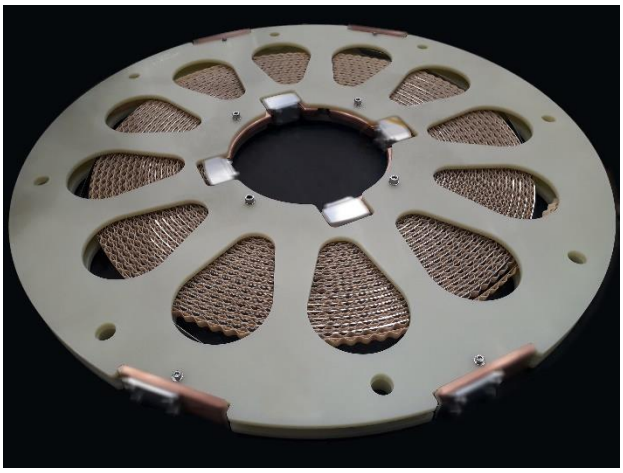
FastGrid

COST EFFECTIVE FCL USING ADVANCED SUPERCONDUCTING TAPES FOR FUTURE HVDC GRIDS

Newsletter #3
February 2019

FASTGRID AT A GLANCE

The SuperConducting Fault Current Limiter (SCFCL) ideally limits fault currents thanks to an intrinsic property: the instantaneous transition from zero resistance to a high resistance when the current exceeds a threshold value. Some present and future grids are clearly looking for such a new device especially high voltage grids. FASTGRID aims to significantly improve the attractiveness of the SCFCL through strong cost reduction but also through robustness enhancements. For these objectives FASTGRID inter alia improves the Superconductor, implements an innovative concept (Current Flow Diverter, see this newsletter) as well as an advanced control system for the device and develops a breakthrough tape based on a sapphire substrate.



Pancake prototype of FASTGRID

Dear readers,

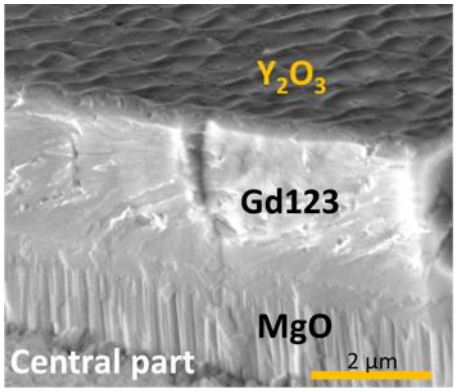
The FASTGRID project has been running for two years already. During this period, the 12 partners have worked very hard to advance superconducting fault current limiters from material to device. This third newsletter will highlight the work carried out by the company OXOLUTIA concerning the innovative Current Flow Diverter (CFD) concept.

We hope you enjoy this newsletter, please visit our website to learn more.

Pascal Tixador, FASTGRID coordinator.

FOCUS ON

Success in the manufacture of REBCO tapes with Current Flow Diverter (CFD) by reel-to-reel inkjet printing



Y_2O_3 thickness central part ~130 nm

One of the main objectives of the FASTGRID project is the production of long lengths of tapes implemented with the Current Flow Diverter approach invented by F. Sirois and C. Lacroix from Polytechnical University of Montréal. This approach allows for a significantly larger normal zone propagation velocity and thus improves quench-safety and reduces the effect of heterogeneities in the fault current limiter material. In other words, the tape becomes more robust, mitigating the appearance of destructive hot spots at currents close to the limit.

This was achieved by using an inkjet printing pilot plant in reel-to-reel continuous mode. A central track of about 80% of the width is inkjet printed with a specially-formulated ink that leads to an electrically-insulating nanocrystalline yttrium oxide layer of 100 nm in thickness upon mild heating. The resulting CFD layer is not altering the superconducting layer below, although it acts as a barrier for the oxygenation process. However, the CFD tapes could be successfully oxygenated to have optimum critical current after careful process optimizations. The result is a nice example of the application of digital manufacturing techniques like inkjet printing coated conductors.

A patent covering the used materials and the above-mentioned manufacturing process was recently filed.

More information: www.oxolutia.com

NEWS

The consortium welcomes new faces

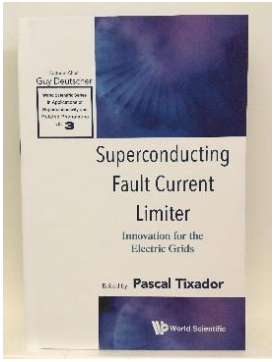
Julie DJEBRANI joined CNRS as the new project manager of FASTGRID on October 1, 2018. After completing a master's degree in foreign languages, Julie worked at the international office of several higher education and research institutions for 4 years. This is the first time she has the opportunity to manage a European project such as FASTGRID. She will be responsible for ensuring an efficient management of the project and the consortium.

Alexandre ZAMPA obtained his M.Sc. degree in Electrical Engineering from Grenoble INP. He started his PhD on October 1, 2018 at G2Elab and Institut Néel under the supervision of Pascal Tixador. As part of FASTGRID, he will contribute to the improvement of the conductor so that it presents a very high electric field under limiting conditions while remaining protected in the event of a low prospective fault current (so-called hot-pot problem). We are very glad to welcome Alexandre to the consortium and wish him all the best for his PhD.

Alexander BUCHHOLZ started on July 16, 2018 as a new member in FASTGRID to perform detailed analysis with cradle to grave approach on the environmental impact and energy balance of high performance superconducting tapes. He will be working in the well-known Institute for Technology Assessment and System Analysis at KIT in Karlsruhe with its long established competence in investigations about the environmental impact of scientific innovations. We welcome Alexander in the group and wish him all the best for his PhD.

Arooj AKBAR joined the FASTGRID project as a new PhD student at EPFL on February 1, 2019. After graduating from the University of Nottingham, she had her first research experience at EPFL as an intern and then worked on IEEE publications focusing on power quality and power factor correction at Lahore University of Management and Sciences (LUMS), Pakistan. We are pleased to welcome Arooj to the consortium.

Prof. Tixador edits a new book



Pascal Tixador, coordinator of the FASTGRID project, has just edited a new book entitled “Superconducting Fault Current Limiter” with many contributions of FASTGRID partners. This book is for graduate students, post-docs, researchers, electrical engineers and others even inexperienced but interested in superconductivity. Basics of superconductivity are given.

“The book is an indispensable and complete tool for those who want to know the state-of-the-art of SCFCLs and their benefits to power grids.”

Nouredine Hadjsaid, Treasurer, IEEE Power & Energy Society

Content:

- Environment of the SFCL: The Electric Grid (Bertrand Raison)
- Superconductivity and FCL (Pascal Tixador)
- AC Losses in Superconducting Fault Current Limiters (Fedor Gömöry and Ján Šouc)
- Superconducting Materials for SFCL (Steffen Elschner, Joachim Bock, Xavier Obradors, Teresa Puig and Javier Granados)
- Superconducting Fault Current Limiters (Mathias Noe)
- Resistive SFCL Design (Pascal Tixador and Arnaud Badel)
- Modeling Resistive Superconducting Fault Current Limiters in Power System Transient Simulators (Frédéric Sirois)
- Electrical Insulation in Cryogenic Environment (Naoki Hayakawa)
- Cryogenics (Alain Ravex and Pascal Tixador)
- Major SFCL Locations with Economical Aspects (Pascal Tixador)
- SFCL Developments at Nexans (Steffen Elschner, Achim Hobl and Joachim Bock)
- The First Italian SFCL: From Design to Live-Grid Testing Activity and Effective Current Limitation of a Severe Three-Phase Short-Circuit (Luciano Martini, Marco Bocchi and Giulano Angeli)
- SFCL Developments at Innopower (Ying Xin)
- Status of Development and Demonstration of SCFCLs in Korea (Hye-Rim Kim)
- Introduction of SFCL 220 kV in Moscow Energy Grid (M. Moyzykh, D. Sotnikov, D. Gorbunova and S. Samoilenkov)
- Accelerating Quench Propagation in 2G HTS, Coated Conductors by Engineering the Tape Architecture (Christian Lacroix)
- Sapphire-Based SFCL Conductors (Amir Saraf, Boaz Almog, Mishael Azoulay and Guy Deutscher)

EVENTS

5th FASTGRID project meeting at IEE, Bratislava

The 5th project meeting of the Horizon 2020 EU Project FASTGRID, jointly managed by CNRS, France and KIT, Germany was hosted at the Institute of Electrical Engineering, SAS in Bratislava, Slovakia on 22-23 November 2018.

Members of the consortium at the 5th project meeting in Bratislava

During the two-day project meeting, the members of each work package presented the results of the work carried out since last project meeting. They also had the opportunity to work in parallel sessions and to visit several labs at IEE and STU.

Next face-to-face project meeting in planned for April 2019 and will take place at EPFL in Lausanne, Switzerland.

Members of the consortium participated in ASC 2018

Several members of the consortium attended the 2018 Applied Superconductivity Conference from October 28 to November 2, 2018 in Seattle, USA and presented the following topics:

- *Status of EC project FASTGRID*, P. Tixador, M. Bauer, C.E. Bruzek, A. Calleja, G. Deutscher, B. Dutoit, F. Gömöry, L. Martini, M. Noe, X. Obradors, M. Pekarcikova, F. Sirois

- *Growth of all chemical $YBa_2Cu_3O_7$ thick films and coated conductors using different architectures*, C. Pop, B. Villarejo, F. Pino, N. Chamorro, F. Valles, B. Mundet, P. Barusco, A. Palau, J. Gazquez, A. Usoskin, S. Ricart, X. Granados, T. Puig, X. Obradors
- *Influence of the type and thickness of the shunt and substrate on REBCO tapes with a current flow diverter architecture for fault current limitation in an HVDC grid*, C. Lacroix, F. Sirois
- *Optical fiber hot spots detection for Fault Current Limiter health monitoring*, Z. Yang, J. Yang, L. Zhang, G. Escamez, C.E. Bruzek, L. Thévenaz, B. Dutoit
- *Study of Turn-to-Turn Electrical Breakdown for Superconducting Fault Current Limiter Applications*, R. Chassagnoux, O. Lesaint, O. Gallot-Lavallée, N. Bonifaci, S. Flury, J.L. Palenzuela, P. Legendre, G. Escamez, C. Creusot, A. Girodet
- *Characterizations and AC losses measurements on 2G HTS tapes and small-scale bifilar pancake for HVDC SFCL applications in the framework of FASTGRID project*, G. Escamez, G. Angeli, M. Ascade, Marco Bocchi, V. Rossi, A. Valzasina, L. Martini, C.E. Bruzek
- *Development of 150 V/m HTS conductor for fault current limitation in high voltage DC networks*, G. Escamez, C.E. Bruzek, B. Dutoit, F. Sirois, C. Lacroix, M. Bauer, V. Grosse, P. Tixador
- *Improved quench robustness of CC tapes for FCL due to increased thermal capacity*, F. Gömöry, M. Vojenčiak, M. Mošať, E. Pardo, M. Buran, M. Pekarčíková, E. Michalcová, J. Mišík, M. Bauer, C. Lacroix, F. Sirois

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This newsletter has been developed within FASTGRID project. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 721019