PROMOTioN
PROGRESS ON MESHED HVDC OFFSHORE TRANSMISSION NETWORKS

cigre

HVDC CIRCUIT BREAKER TESTING

CIGRE / PROMOTioN Workshop on HVDC Circuit Breakers

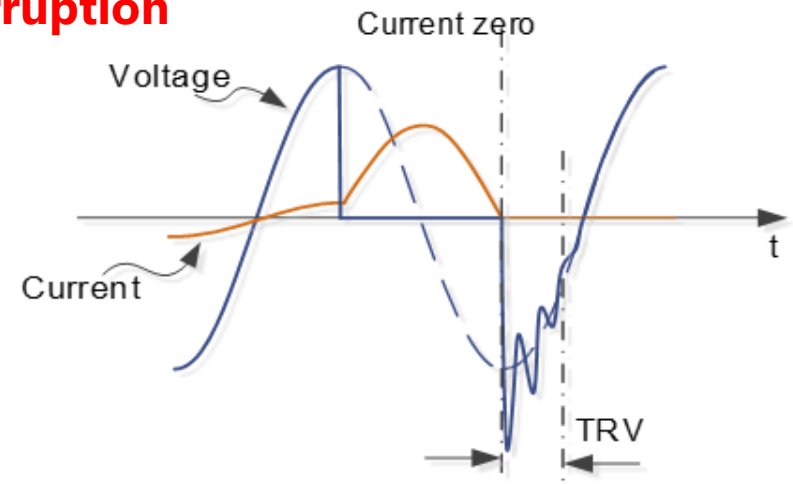
Rene Smeets, Nadew Belda, KEMA Laboratories DNV GL

DNV·GL
KEMA Laboratories

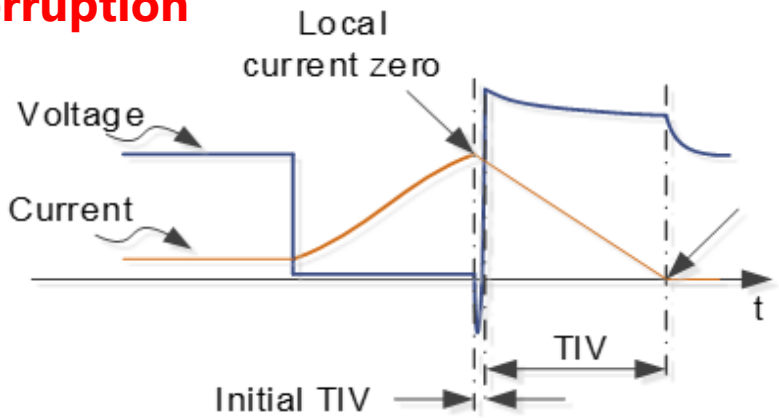
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.

Sitting duck or fighter?

AC interruption

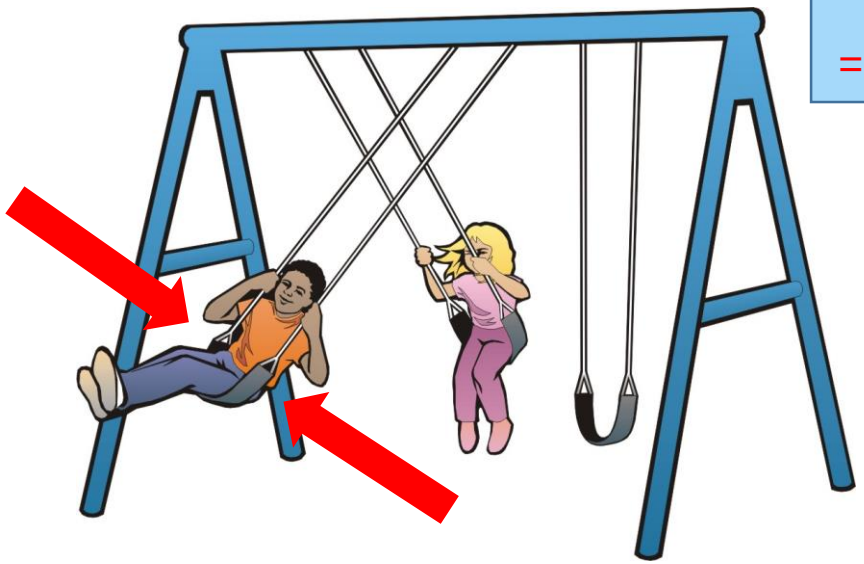


DC interruption

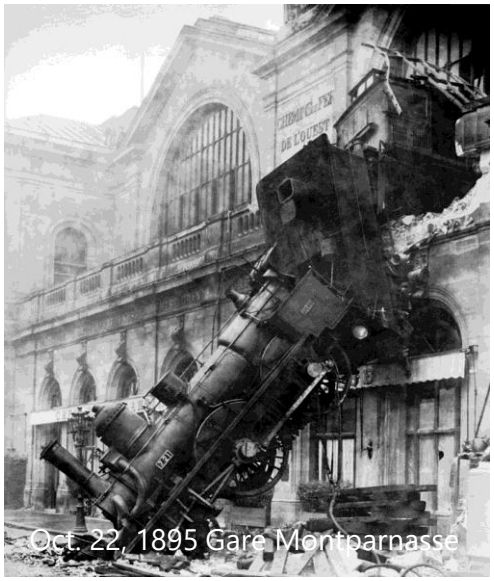


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.

Interruption strategy



15 kA in 100 km line =
11 MJ
= 30 t train at 100 km/h



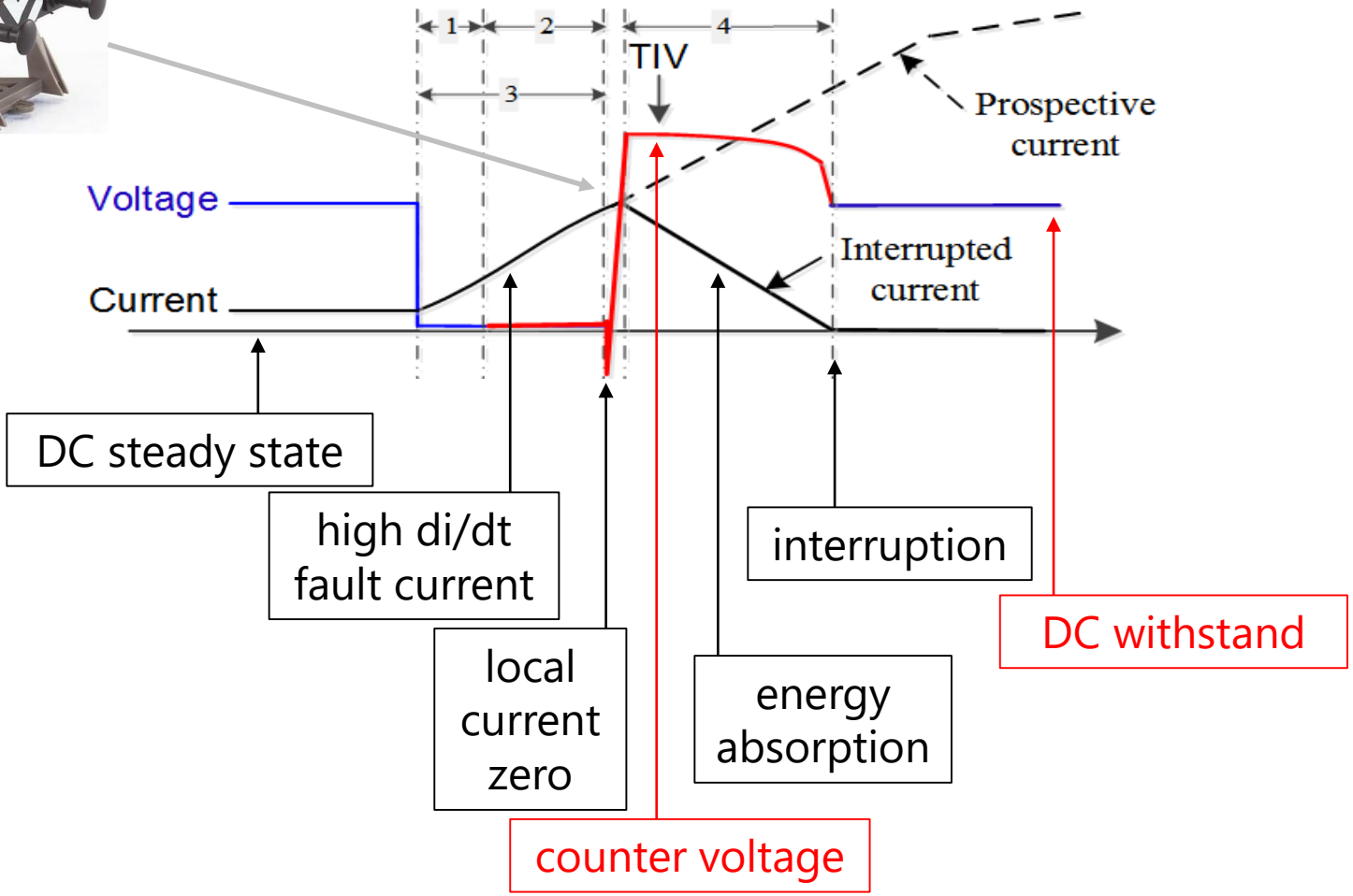
AC interruption:
Capture the swinging mass in its outer position (current zero)
Zero kinetic energy – Max potential energy

DC interruption:

Oppose the motion of a linearly moving mass (counter voltage)

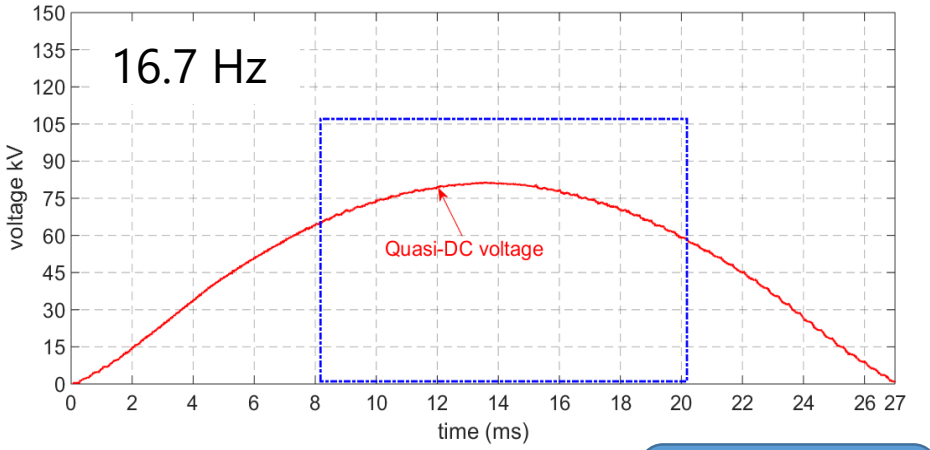
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.

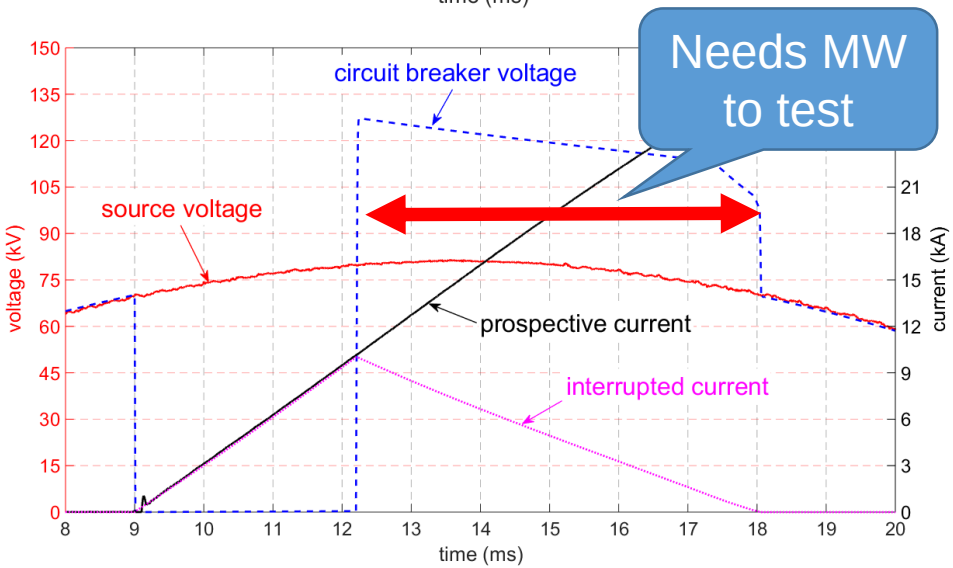
Requirements of test-circuits?



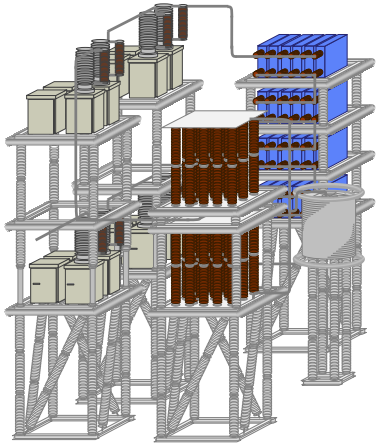
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.

DC testing with AC? → LF AC

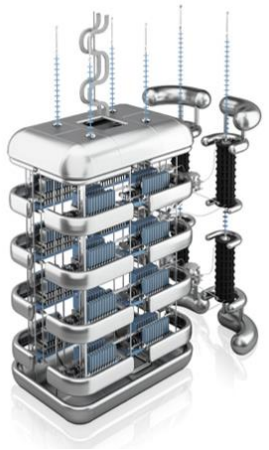




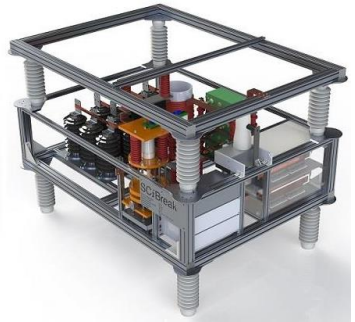
active current injection



hybrid



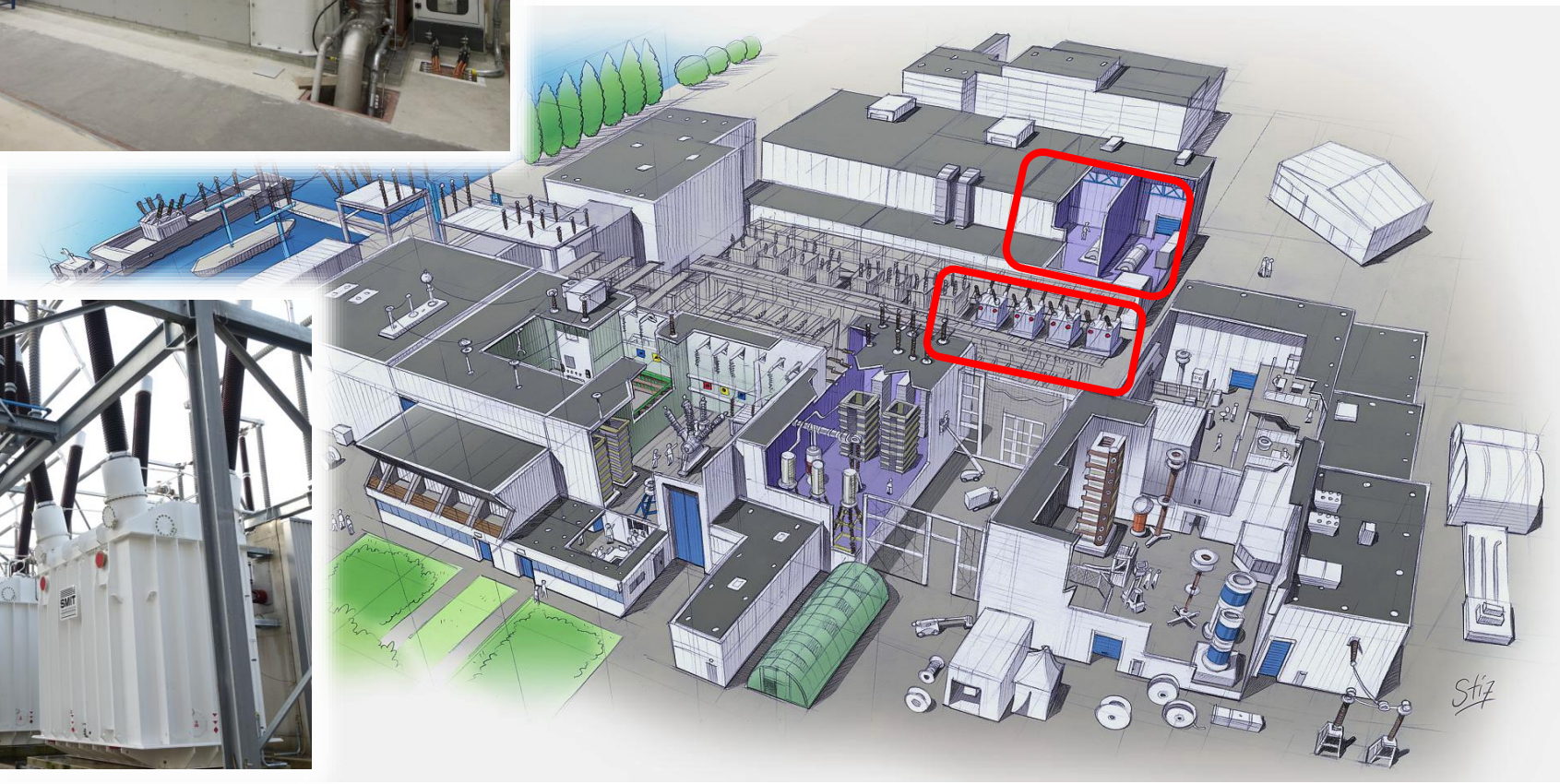
VSC assisted



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.

High-Power Testing of HVDC Breakers with AC

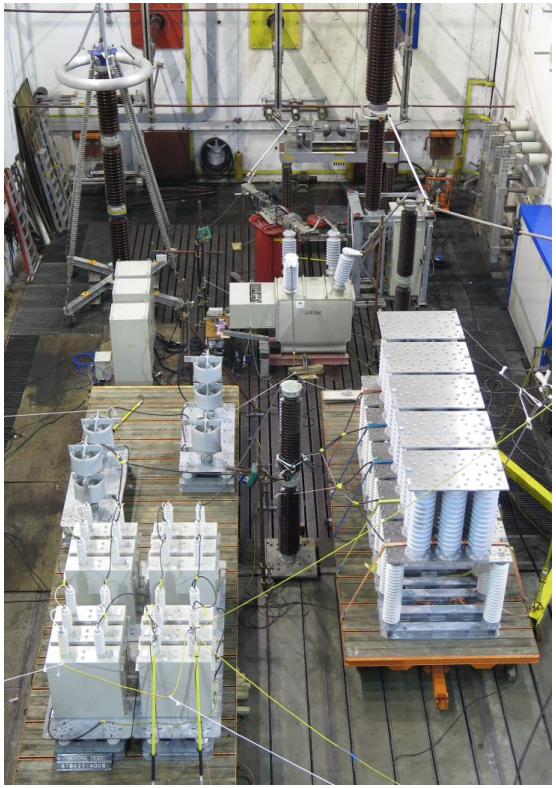
550 kV / 12000 MVA @ 50 Hz



© PROMOTioN – Progress on Meshed HVDC Offshore Transmission Networks
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.

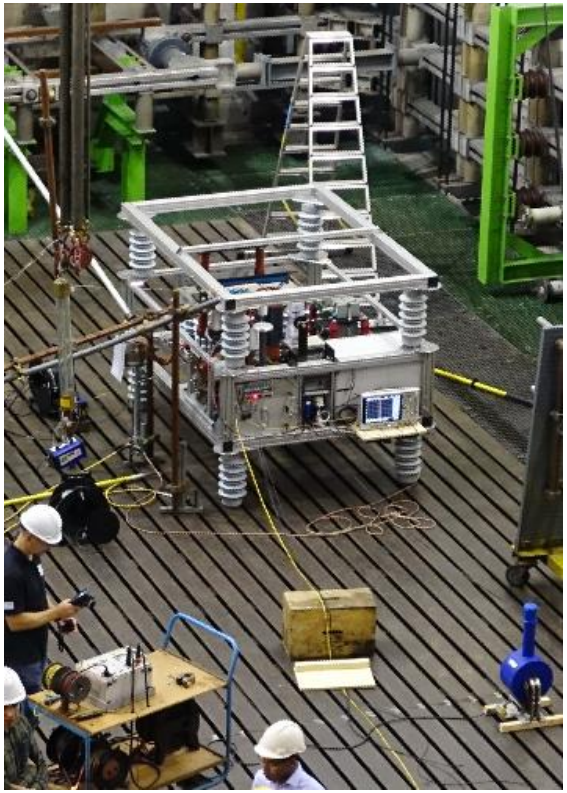
PROMOTioN project demos

Current injection type demo



110 kV TIV, 16 kA

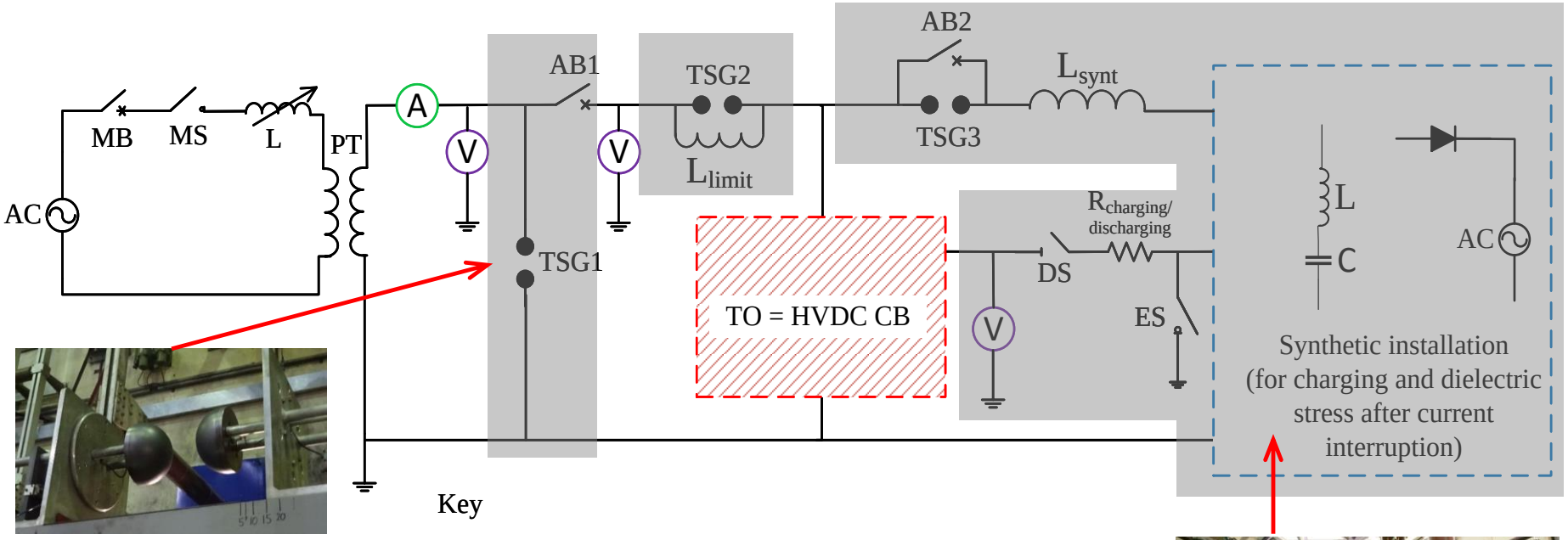
VSC assisted type demo



40 kV TIV, 10 kA

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.

Test-circuit incl. protection and DC injection



Key

MB= Master Breaker

MS= Making Switch

L= adjustable reactor

PT= Power Transformer(s)

AB1= Auxiliary AC breaker

A = current measurement

V = voltage measurement

Lsynt = inductance in the synthetic circuit

DS=Disconnector switch

ES=Earthing switch

TSG=Triggered Spark Gap (Triggered make gap)

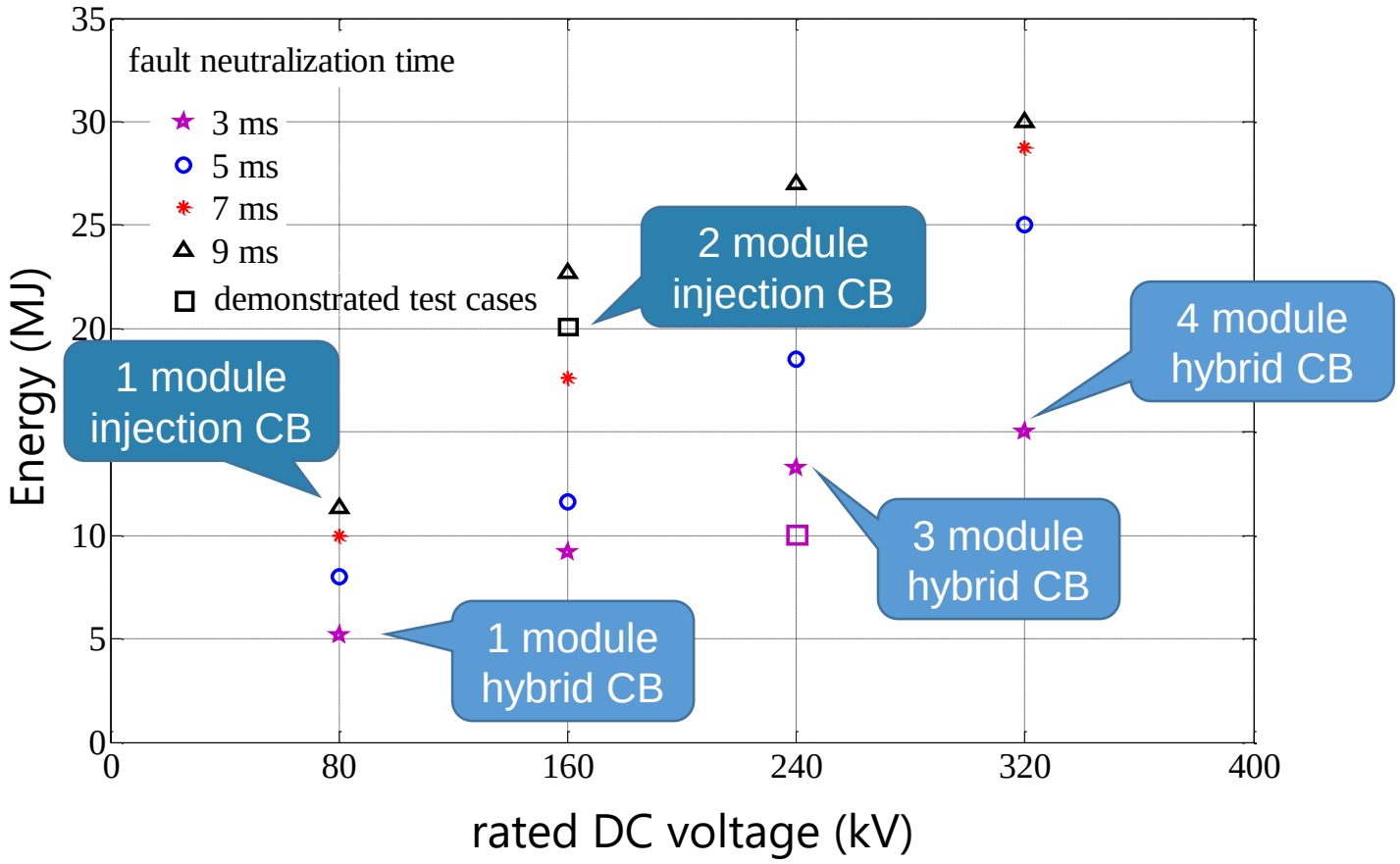
Rcharging/discharging = charging and discharging resistor

L_{limit} = initial current limiting reactor

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.

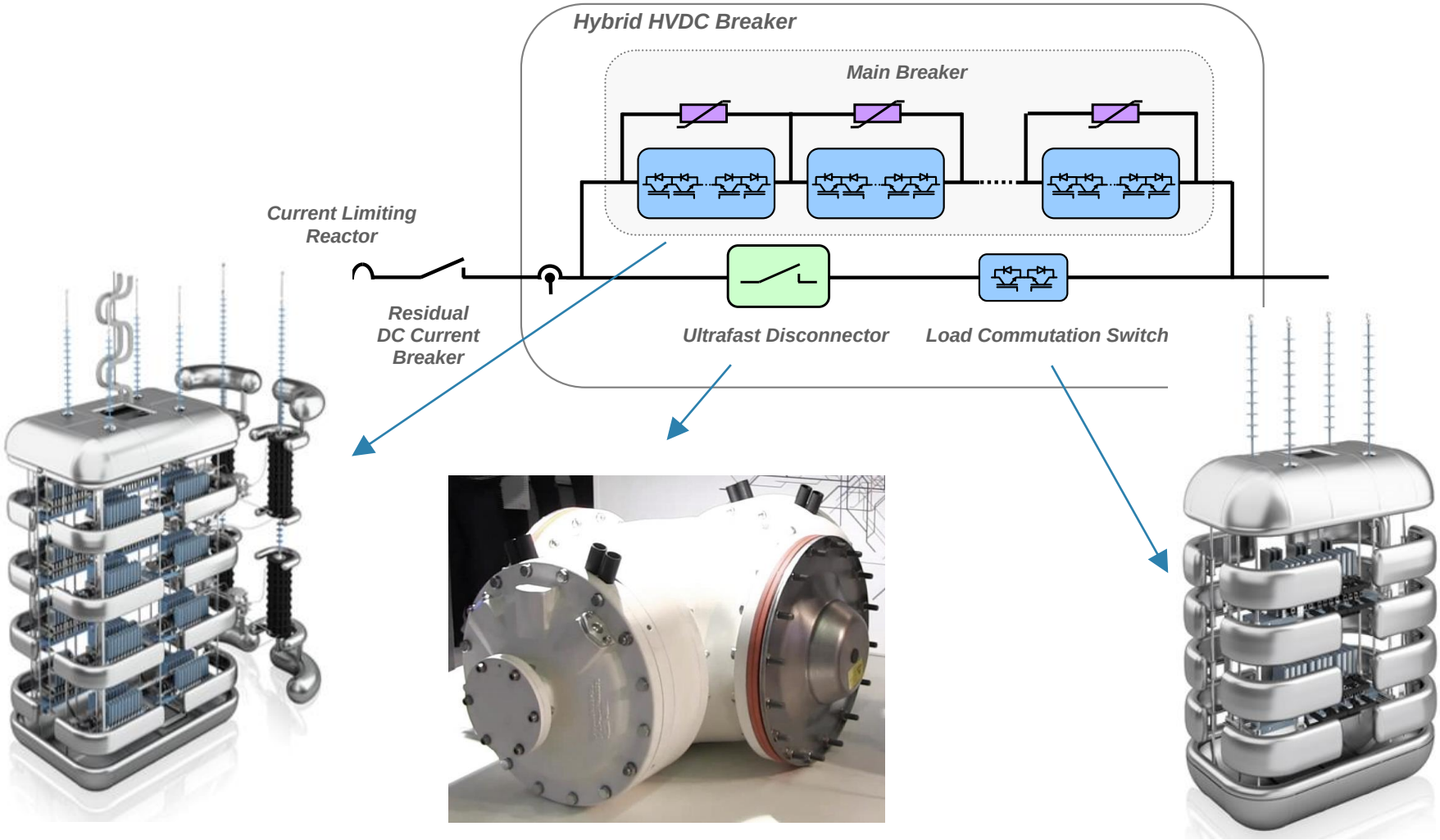
Feasibility of LF AC testing of HVDC CB

- including energy dissipation



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.

Hybrid DC circuit breaker technology

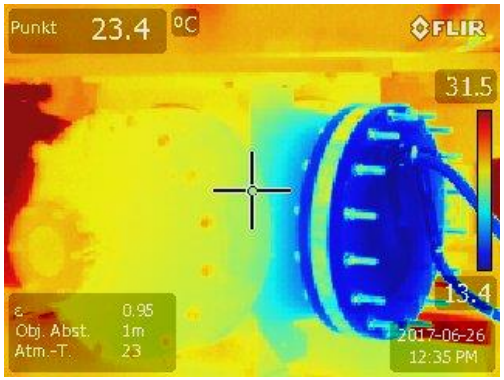


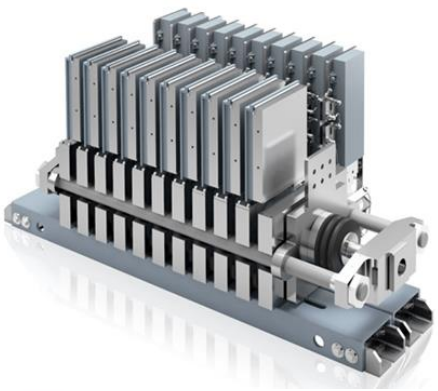
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.

Final test-campaign in PROMOTioN

Hybrid breaker technology to be demonstrated on a 350 kV hybrid HVDC CB (ABB) at KEMA Laboratories during 2019

The complete functionality test on the full-scale hybrid HVDC CB will be performed to maximum current interruption level





This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.

APPENDIX

DISCLAIMER & PARTNERS

COPYRIGHT

PROJECT COORDINATOR

DNV GL Netherlands B.V.
Utrechtseweg 310, 6812 AR Arnhem, The Netherlands
Tel +31 26 3 56 9111
Web www.dnvgl.com/energy

CONTACT

rene.smeets@dnvgl.com

PARTNERS

DNV GL Netherlands B.V., ABB AB, KU Leuven, KTH Royal Institute of Technology, EirGrid plc, SuperGrid Institute, Deutsche WindGuard GmbH, Mitsubishi Electric Europe B.V., Affärsverket Svenska kraftnät, Alstom Grid UK Ltd (Trading as GE Grid Solutions), University of Aberdeen, Réseau de Transport d'Électricité, Technische Universiteit Delft, Statoil ASA, TenneT TSO B.V., Stiftung OFFSHORE-WINDENERGIE, Siemens AG, Danmarks Tekniske Universitet, Rheinisch-Westfälische Technische Hochschule Aachen, Universitat Politècnica de València, SCiBreak AB, Forschungsgemeinschaft für. Elektrische Anlagen und Stromwirtschaft e.V., Ørsted Wind Power A/S, The Carbon Trust, Tractebel Engineering S.A., European University Institute, Iberdrola Renovables Energía, S.A., European Association of the Electricity Transmission & Distribution Equipment and Services Industry, University of Strathclyde, ADWEN Offshore, S.L., Prysmian, Rijksuniversiteit Groningen, MHI Vestas Offshore Wind AS, Energinet.dk, Scottish Hydro Electric Transmission plc, SCiBreak AB

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691714.