



Workshops on Hardware-in-the-Loop Testing of Protection Relays using HYPERSIM (Part 2)

Bouna Cisse, P.E., MSc.E.

bouna.cisse@opal-rt.com

Jean-Philippe Gagnon, eng.

jpgagnon@gentec.ca

Derek Brown

derek.brown@alstom.com

About ALSTOM Grid and the P476 Busbar Differential Protection Relay



HIL Testing of P476 Relay with HYPERSIM : Testbench and Results



Bus Protection Using The Simulator

- Bus are one of the most important component in a network
- Require speed
- Selectivity
- Stability

- **High complexity for multiple busbars**
 - increased costs for engineering and documentation
 - increased wirin

Busbar Protection Must Be:

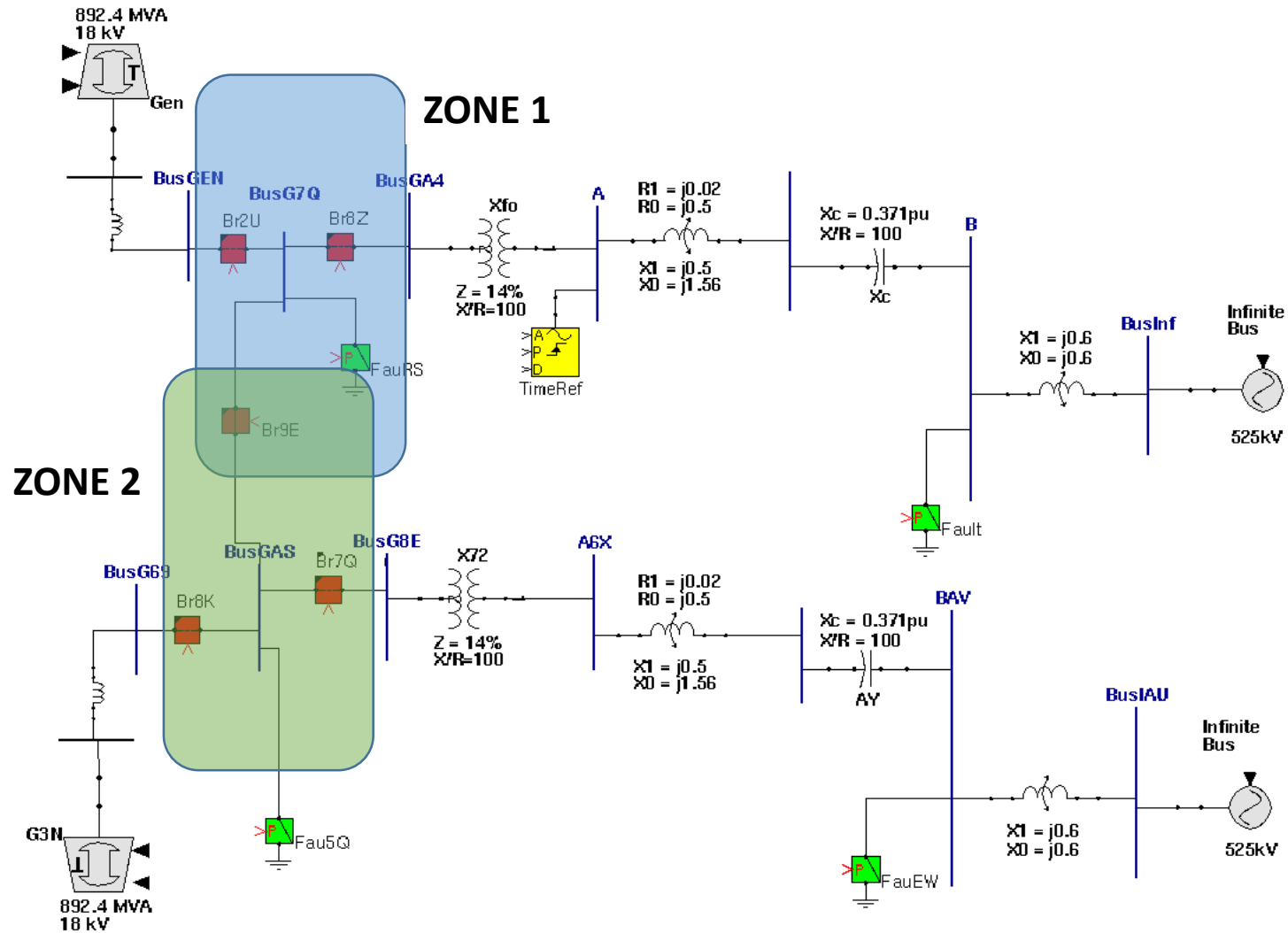
- **RELIABLE**
 - Failure to trip could cause widespread damage to the substation
- **STABLE**
 - False tripping can cause widespread interruption of supplies to customers / possible power system instability
- **DISCRIMINATING**
 - Should trip the minimum number of breakers to clear the fault
- **FAST**
 - To limit damage and possible power system instability

Busbar Faults Are Usually Permanent

Causes of Busbar Faults :

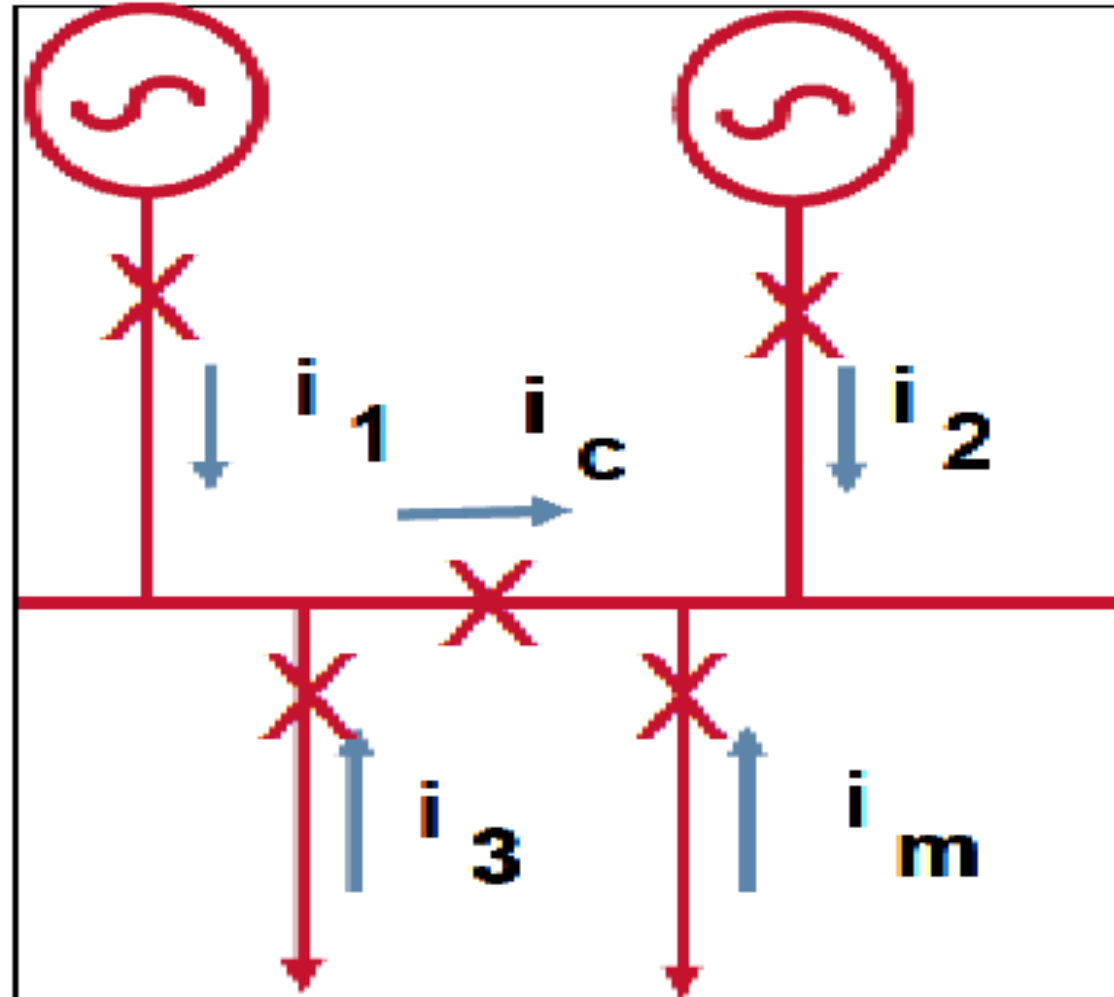
- Falling debris
- Insulation failures
- Circuit breaker failures
- Current transformer failures
- Isolators switches operated on load or outside their ratings
- Safety earths left connected

Power System Model



HYPERSIM Real-Time Simulator

Scheme Tested

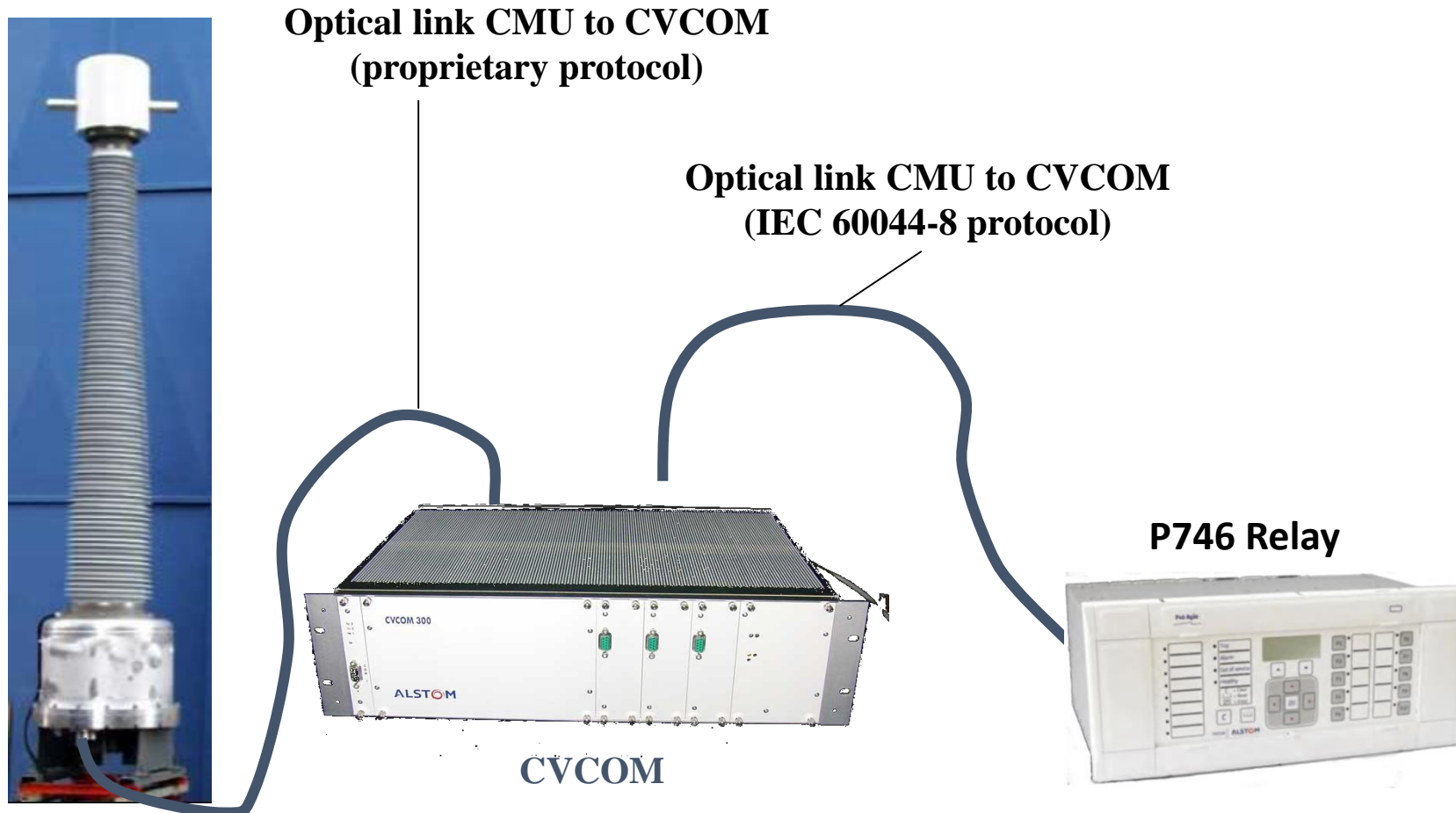


Non Conventional Cts

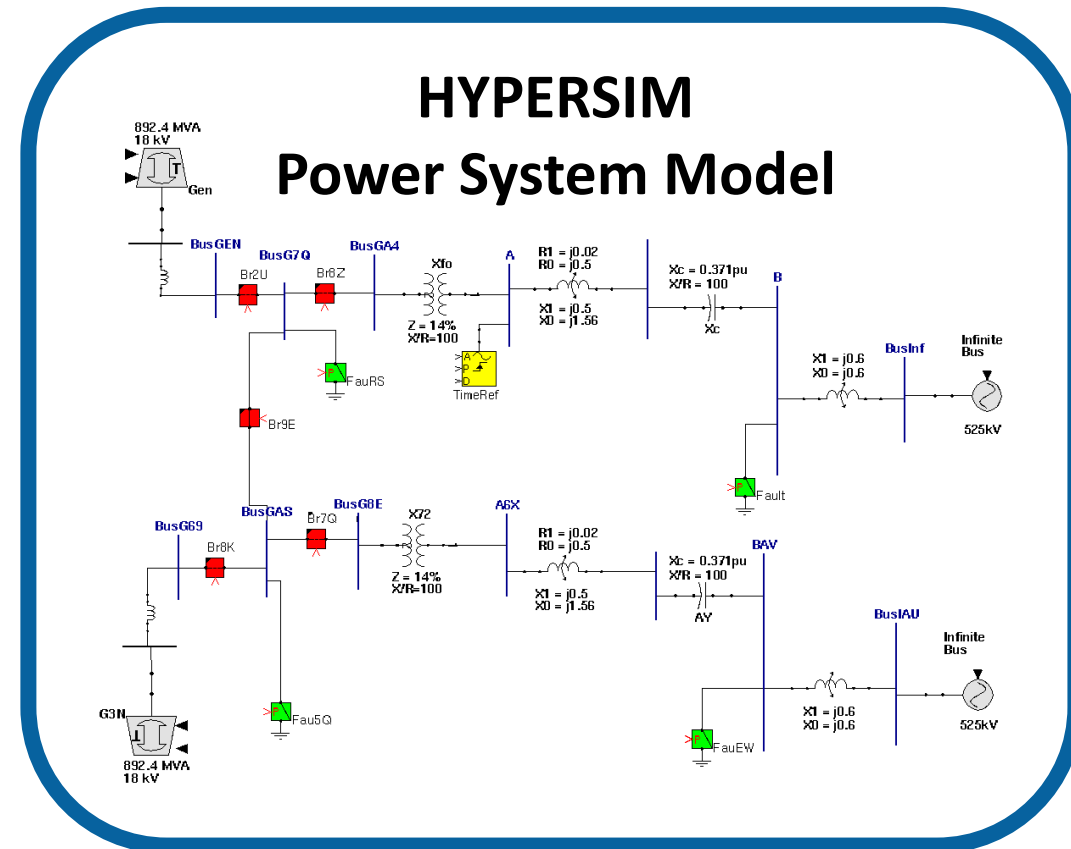
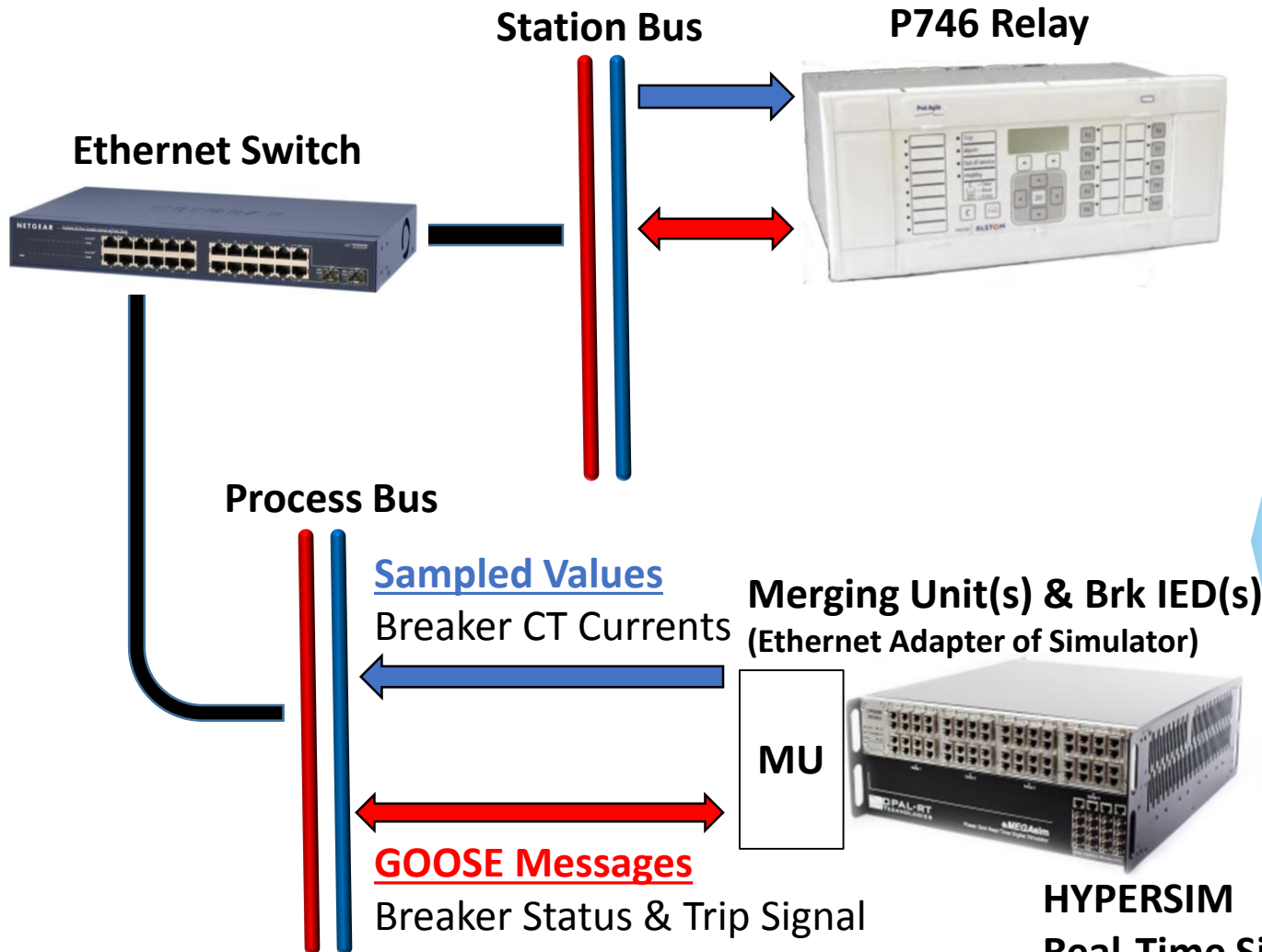
Two methods are commonly referred to:

- Rogowski Coils
- Optical CT`s

THE IDEA OF THE TEST

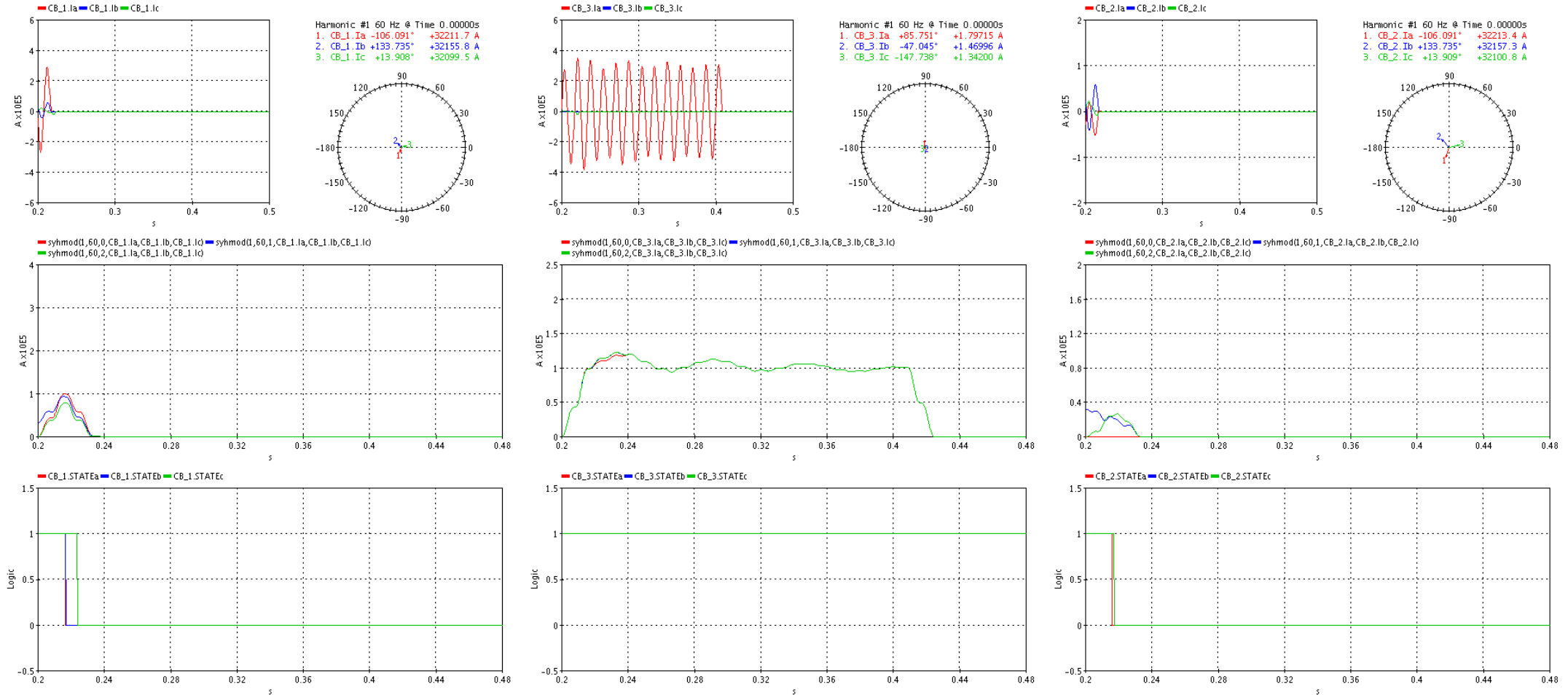


Application : IEC-61850 HIL Testbench

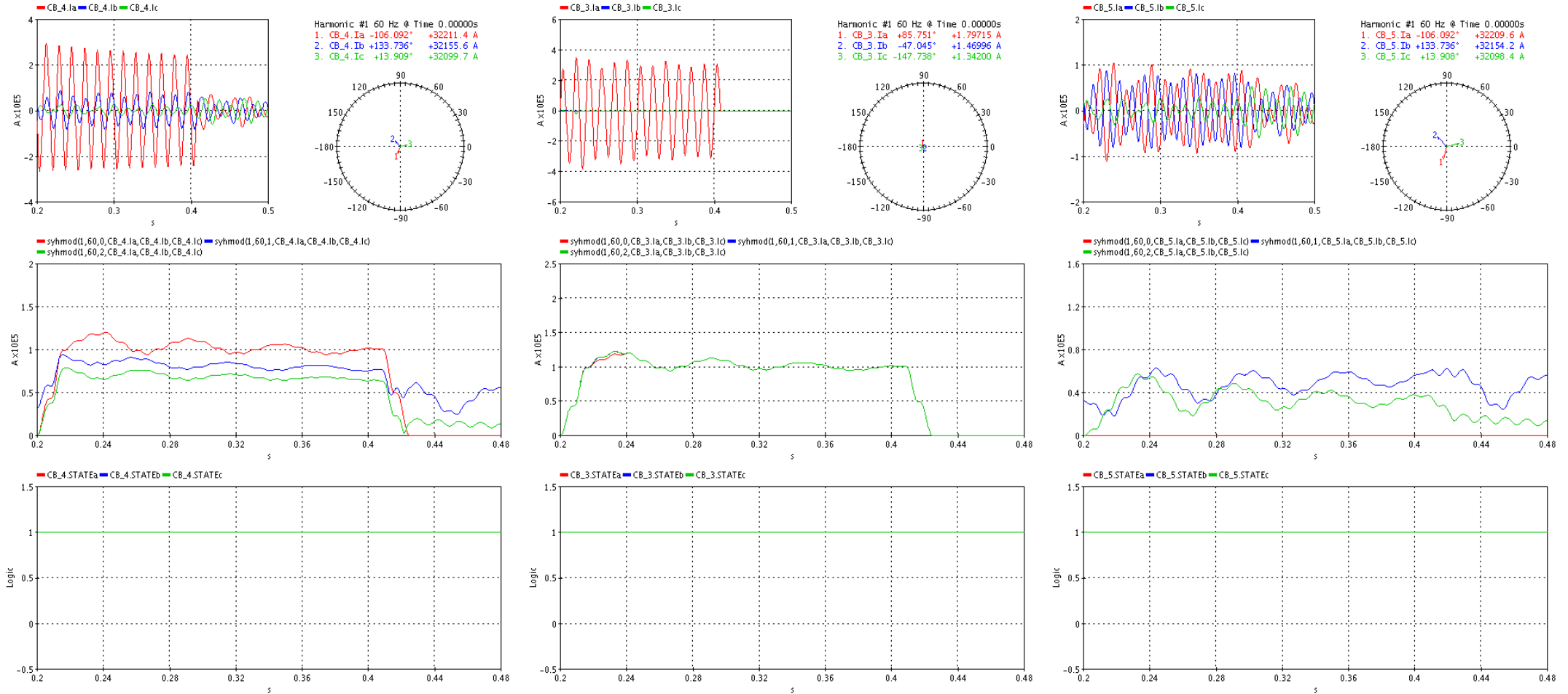


HYPERSIM
Real-Time Simulator

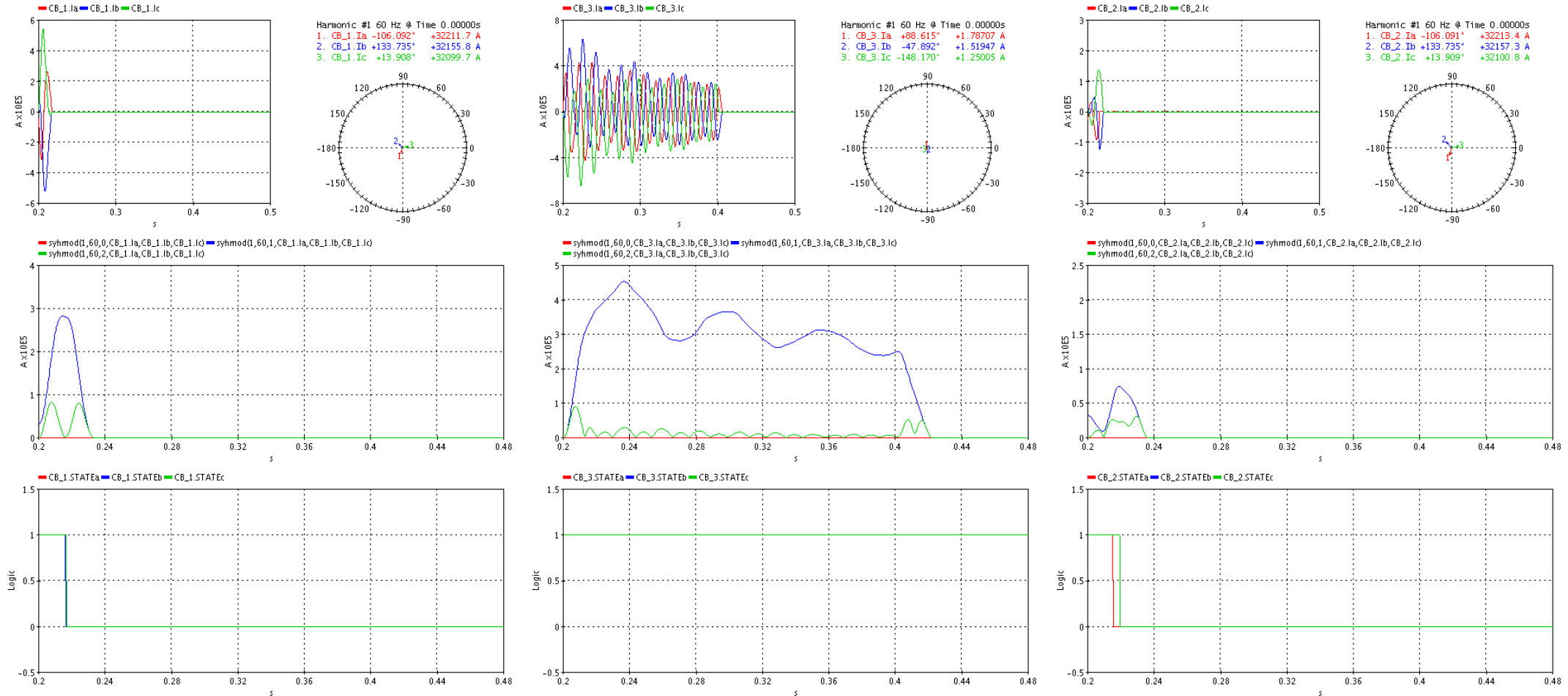
Zone 1 PHASE TO GRND INTERNAL



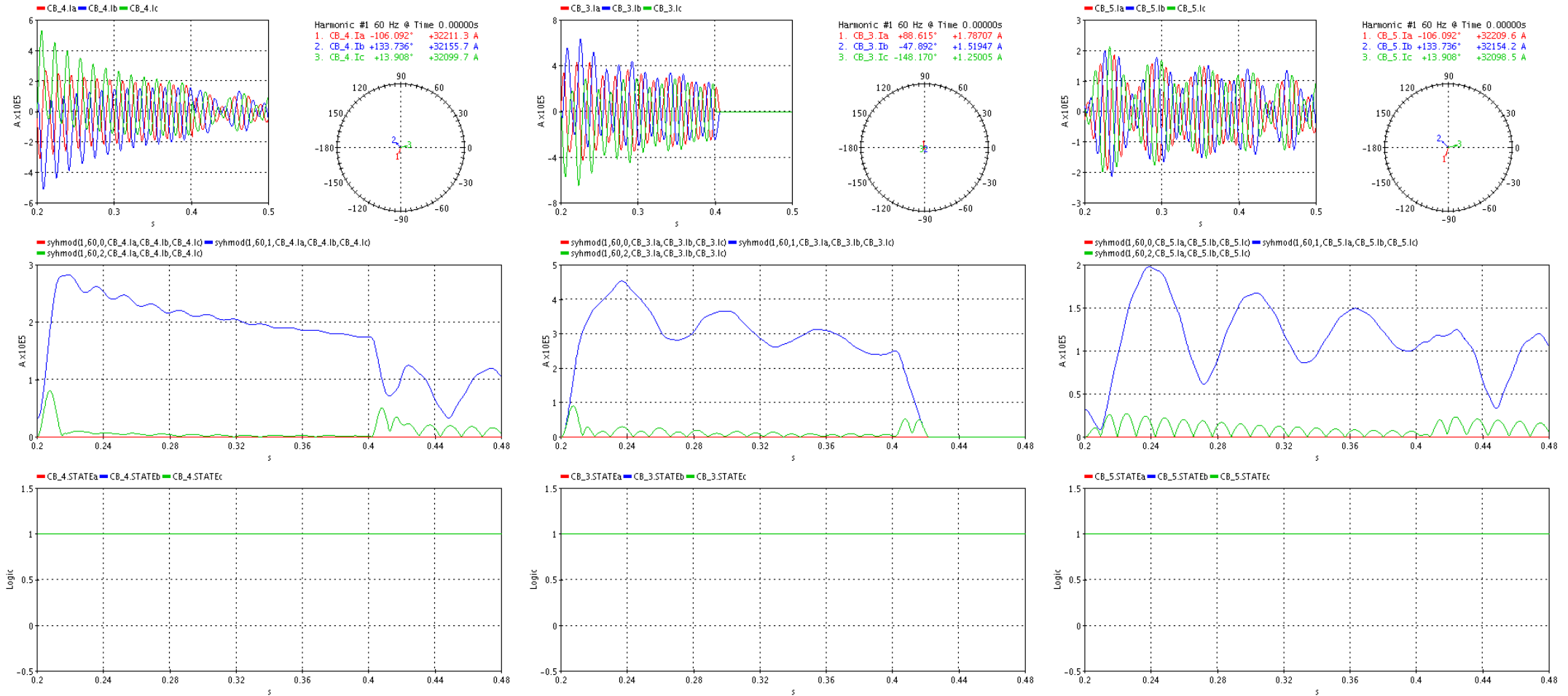
PHASE TO GRND INTERNAL



ZONE 1 THREE PHASE FAULT



THREE PHASE FAULT INTERNAL ZONE 2



Conclusions



Conclusions

- Real Time simulator can be used for type testing by the relay manufacturer to prove some change made on the software or for quality control.
- As of today it can be done in a matter of day and repeated as many as we want.
 - ▶ As type of test can be very involving because use to take months
 - ▶ A pre-commissioning test can be perform using the same characteristics of a real network.
 - ▶ Dynamic testing allow to test the relay applying fault to determine timing of the relay.
 - ▶ HYPERSIM is a tool design by engineer for engineers, student and researchers.

Thank you!

Questions ?