Superconducting Sizzle

A NEW CABLE TECHNOLOGY TESTED

By Salvatore Salamone

A TWO-YEAR PILOT project is under way that will test a new second-generation high-temperature superconducting (HTS) cable in a real-world environment. The $9 million project will use an HTS cable to deliver more than 50 megawatts to more than 8,600 homes and businesses in suburban Columbus, Ohio.

The project is a joint effort of the Department of Energy, the DOE's Oak Ridge Laboratory, American Electric Power (AEP), Southwire, nkt cables, American Superconductor, and Praxair.

The cable is installed at AEP's Bixby Station. If something were to disrupt the transmission, AEP will automatically switch the load over to traditional lines to keep its customers up and running.

During the test, the companies involved will monitor the cable's performance and evaluate the economics of using this new type of HTS cable.

While there have been past tests of superconducting cables, this pilot uses what the organizations involved call a next-generation cable, which the developers claim is less expensive and easier to maintain than older generation cables. Specifically, previous pilots typically used superconducting cables that bundled together three coax structures – one to carry each phase of a common three-phase electrical transmission – in a single cable. The cable used in the Bixby Station trial, called a Triax cable, places the three phase conductors concentrically around a single core.

Southwire claims this design reduces the amount of superconducting material needed in a cable, which reduces the cost. And the concentric design reduces the amount of cryogenic coolant needed to keep the cable at a suitable temperature (just below – 321 degrees Fahrenheit) to maintain its superconducting properties. This reduces the operating costs of using an HTS cable.

This latter point is a key financial concern for companies exploring the use of HTS cables. "Cryogenics is a big issue, you cannot have a large operating cost," said Ben Mehraban, AEP's principal engineer and Bixby HTS cable project manager.

Additionally, Southwire and nkt cables, the developers of the cable used in the pilot, say the Triax cable can carry up to 3,000 amps of power, which is about three times more current than other superconducting cable pilots currently under way.

Workers install superconducting cable in AEP's Bixby Station for a two-year test.

EXPECTED BENEFITS

Superconducting cables hold great promise in two areas.

First, they can carry more power than a traditional cable making them ideal for urban areas where power demands are going up, yet space is limited so new cables cannot be deployed.

"Long term, [HTS cables] could help us make better use of our rights of way," said Navin Bhatt, AEP's manager of advanced transmission studies and technologies.

In this regard, the HTS cables can deliver up to five times more electricity than traditional aluminum or copper cables, according to AEP. In the future, by swapping out existing underground cables for HTS cables, a provider could deliver more electricity to meet the growing needs in many high-density population areas.

The second area in which HTS cables offer benefits over existing cables has to do with delivering power over great distances. HTS cables exhibit less energy loss. The DOE and many within the industry see this property being leveraged over time in several ways.

For instance, to avoid potential objections from groups that do not want power plants in populated areas or in their backyards, new generating plants could be located in remote regions and low-loss superconducting cables could be used to deliver electricity to the regions that need it.

Additionally, the DOE and others believe such cables might be used to replace today's current electrical grid infrastructure. The use of HTS superconducting cables in this environment would provide a low-loss transmission and grid system with a higher capacity than today's existing grid.