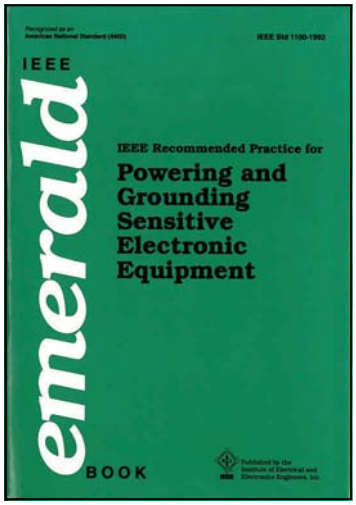
Tech Byte 1: TVSS Installation - External Versus Switchgear Integrated

TVSS Installation: The Truths About TVSS Integrated into Switchgear

Application of a properly designed surge suppression system within a facility is essential in protecting electronic equipment, as well as the facility electrical infrastructure itself. There are many design considerations that are evaluated in choosing and applying these TVSS systems, and one of these considerations is how to install the TVSS product: Should the TVSS be integrated into building switchgear and panelboards, or should the TVSS be individually enclosed systems that tie into the switchgear and panelboards?

The IEEE Emerald Book, *Power and Grounding*, is a great resource for recommendations related to the design and application of surge suppression. The latest revision of the Emerald book in 2005 has recommendations regarding the topic of integrated vs. non-integrated TVSS systems. Below are topics that the Emerald Book touches on:



TVSS Failure and Collateral Damage in an Integrated Application:

Of significant concern, per IEEE, is the collateral damage potential that exists in a TVSS failure event. IEEE describes this as follows:

"When metal oxide varistors reach and end-of-life condition, they lose their ability to block normal system voltage and begin to conduct current continuously. The continuous current condition creates heat. The metal oxide varistor (MOV) initiates a conductive condition identified as thermal runaway that inevitably results in the destruction of the MOV. The resulting destruction of the MOV might expel hot metal fragments, conductive ionized gases, and dense conductive smoke and soot. In addition to immediate hazards, the introduction of such materials into the interior of electrical distribution equipment can damage or compromise an insulation system and result in a cascading effect and serious equipment damage. Resulting damage from cascading effects can be substantial when the electrical equipment, affected by the damaged MOV, is the service entrance equipment..."

In a failure mode as described above, a cascading failure can result in significant duration outage to the facility. On top of this, due to the conductive debris alone, entire replacement of the affected switchboard or panelboard may be required. Conversely, in an application with an externally mounted TVSS device with a sealing conduit, there is no collateral damage. The branch breaker feeding the TVSS acts to isolate the fault condition from the panel, and the TVSS can be disconnected and replaced without affecting power to the panelboard.

Switchgear Damaged By TVSS Unit Failure

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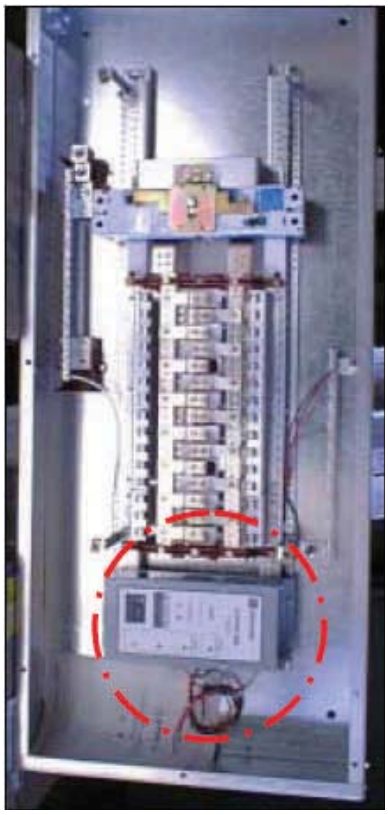
Personnel Safety for Service Work:

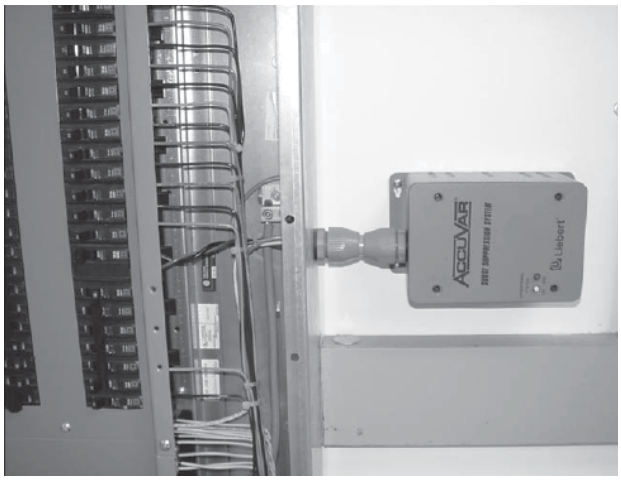
Also of concern is the ability of personnel to SAFELY service or remove a TVSS component as needed. The Emerald Book goes on to recommend the following:

"…It is recommended practice that all SPDs have a means to disconnect them from service. Locating the SPD external to the switchboard or panelboard allows a disconnecting means to be located inside the switchboard or panelboard and does not require access to the switchboard or panelboard interior when servicing the SPD."

A couple of design issues can arise from this recommendation, based on how the TVSS is intended to be installed. Integrated TVSS systems are typically bus connected with no dedicated, external disconnecting means. This requires that personnel remove the panelboard accent or switchgear deadfront to access the TVSS, and be exposed to live parts. Or, it would require that the panelboard or switchgear main breaker that is connected to the TVSS be opened, shutting down the connected load so personnel can safely access the TVSS system. Many times the facility owner does not want an outage event for any reason, which would complicate the safe approach, which would be to shut the panel down. This means that operation on hot equipment would be the only other choice, which does not promote personnel safety during service.



Integral TVSS—Exposes Service Personnel To Live Bus



External TVSS - Service-Safe Installation

Externally mounted TVSS systems can be supplied with their own integral disconnecting means, or be fed from a panel branch breaker. This allows for easy disconnecting means for service or replacement. Likewise, it does not affect operation of parallel connected loads on the panel, nor does it expose the service personnel to a live bus if maintenance must be performed without shutting down the connected loads..

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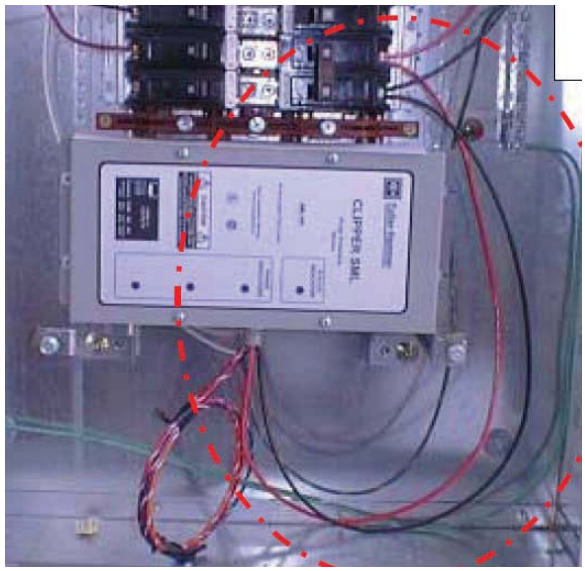
Limitation of Lead Lengths:

Critical for the effectiveness of surge devices is limiting the lead lengths connecting the TVSS device to the switchgear or panelboard it is protecting. A lower impedance value allows more energy to be dissipated, and less energy continuing downstream. The Emerald Book supports this in stating:

Integral TVSS with Long Neutral Conductor

"…Surge Protective Devices may not perform properly under field conditions of use unless installed in a correct manner. Recommended surge protective device installation practice is for ALL lead lengths to be short and shaped to minimize open loop geometry between the various conductors. This is accomplished by removing excess and unneeded lead lengths to the surge protective devices..."

It is generally assumed that lead lengths are as short as possible in an integrated TVSS solution. However, it can be quite difficult to ensure that **ALL** lead lengths are short in length. The phase connections are typically very short, since the TVSS can be directly bus connected. However, the location of where the TVSS must be placed can be a significant distance from the neutral connection of the panel. The neutral lengths can therefore be significant in length. It is important to remember that the the critical element is that ALL lead lengths must be short. Not just a select mode connection.



Integral TVSS Connected to Branch Breaker with Long Conductors

By contrast, an external TVSS solution can be mounted beside the panelboard, directly adjacent to where the neutral connection is in the panelboard. A branch breaker can be positioned close to the neutral connections to feed the phase connections of the TVSS panel. The conductors can then be fed thru the side of the panel. With this approach, desirable lead-lengths are attained.