

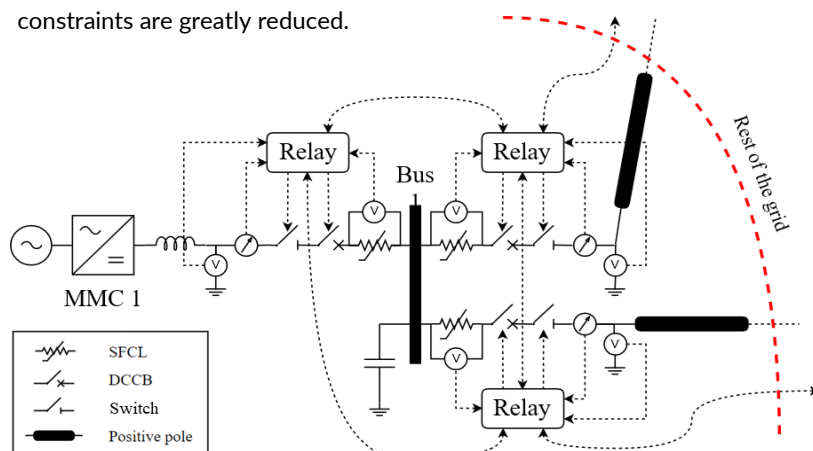


# MTDC protection with superconductors

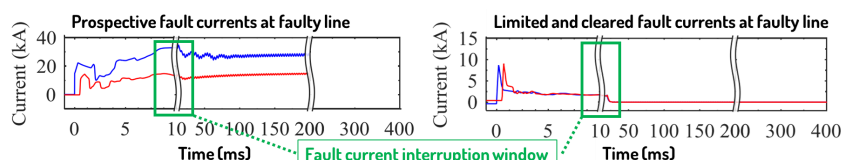
*An innovative selective protection approach with inherent security properties*

## CONTEXT

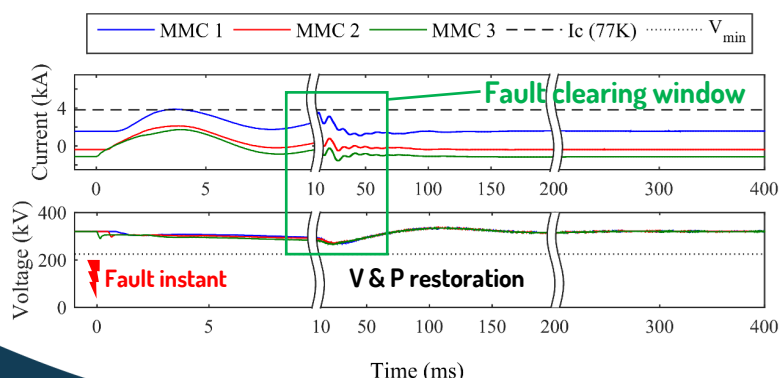
DC grid protection is one of the main technical challenges to overcome in order to unlock the development of multi-terminal HVDC grids. Superconducting (SC) technology can solve some of these. For instance, SC fault current limiters (SFCL) are already being used in AC to reduce the risk of high fault current values in transmission and distribution networks. The limitation properties of resistive-type SFCLs are also effective in DC, where a single device can keep fault currents below 2-3 times its rated value. At this level, a DC breaker is still needed, but its sizing constraints are greatly reduced.



## TECHNOLOGY DESCRIPTION



When installed at both cable ends, SFCL devices are unseen by the system and have no electrical losses. In the event of a fault on the protected cable, both limiters will become highly resistive and dissipate energy through heat. In the case of multiple SFCLs located in the same bus, selectivity is passively achieved. Indeed, a selective fault detection and identification is possible by analyzing the voltage at the SFCL terminals. In some cases, fault current transients can still endanger the secure operation of SFCLs protecting healthy cables. Properly sizing the SFCL is key to avoid this (a busbar condenser can be considered as a last resort solution).



## APPLICATION DOMAIN

- Multi-terminal HVDC networks dominated by cable transmission.
- HVDC protection.

## ADVANTAGES

- Fail-safe protection system ensuring maximum MTDC grid security.
- Passive selectivity obtained from the SFCL physical behavior.
- Reduced sizing constraints for DCCB: low fault current capability.
- Innovative DCCB + SFCL breaker solution compatible.

## TRL SCALE



Proof of concept

## DELIVERABLES

- Patent FR3042656, WO2017/064434, CN108292845, US20190074685
- Technical reports: system topology, design and algorithms.
- Extensive EMT simulation studies
- EMT models: HVDC test grid and components, algorithms.
- Technical support and advisory

## SCIENTIFIC REFERENCES

W. R. Leon Garcia, P. Tixador, B. Raison, A. Bertinato, B. Luscan and C. Creusot, "Technical and Economic Analysis of the R-Type SFCL for HVDC Grids Protection," in IEEE Transactions on Applied Superconductivity, vol. 27, no. 7, pp. 1-9, Oct. 2017, Art no. 5602009, doi: 10.1109/TASC.2017.2739642.