Best Paths interview: Nexans' Christian-Eric Bruzek

Super-cooled superconductivity tests offer a glimpse of a simpler super high voltage future.

The EU-funded "Best Paths" superconductor project has just completed qualification testing.

The project, led by French cable company Nexans, created a modular HVDC superconductor cable system designed for bulk power transmission over long distances with minimal resistive losses.

The test program has qualified a 320 kV direct current superconducting cable for currents up to 10 kA with a 3.2 GW power transmission capability.

The reduction in cable size, trench size and so civil work disruption is remarkable, raising the prospect of faster permitting at reduced costs over long distances, Nexans' project manager Christian-Eric Bruzek told S&P Global Platts June 25.

"With conventional cable you often have to work around zones because an eight to 10 meter trench is just too wide. With this technology, with a 100 cm wide trench for dipole carrying 6.4 GW, you can more often than not go straight. Wayleaves are shorter, it is easier to get permits and, over long distances, this is going to be cheaper," he said.

In the short term, the technology is seen as part of a solution alongside conventional overhead lines and underground cables, helping bridge challenging sections as when crossing rivers, mountains, parks and congested city centers, Bruzek said.

Longer term the goal is hundreds of kilometers of superconducting line on major international corridors minimizing losses and expensive civil works. When transferring 10 kA a resistive cable will lose 220 kW per kilometre. Superconducting cable will lose 70 kW per km.

There are challenges. This latest technology, which is super-cooled, uses cheaper cabling materials but requires expensive cooling stations.

It needs a long-term real-world test, then some local projects to get it off the ground. Grid companies are notoriously conservative, so nobody is expecting an over-night revolution. But the benefits, if proved, are compelling.

Super-cooled technology

The Best Paths test has focused on cryogenic superconductivity – super-cooling a cable made of magnesium diboride (MgB2), a simple compound based on abundant raw materials.

Helium gas is used to cool the superconductor itself, while liquid nitrogen acts as insulation (see schematic).

"The low cost of the materials is partially offset by the cost of the cooling systems," Bruzek said.

"Nevertheless these machines exist, they are on the market. Over time they will become cheaper," he said.

The materials used in low temperature superconductors are of the order 50 to one cheaper than those used in high temperature superconductors, Bruzek said.

"You pay for the cooling machines with the savings. If you need a very high current cable you will need a lot of superconducting wires, that is when the ratio becomes significant," he said.

The new cables take up even less space than previous superconductors, opening up cheaper, more efficient options when routing a project.

"It is remarkably compact - you can transmit 6 kA in a three millimeter diameter cable," he said.

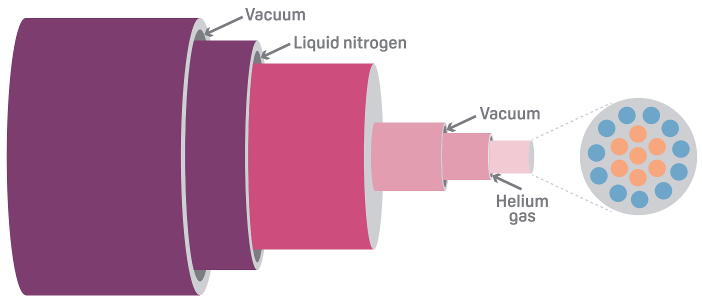
Another benefit is the lack of heat transference to soil and plant life, Bruzek said – an environmental concern when burying conventional cables.

Next steps

With the technology now qualified the next stage is to test a limited section of 100 meters or so in the field, Bruzek said, followed by a genuine use-case (for instance, under a canal) and finally a first long-distance project in perhaps, 10 years' time.

"We need to find partners for these stages," he said. "Grid managers are cautious but there is interest in France and Germany. Then we need to invest in the industrial tools to reach the manufacturing quantities required for long length."

SUPERCONDUCTOR FOR VERY HIGH POWER TRANSMISSION



- Outer cryogenic envelope
- High-voltage lapped insulation in liquid nitrogen
- Inner cryogenic envelope
- 10 kA MgB_2 conductor in helium gas
- Magnesium dibromide (MgB_2)
- Copper (Cu)

Source: EU Best Paths project Demo 5

BEST PATHS PROJECT SUMMARY

- Project leader Nexans. Nine industrial/academic partners: CERN, Columbus Superconductors, ESPCI Paris, IASS Potsdam, Karlsruhe Institute of Technology (KIT), Ricerca sul Sistema Energetico (RSE), Réseau de Transport d'Électricité (RTE), Technische Universität Dresden and Universidad Politécnica de Madrid (UPM)
- First successful qualification on a test platform of full-scale 320 kV HVDC superconducting loop
- Two terminations and a 30 meter length of cable carrying a current of 10 kiloamps (kA) for a rated power transmission capacity of 3.2 GW
- Complete sequence of voltage testing at 1.85 time the rated voltage (up to 592 kV) and impulse tests
- Magnesium diboride/copper cable housed in thermally insulating cryostat cooled by helium gas
- Installation footprint of one meter in width for dipole carrying 6.4 GW vs 10 meters for traditional circuit based on XLPE insulated copper cables
- Same cable technology could be employed in AC applications upto Extra High Voltage levels of 400 kV

Source: Nexans

