Testing and Monitoring of SPD Systems

By: Stephen N. Olson, Precise Power Inc.

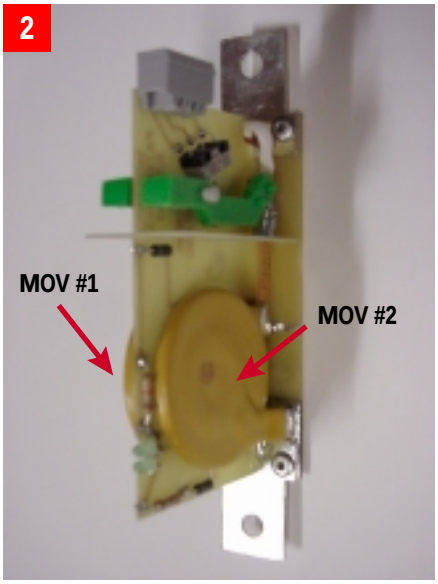
Virtually every SPD unit has indicator lights. In most cases, the lights are green, and when a failure occurs, they go out. This alerts the user that the unit needs service or replacement. Beyond the three lights, how each SPD vendor designs their monitoring differs greatly. For example, one SPD manufacturer uses eight 130 volt MOVs (on a 120 volt system). These MOVs are not connected to the monitoring circuit. A ninth, 150 volt MOV is connected to the monitoring circuit. It is very possible (and likely) that the eight 130 volt MOVs will fail first, due to their lower clamping voltage, while the 150 volt MOV,

1

Note: Only one MOV monitored

still intact, indicates an operational system. (See photo #1 showing only one of nine MOVs connected to the monitoring circuit.) In this case, a system with only 1/9th of its protection capability, intact would still show itself as 100% operational. Depending on the manufacturer, the monitoring will indicate a failure when anywhere from 92% to 20% of the protective elements in a mode have failed. In most cases, the monitoring indicates a failure at a level of approximately 50%. Some manufacturers use fewer large MOVs, such that a mode may only have one or two MOVs per mode. (See photo #2.) This scenario is even more likely in panel type units with lower surge current ratings. It is

2



not reasonable to expect these units to alarm at a level above 50%. **In order to assure a minimum level of protection, we recommend a specification be worded as follows: "The monitoring on the SPD system shall monitor all protective elements and alarm when the remaining operational protective elements drops below 80%."**

In addition to the simple "pass/fail" issue, there is also the issue of MOVs that have degraded, but have not failed. Thirty, 10,000 amp MOVs that when new could withstand a 300,000 amp transient, may only be a 1,000 amp transient away from failure and still show as operational. Monitoring systems do not monitor the MOV, they monitor the fuse(s) protecting the MOV. As MOVs take "hits", the clamping voltage increases. Obviously, the best solution is a system that allows the unit to be tested to determine the exact clamping voltage of the system, and thereby the amount of life remaining in the system. **When the actual clamping voltages are compared against the factory benchmark test and subsequent testing in the field, the user has a very good idea of the protection level remaining within the SPD unit and, if necessary, can pro-actively replace the system and prevent a situation where a unit appears to be 100% operational while it is actually a 1,000 amp transient away from failure and is providing virtually no protection. If this sounds like a good design to you, state in your specifications: "The SPD equipment shall have a clamping voltage benchmark test conducted at the factory. The SPD unit shall be capable of having the clamping voltage tested in the field and compared to the factory benchmark testing. The local representative shall own and operate clamping voltage test equipment which allows the actual remaining protection levels to be proactively measured."**

Who makes such an SPD unit? Current Technology and Joslyn manufacture SPD units that can be tested in the field. Equally important, both companies factory benchmark test their units so the user has an accurate point of reference. Diagnostic Test Systems (DTS) can test units in the field. The DTS generates an identical impulse to the test performed at the factory so a person testing the unit in the field has a benchmark to compare against. A photo of a DTS unit is shown in photo #3. Testing may be conducted by the user or by the local representative. Precise Power, Inc. owns and operates two of these test units. In the case where the user believes a failure has occurred, we provide lifetime "on-site" testing at no charge. If the user wishes to conduct testing on a periodic basis, our policy is to loan out the DTS at no charge, or charge a nominal fee if the

3

continued...

continued

4

CTI MasterMind monitoring panel

client wishes us to perform the testing and prepare a test report.

Many users have stated that they do not want to carry around a test kit and would like something integral to the SPD unit that, with a push of a button, advises them of the exact percent remaining protection levels within the system. **With this in mind, Current Technology developed their "MasterMIND" monitoring system. This system has a press-to-test which indicates the exact percent remaining protection level for each mode in the system.** We also realize that units may not be regularly checked, so as an added level of monitoring, if the protection level drops below 80% in any mode, the unit indicates the need for service with an audible alarm and red & green LEDs. A photo of a Master-MIND monitoring system is shown in photo #4. The approximate cost adder for the MasterMIND monitoring over a standard, main service, monitoring package is $200. Most users utilize the MasterMIND monitoring package on the main service unit and the basic monitoring on the downstream units. If the main service unit experiences a failure, the downstream units are checked with the DTS to verify their operational status.

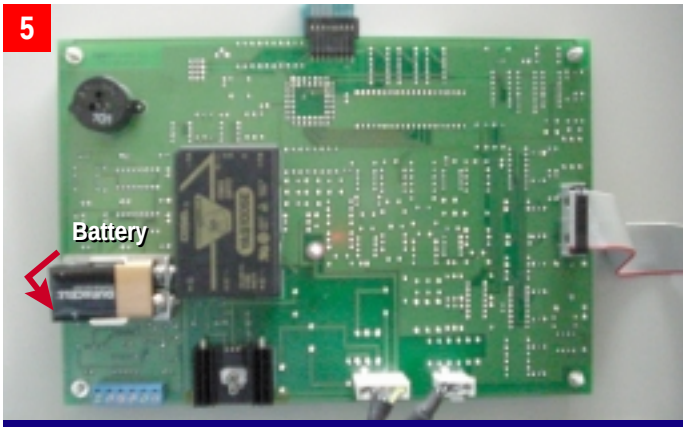
The MasterMIND also has other features. In addition to the sophisticated monitoring, an audible alarm, and surge counter, the Master-MIND provides: neutral-to-ground fault detection, neutral-to-ground current sensing, true RMS voltage monitoring, voltage sag detection, voltage swell detection, power dropout detection, and power outage detection. There are other important things to look for when selecting a monitoring package for your SPD equipment. They are:

SURGE COUNTER - The surge counter should have battery back-up. If the surge counter does not have battery back-up, when the unit experiences a catastrophic failure, which trips the breaker or clears the fuses feeding the unit, the counter resets to zero. Additionally, if there is an interruption of power to the unit, the counter may reset. **If the surge counter does not have battery back-up, the user is unable to keep track of the number of impulses the unit is experiencing. To eliminate this problem, accept only SPD units with battery back-up on the surge counter.**

AUDIBLE ALARM - The audible alarm should also have battery back-up. If a unit experiences a catastrophic failure which trips the breaker or clears the fuses feeding the unit the alarm not having a power supply, goes silent. Depending on the manufacturer, this may also reset the audible alarm. An audible alarm could also be reset on a SPD unit that experienced a partial failure, which did not totally lose power, if an outage occurred after the failure, before the failure was noticed. (This is a common occurrence during storm conditions or utility reclosure events.) Users tend to be overly reliant on audible alarms when they exist, and usually do not take the time to visually inspect units equipped with this feature. In such a case, as described, the critical equipment could go unprotected for months or even years before the problem is discovered. Unfortunately it is usually discovered when a second large impulse damages the now unprotected downstream equipment. **To eliminate this problem, accept only SPD units with battery back-up or an alternate power source (not powered off the SPD unit) on the audible alarm. (See photo #5 showing a monitoring board with battery back-up. Note that the battery is easily accessible, and the type of battery is commonly available.)**

REMOTE CONTACTS - Most SPD units offer remote contacts with which to connect the SPD equipment to a building management system. The thought being, that if an SPD unit experiences a failure, the building management system will alarm. Theoretically thinking, this is a good idea. Unfortunately, many SPD manufacturers, in order to cut costs, do not properly isolate the remote alarm contacts from the power circuits of the SPD unit. The impulse that "fries" the SPD unit also "fries" the building management system because the SPD monitoring circuit allowed transient enegry to jump over to the monitoring circuit. In most cases, the cause of the failure of the building management system is not traced back to the SPD unit, but rather blamed on the high level of energy coming in the building or an impulse coming in through a phone line or other path. **To eliminate this problem, accept only SPD units with optical or mechanical isolation between the power and monitoring circuits.**

5



Photograph of MasterMIND monitoring in Current Technology Main Service TVSS unit.

If you would like assistance in amending your specification to incorporate any of our recommendations or if you have any questions about the type of monitoring package best suited for your application, please call Precise Power, Inc. @ 1-800-578-5702.