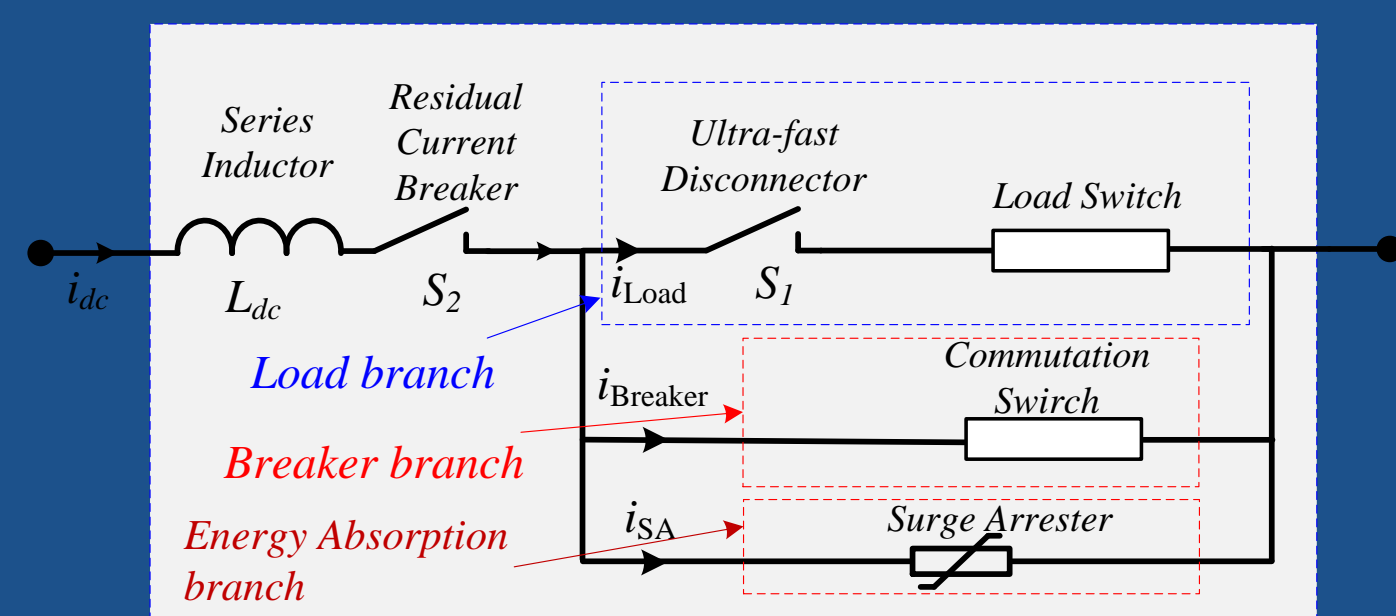


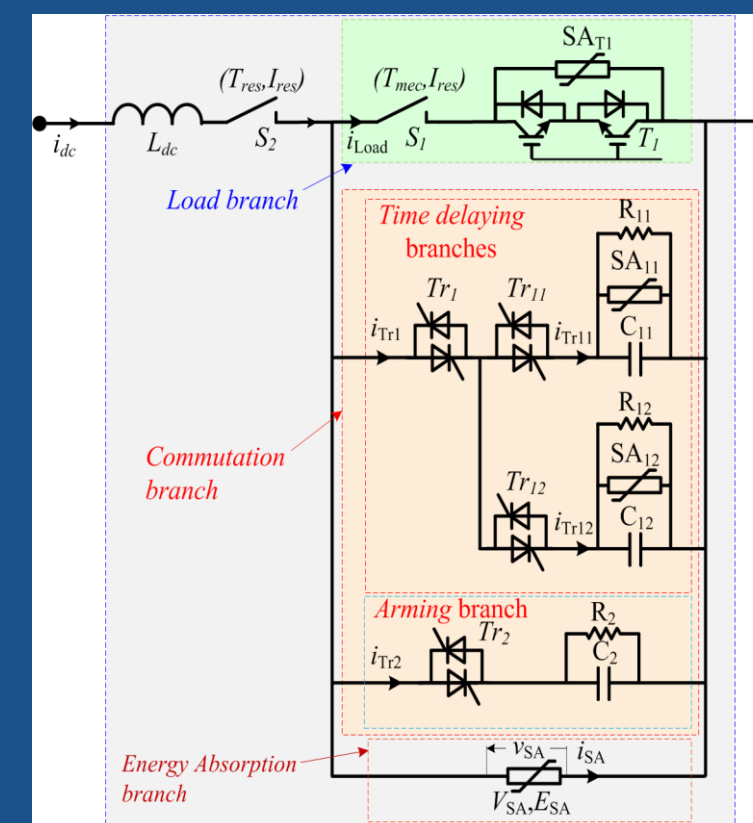


# WP6 characterization of DC Circuit Breakers

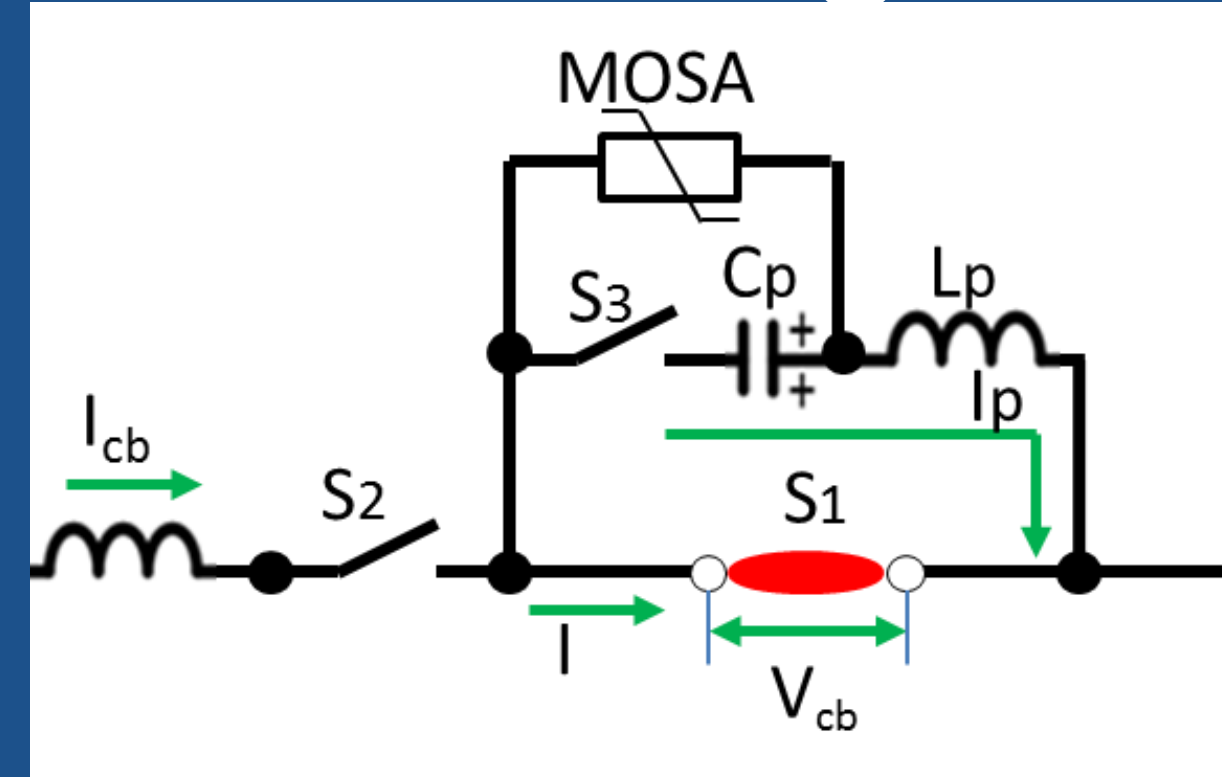
## Four DC CB technologies



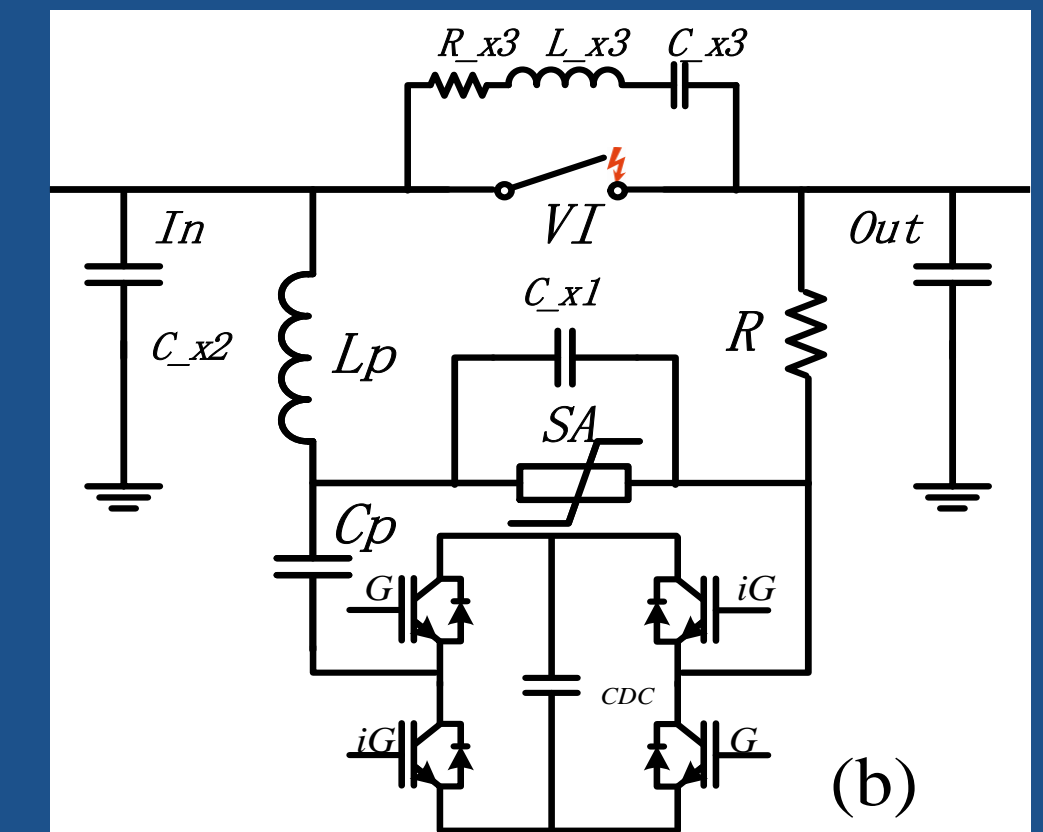
Hybrid IGBT DC Circuit Breaker



Hybrid thyristor DC Circuit Breaker

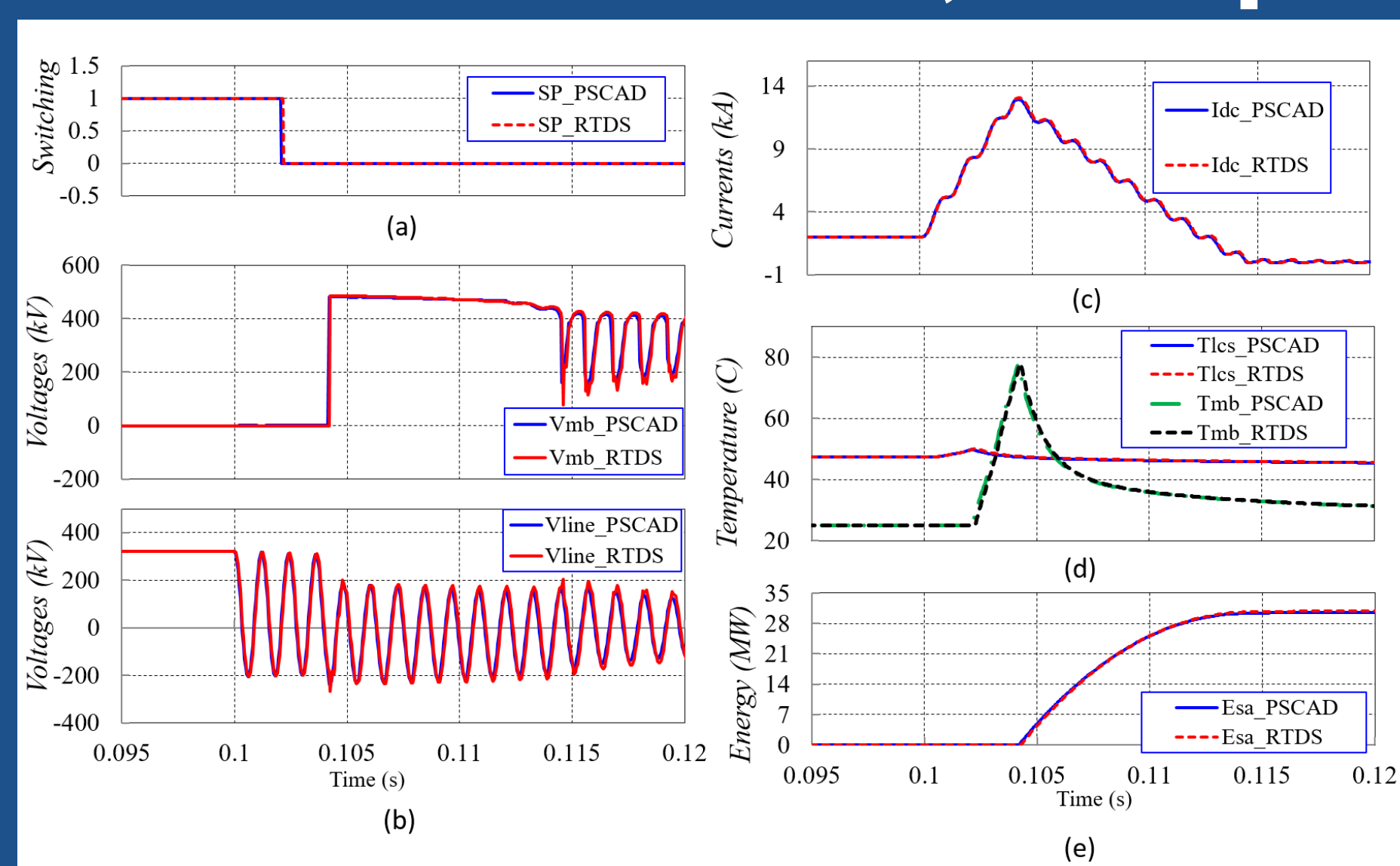


Mechanical DC Circuit Breaker

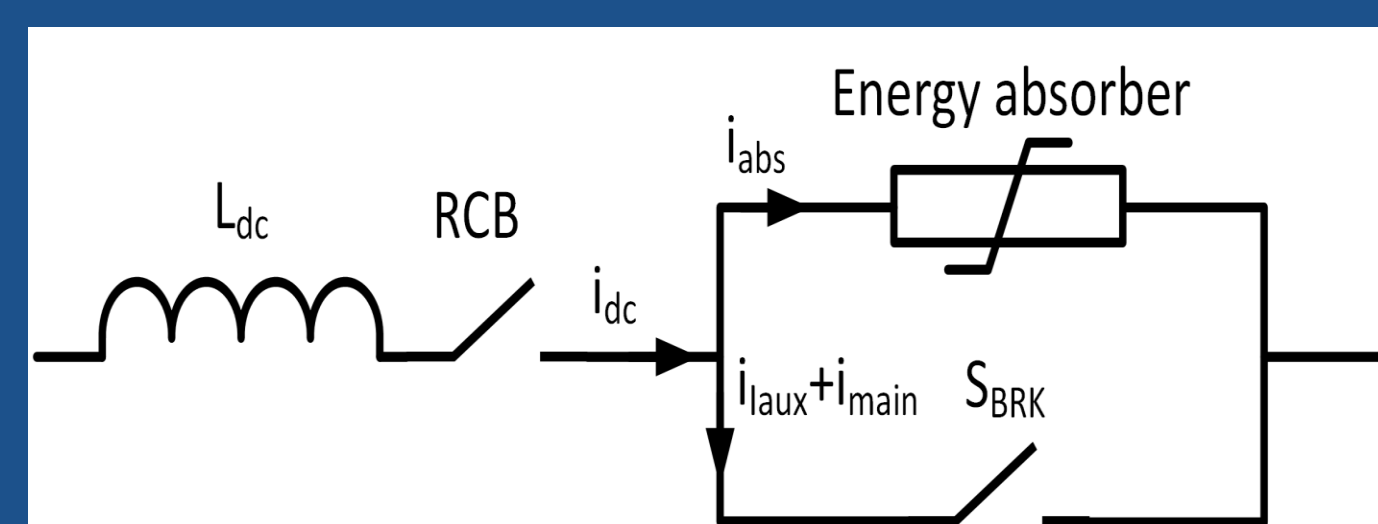


VARC DC Circuit Breaker

## Detailed, Simplified, Generic and Real-Time DC CB models



Verification of RTDS DC Circuit Breaker model

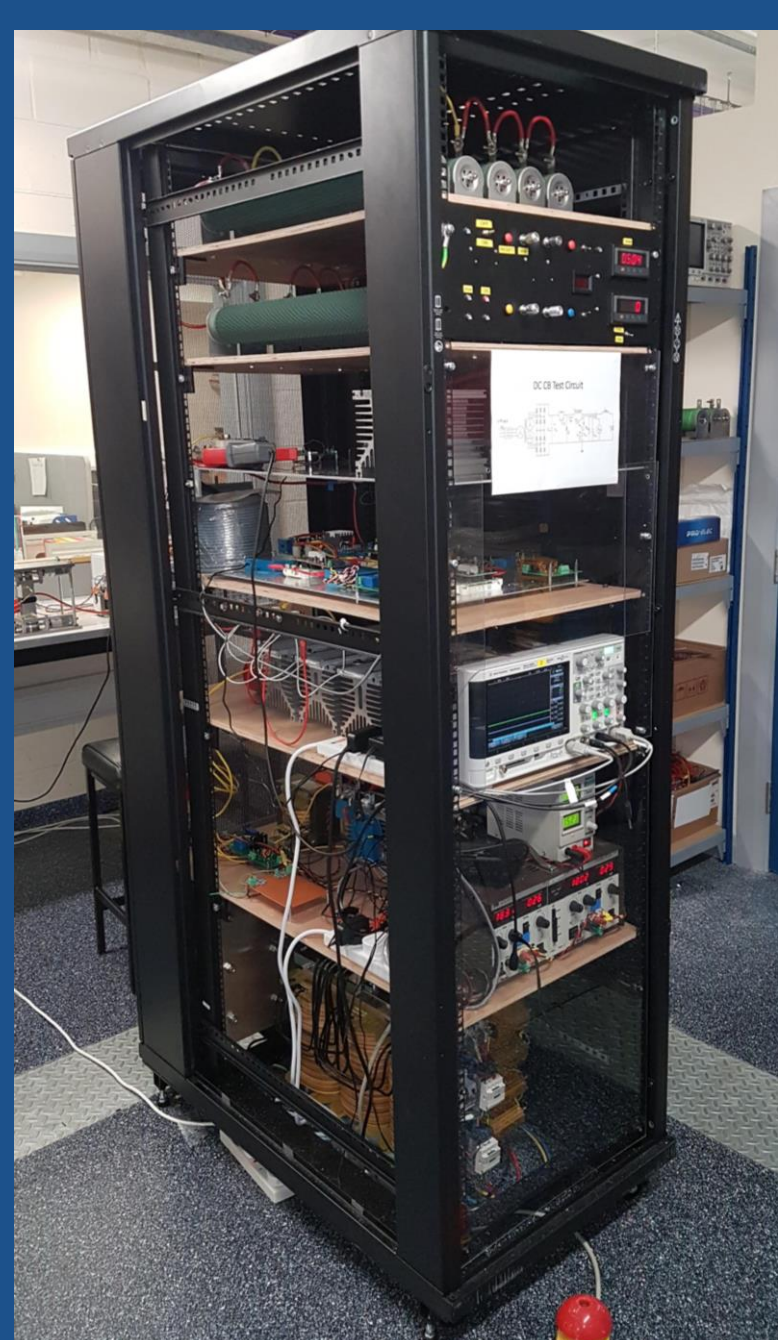


Generic DC Circuit Breaker model

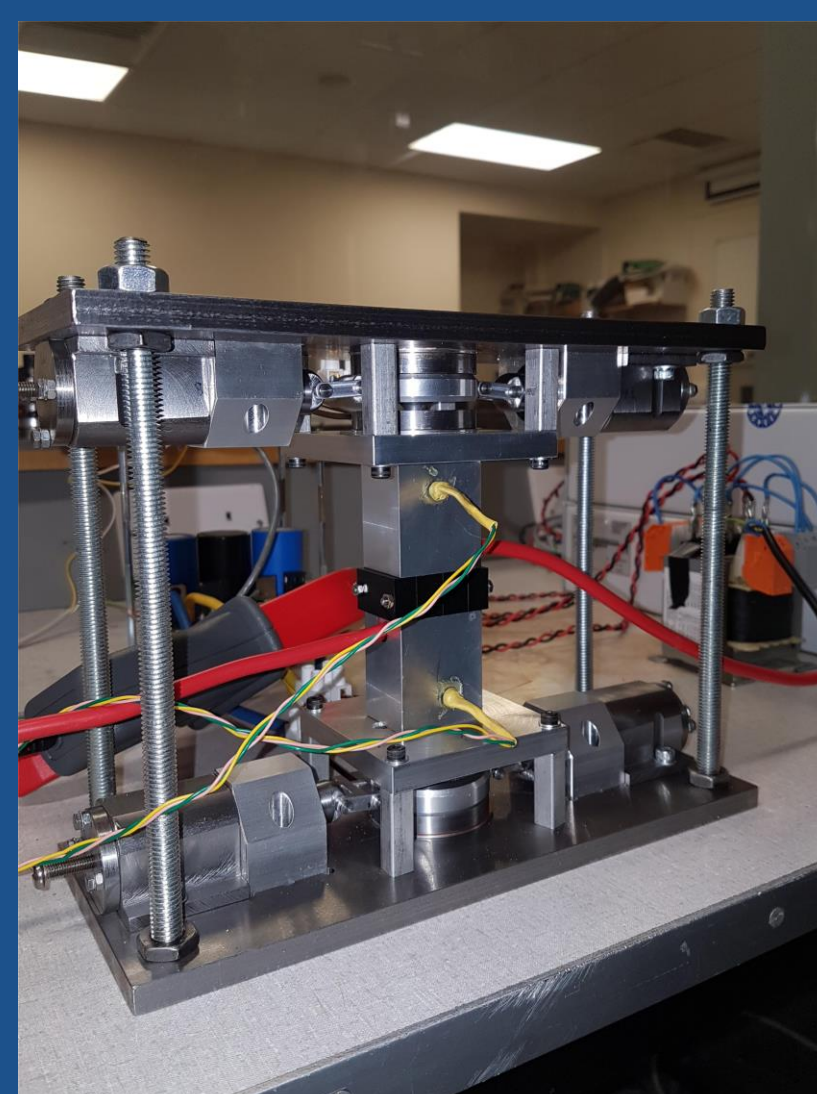
Topology	Detailed	Simplified	Generic
Hybrid DC CB	690 min ~ 11.5 h	25 min	2.5 min
Active-resonant	6.0 min	2.5 min	2.5 min
VARC	197 min ~ 3.3 h	2.5 min	2.5 min

Comparison of simulation time for DC Circuit Breaker models

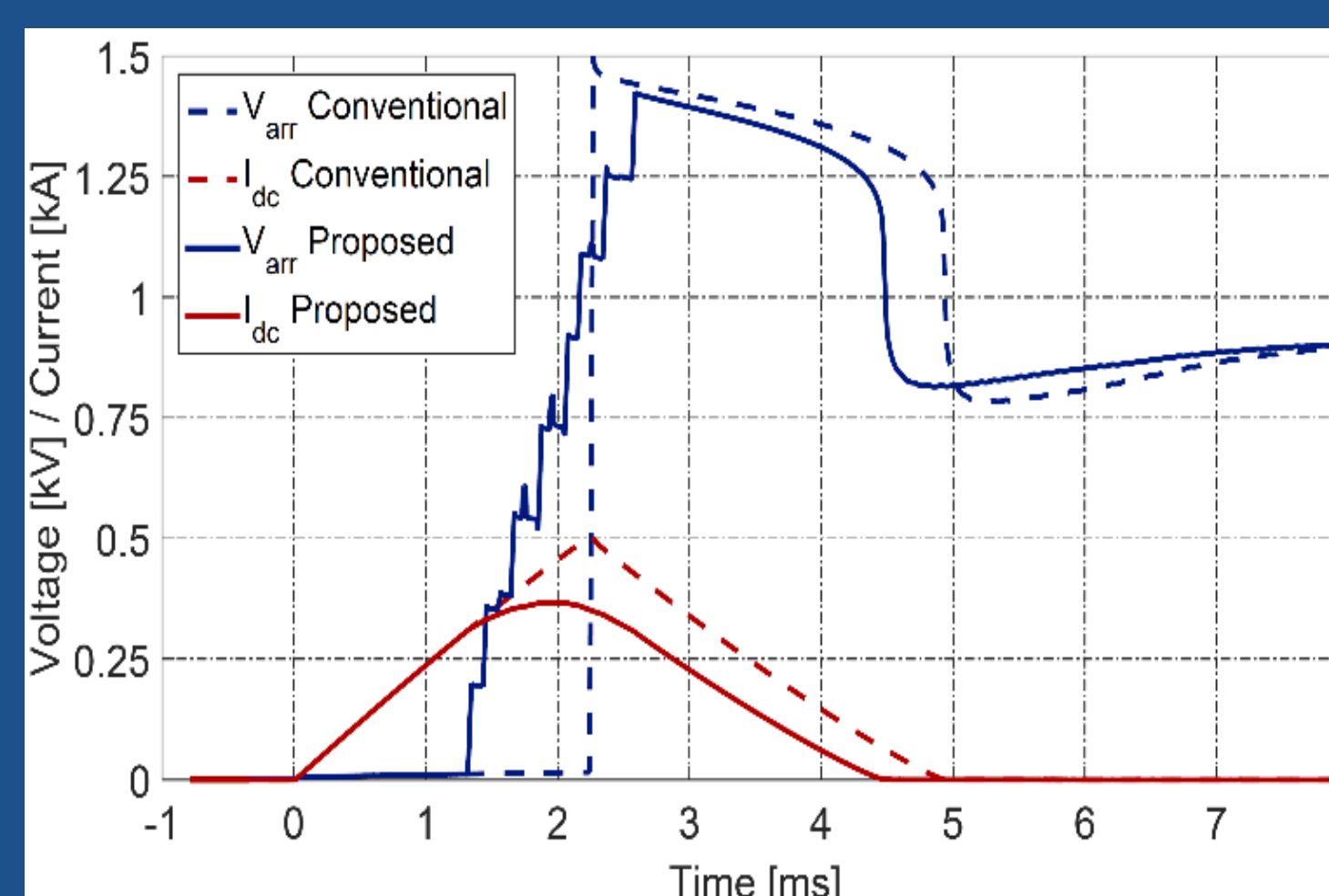
## Hardware Demonstration of DC CB technologies



DC CB test circuit and hybrid DC CB



Ultrafast disconnector (2ms, 5kV)



Hardware testing of disconnector

voltage control

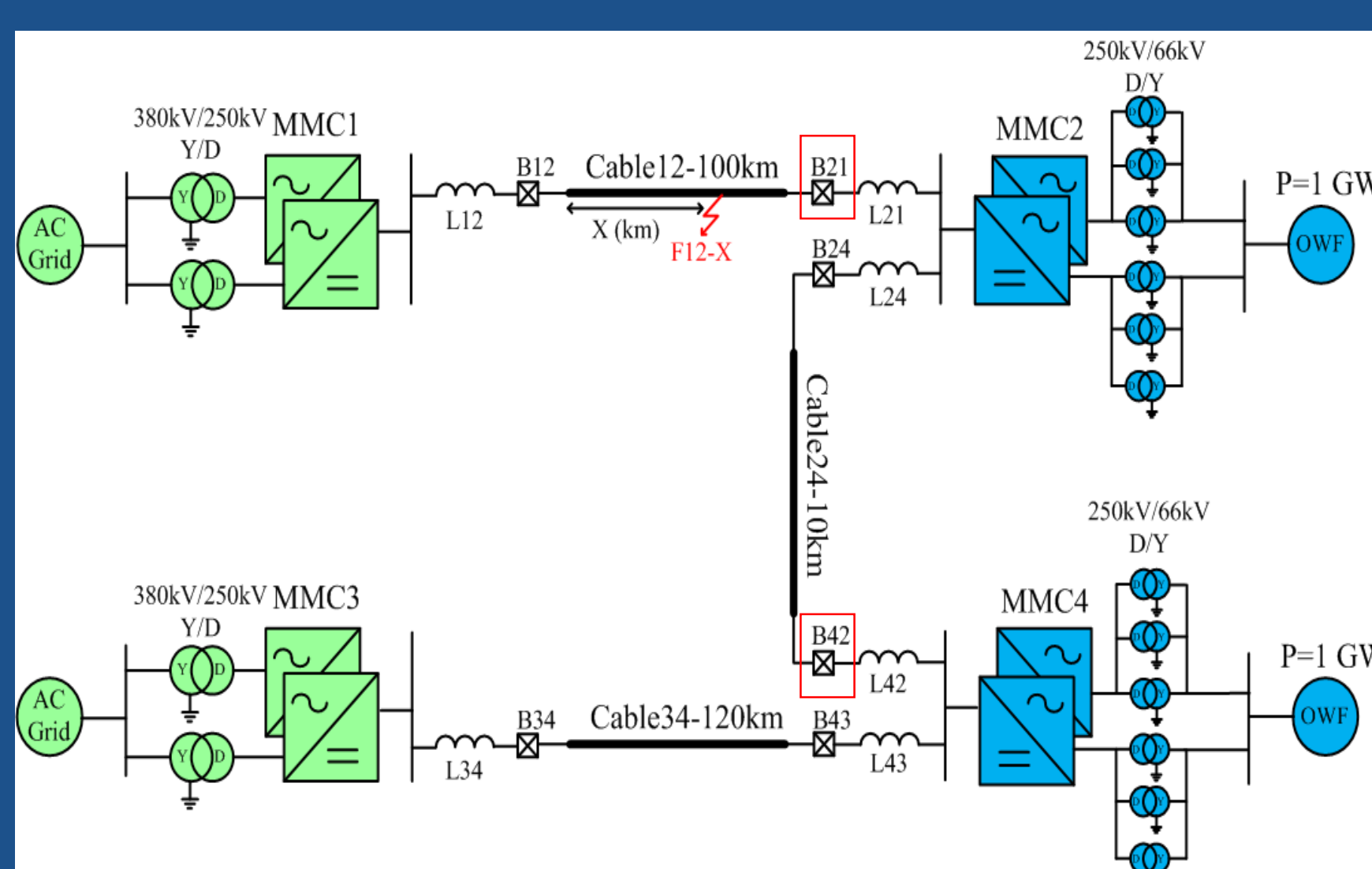
### Hardware demonstrator

- 5kV, 2kA, DC CB test circuit,
- 500A, 1.3kV, Hybrid DCCB demonstrator,
- 500A, 1.3kV, mechanical DC CB demonstrator,

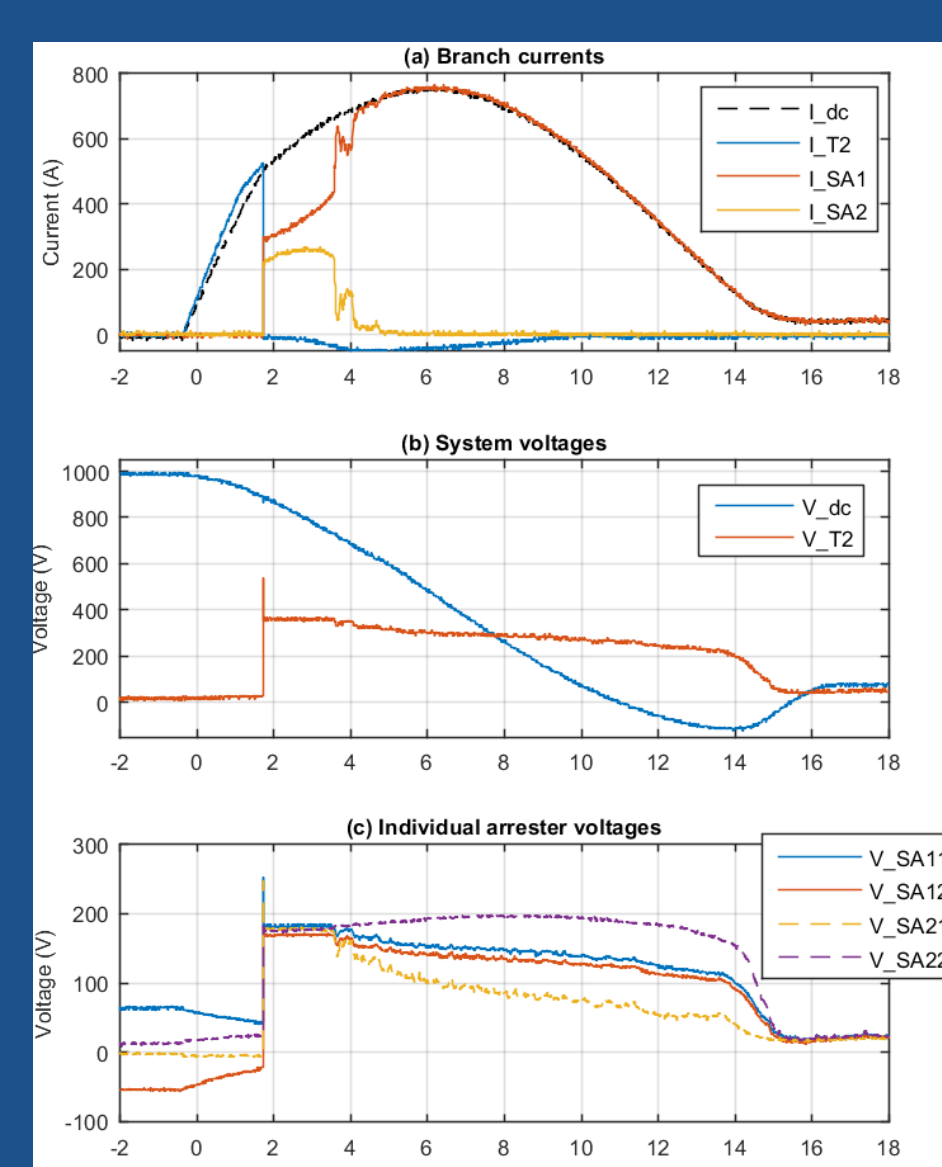
### Hardware demonstration of DC CB improvements

- Disconnector voltage control,
- Hybrid DC CB with unidirectional valve,
- LC DC Circuit Breaker

## Roadmap for DC CB technology scaling to High Voltages



DC CB integration in near-term multiterminal HVDC



Failure demonstration of a single arrester unit

- Scaling of mechanical DC CB to 525kV,
- Scaling of VARC DC CB to 525kV,
- Integration of 3 DC CB technologies in a near-term multiterminal HVDC,
- Failure mode of study of DC Circuit Breakers,
- DC CB cost modeling,