<td>750</td>
<td>1675</td>
<td>2100</td>
</tr>
</tbody>
</table>
2.12 REDUNDANT OVERCURRENT PROTECTION

Each suppression element shall utilize individual UL 248-1 recognized, 200 KAIC tested fuses to ensure that the **failure of a single suppression component, or** operation of any single fuse does not render the entire mode, phase or product deficient by more than ten percent (10%). At service entrance locations only, in the event a catastrophic or swell voltage occurrence causes the failure of all the MOV elements, the fusing for the selenium cells shall be independent to provide redundancy. The filter shall be capable of withstanding the rated single pulse surge current capacity without fuse failure.

2.13 INTERNAL CONNECTIONS

Internal surge current paths shall utilize low-impedance copper bus bar. No plug-in modules or quick-disconnect terminals shall be used in the surge current-carrying paths.

2.14 BUILT-IN FIELD TEST CAPABILITY

The unit shall incorporate an integral test point for off-line diagnostic testing to verify operational integrity of the suppression filter system. Testing shall include injection of an impulse at least two times the nominal system voltage, and provide metering to indicate the resultant clamping voltage. The unit shall also include an integral test point for a secondary test meter that displays the status of the internal fusing, to include indication of partial degradation of surge current capacity capability.

2.15 ENCLOSURE

The service entrance unit shall utilize a NEMA 4 metallic enclosure.

2.16 ADDITIONAL FEATURES/EQUIPMENT

Advanced Monitoring Feature. A battery-powered audible alarm with event counter display and two sets of form C dry contacts (N.O. or N.C.) shall be provided. The alarm shall indicate single or multiple phase failure of the filter.

PART 3 – EXECUTION

3.1 INSTALLATION

The service entrance and panelboard filters shall be installed external to the switchgear/panelboard as close as possible to the connection point following the manufacturer’s recommendations for conductor size and minimal bends.

3.2 EQUIPMENT MANUAL

An equipment manual shall be provided that details installation, operation, and maintenance instructions for the filter. Information shall include unit dimensions, weights, mounting provisions, connection details and a layout diagram.
### ATTACHMENT 1 - TVSS SUBMITTED COMPLIANCE FORM
(SERVICE ENTRANCE)

<table>
<thead>
<tr>
<th>Performance/Feature</th>
<th>Specification Requirement</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>UL Dual Listed (Surge Suppressor and Surge Arrester)</td>
<td>Surge Suppressor - Yes&lt;br&gt;Surge Arrester - Yes</td>
<td></td>
</tr>
<tr>
<td>Single Pulse Surge Rating Per Mode</td>
<td>150 KA L-N&lt;br&gt;150 KA L-G&lt;br&gt;150 KA N-G</td>
<td></td>
</tr>
<tr>
<td>Single Pulse Surge Rating Per Phase</td>
<td>300 KA L-N + L-G</td>
<td></td>
</tr>
<tr>
<td>Number Of Components Used For Above Rating (Attach Component Manufacturer’s Product Data)</td>
<td>L-N: 16, L-G: 16; N-G: 16&lt;br&gt;Each component rated for 10,000 transient Amps&lt;br&gt;(Manufacturer: Harris Ultra MOV V20E320)</td>
<td></td>
</tr>
<tr>
<td>Number of MOV’s/Mode</td>
<td>L-N _____ L-G _____ N-G ____</td>
<td></td>
</tr>
<tr>
<td>Documentation of Rating</td>
<td>Independent Test Reports</td>
<td></td>
</tr>
<tr>
<td>Warranty For Damage To TVSS Due To Lightning</td>
<td>15 years</td>
<td></td>
</tr>
<tr>
<td>Dispatch Location For Local Support And Start-Up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Continuous Operating Voltage (MCOV) For All Suppression Components</td>
<td>Greater than 115 percent and less than 130 percent</td>
<td></td>
</tr>
<tr>
<td>Protection Modes Provided</td>
<td>L-L, L-N, L-G and N-G</td>
<td></td>
</tr>
<tr>
<td>Category C3 Repetitive Surge Current Capacity</td>
<td>&gt; 12,000 impulses</td>
<td></td>
</tr>
<tr>
<td>High Frequency Noise Filtering Attenuation</td>
<td>50 KHZ 50 dB&lt;br&gt;100 KHZ 41 dB&lt;br&gt;1 MHZ 31 dB&lt;br&gt;10 MHZ 35 dB&lt;br&gt;100 MHZ 53 dB</td>
<td></td>
</tr>
<tr>
<td>Internal Surge Current Path</td>
<td>Copper Bus Bar</td>
<td></td>
</tr>
<tr>
<td>Field Test Capability With Surge Generator and Secondary Fuse Meter?</td>
<td>Required? ___ No X Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;If Yes, How?________________________</td>
<td></td>
</tr>
<tr>
<td>Individually Fused Elements</td>
<td>Required? ___ No X Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes</td>
<td></td>
</tr>
<tr>
<td>UL 248-1 Recognized Fuses</td>
<td>Required? ___ No X Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes</td>
<td></td>
</tr>
<tr>
<td>Individual Fuse - Surge Current Rating</td>
<td>~12,000 Transient Amps</td>
<td></td>
</tr>
<tr>
<td>Disturbance Counter</td>
<td>Required? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes</td>
<td></td>
</tr>
<tr>
<td>Microprocessor-Based Diagnostics</td>
<td>Required? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes&lt;br&gt;Provided? ___ No ___ Yes</td>
<td></td>
</tr>
<tr>
<td>Enclosure</td>
<td>Metal NEMA 4</td>
<td></td>
</tr>
</tbody>
</table>
## Performance/Feature | Specification Requirement | Proposed
--- | --- | ---
Single Pulse Surge Rating Per Mode | 100 KA L-N | __________ L-N  
100 KA L-G | __________ L-G  
100 KA N-G | __________ N-G
Single Pulse Surge Rating Per Phase | 200 KA L-N + L-G | __________ L-N + L-G
Number Of Components Used For Above Rating (Attach Component Manufacturer’s Product Data) | L-N: 11, L-G: 11; N-G: 11 Each component rated for 10,000 transient Amps (Manufacturer: Harris Ultra MOV V20E320) | Number of MOV’s/Mode  
L-N _______  
L-G _______  
N-G _______
Documentation of Rating | Independent Test Reports |  
Warranty For Damage To TVSS Due To Lightning | 10 years |  
Dispatch Location For Local Support And Start-Up |  
Maximum Continuous Operating Voltage (MCOV) For All Suppression Components | Greater than 115 percent and less than 130 percent |  
Protection Modes Provided | L-L, L-N, L-G and N-G |  
Category C3 Repetitive Surge Current Capacity | > 4500 impulses |  
High Frequency Noise Filtering Attenuation | 50 KHz 50 dB  
100 KHz 41 dB  
1 MHZ 31 dB  
10 MHZ 35 dB  
100 MHZ 53 dB | 50 KHz ____ dB  
100 KHz ____ dB  
1 MHZ ____ dB  
10 MHZ ____ dB  
100 MHZ ____ dB
Internal Surge Current Path | Copper Bus Bar |  
Field Test Capability With Surge Generator and Secondary Fuse Meter? | Required? ____ No _X_ Yes  
Provided? ____ No ____ Yes  
If Yes, How? |  
Individually Fused Elements UL 248-1 Recognized Fuses | Required? ____ No _X_ Yes  
Provided? ____ No ____ Yes  
~12,000 Transient Amps |  
Individual Fuse - Surge Current Rating | Required? ____ No _X_ Yes  
Provided? ____ No ____ Yes  
_______ Transient Amps
Disturbance Counter | Required? ____ No _x_ Yes  
Provided? ____ No ____ Yes
Microprocessor-Based Diagnostics | Required? ____ No _x_ Yes  
Provided? ____ No ____ Yes

END OF SECTION 16675