SEL PowerMAX VALIDATION USING RTDS

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SEL ES

ENGINEER - POWER SYSTEMS

USER SPOTLIGHT SERIES BY RTDS Technologies

CONTENTS

- The System
- The Problem
- The Simulation model
- The HIL setup
- SEL solutions
    - Generation Control (Active and reactive)
    - Load Shedding

THE SYSTEM

- Islanded and Isolated
- Strict EPA regulations
- Expensive down time
- Similar rated generators
- Industrial load
- No renewable energy

THE SIMULATION MODEL

- Accurate model of generators and loads, with some approximations.
- IEEE model of generator.
- Two generators controlled by Hardware. Six generators of power system simulated in RTDS.

WHAT WE DO

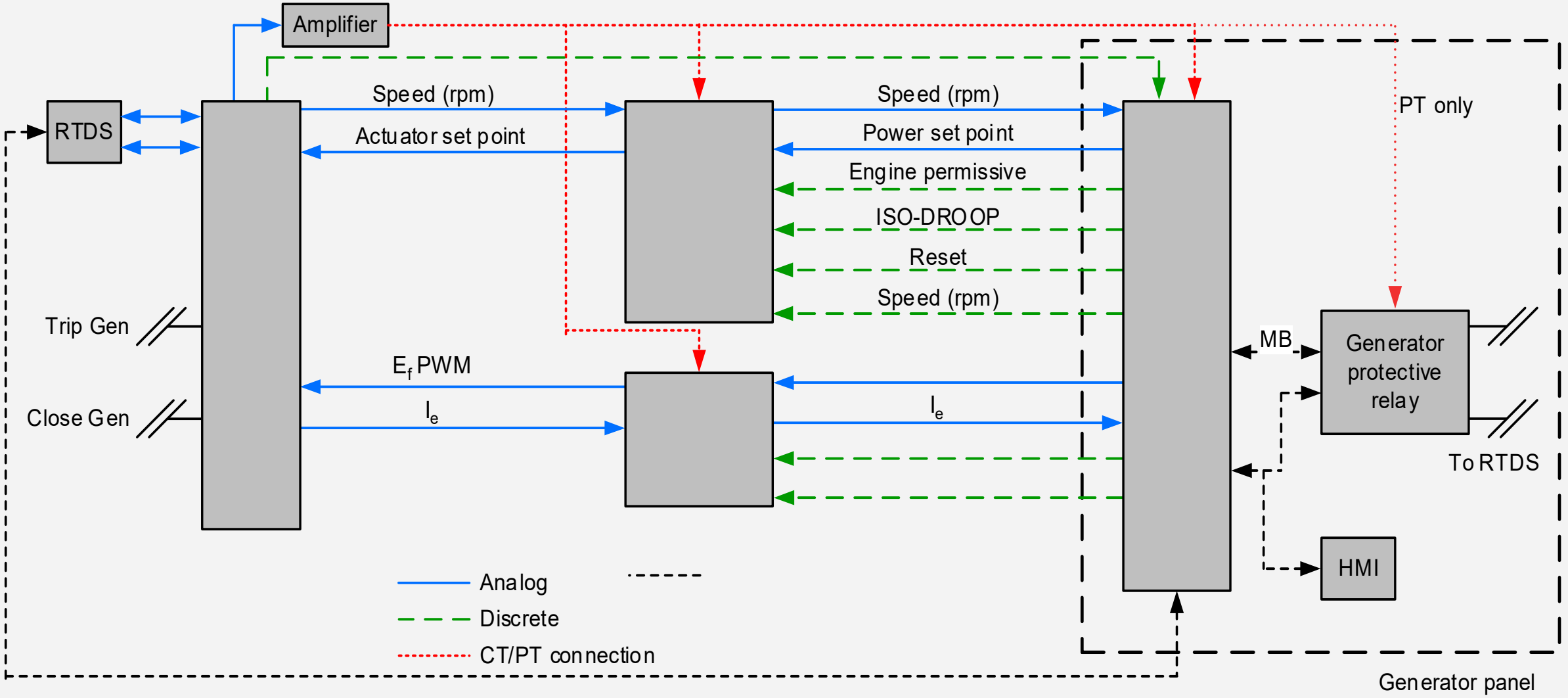
Special Protection Systems (SPS) Group

- System Stability studies
  - Voltage stability
  - Frequency stability
- Generation control
- Load shedding solutions
- SCADA
- Island based or Grid based operations
- Remedial Action Schemes (RAS)

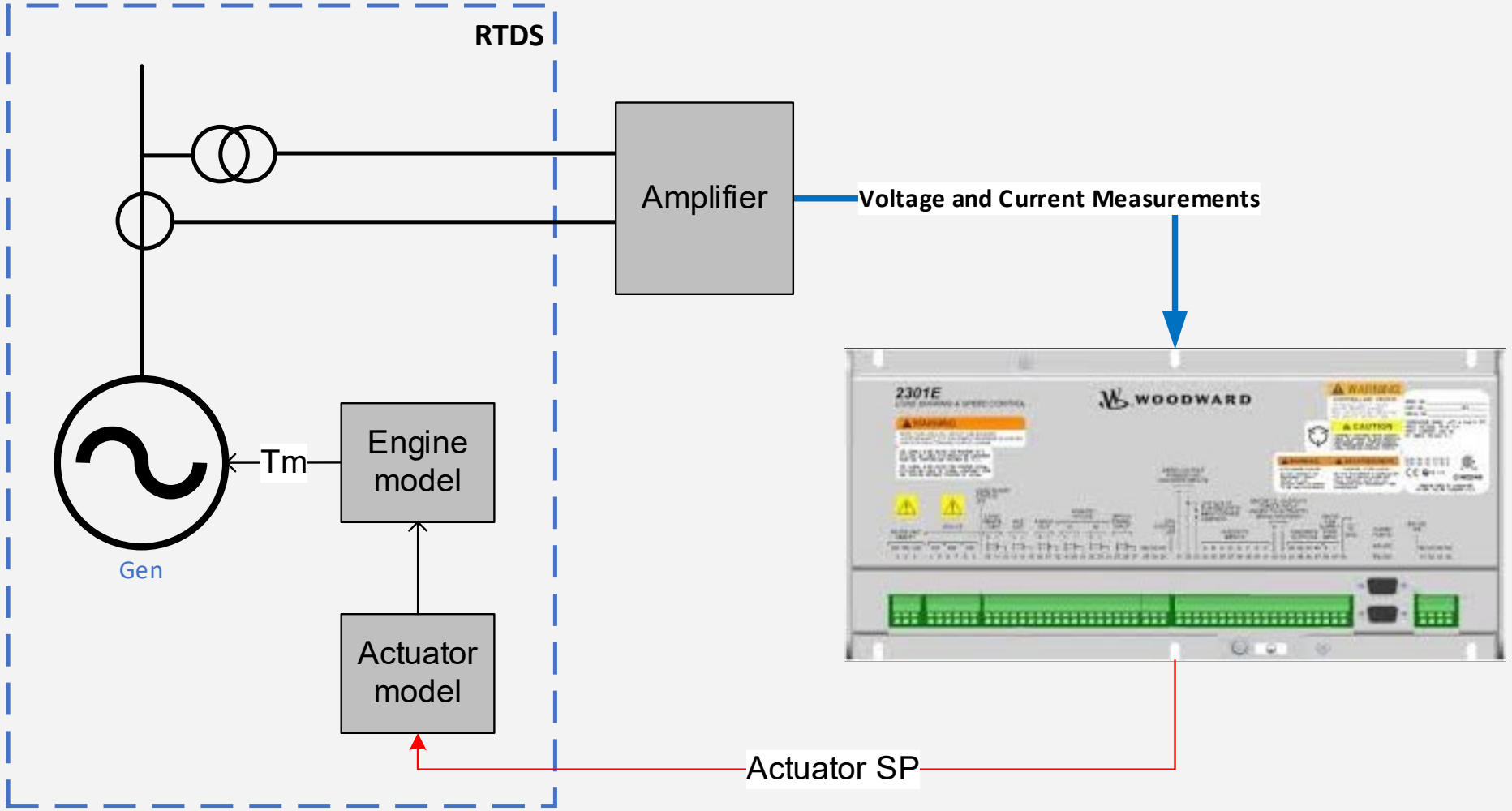
GOALS FOR THIS SYSTEM

- Generation control.
- Tuning Governor and Exciter.
- Protection for generators and feeders.
- Reactive Power control through VFDs.
- Load shedding
    - Contingency based load shedding
    - Under Frequency based load shedding
    - Rolling average algorithm (PLSP)

OVERALL SETUP



GOVERNOR DESIGN



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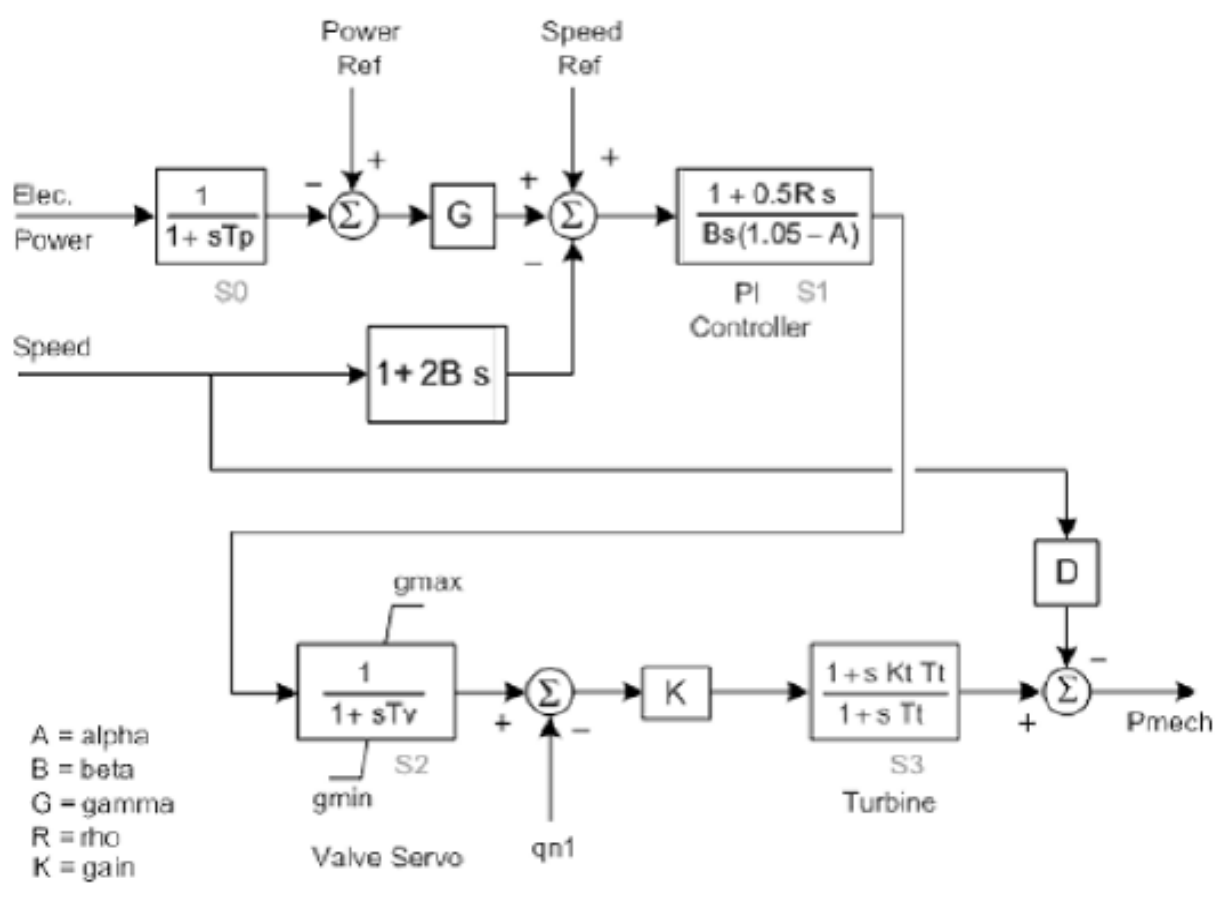
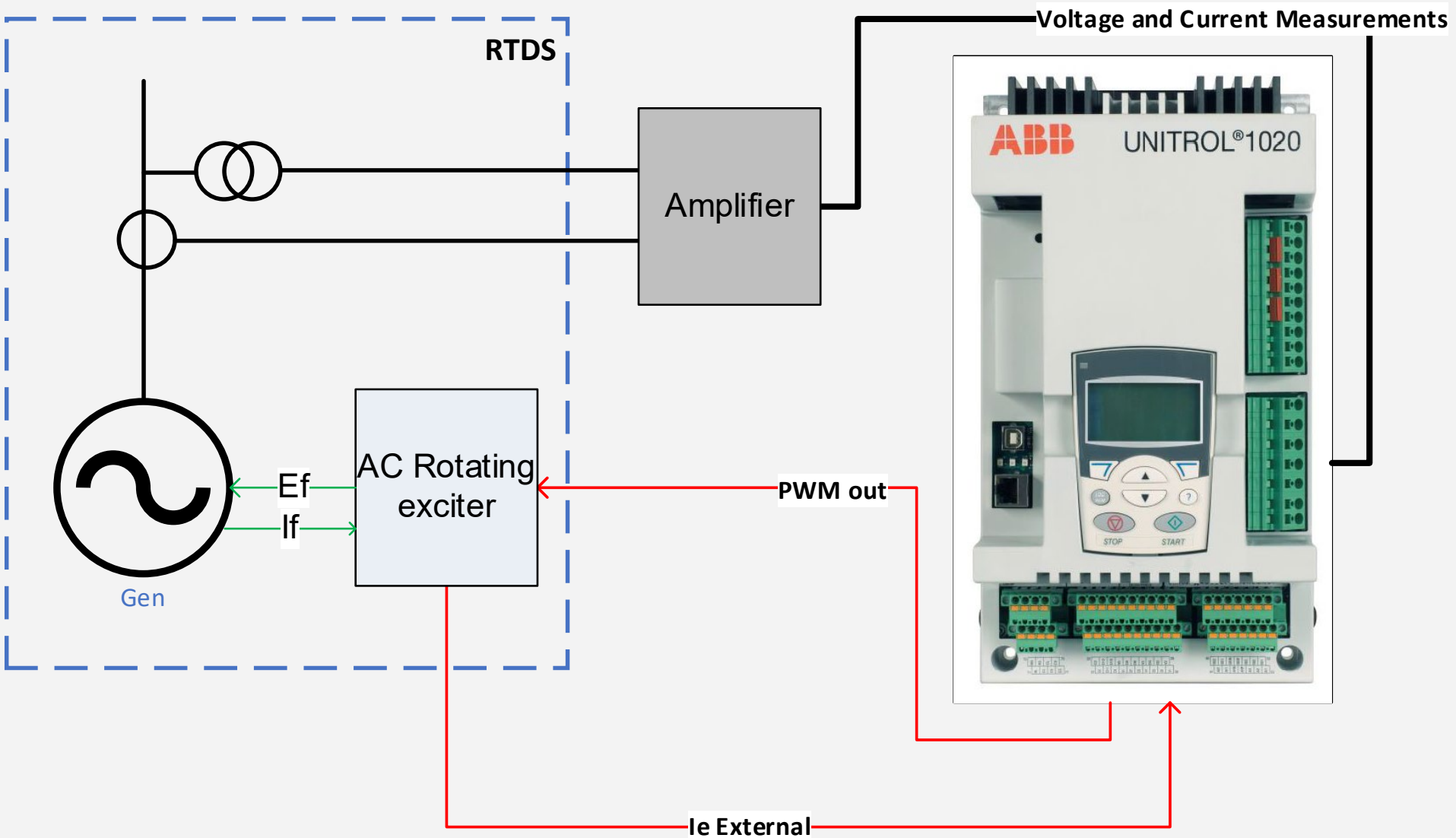


2301E model
Courtesy: ETAP

EXCITATION DESIGN



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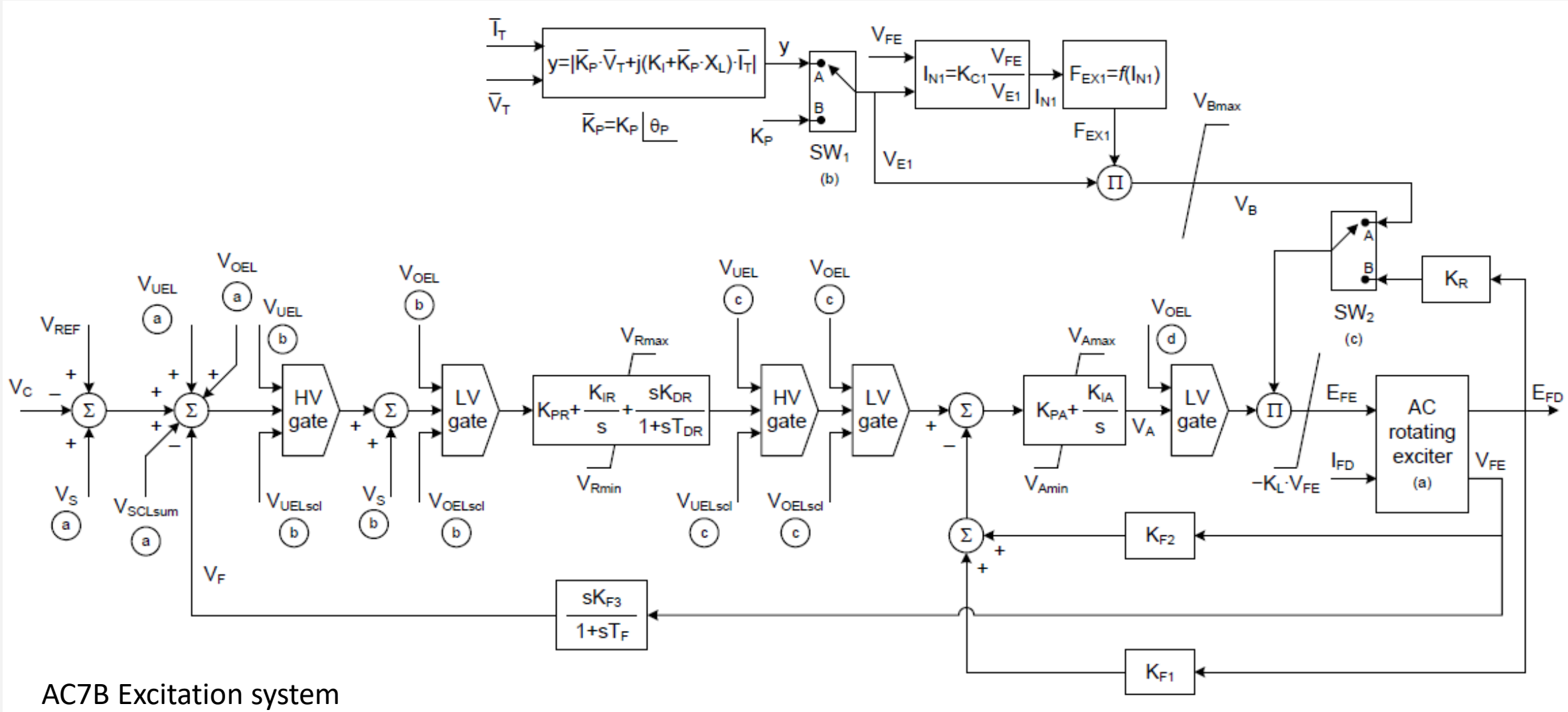
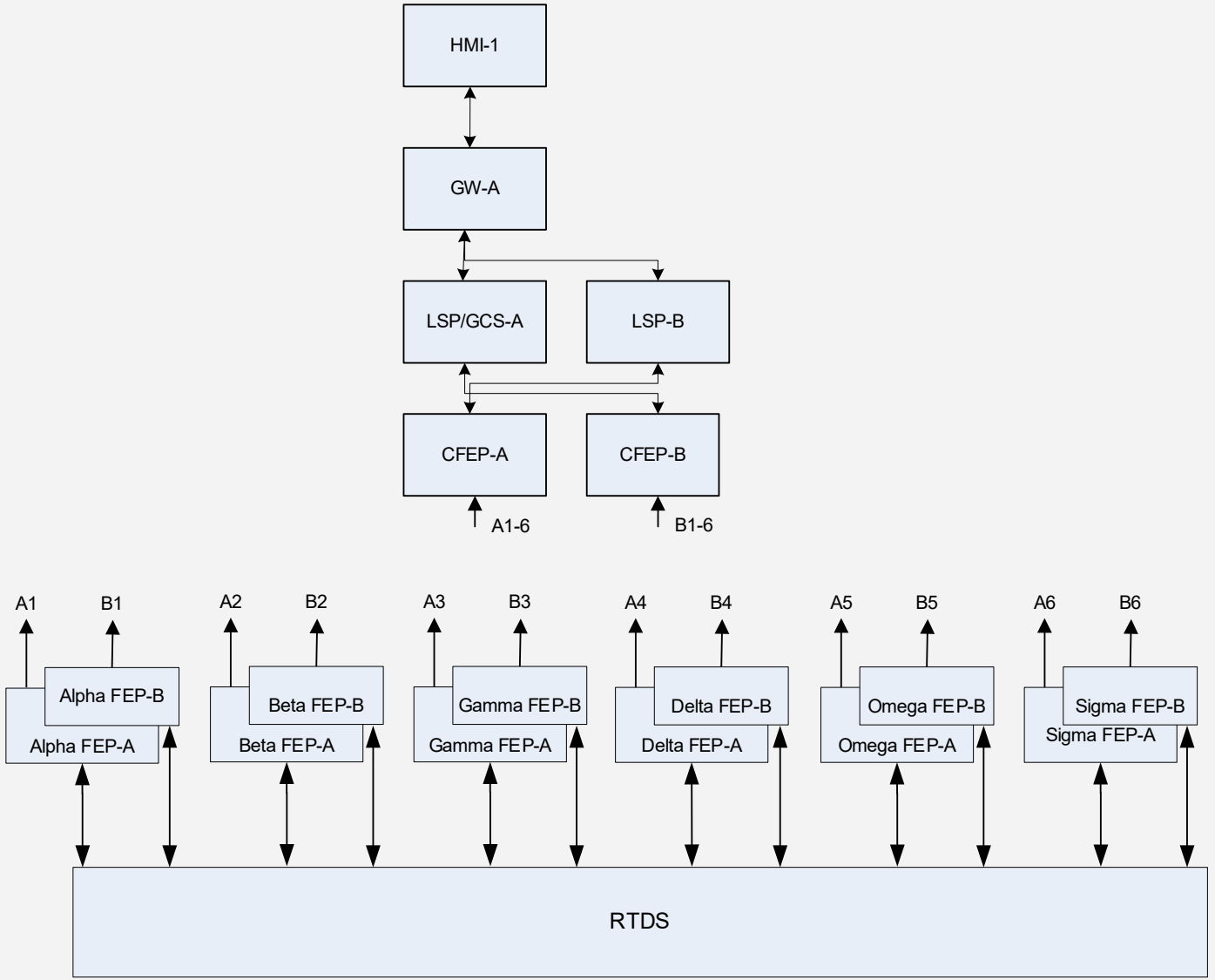


AC7B Excitation system

Ref: IEEE Std 421.5-2016

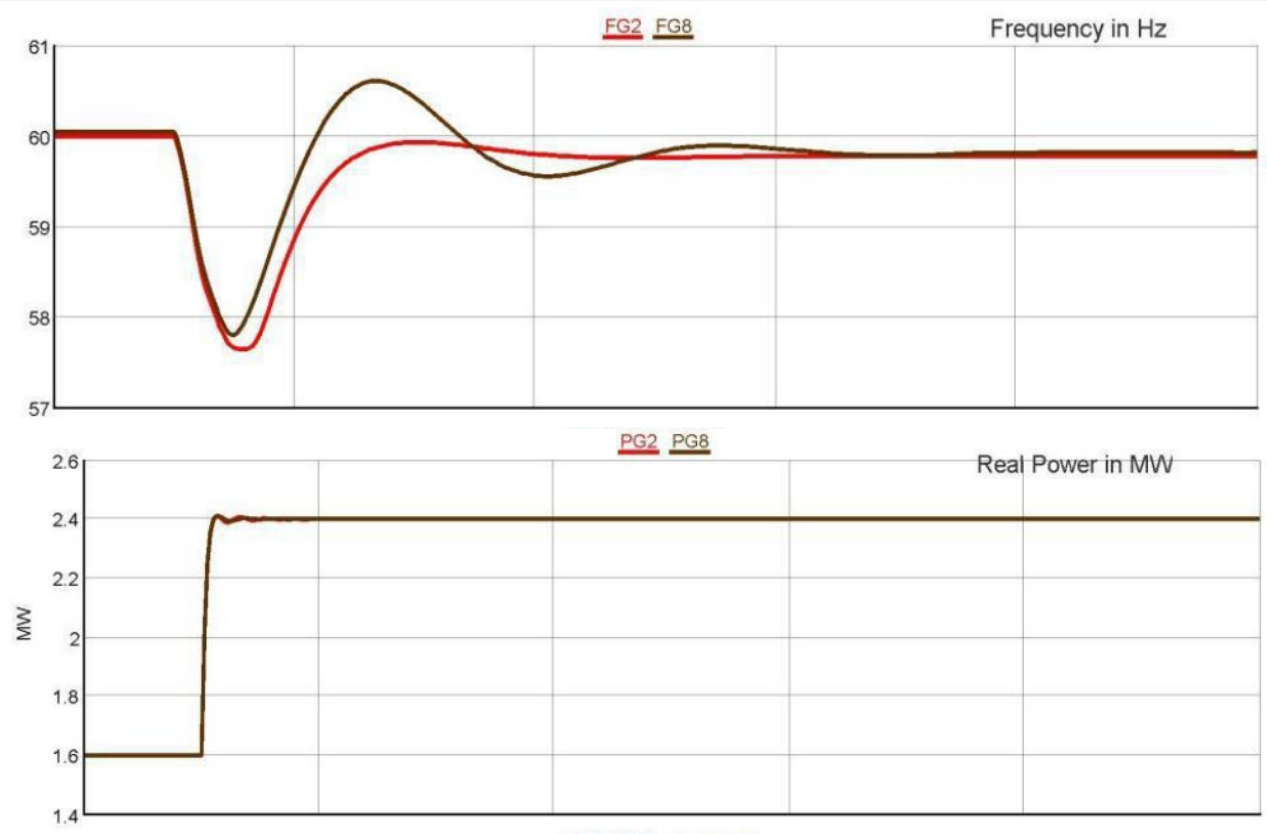
POWERMAX DESIGN

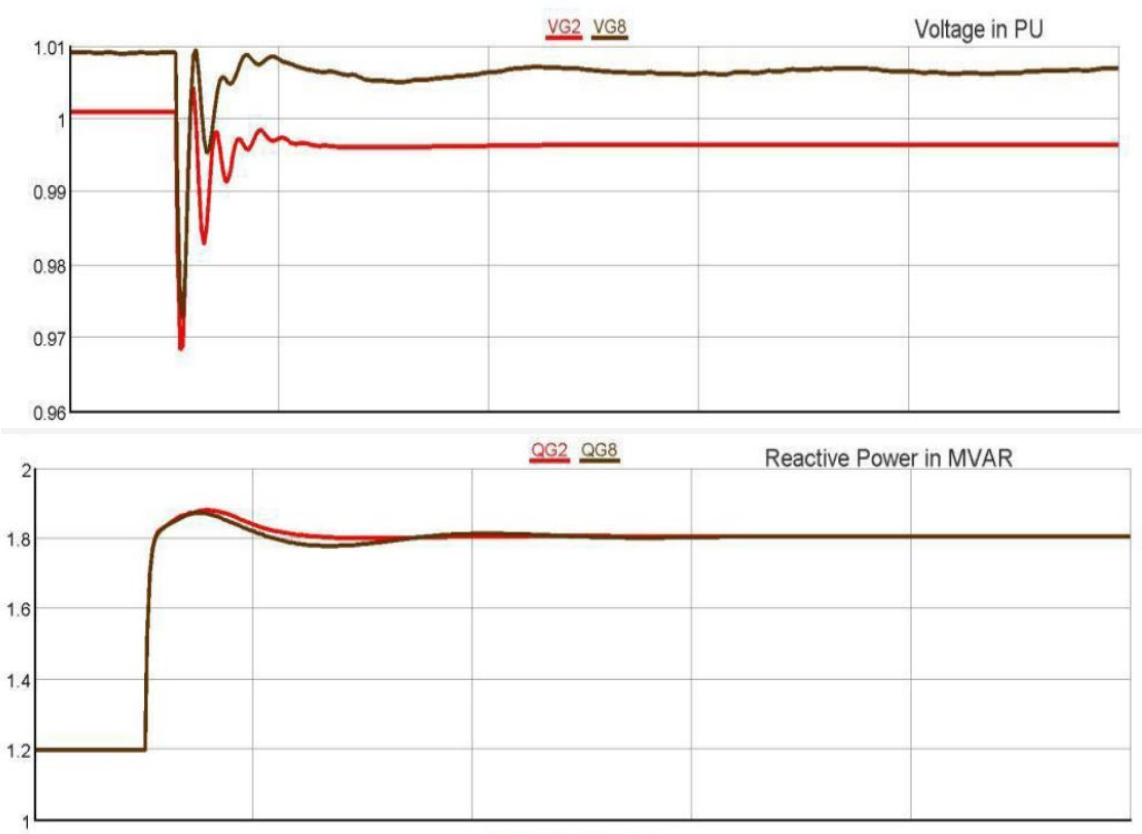


GENERATION CONTROL USING SEL-751 & SEL-700G

- Loading and Unloading generator.
- Power setpoints.
- Generator mode control (ISO/Droop; Volt/PF)
- Generator breaker trip and synchronize.
- Pushbutton interface for generation control and remote control through centralized POWERMAX™ solution.

HARDWARE VS SOFTWARE



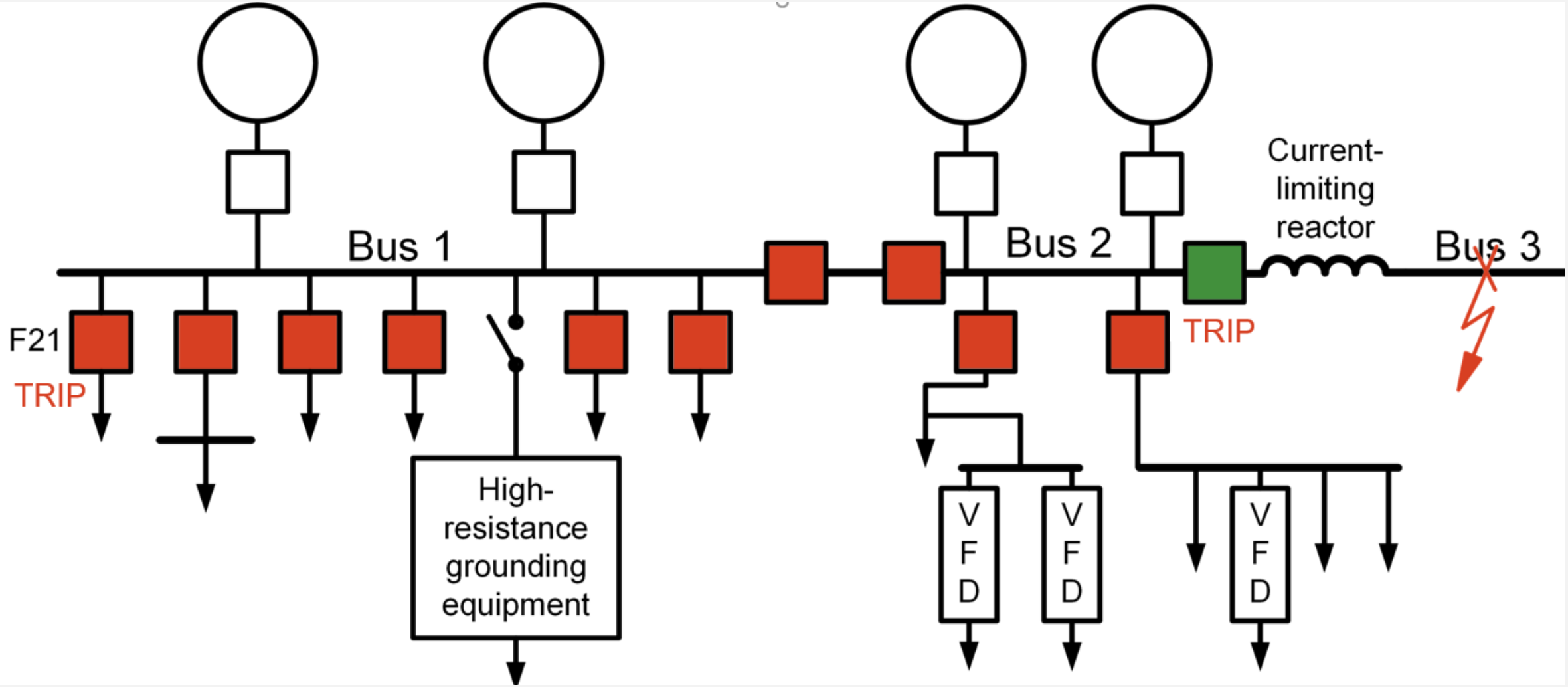


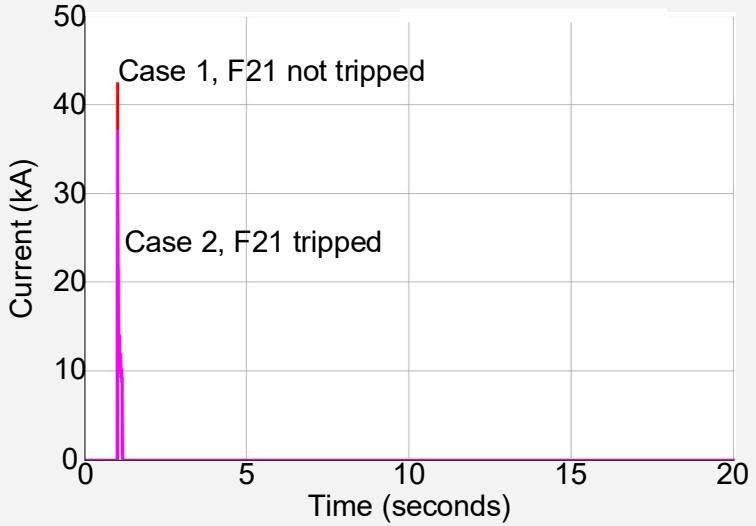
SIMULATION VS SITE

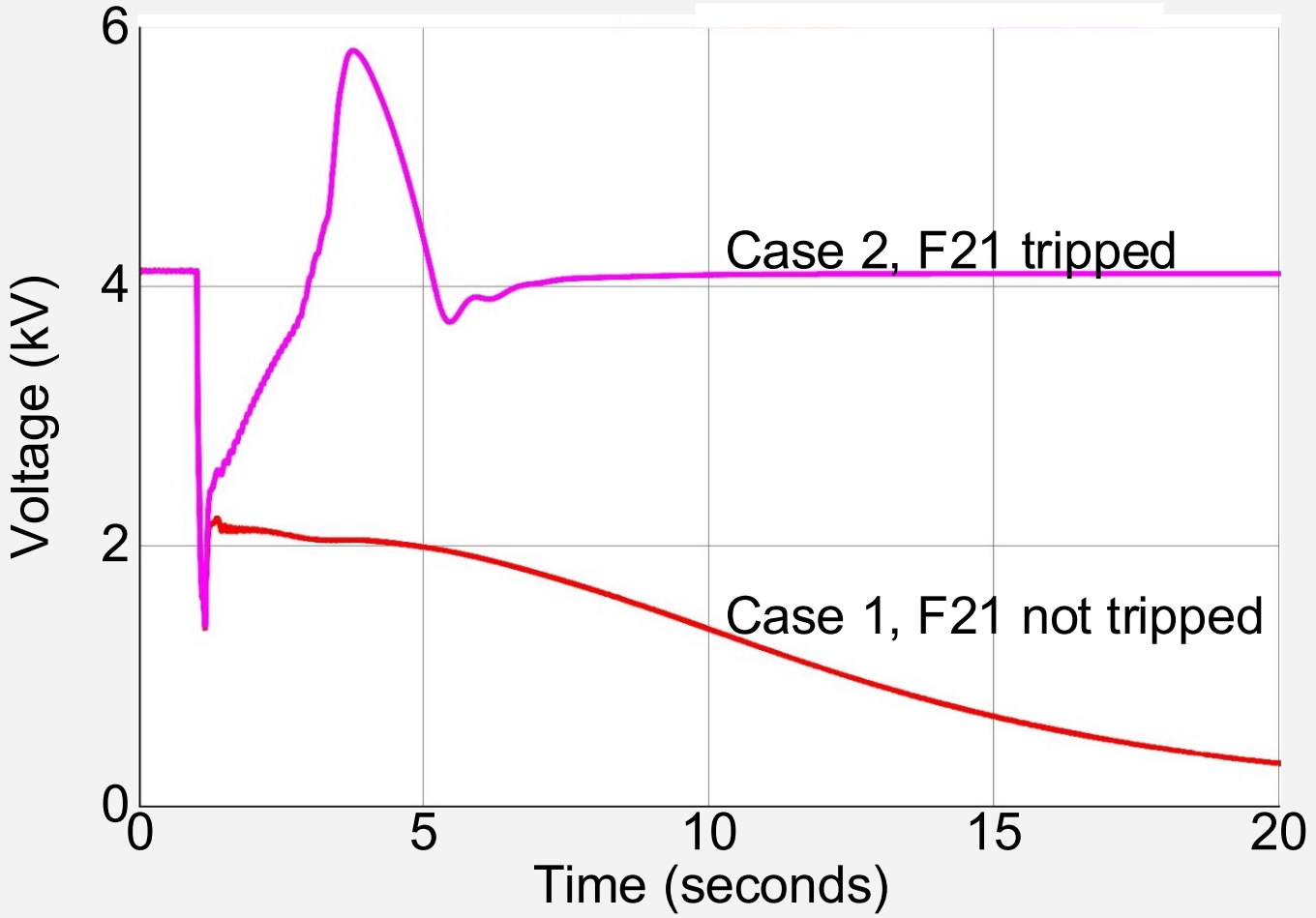
Governor	Simulation estimate	Site setting
P	3.15	3.15
I	0.75	0.75
D	0.15	0.15

AVR	Simulation estimate	Site setting
Vp	22.7	22.7
Ta	1.38s	1.38s
Tb	0.15s	0.15s

SOME INTERESTING EVENTS




Case 1, F21 not tripped
Case 2, F21 tripped
Current (kA)
Time (seconds)
0
10
20
30
40
50
0
5
10
15
20


Case 2, F21 tripped
Case 1, F21 not tripped
Voltage (kV)
Time (seconds)
0
2
4
6
0
5
10
15
20

WHAT WE ACHIEVED THROUGH HIL TESTING

- Validation of Power system.
- Validation of generator controls through SEL 751.
- Validation of PowerMAX algorithms.
- Protection validation.
- Corner cases and special logic for system stability.
- Pre tuning generator governor and exciter.