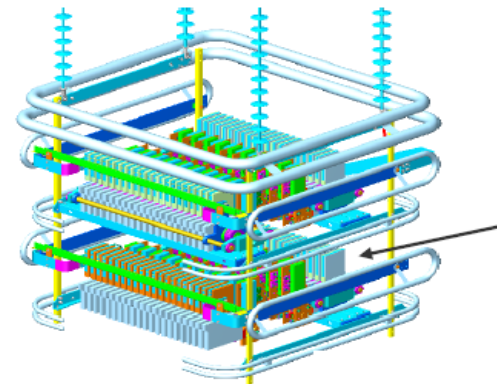
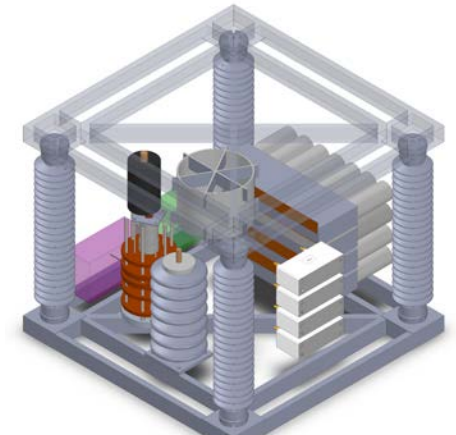
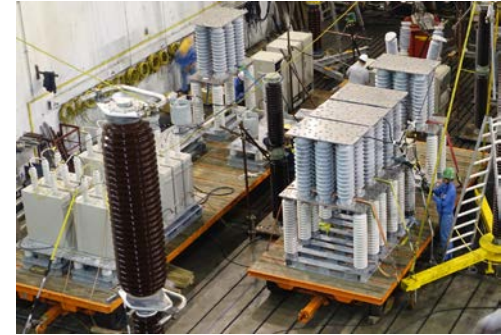


HVDC CIRCUIT BREAKER TESTING

Midterm Conference, June 6, Amsterdam
René Smeets, KEMA Laboratories DNV GL

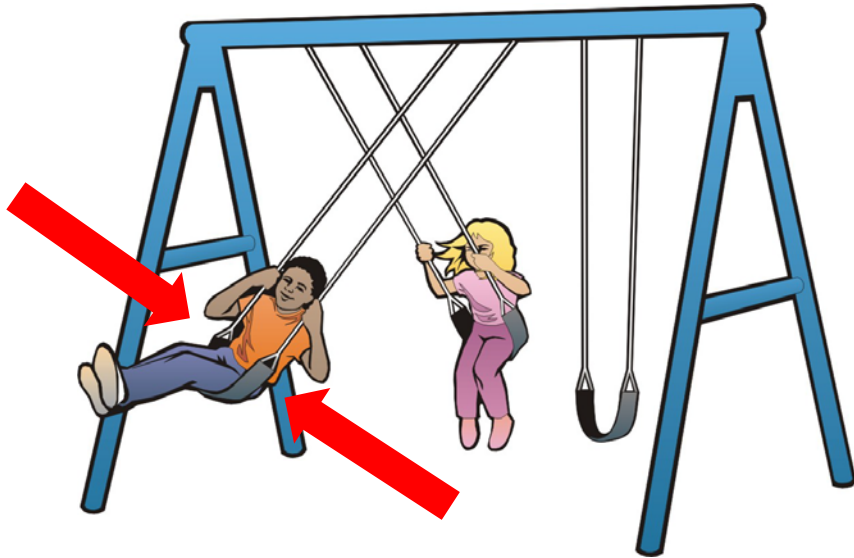
WPs 5/10: Testing of HVDC CBs

- Define test requirements from system transient studies
- Analyse, compare and design test-circuits
- Validate suitable test-circuits in high-power laboratory
- Define and quantify actual stresses on breaker sub-components, analyse failure modes
- Provide input data for models of HVDC circuit breakers
- Demonstrate testing HVDC circuit breakers of various technology
- Multi-module testing of HVDC CBs
- Initiate standardization

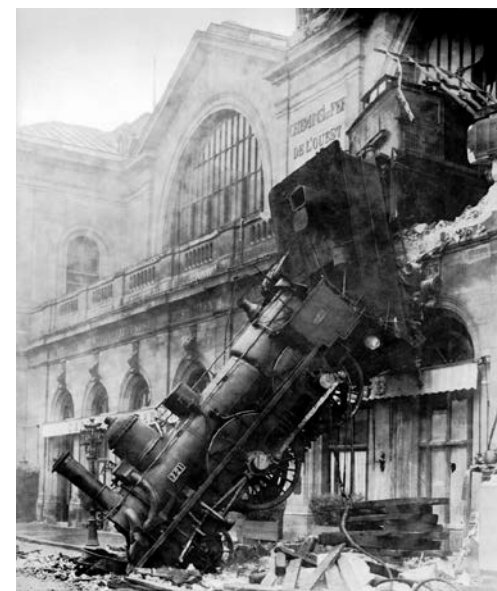


Interruption strategy

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

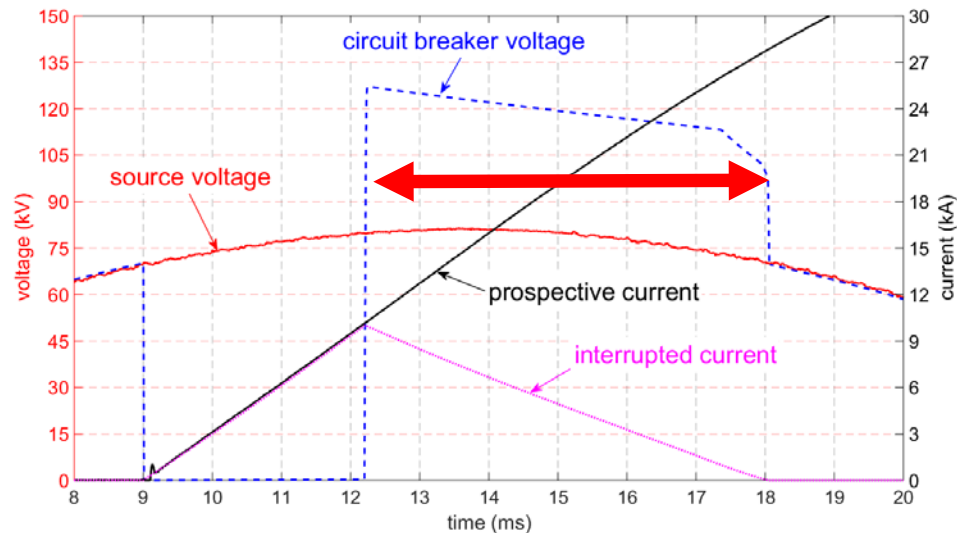
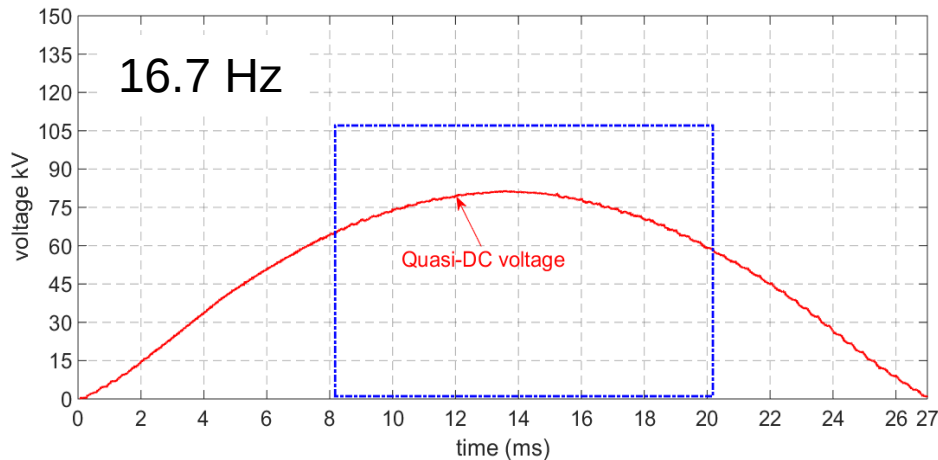


AC interruption:
Capture the swinging mass in its outer position (current zero)
Zero kinetic energy – Max potential energy



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

Testing DC with AC?



Test Circuits for HVDC Circuit Breakers,

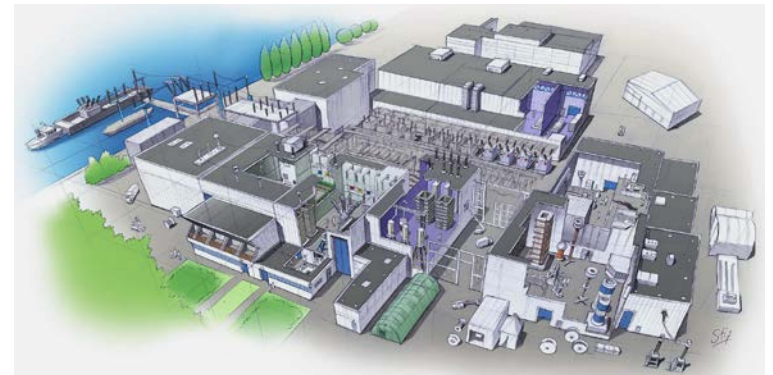
N. A. Belda and R. P. P. Smeets,
IEEE Trans. on Pow. Del., Vol. 32, No. 1, 2017

Analysis of Faults in Multi-Terminal HVDC Grid for Definition of Test Requirements of HVDC Circuit Breakers,

N.A. Belda, C.A. Plet, R.P.P. Smeets
IEEE Trans. on Pow. Del., Vol. 33, no.1, 2018

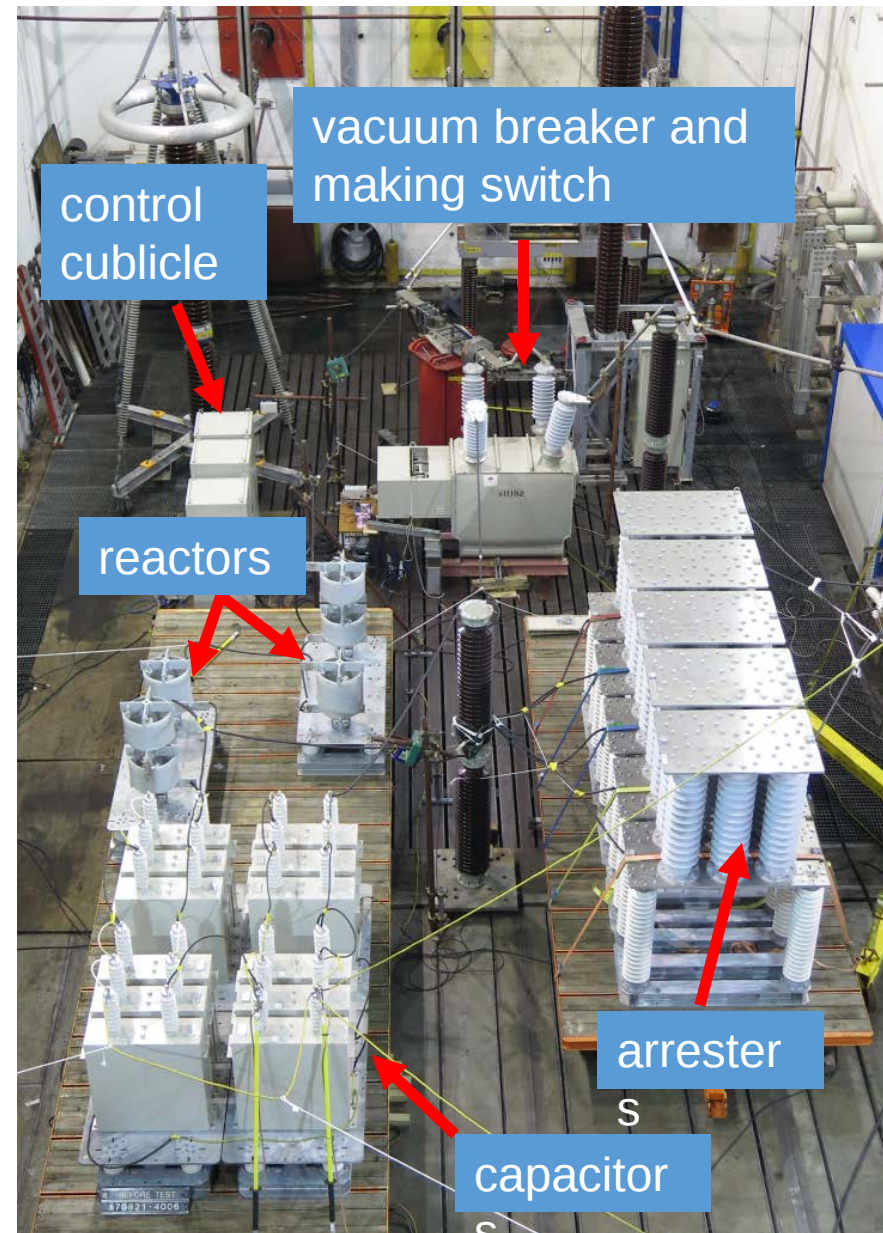
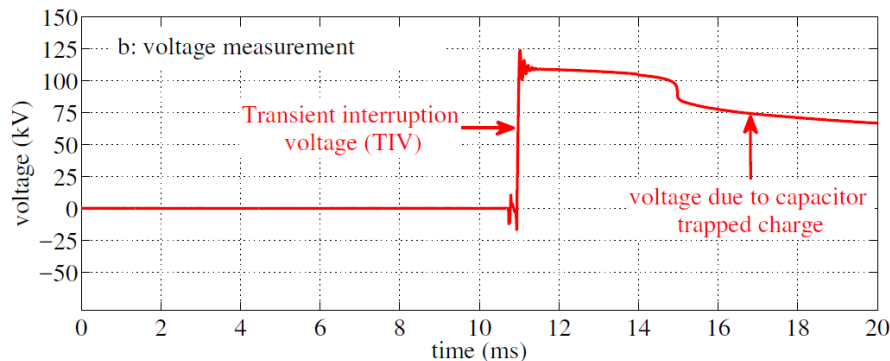
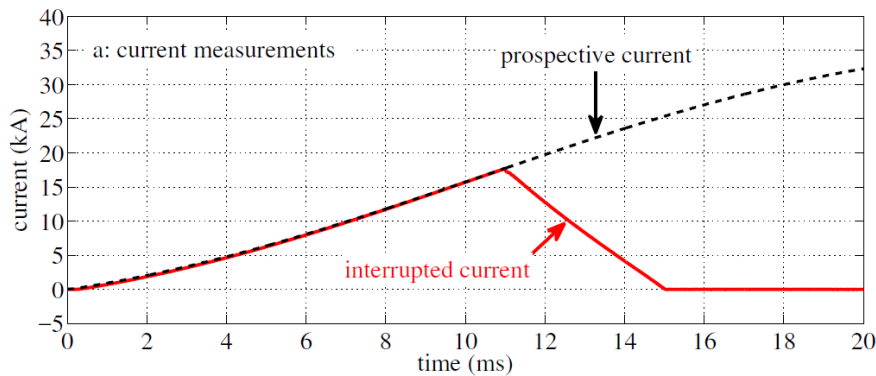
Full-Power Testing of HVDC Circuit-Breakers with AC Short-Circuit Generators Operated at Low Power Frequency

N.A. Belda, C.A. Plet, R.P.P. Smeets
IEEE Trans. on Pow. Del. (in review)

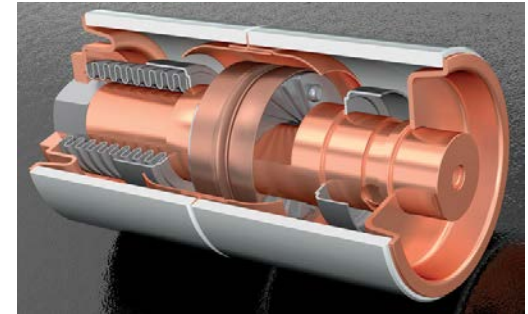
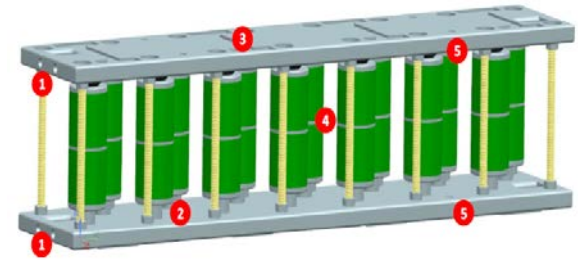
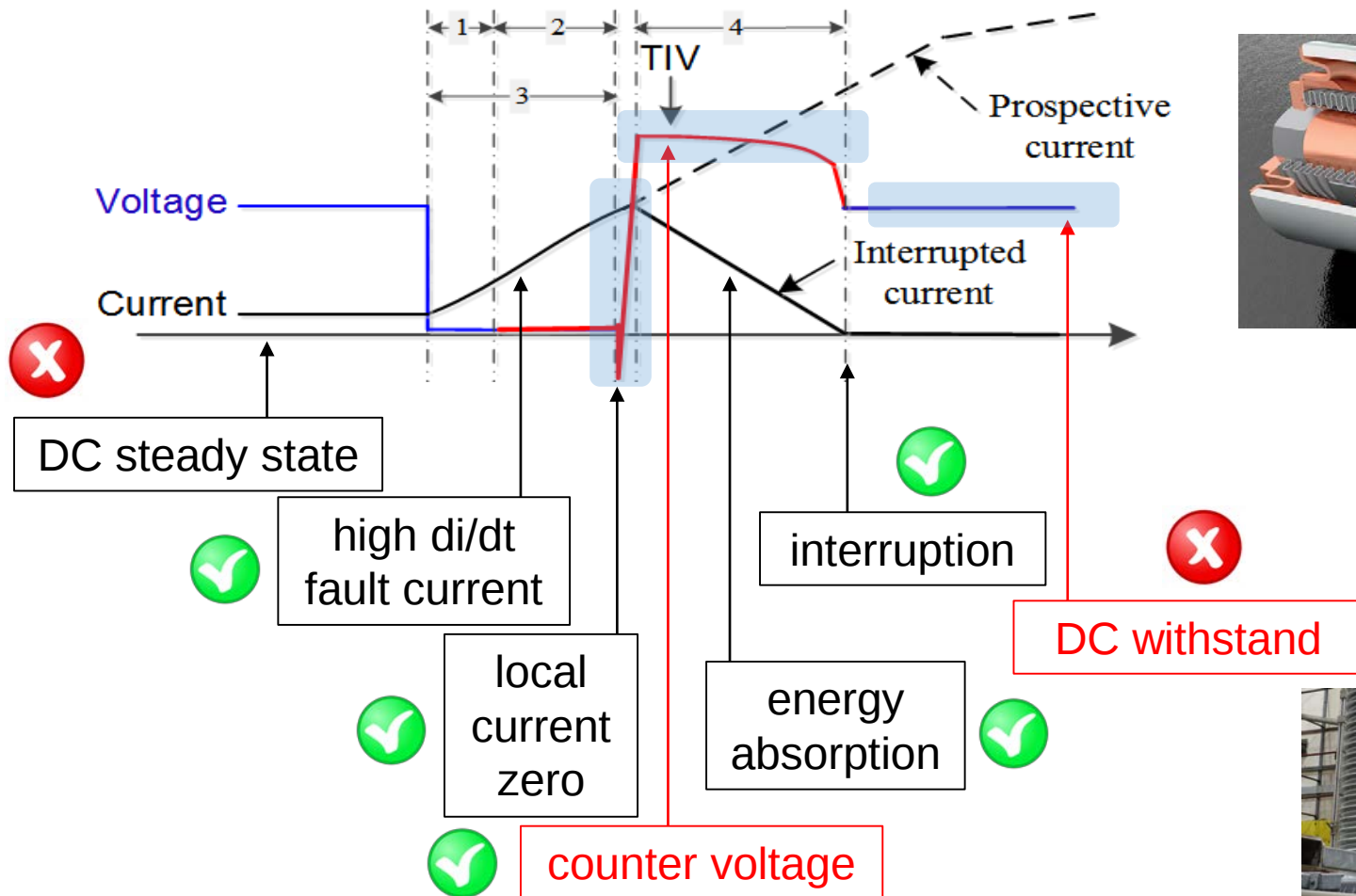


Active Current Injection prototype breaker testing

- 16 kA fault current, 125 kV pk TIV
- Up to 4 MJ energy
- 16.7 Hz test-circuit



Next: subcomponent stresses - failure mode analysis



APPENDIX

DISCLAIMER & PARTNERS

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PROMOTioN – Progress on Meshed HVDC Offshore Transmission Networks

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The opinions in this presentation are those of the author and do not commit in any way the European Commission

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