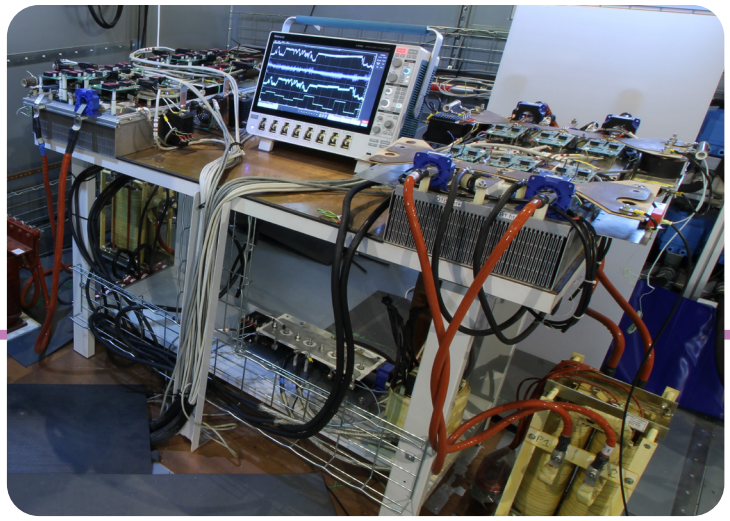
DC Solid State Transformer for MVDC networks

Enabling future MVDC networks with our highly efficient, compact solution

A key technological element for enabling future direct current (DC) networks, our DC solid state transformer (SST) provides full power flow control & fault current limitation while maintaining 99% energy efficiency and a significantly reduced size and weight in comparison with a 50/60 Hz transformer!



DC SST Test bench

OVERVIEW

Energy requirements are changing rapidly, with an ever-increasing demand for innovative solutions capable of integrating renewable energy sources, supporting data centres, electrical transportation, electrolysers, etc. In response to the requirement to drastically reduce CO2 emissions globally, MVDC electricity networks are the solution.

A DC solid state transformer (DC SST) is required to interface MVDC systems with low or high voltage direct current systems (LVDC or HVDC). The DC SST provides galvanic separation using the medium frequency transformer (MFT). In addition, it provides full power flow controllability, and blocks/limits the fault current. The DC SST can be designed to provide unidirectional or bidirectional power flow, according to application requirements, in monolithic or modular configurations.

OUR SERVICES

The results of our in-house DC SST solution research & development are now available for further development by network developers, operators and equipment manufacturers.

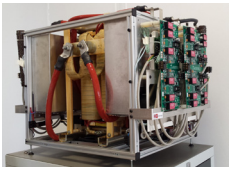
- Collaborate with us, using our DC SST prototype for demonstrator or pilot projects.

- Use our intellectual property (IP) and technology transfer to integrate our DC SST solution into your MVDC network projects.

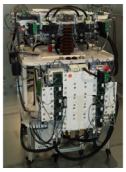
DC SST DEVELOPMENT TIMELINE

2015

100 kW low ratio bidirectional monolithic 1-phase

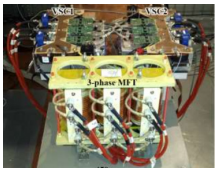


1 MW low ratio bidirectional modular



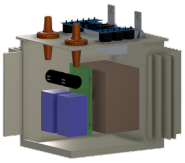
2020

100 kW low ratio bidirectional monolithic 3-phase



2025

250 kW high ratio unidirectional monolithic



250 kW high ratio bidirectional monolithic

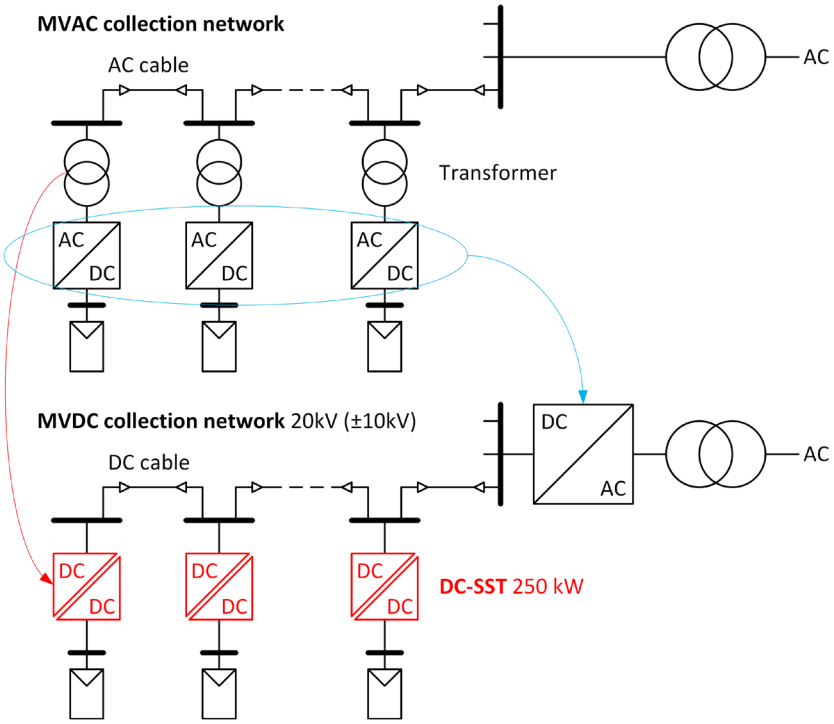
OUR ADDED VALUE

- Over 5 years of DC SST research & development
- Broad expertise, from enabling technologies (SiC semiconductors & MFT) to MVDC network integration.
- Design and testing services available
- Proven experience in national & multi-national collaborative projects

BENEFITS OF DC SST

- Very high energy efficiency for low levelized cost of energy (LCOE)
- Small size for easy installation, low raw material consumption and low manufacturing CO2 emissions
- Full power flow controllability for network resilience and energy trading
- Fault current blocking/limitation for simple network protection

PV POWER PLANT CASE STUDY



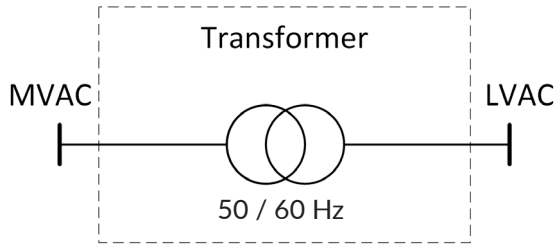
DC SST in MVDC collection network for solar PV power plant

TECHNICAL FEATURES

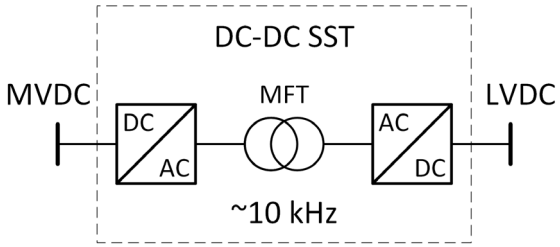
Power flow & ratio	Unidirectional step-up
Galvanic isolation	Yes (Input/Output)
Modularity	Monolithic
Nominal power	250 kW
Energy efficiency	99% (targeted)
Input voltage	1.2 kV DC
Output voltage	20 kV (±10 kV DC) ±10%
Internal frequency	10 kHz
Semiconductor	SiC MOSFET / SBD
Insulation	Oil
Cooling	Air
Audible noise	None (targeted)
Electrical interface	MV standard (EN 50180/50181)

The LCOE of large PV solar power plants can be reduced thanks to MVDC collection networks. The PV inverter (DC-AC converter) is mutualised for the entire PV power plant (up to few tens of MW) and the LV/MV transformer is replaced with the DC SST. Power losses and costs are expected to be reduced in MV cables and accessories. Further savings are possible if DC loads or DC storage are integrated within the MVDC network.

20 kV TRANSFORMER VS. 20 kV DC SST

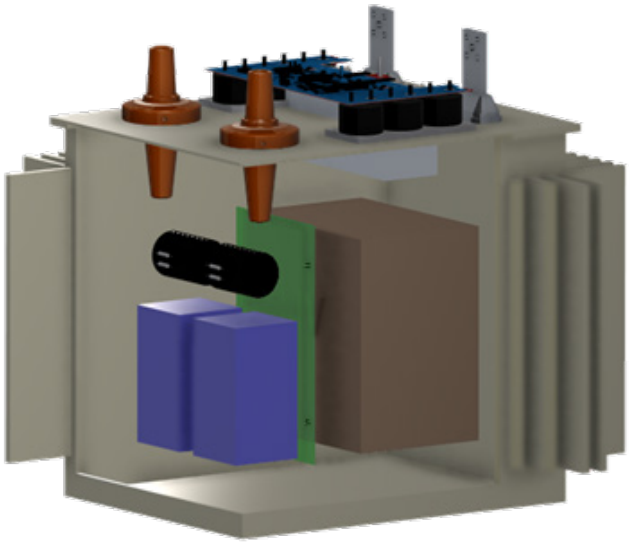


99% energy efficiency



99% energy efficiency
25% smaller than 50 Hz transformer

OUR 20 kV DC SST DESIGN



TRL5 - End of 2022
TRL6 - End of 2023

CONTACT

For additionnal information or to ask for a quote, please contact:

sales@supergrid-institute.com