SOUTHERN CALIFORNIA EDISON®
Energy for What's Ahead℠

Santiago Synchronous Condenser Replica Controller HIL Setup

for Apparatus Training and Operational Support

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Outline

- Introduction of Company
- Introduction of Project
- RTDS Involvement
- Challenges of this project
- Status of the project

Introduction of Company

- Southern California Edison: Energy for What's Ahead
- To safely deliver reliable, clean, and affordable energy to our customers.
- Aspire to lead the transformative change underway in the energy industry, through investing in new technologies, achieving outstanding operational performance, and supporting the goals of our customers and policymakers.
- 131 years of history
- 87 billion kWh of electricity in 2015
- 15 million people

Introduction of Project

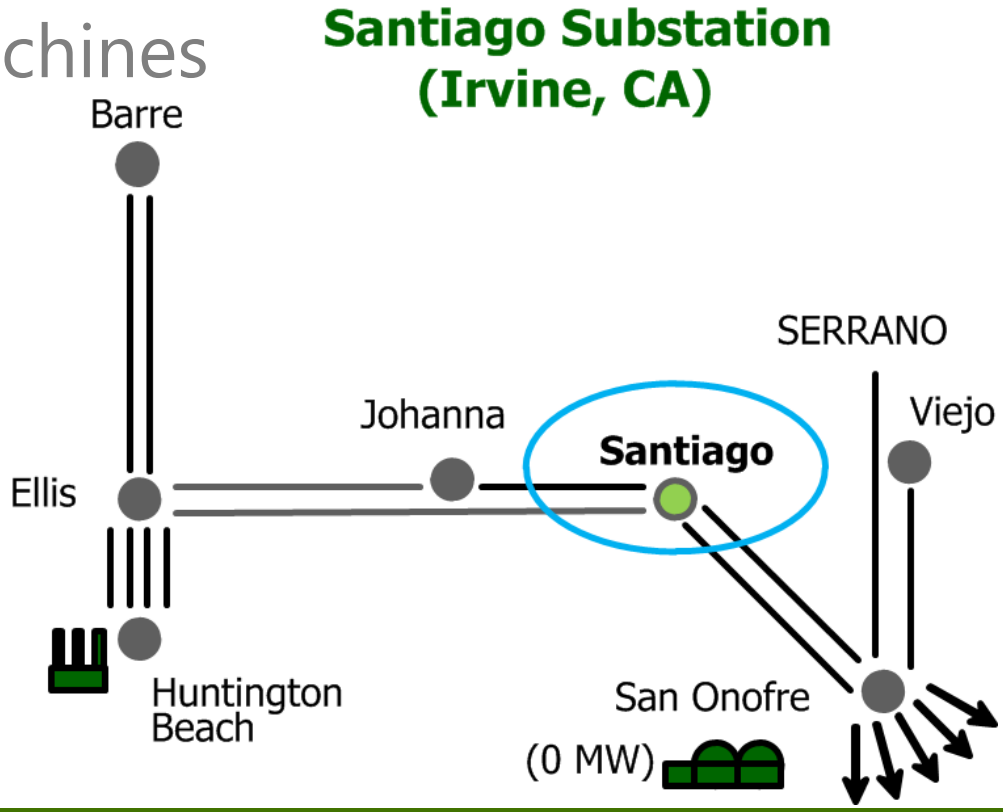
- Purpose: Address the post transient voltage instability following loss of two 500kV transmission lines from San Diego to Arizona.
- Need: California Independent System Operator (CAISO) requested SCE to install 225MVAR condenser at Santiago Substation in Orange County, California.
- Purpose of using RTDS is to test the controls of the synchronous condenser in an “offline” setting. Access to operators to get trained to actual synchronous condenser controls. To provide operation support (field events) to planning engineers and protection.

RTDS Involvement

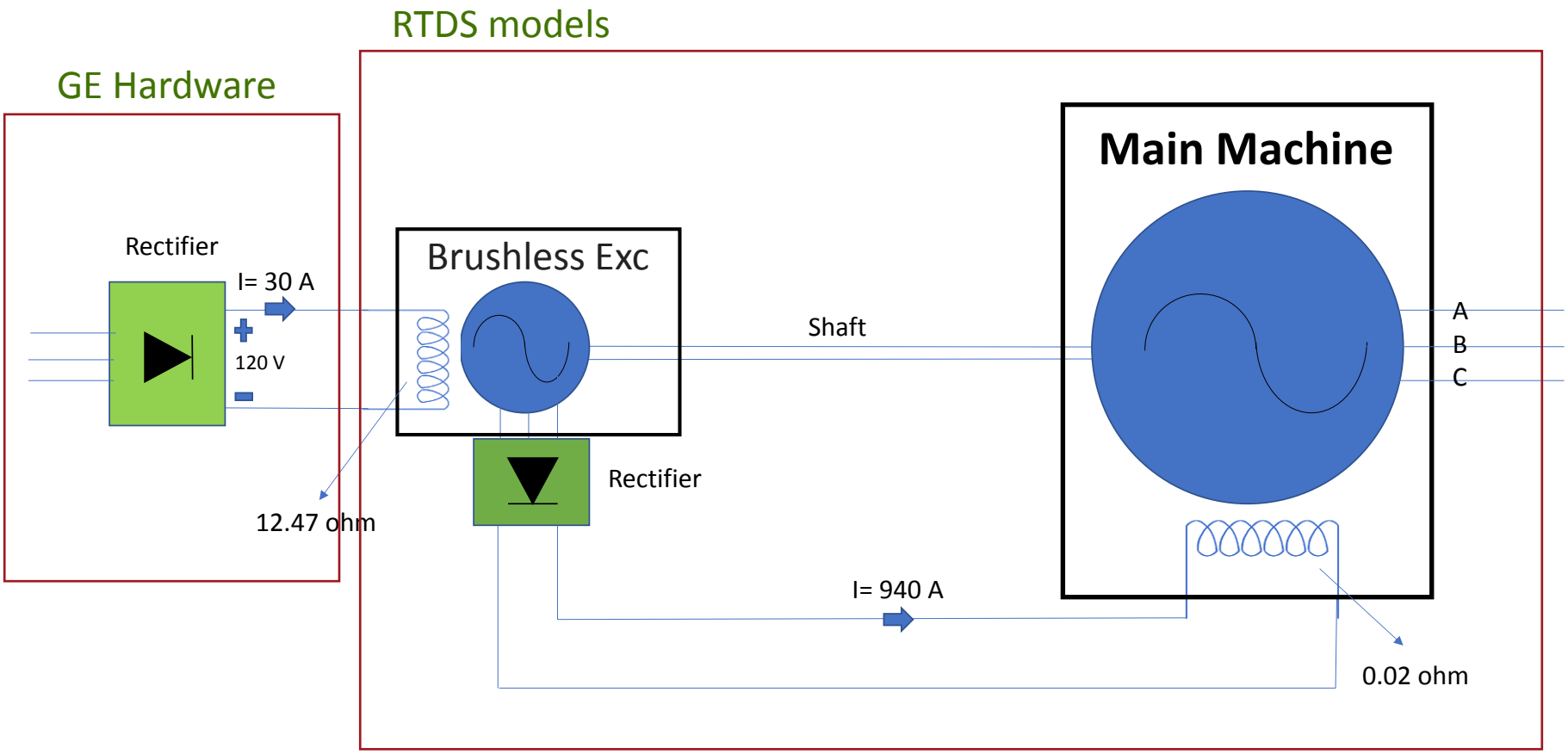
- Model
- Hardware-In-Loop Integration
- Exciter Regulator
- Protective Relays
- Input output list from RTDS
- Test Plan

RTDS System Model

- RTDS modeling: 18 buses, 3 racks
- Validation process (SCD and power flow)
- RTDS model is already prepared and validated
- Three 80MVAR GE machines

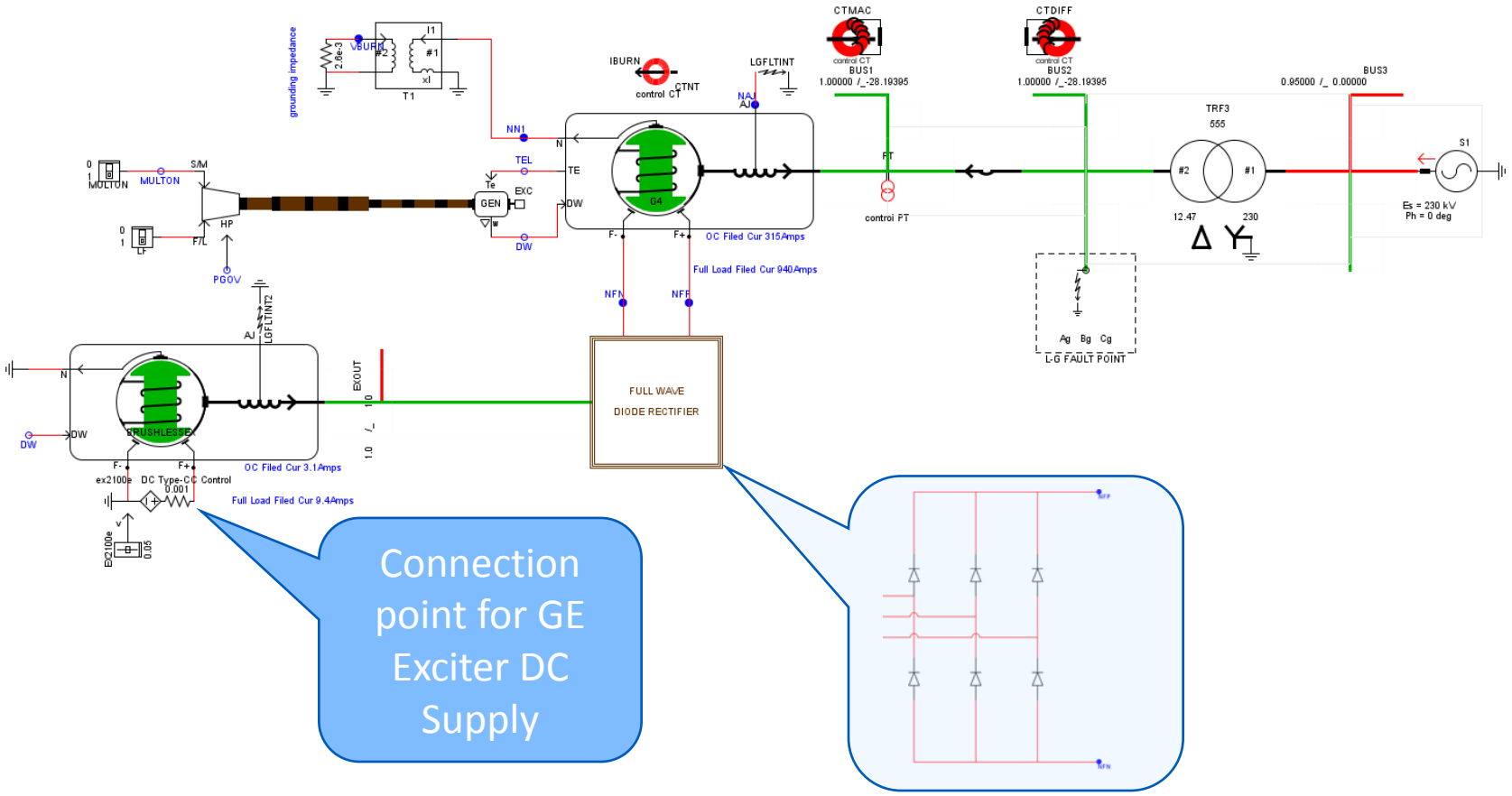


Synchronous Condenser Machine Model

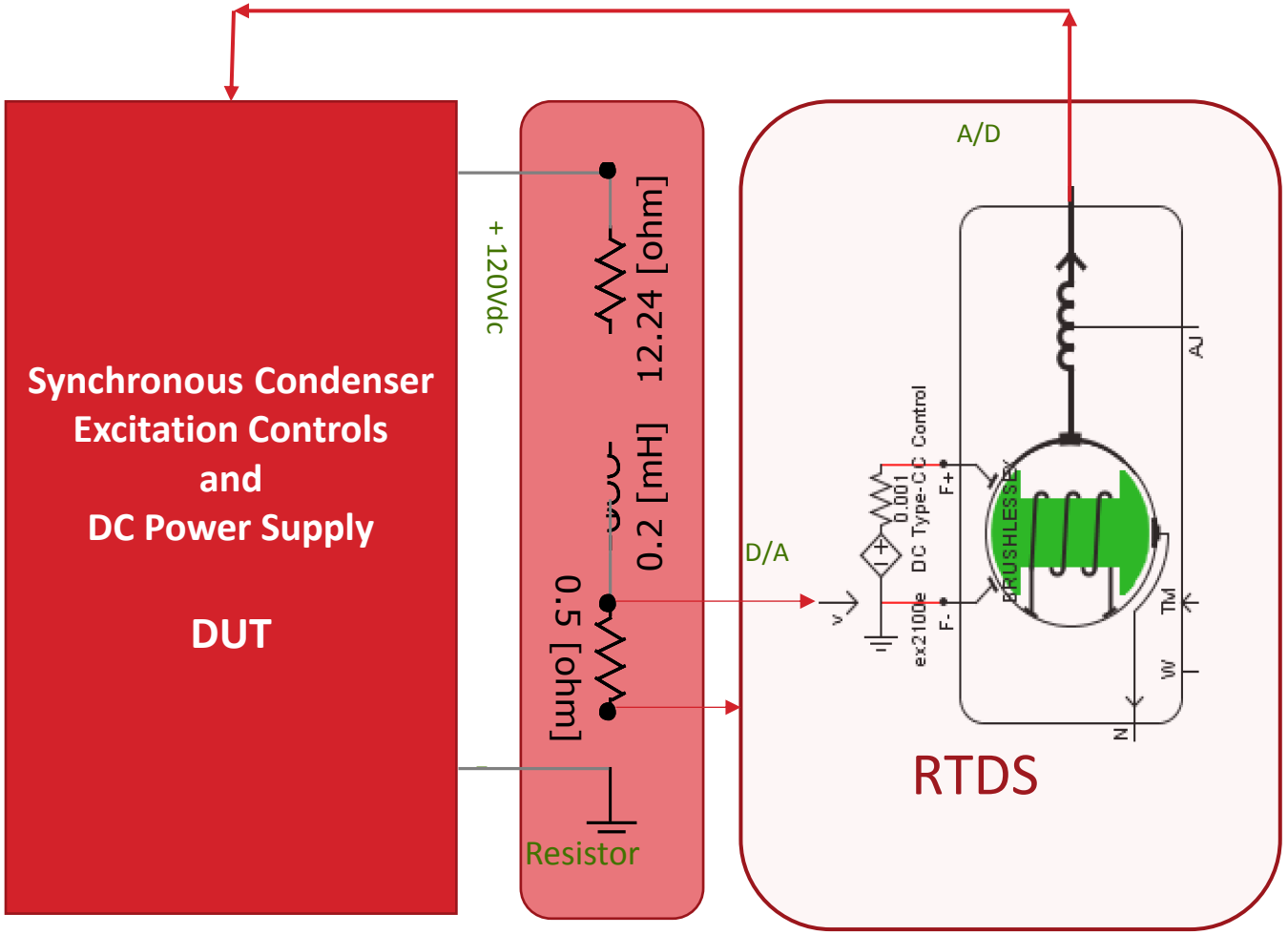


GE Exciter Picture

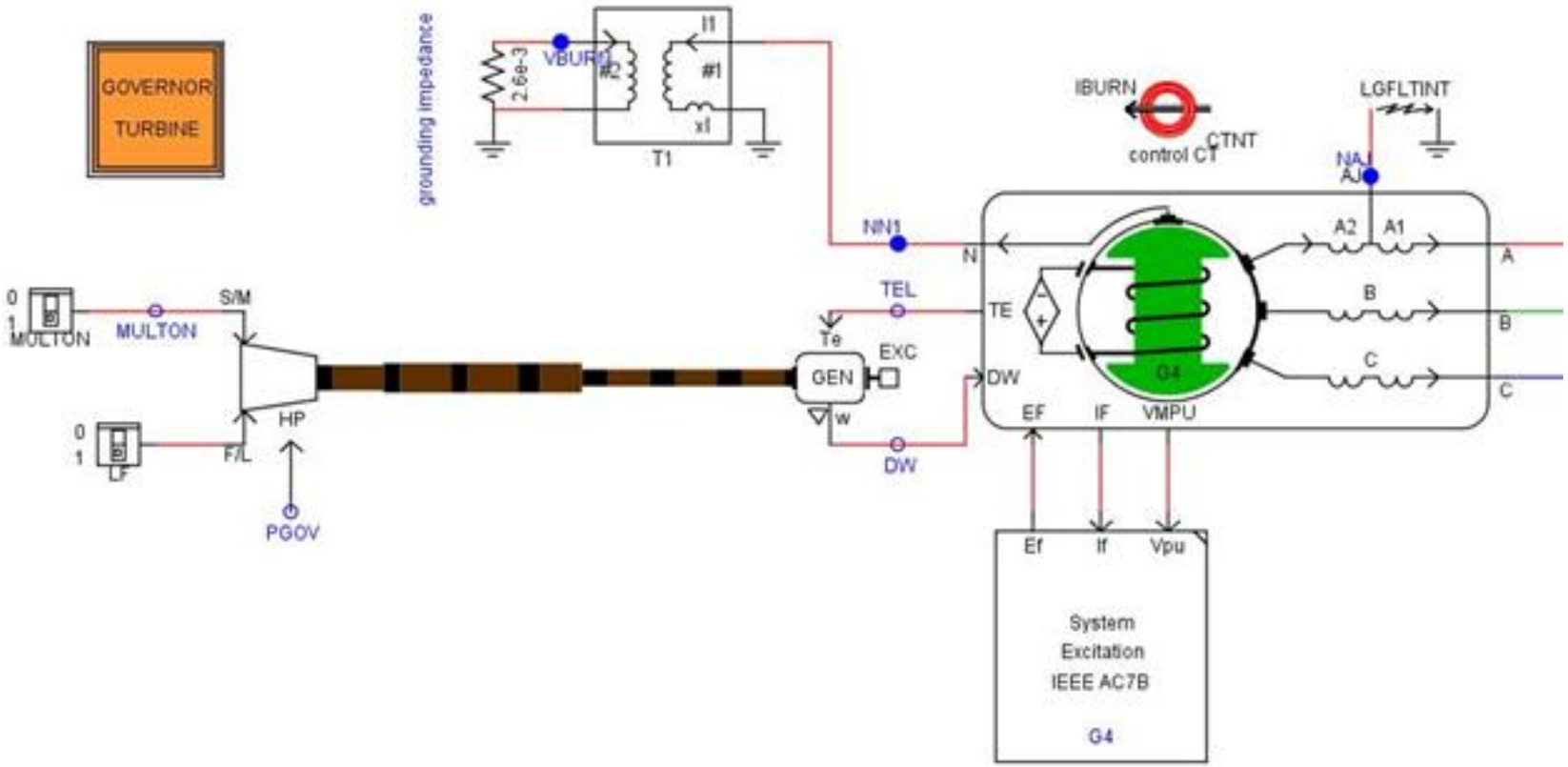
RTDS Model with Brushless Exciter



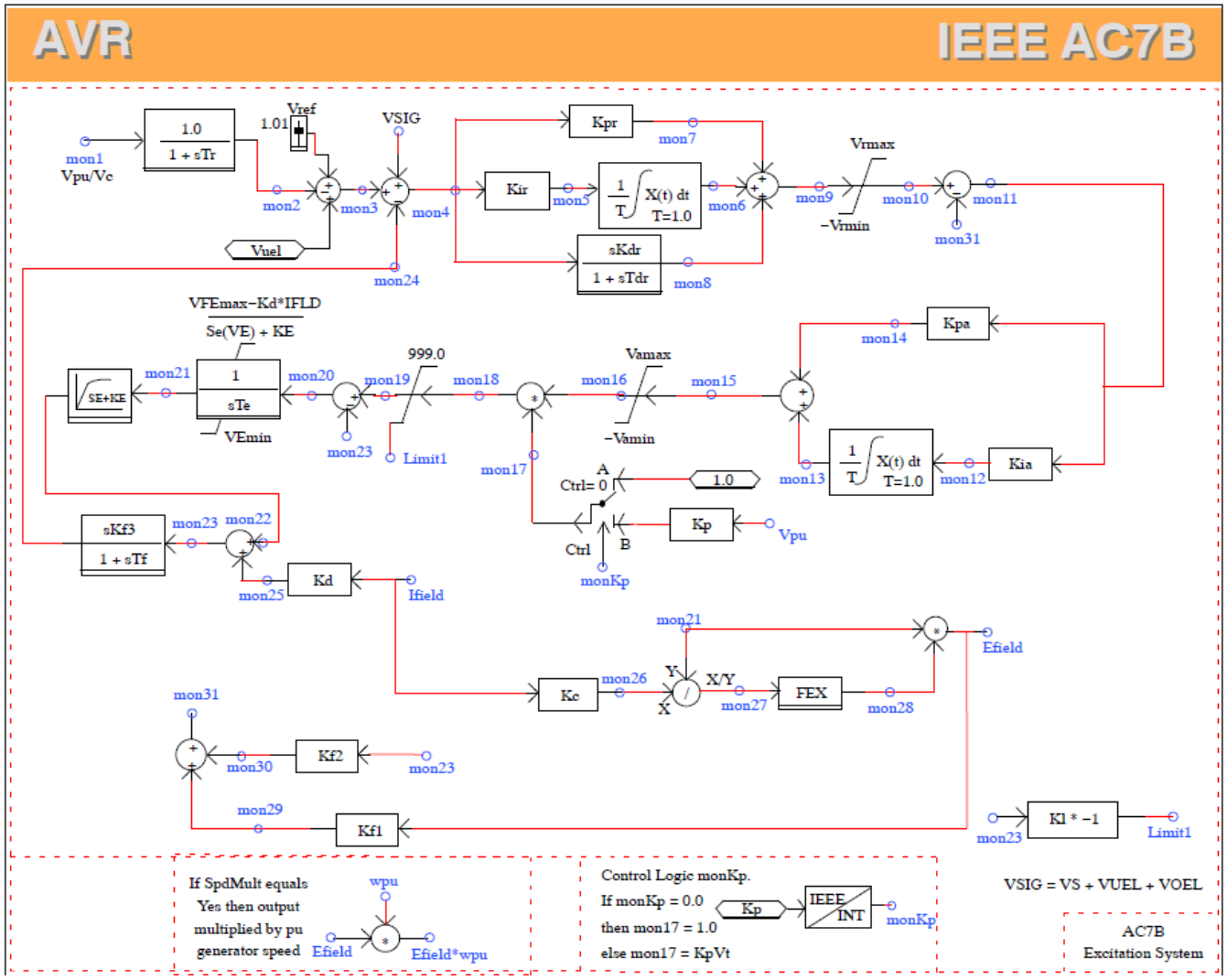
RTDS HIL Connections to exciter



Sync Condenser with AC7B Exciter



AC7B Exciter



Two options for HIL Test

- Small machine and the rectifier as a control system based on AC7B excitation model
- Small machine and rectifier connected to actual hardware exciter regulator control system

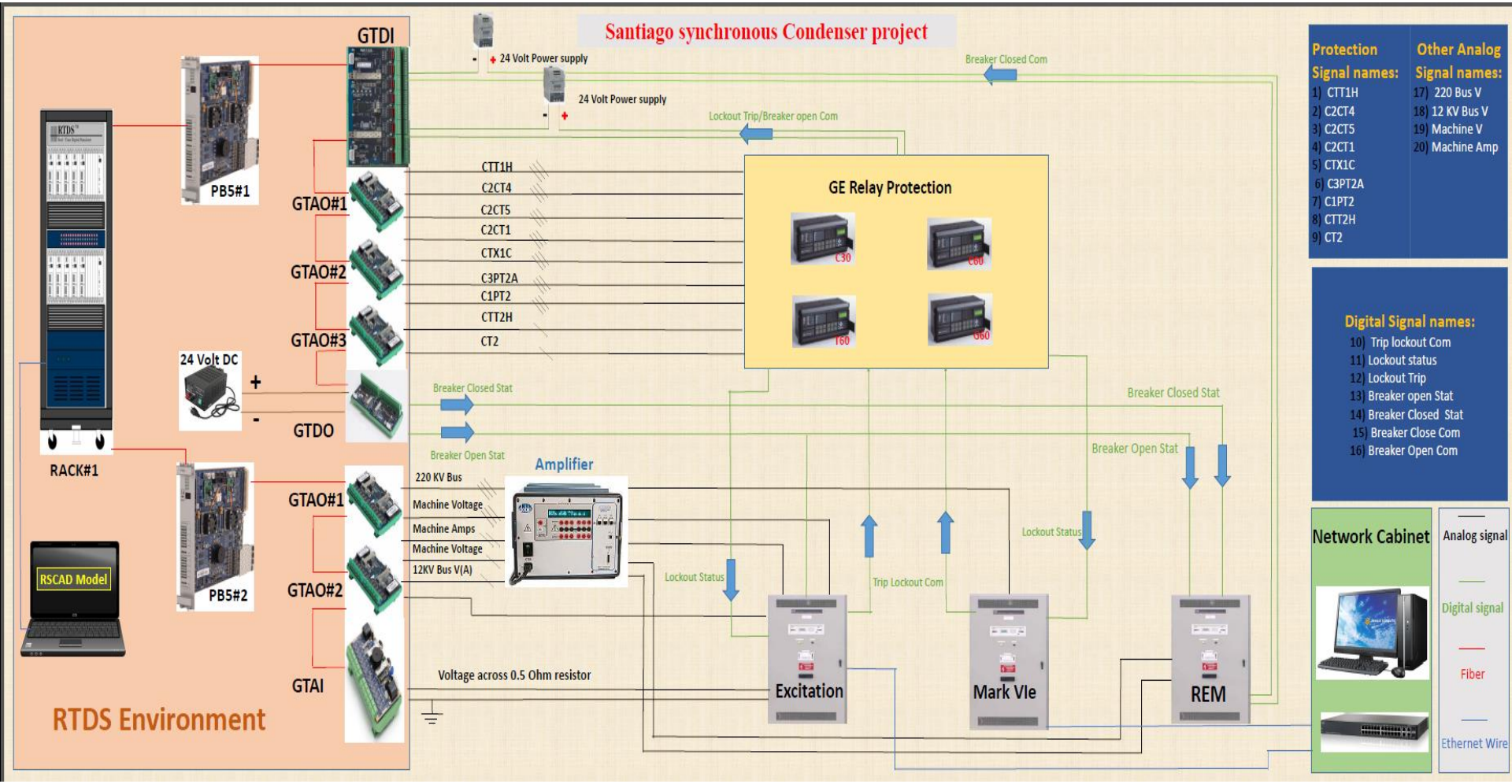
Software Equivalent of GE Exciter

- Complete software version of the GE EX2100e is going to be represented in RSCAD as complete AC7B excitation system
- Parameters of AC7B system will be validated against the actual hardware excitation system
- Software version of AC7B will be used for two of the three machines
- While the third machine will have the actual hardware (exciter cabinet)
- Once model is validated, this can be used in bulk system model

Protective Relays

- *Z2: GE C60, G60*
- *Z1: GE T60, C30*

Input/Output Connections



Test Plan

- Verify the objectives of the synchronous condenser project
- Simulate the “problem”
- Other tests that will verify the performance of the controls and various test scenarios
- Setup for operator training

Test Scenarios

- Verify the network system stability
- Performance verification tests
- Operator/Training tests

Challenges

- Power grid verification
- Analog/Digital Input/Output
- Mimic real life exciter hardware
- Mimic real life exciter software

Status and Next Steps

- Wired and changes that still need to be made by GE
- Process of procuring the burden
- Ready to perform first HIL test

Acknowledgement

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