- Superconducting power cable represents world first for European high-voltage grid
- Cable may be suitable for integration of high-voltage infrastructure in urban areas
- Demonstration project comprises two to four kilometres of underground 150 kV HTSC cable

TenneT is planning to install two to four kilometres of underground superconducting high-voltage cable as part of the Dutch electricity grid. The project will be a world first: a section of superconducting cable of this length has not yet been installed anywhere else in the world. “With this project, we are meeting society’s demand to install more high-voltage lines underground,” says TenneT CEO Mel Kroon. “With these superconducting cables, it should become easier in future to integrate high-voltage lines in urban areas.”

Super cable

HTSC stands for ‘High-Temperature Super-Conducting’. Superconductors can transmit up to a thousand times more electricity than copper, the main material currently used in underground high-voltage cables. Because a superconducting cable is cooled to a temperature of approximately minus 200 degrees Celsius, it has no electrical resistance and creates no electricity losses. The superconducting state is achieved by means of refrigeration using liquid nitrogen. The 150 kV cables currently in use require a strip of soil of at least 12 metres wide to dissipate the heat generated. HTSC cables can be laid much closer together because they generate no heat, so that a 3-metre-wide strip will probably be sufficient. In addition, HTSC cables do not generate any magnetic field.

Demonstration project

TenneT is currently determining the location of the first ‘super cable’. The TSO is selecting a suitable demonstration site where the cable can be taken into operation for the first time. “This is highly innovative technology,” says Mr Kroon. “The results of this demonstration project will show whether cables of this type can be used more widely in future.”

Collaboration

TenneT is working together with several leading knowledge institutes on this project. Researchers at Delft University of Technology, University of Twente, the Institute for Science and Sustainable Development (IWO), HAN University of Applied Sciences and Imtech Marine will investigate topics including the control engineering aspects and the requirements that the cable must meet. The project is scheduled for completion in June 2019.

Future

TenneT does not expect that superconducting cables can be applied in current projects. Further research must be conducted and additional experience gained before such a step can be taken. Initially, it will only be possible to use superconducting cables in sections of up to four kilometres. For the time being, longer sections cannot be realized because of the nitrogen supply required to cool the cable. Superconducting cables are also expensive, costing approximately three times as much as a standard 110 kV or 150 kV cables. However, the technology is developing quickly. It is expected that it will be possible to use superconducting cables more widely and/or across longer distances in future, thanks to improved cooling methods and mass production.

Experiences

HTSC cables are already used on a small scale in other countries, but they are usually not part of the meshed high-voltage grid and the length of the relevant cable section generally does not exceed one kilometre. In 2009 a 600-metre section of HTSC cable was installed in New York, and in 2014 a 1-km-long section of superconducting cable was taken into operation in Essen, Germany, to replace a 10 kV medium-voltage line. The demonstration project to be undertaken by TenneT involves a cable section of two to four kilometres.

Leader in technology

The HTSC cable demonstration project is just one of many ‘world firsts’ achieved by TenneT in the past few years. TenneT has also developed the innovative new Wintrack pylon, has applied HVDC technology on a large scale to connect offshore wind farms to the onshore grid, and is planning to use new 66 kV connections to connect future offshore wind farms in the Netherlands. In addition, the TSO is taking the lead in the underground installation of high-voltage connections. TenneT is the first TSO to construct a 20-km-long section of 380 kV cable, and is investigating additional possibilities in this area. The HTSC cable project complements these efforts with an innovative solution for underground installation in urban areas.