Karlsruhe Institute of Technology

FastGrid

Institute for Technical Physics

Project FASTGRID - Tests on 2G HTS for its Application in DC Resistive SC FCL

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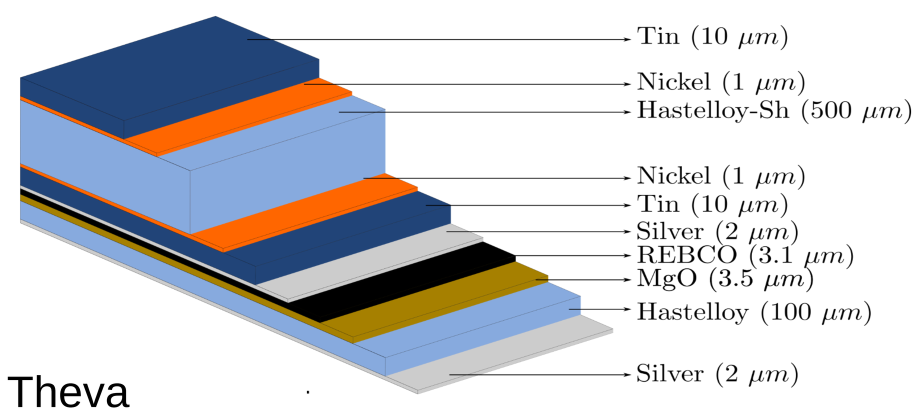
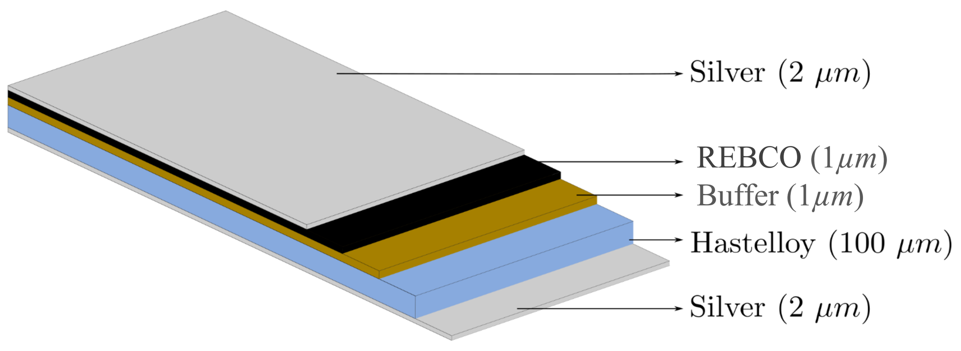
HVDC (High Voltage Direct Current) super-grids could become a future solution for the long-distance power-transmission. The Superconducting Fault Current Limiter (SCFCL) is a necessary facility to protect such transmission lines. In the framework of the project FASTGRID dedicated HTS wires for resistive type DC-SCFCL are under development.
To reduce the cost per switching capacity: Reduction of the amount of HTS shall be achieved by increasing the allowed electrical field and the critical current density at operating conditions.
A wire with an additional laminated 500 µm Hastelloy® shunt is the basic solution for FASTGRID. This work shows experiments on this prospective solution, compared with tests on bare coated conductors at lower E-field, once applied in ECCOFLOW SCFCL.
The goal of this work is the validation of the HTS conductor for an electric field higher than 130 V/m for a fault clearing time of 50 ms.

Architecture of tested 2G HTS:

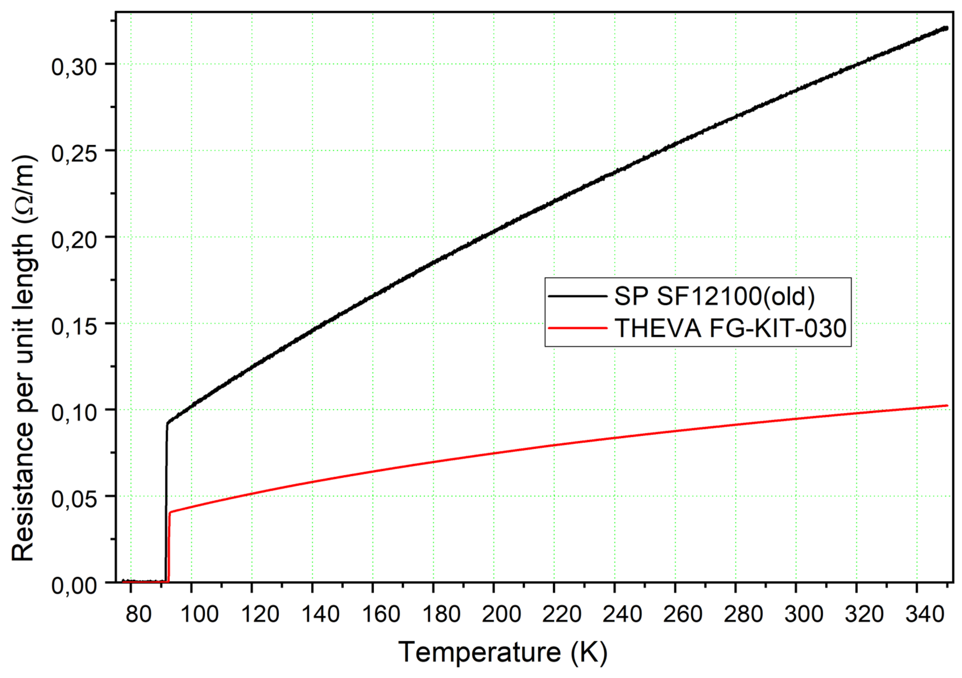


Theva FG-KIT-030

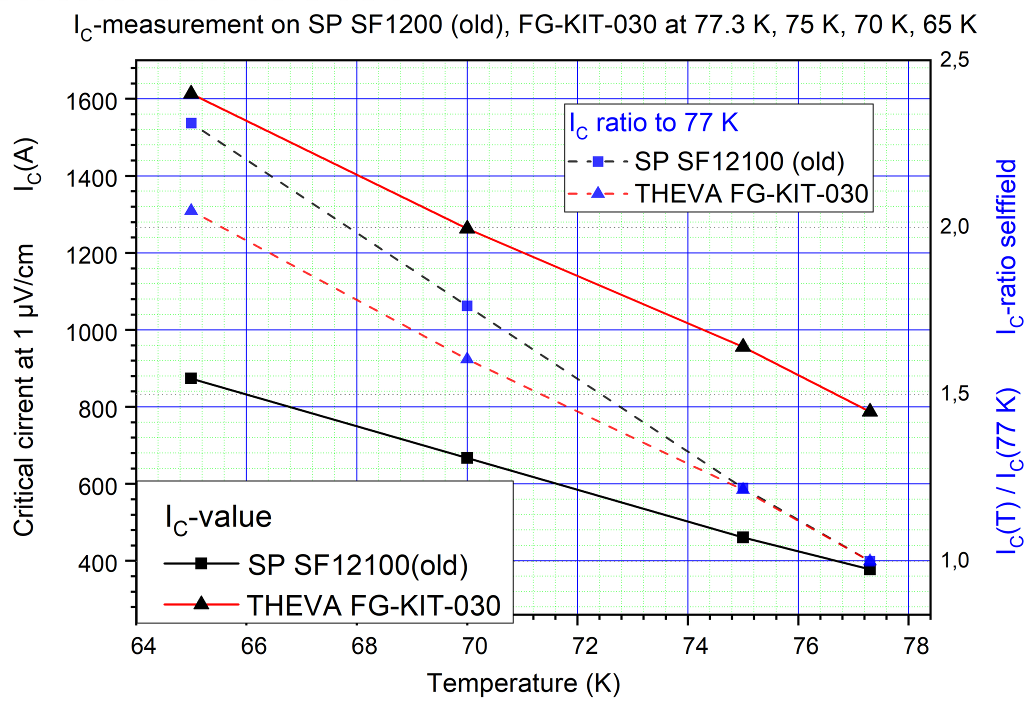


SuperPower® SF12100

Experiments needed to evaluate limitation tests:

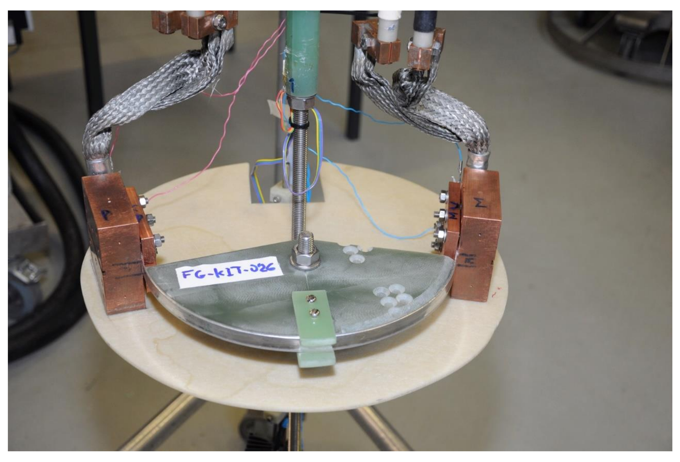


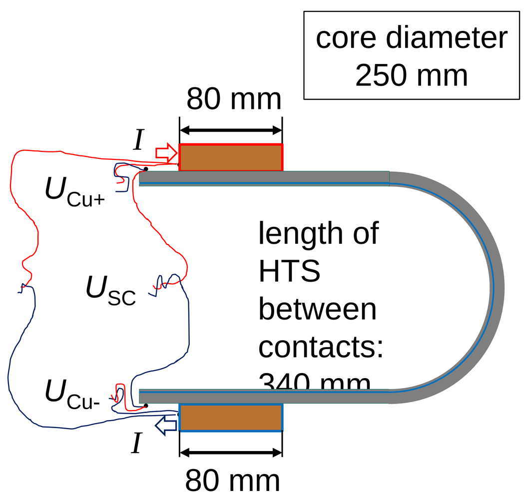
Resistance per unit length vs. temperature



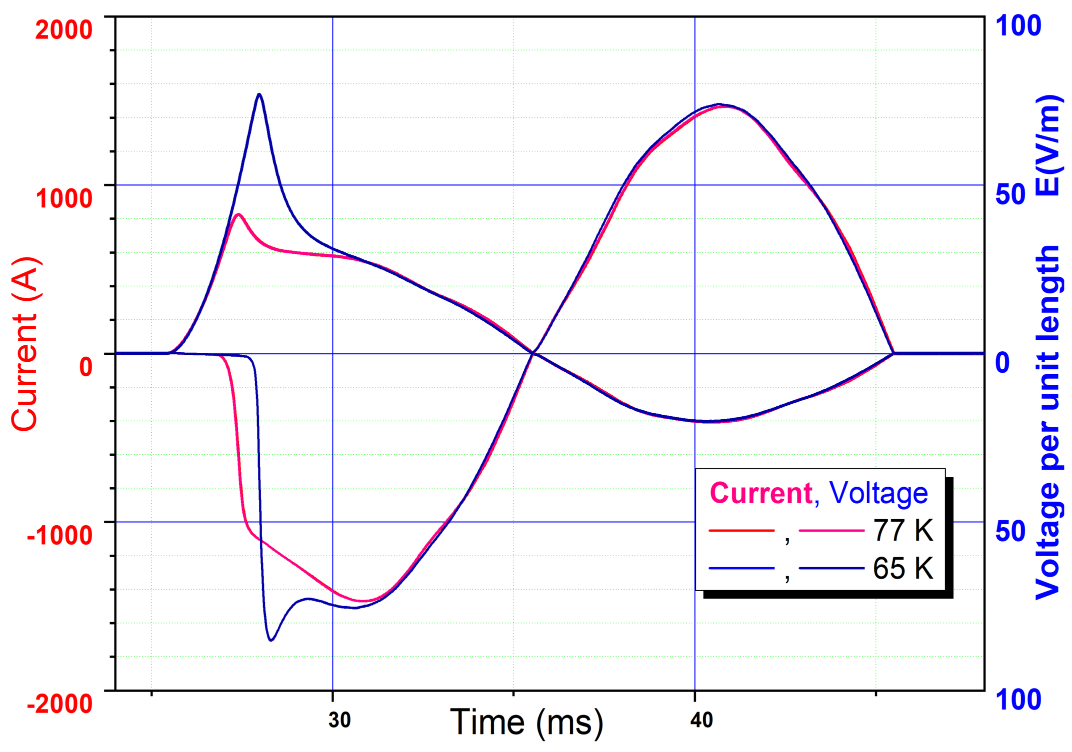
Critical current at operating (limitation test) temperature

Experimental setup for limitation tests

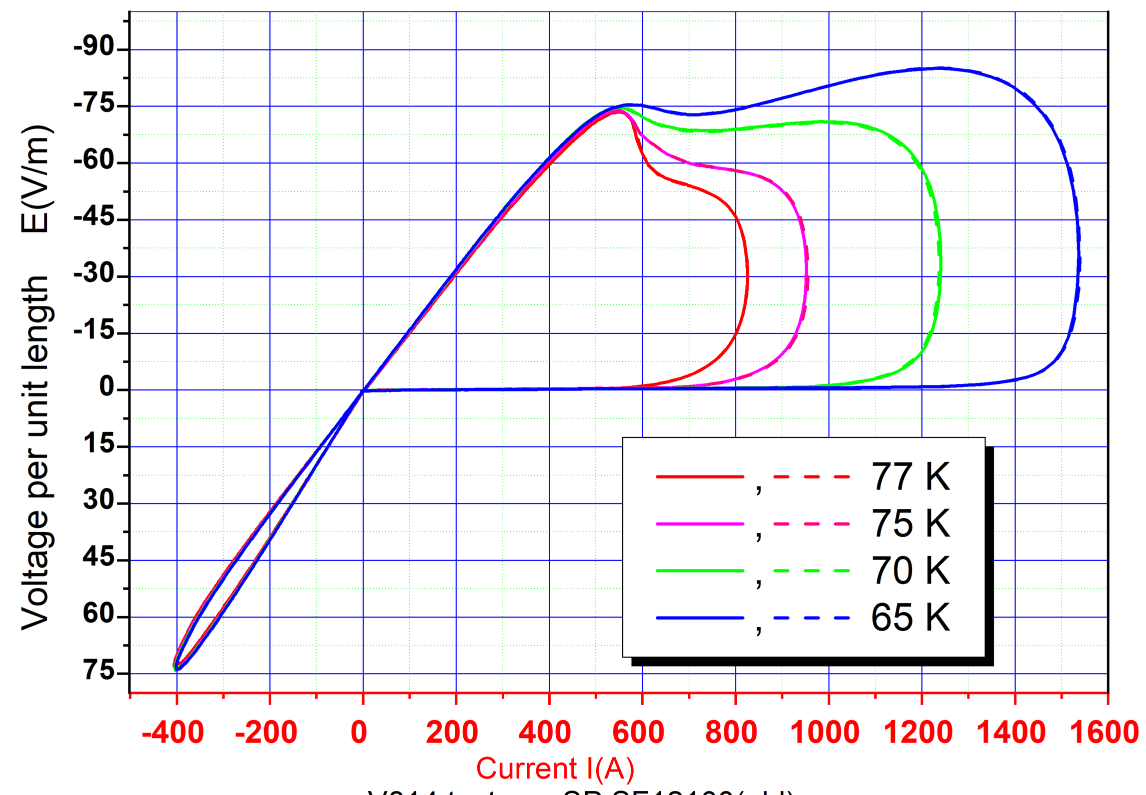




Tests performed on SuperPower® SF12100

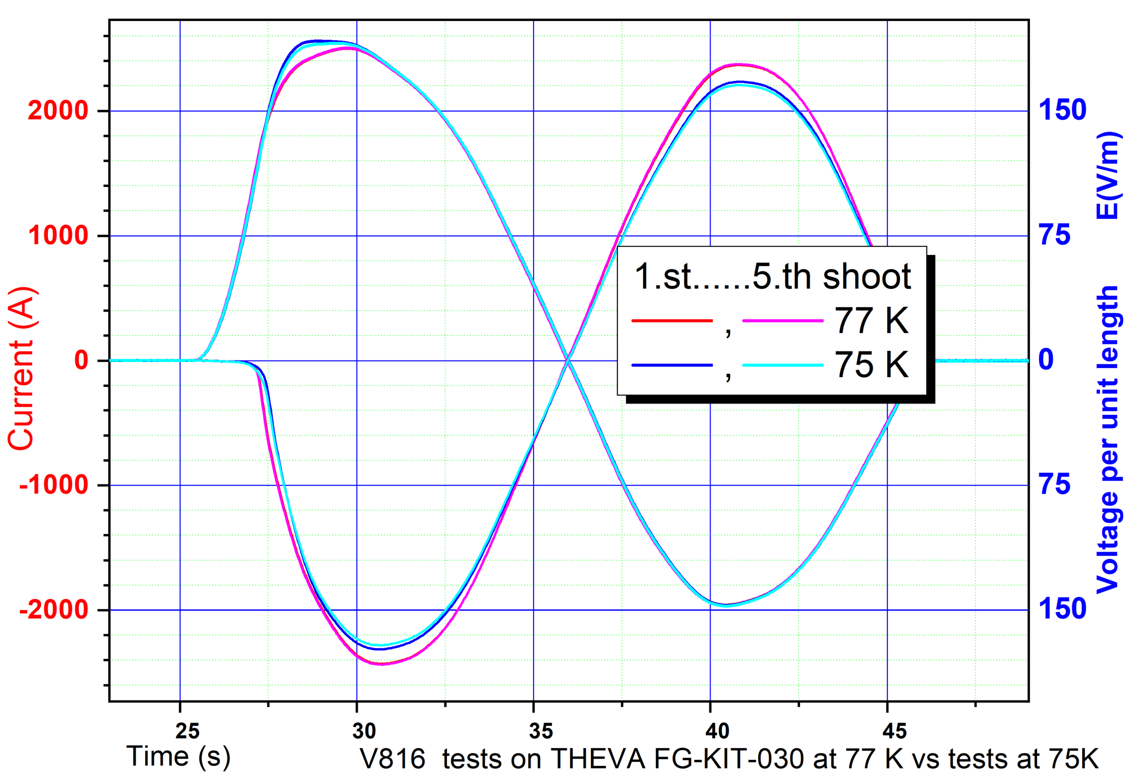


V814 limitation tests on SuperPower SF12100 at 77 K vs tests at 65K

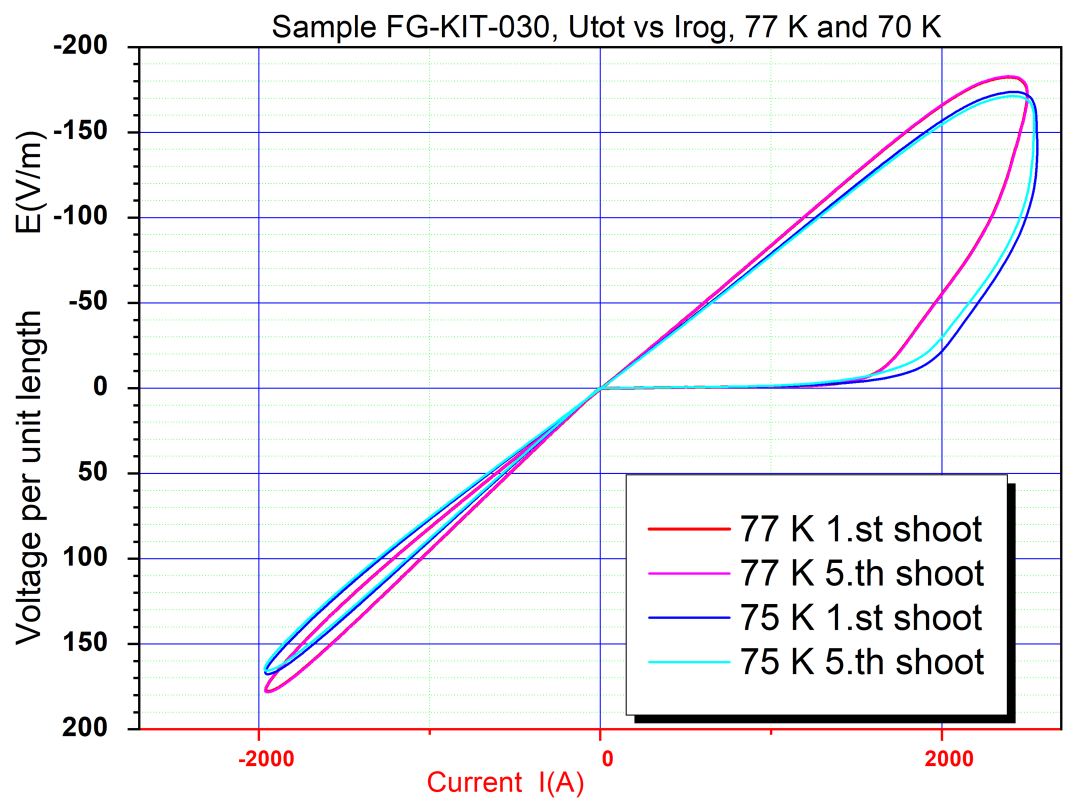


V814 tests on SP SF12100(old)

Tests performed on Theva FG-KIT-030



V816 tests on THEVA FG-KIT-030 at 77 K vs tests at 75K



Conclusion:

Results analysis:

- The final average temperature after limitation does not depend on I_C (Variation of operating temperature hardly effects the resistance of HTS after limitation.
- The critical current value effects the amplitude of the 1st limited peak current
- The increase in the critical current value leads to the development of local hot spots
- V(I)-plot of limitation allows to recognize progressing degradation of HTS.
- Local defects of HTS hardly change the whole limitation effect.
- Visible defect after tests on THEVA is a local delamination. It zigzags through four layers from buffer through REBCO, Ag to Sn solder interface

??? The presumed causes of insufficient thermal stability: ???

- Local defects in soldered interface HTS-Hastelloy® shunt
- Combination of high local temperature and mechanical bending forces
- Insufficient thickness of silver stabilization against formation of hot spots

The work on the development and testing of 2G HTS, optimized for DC SC FCL FASTGRID continues.

See also poster **2-LP-FCT-S07** (simulations)

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