TECHNOLOGY ADVANCES IN SURGE ARRESTERS IMPROVE RELIABILITY AND ENERGY EFFICIENCIES

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Performance expectations are set high for electric utilities. Reliable service, environmental leadership, financial returns for shareholders, and value creation for customers are common goals set by the more than 3,500[1] electric utilities serving the United States.

Historically a low-cost, often commoditized asset, surge arresters were purchased only to protect distribution equipment from overvoltages and offered little in added value beyond basic surge protection. With the introduction of the UltraSIL polymer-housed Evolution distribution-class surge arrester, Cooper demonstrates that, through technology advancement, a surge arrester can provide added value:

- Measurably improve energy efficiencies
- Reduce carbon emissions
- Boost asset utilization
- Support inventory objectives
- Improve system reliabilities

Cost-Effective, Energy-Efficient Improvements

Electric power generation is a large contributor of greenhouse gas emission in the world. Because of this, environmental leadership is a role that utilities are taking on in increasing numbers. This is driving demand for energy-efficient technologies.

Each year millions of distribution-class surge arresters are sold into the market to protect transformers and underground lines. Some large investor-owned utilities estimate that their arrester installed base exceeds one million arresters. A common 10 kV class surge arrester can generate up to 500 mW of power loss. One arrester energized 24 hours/day results in measurable inefficiencies on an annual basis:

$$500\ mW \times 24 \frac{hour}{day} \times 365 days = 4.38\ kWh$$

For a utility with one million arresters on their system, this represents 4,380,000 kWh of unbilled energy, generating 3,408 metric tons[2] of CO_2 emissions.

The technology used to construct the Evolution surge arrester reduces watts loss to 20 mW on average. Assuming the same conditions described above but calculating energy lost if the Evolution surge arrester replaced the common 10 kV product, the utility could avoid releasing 3,271 metric tons of CO_2 into the atmosphere. As a point of reference, in 2001 a single-family home's electricity consumption generated 7.55 metric tons of CO_2 annually[2].

Modernizing the electric grid to reduce harmful emissions will come through investment in new technologies. But it begins with incremental changes taken one transformer, riser, and mid-line arrester at a time. The Evolution surge arrester is a small, cost-effective, energy-efficient modern technology. Utilities with a financial interest in saving energy now have an option—adopting arresters that cost tens of dollars adds up to big savings for the climate.

Boost Asset Utilization

Utilities maximize asset utilization by ensuring systems are running efficiently and reliably. The Evolution surge arrester addresses efficiencies with the 20 mW loss.

Maximizing asset utilization demands an evolution in surge arrester technology. Based on field experience, moisture ingress has been widely accepted as the most significant contributor to premature arrester failure. The Evolution surge arrester incorporates a patented manufacturing process that utilizes composite matrix technology to encapsulate the arrester module assembly. A photograph of a composite matrix module is shown in Figure 1.

Figure 1. 10 kV Composite Matrix Module.

The composite matrix material consists of a homogenous fiberglass and epoxy resin matrix. The composite matrix has excellent dielectric properties and moisture impermeability. Cooper Power Systems performed the Water Immersion Test (IEEE C62.11™-2005 Standard) on the Evolution surge arrester *without* the polymer housing installed. The arrester module was submersed in deionized water with 1kg/m³ NaCl content while elevated to 80 °C for 52 hours.

Parameters for pre- and post-tests consisted of the following:

- < 10% Change in 60 Hz Power Frequency Sparkover
- < 10 pC Internal Partial Discharge

Each sample met the verification testing and demonstrated superior resilience against moisture ingress.

The result is an arrester that will survive the elements and protect equipment from damaging overvoltages.

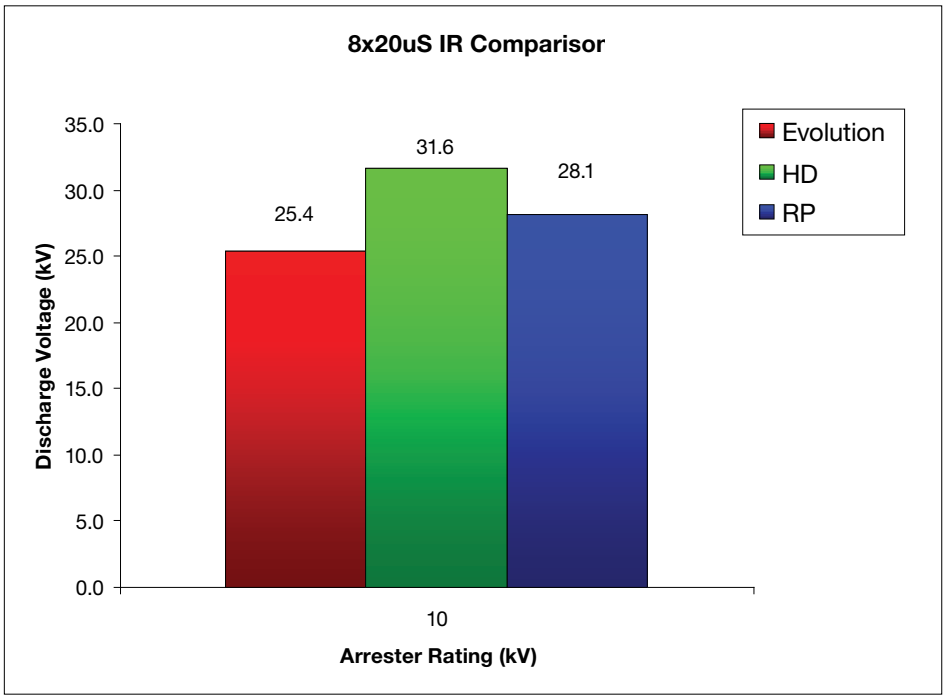

Figure 2. The Evolution surge arrester has lower discharge voltages as compaired to standard heavy-duty and riser-pole arresters.

Lower Discharge Voltage, Potentially Lower Inventories

The demand for better discharge voltages and improved margins of protection for equipment has led Cooper Power Systems to develop an arrester that can be used for overhead and riser-pole applications. The Evolution surge arrester will lead the way in reducing equipment failure rates by vastly improving discharge voltages. The Evolution surge arrester has lower discharge voltages as compared to standard heavy-duty (HD) and riser-pole (RP) arresters, which are shown in Figure 2.

Lower discharge voltages result in greater margins of protection. The greater the margin of protection, the less stress is on the protected asset, resulting in longer asset life.

By applying the Evolution surge arrester for both riser-pole and heavy-duty installations, one arrester can be stocked for both applications.

- Reduce inventory
- Better match supply with demand
- Have the right arrester at the right time

Consolidating part numbers reduces forecast complexity. This allows for reductions in safety stock, decreased freight costs due to fewer expedites, and lowered cost of inventory.

Increased Expectations

As expectations for performance increase, electric utilities will turn to manufacturers to assist them in achieving their goals. Green supply chain managers will expect products that meet their requirements; supply chain improvement initiatives will continue to be a top corporate priority; and system reliability requirements will increase. With the UltraSIL polymer-housed Evolution surge arrester, utilities can achieve measurable improvements in reliability and energy efficiencies, while reducing carbon emissions—satisfying those increased expectations. ■

1. *Source: The EIA Form 861-Annual Electric Industry Report*
2. *http://epa.gov/greenpower/pubs/calcmeth.htm#homeelectric EPA Emissions Green Power Equivalency Calculator 7.78 x 10-4 metric tons CO_2 / kWh.*