

PUBLIC

HITACHI **ABB**



Real Time Simulation at HAPG

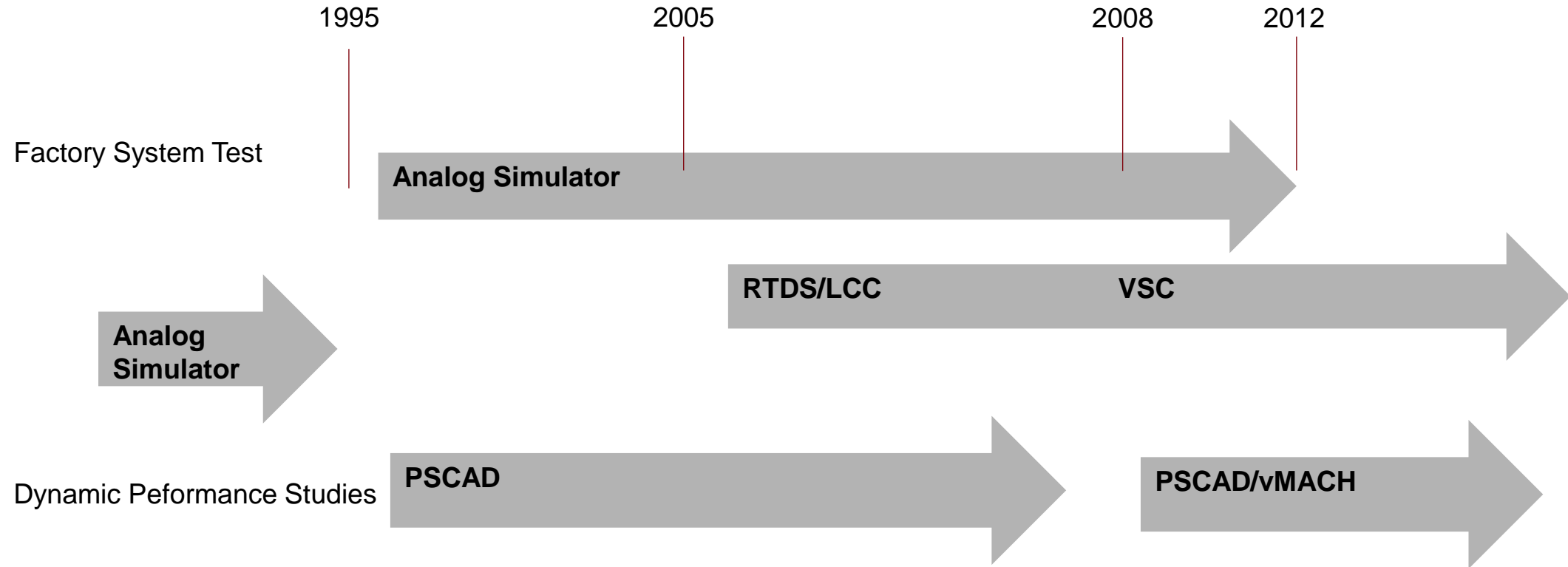
POWERING GOOD FOR SUSTAINABLE ENERGY

2021-09-17

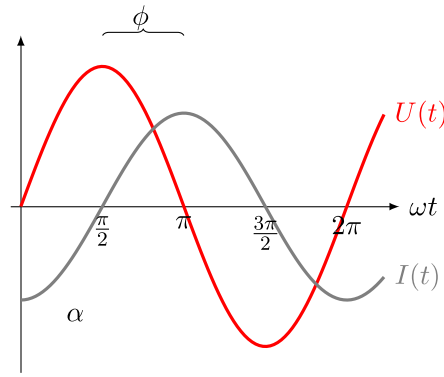
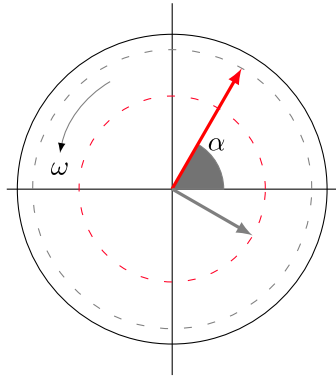
HITACHI ABB POWER GRIDS

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1. Brief history on RTS at Hitachi ABB Power Grids
2. Code development during project execution
3. RTS in projects (FST)
4. Benefits and drawbacks of RTS
5. Future of RTS



From simulation to site



RMS test

Upper level control design
Stability studies

Network model
Fast calculation

EMT test

Lower level control design
Transient studies

Reduced AC network
Slow calculation

Factory test

Control implementation
Hardware test

AC equivalent
Real time

Site test

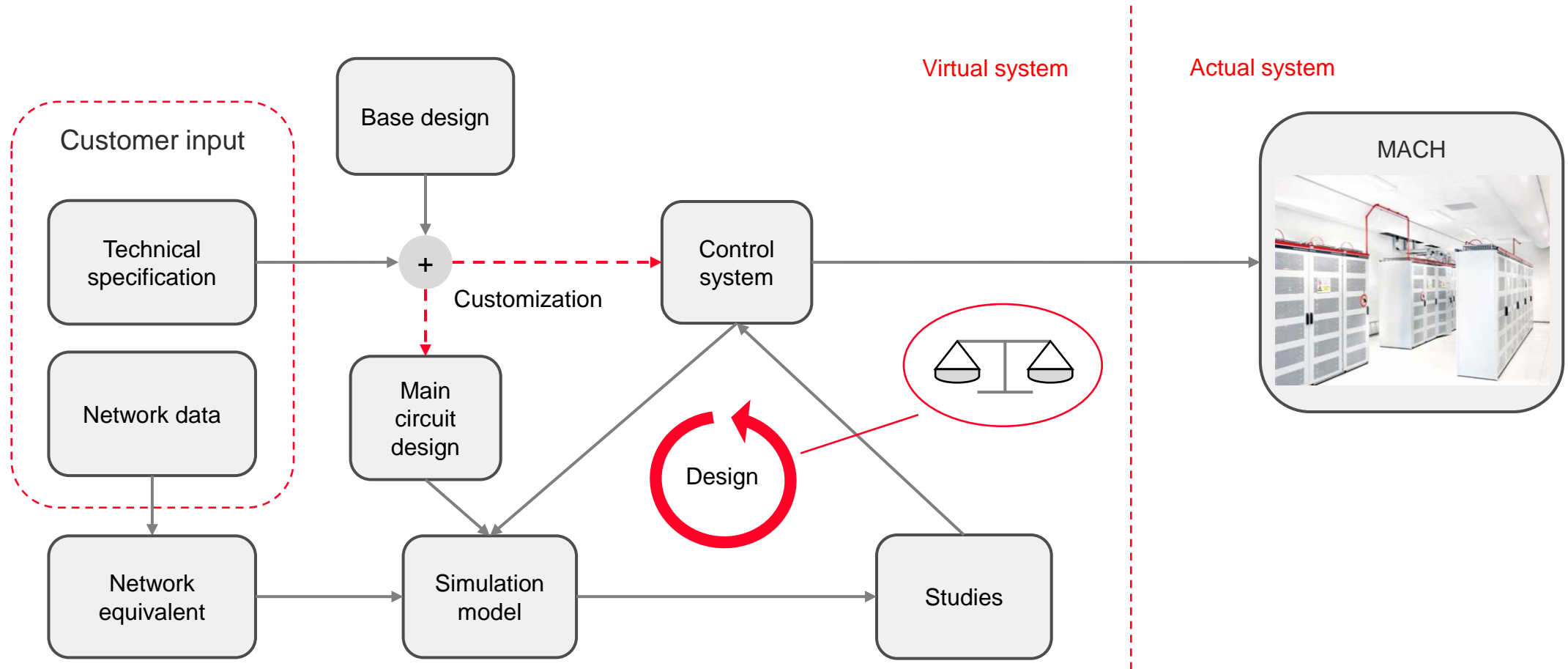
Commissioning

Real network
Real life

Control design and verification

Control integration and testing

From base design to customized project solution



To test the real and complete HVDC C&P system as one unit – system test



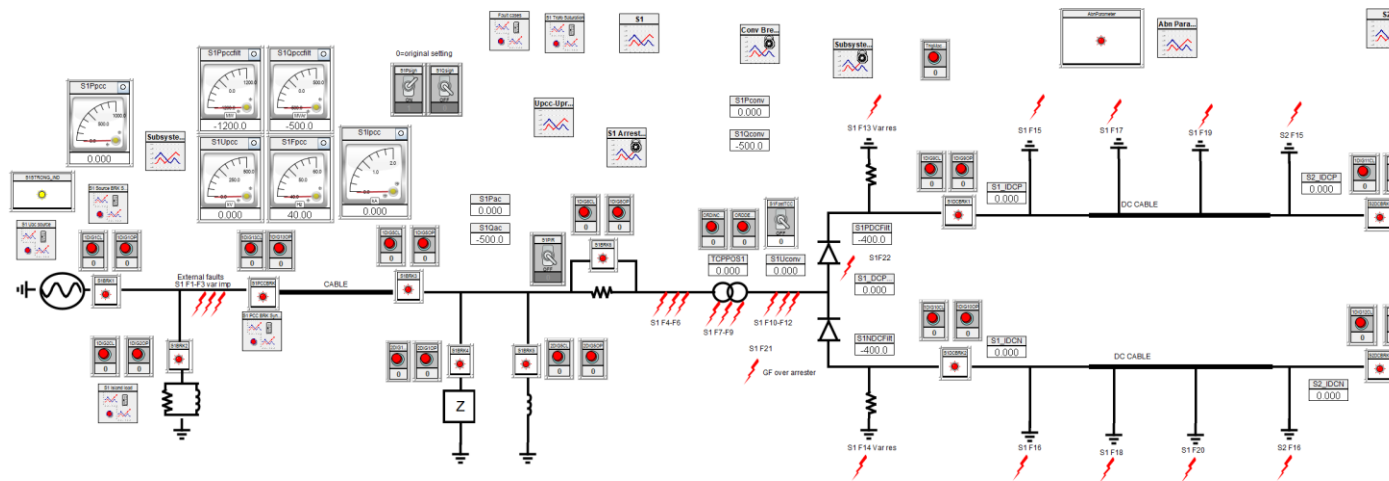
What we are testing and where

HVDC C&P System

1. Testing and greenlining the C&P cubicles
2. To verify the code implementation.
3. Functional test of the complete C&P system.

Real Time System

1. Real time model and interfaces
2. Can the system control the simulation
3. Fault initiation ...



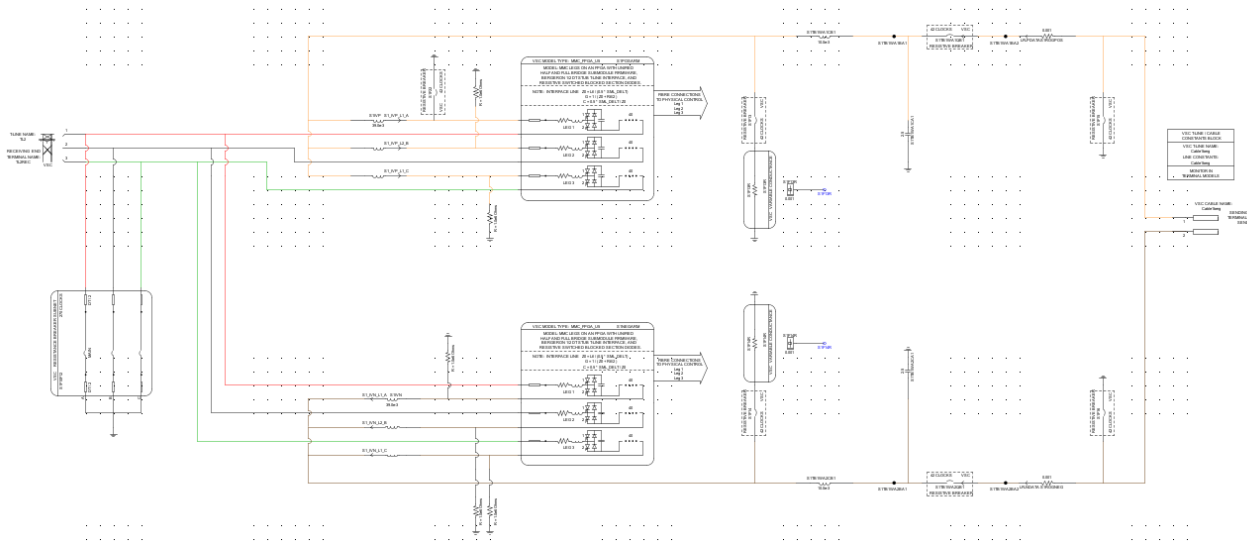
What are we representing

HVDC C&P System

1. Main circuit equipment Valve, transformer DC line etc.
2. AC network
3. Essential breakers and disconnectors
4. None-essential disconnectors and grounding switches

Real Time System

1. Detailed model
2. Single source
3. In the model with timing
4. Externally with relays



FST is not a repetition of the DPS

Simplified explanation:

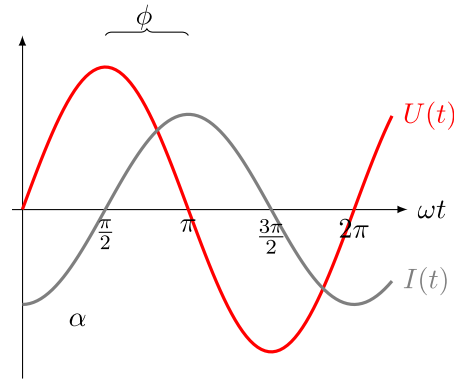
- EMT: Control system impact on AC network
- FST: AC network impact on control system

Dynamic testing is done during the FST like AC DC faults and step responses.

HAPGs approach is that a AC equivalent is sufficient for the testing done in the FST.

Non-real time – vMACH

Software-in-the-loop (SIL)
MACH control logic
MACH software
vMACH hardware emulation



Standard PC

Bigger model is a plug-and-play operation

Model design dictates simulation speed

Snapshot functionality (tests can be automated)

Tests can be run:

- in parallel
- at any time
- on any computer
- by multiple engineers

Real time – MACH

Hardware-in-the-loop (HIL)
MACH control logic
MACH software
MACH hardware



Real-time simulator

Bigger model requires new hardware and extensive engineering work

Simulation speed dictates model design

No snap-shot functionality (tests must be supervised)

Tests can be run:

- one at the time
- only during the project stage
- in the factory system test
- by a few engineers

Drawbacks

Long time: all testing done in series

Requires several and different experts involved in the testing

Not real signal levels and signal types: All signals from RTS low level voltage

Expensive hardware

Can only be run on the real system during project execution.

Fitting complex model in the RTS and maintaining a good time step.

Benefits

The only way to know that your delivery will work on site.
Has to be done.

Simulators

More powerful simulators allowing for larger and more detailed models.

Customer requests:

Internal control systems (inside RTS)

A fully digital interface allowing for I/O free study replicas

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