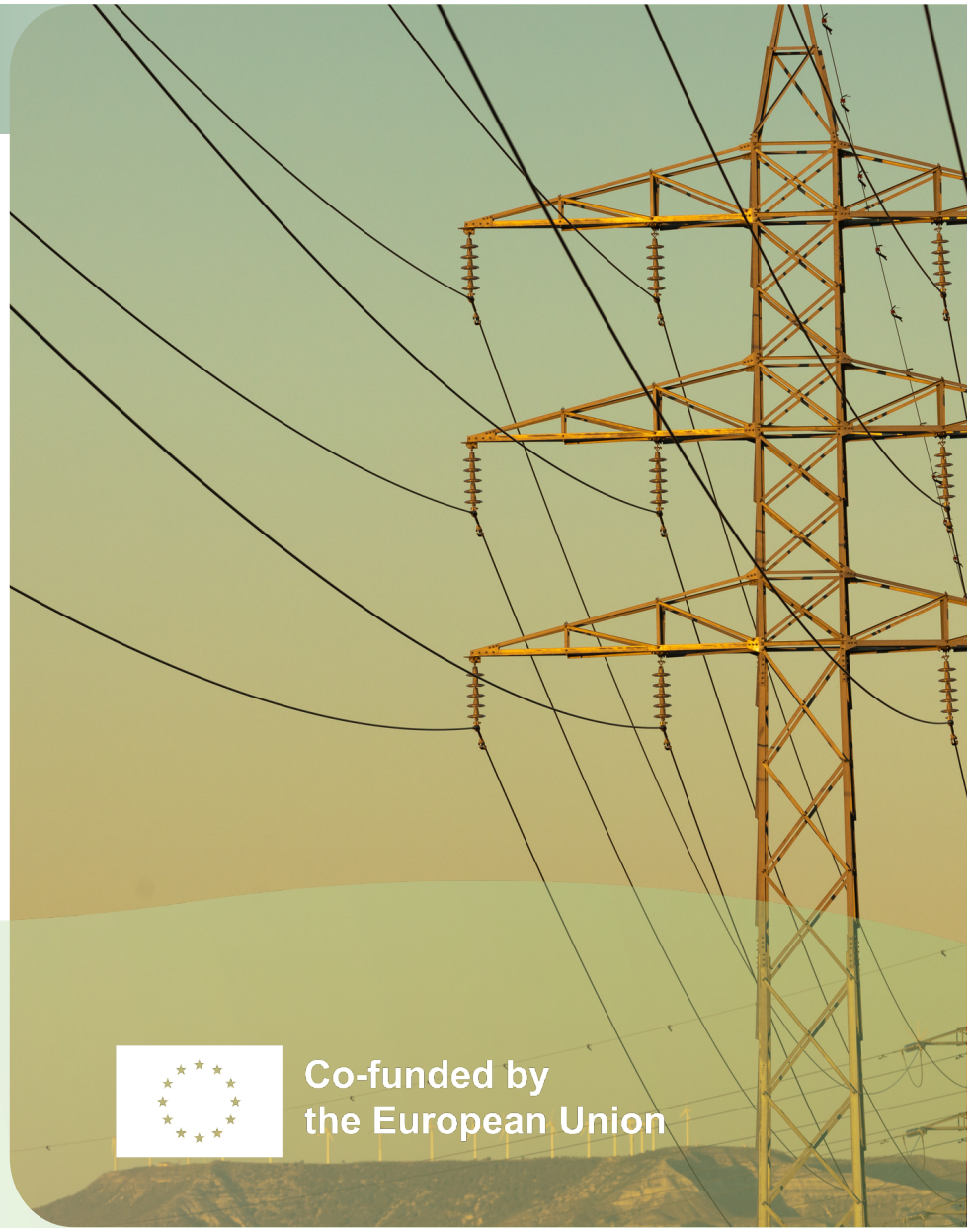
Co-funded by
the European Union

eMISsion-free HV and MV transmisSION switchgear for AC and DC

WP6: New generation of fast mechanical MV DC Circuit Breakers

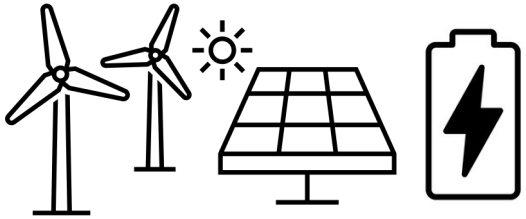
Andres Laso (G&W Electric)



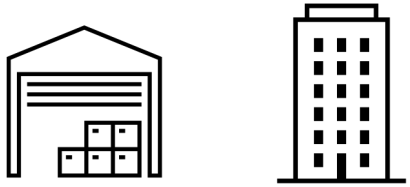
Goal

MISSION will deliver a compact, reliable, and cost-effective MVDC breaker design. Its configuration permits the integration in medium voltage DC grids.

urban load areas



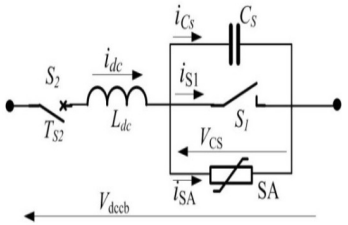
MVDC collection grid of renewable power plants and large battery systems



MVDC power distribution for data centres, and buildings.

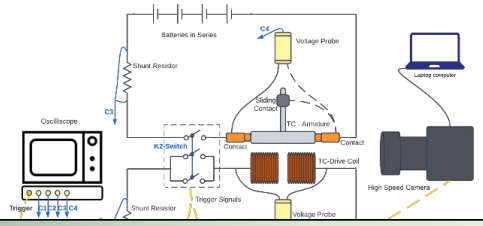
MISSION will perform a dedicated modelling analysis to optimize the **interaction between DC Breaker and Superconducting cables systems** and investigate high voltage DC breakers and synergies with superconducting cables for fault control and HV transmission.

WP6 – Partners and workflow overview



Modelling and Characterization of DC CBs

UNIVERSITY OF ABERDEEN



Analysis of commutation with fast mechanical DC CB

NTNU
Norwegian University of Science and Technology

Ultra-fast 12kV mechanical disconnector

G&W Electric
Engineered to order. Built to last.

Design and Develop 12 kV fast DC CB hardware prototype

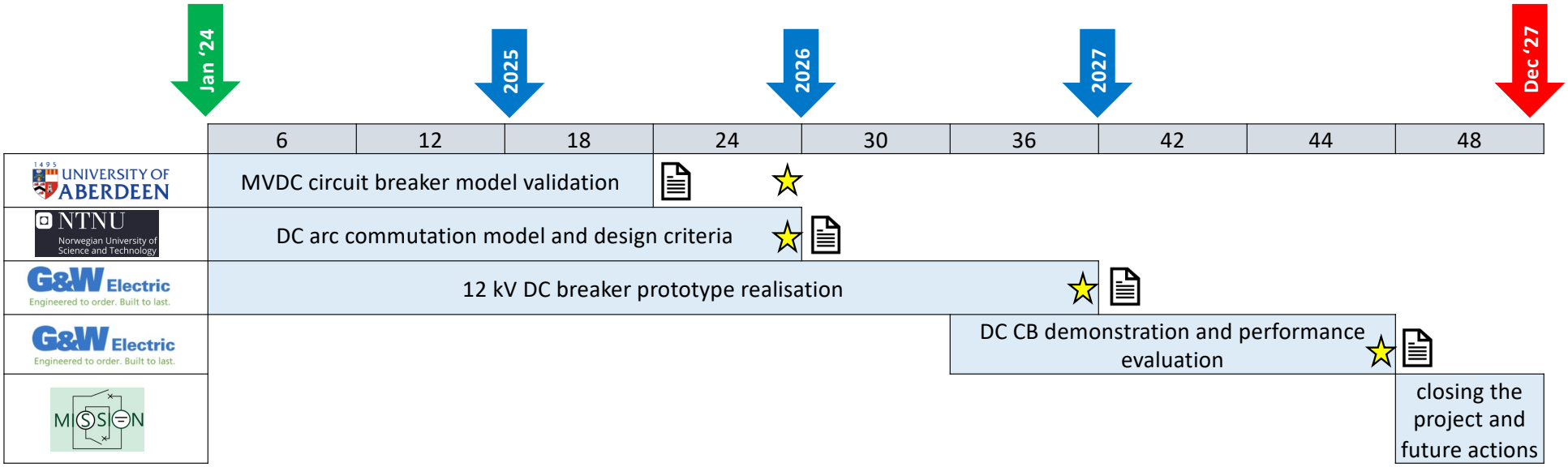
Lab demonstration of a 12 kV DC CB

12/2028

Relevant environment demonstration 12 kV DC CB

SUPERNODE™
Connecting the Future

The **WP6** timeline



Deliverable

Milestone

MVDC MODEL VALIDATION

Tasks:

1) Test System Design
2) Test System assembly
3) Ultrafast Disconnector Modelling
4) DC CB design

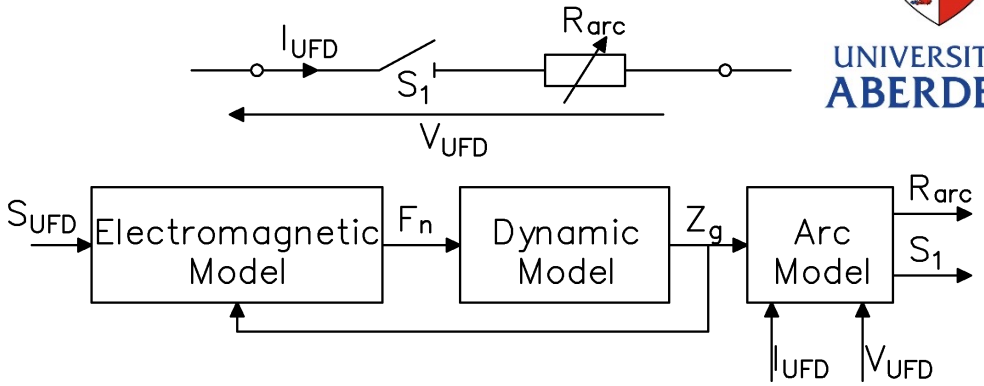


Figure 1: UFD model structure.

V_{UFD}: UFD voltage

I_{UFD} : UFD current

z_g: Electrode gap distance

F_n: Force on armature

R_{arc}: Arc model resistance

S_1: Ideal switch

S_{UFD}: Control signal from DC grid protection

MVDC MODEL VALIDATION

DC CB Designs

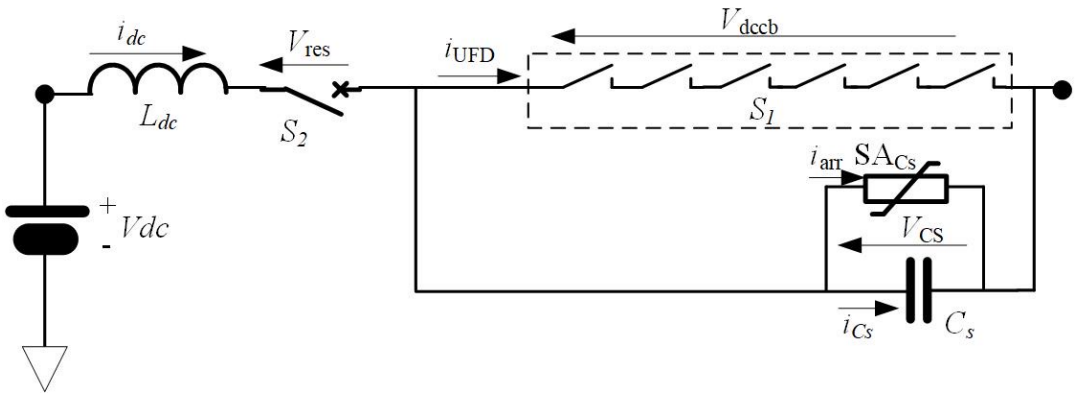


Figure 2: LC DC CB with passive commutation

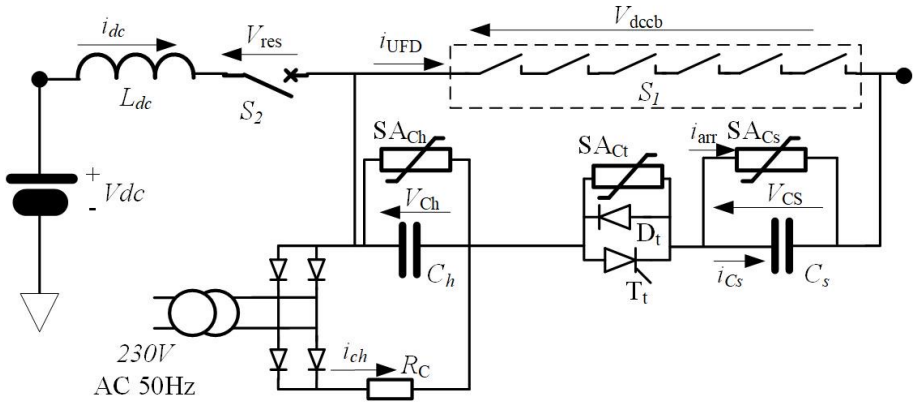
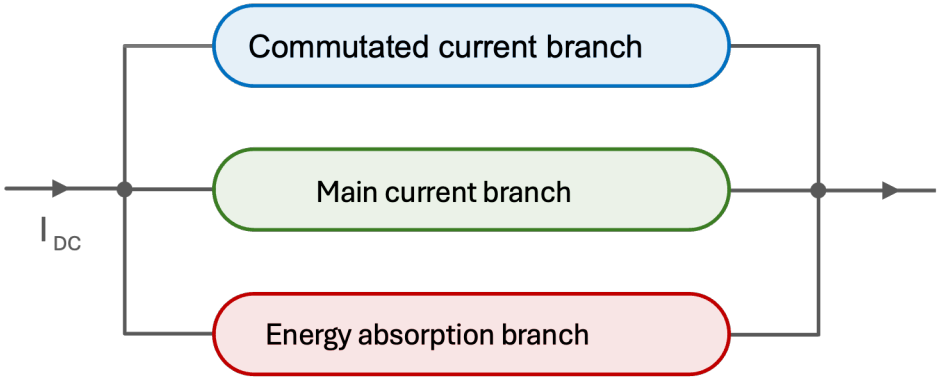
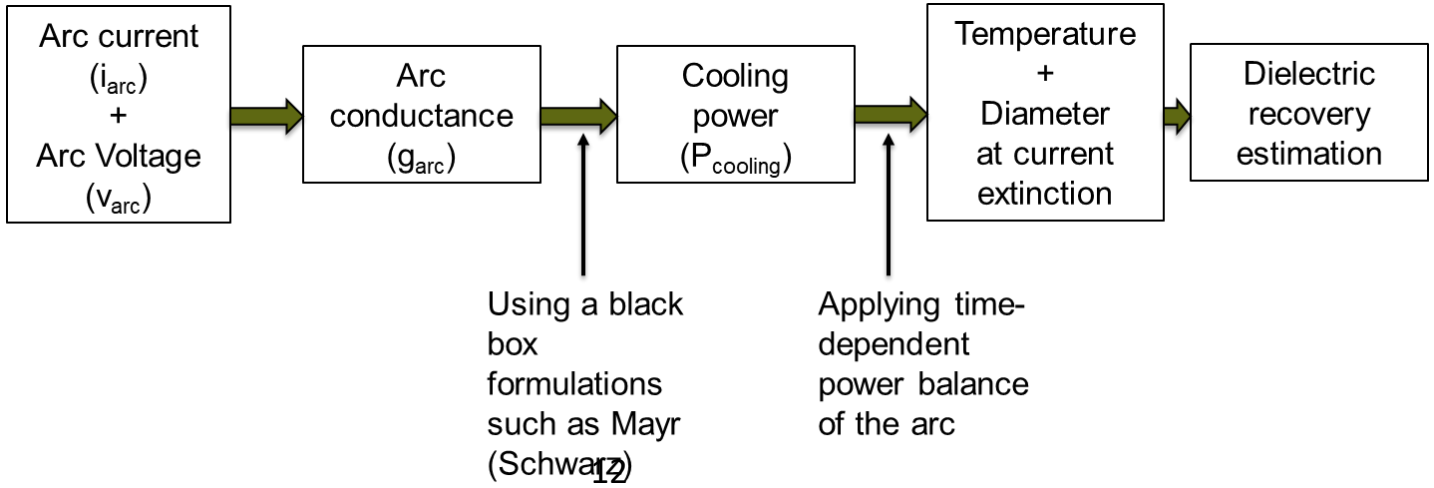
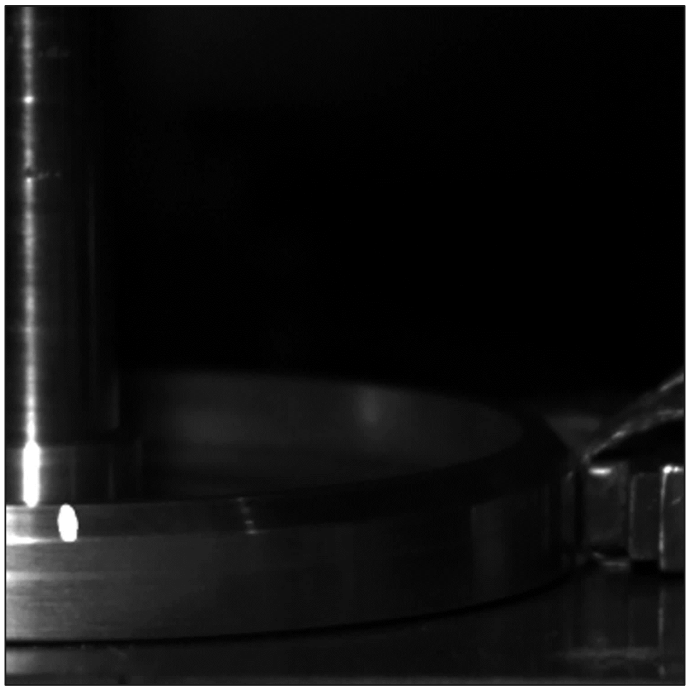


Figure 3: LC DC CB with pre-charged capacitors

ARC COMMUTATION MODEL



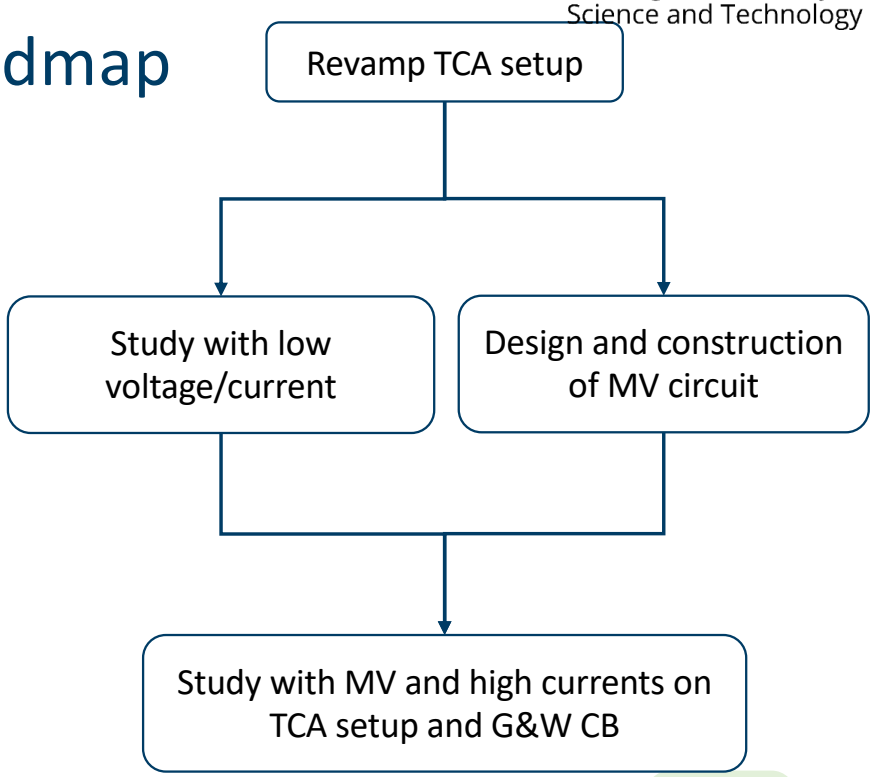




ARC COMMUTATION MODEL

Study Parameters and Experimental Roadmap

- **Contact material** (common materials and basic materials)
- **Contact configuration** (sliding, tulip, etc.)
- Opening **velocity**
- **Acceleration** during contact separation
- **Interruption current** (respectively current rise rate)
- Shape and level of **recovery voltage**



12kV DC CB DEVELOPMENT

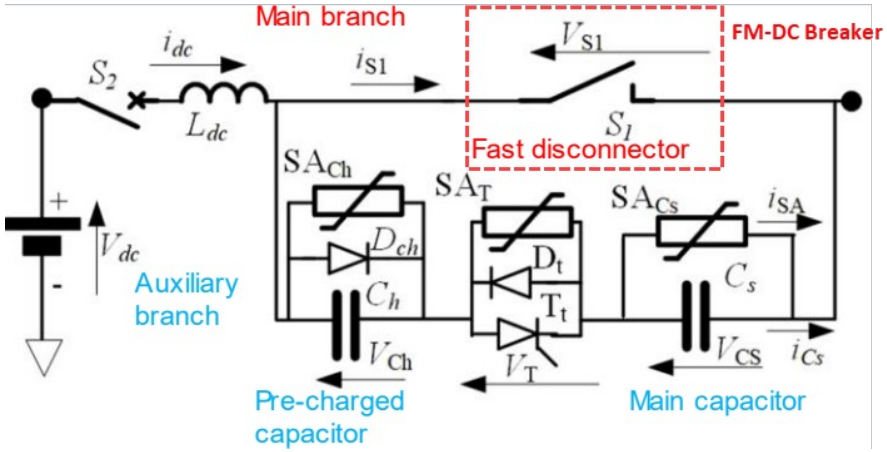
Objective: KPIs

- Rated voltage **12 kV DC**, rated nominal current of **1 kA,** fault current of 4 kA
- Commence **counter voltage insertion** in **< 1ms**
- Demonstrated to near commercial product, **TRL 6**
- **GWP** of insulation and current interruption medium **< 1**
- **Gap dielectric strength** according to interruption voltage profile
- Feasibility studies and preliminary design for higher voltages and current applications. **Integration studies** with test cases based on **superconducting cables** evaluated.

12kV DC CB DEVELOPMENT

Preliminary design of fast disconnector

- Compact and modular design using **sliding contacts**.
- Current nominal rating of 1000A.
- TCA (Thomson Coil Actuator) driven and has an opening time of few milliseconds.
- Total stroke less then 15mm.

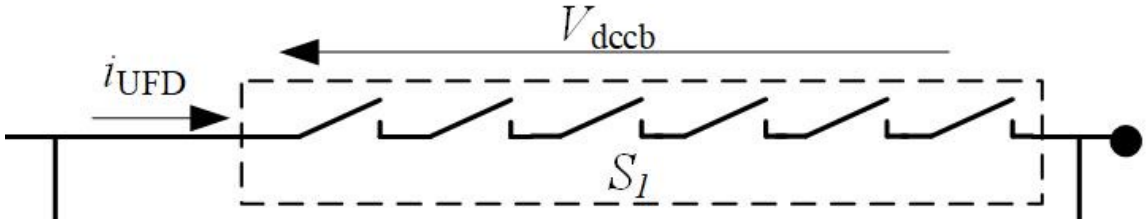


Schematic of LC DC breaker with pre-charged capacitor for improved commutation.

12kV DC CB DEVELOPMENT

Technical activities

- Evaluation of sliding force (contact, bearings) for different materials.
- Evaluation of acceleration/speed for given capacitor voltage.
- Evaluation of forces and deformation.
- Disconnect synchronicity evaluation.
- Reduction of inertia/weight of moving mass.



Interaction between DC Breaker and Superconducting cables systems

- Scaled MVDC Superconducting cable designs for integration with the 12kV MVDC system.
- Cable & system modelling input & development with MVDC CB
- Cable design and optimization for operation with the MVDC CB system.

Links and Info

Mission Project

G&W Electric

Co-funded by the European Union through Horizon Europe

Innovation action, call HORIZON-CL5-2023-D3-01-12

Contact project manager Atle Pedersen atle.pedersen@sintef.no

MISSION

Co-funded by
the European Union

- Co-funded by the European Union through Horizon Europe
- Innovation action, call HORIZON-CL5-2023-D3-01-12
- Contact project manager Atle Pedersen atle.pedersen@sintef.no