

EU Funds SCARLET to Commercialize Long-distance Superconductor Transmission

The EU's Horizon Europe program has awarded €15.0 million (\$16.0 million) in funding for the Superconducting Cables for Sustainable Energy Transition (SCARLET) program for a period of 4.5 years through Grant Agreement No. 101075602. SCARLET unites 15 partner organizations around the goal of designing and industrially manufacturing superconducting cables in kilometeric lengths. The project brings together industrial partners Absolut System, ASG Superconductors, Nexans, RINA Consulting, SuperGrid Institute, SuperNode, and Vision Electric Super Conductors as well as the research institutes and universities ESPCI, the Research Institute for Sustainability (RIFS), RSE SpA, SINTEF, the IEE Slovak Academy of Sciences, the University of Bologna, and WavEC.

“This is an opportunity and now our responsibility to bring this new power cable technology to commercial performance levels,” said Niklas Magnusson, Project Coordinator from SINTEF Energy Research in Norway. “We will enable the supply of renewable energy to Europe at a significantly lower cost than what is possible today.”

SCARLET to Develop 1 GW Cable Systems

Rising amounts of renewable energy coupled with an increase in decentralized power generation call for the modernization and extension of the European grids. Recent studies have shown that European transmission corridors with lengths of several hundred kilometers and capacities of 5 to 20 GW are needed. SCARLET aims to develop 1 GW cable systems and bring them to the type test stage, the last qualification step before a commercial installation.

“The main SCARLET work packages are related to long-length onshore cables, offshore cables, hydrogen-cooled cables, and system protection,” said Adela Marian, senior researcher at RIFS in Potsdam,

Germany. “They are complemented by the work package on integration and economic studies.

“The main milestones are related to designing and manufacturing the components of the cable system in order to have a high-performance cable sample available for the type test. SCARLET will use two conductor materials for the cable demonstrations: HTS operating in liquid nitrogen at 67 K and MgB₂ operating in liquid hydrogen at 20 K.

“The cable systems will be tested on industrial test platforms. For the hydrogen-cooled cable there will be an additional long-term field test carried out in an external field for hydrogen testing available at Absolut System.”

SCARLET Tech Designed for MVDC Operation

Marian explained that an entire work package will be dedicated to offshore superconducting links with offshore cooling systems: “The design of the offshore cooling systems will take into account the technical and economic limits associated with superconducting, cryogenic, and offshore technologies along with the stakeholder needs and requirements derived from current industry knowledge. At the moment we are at the beginning of this iterative process.

“In any case, as a general remark, the SCARLET technologies are designed for MVDC operation, which is enabled by the high-current capability of superconductors. This eliminates costly high-voltage converter stations and allows for significant overall cost reductions.

“This is particularly interesting for offshore applications, as it leads to smaller and much less expensive equipment at offshore wind power farms. The partners involved in the offshore work package

► are Nexans, SuperNode, WavEC, Absolut System, and SINTEF.”

SCARLET to Develop Hydrogen-cooled Superconducting Cables

Another work package is focused on hydrogen-cooled superconducting cables. Such cables would open up the unique possibility of simultaneously transporting both hydrogen and electricity.

“Using hydrogen as a coolant enables so-called dual distribution systems, where both electricity and hydrogen are delivered in the same pipeline to end users,” said Marian. “This is particularly relevant for transportation systems and the energy-intensive metallurgical industry, where both electrical and chemical energy are needed.

“The main challenge arises from the combination of high voltage and liquid hydrogen, which needs to be carefully considered when developing the components of the cable system such as high-voltage insulation, terminations, and cooling system.

“Throughout the project, procedures will be defined for the safe design, operation and performance of the cable system in liquid hydrogen, based on safety rules recommended in standards. The partners involved in the development of hydrogen cooling systems are ASG Superconductors, Absolut System, and RINA Consulting.”

SCARLET Involves End Users at Early Stage

SCARLET is designed to involve the end-users of superconducting cable systems at an early stage of development. Their needs and perspectives as well as practical knowledge will be integrated into the project through the establishment of an Advisory Group.

“The Advisory Group will be composed of external experts covering all of the relevant perspectives related to the superconducting technologies developed in SCARLET,” said Marian. “This will ensure relevance to a wide spectrum of end users and useful feedback throughout the project.”

The inclusion of end users from an early stage will ensure that the developed technologies are relevant to a broad spectrum of users. Moreover, the testing experience gathered in SCARLET will contribute to the development of a first set of recommendations for the HVDC superconducting standard of the future. To this end, a working group will be established, possibly within the framework of the International Council on Large Electric Systems (CIGRÉ), with a focus on testing high-power superconducting cables.

Ideally, the recommendations and testing protocols proposed by the working group will be applied and verified in SCARLET. At the end of the project, the results will be forwarded to the IEC, the international organization that prepares and publishes standards for all electrical technologies.

Within SCARLET, RIFS in Potsdam will be leading the work package on "Dissemination and Exploitation," which includes classic dissemination activities such as media reports, information events, and policy recommendations for public authorities. The activities related to stakeholder integration under the Advisory Group and standardization are also part of this work package. RIFS recently launched SCARLET's website at <https://scarlet-project.eu/>. ■