

ONS Real-Time Dynamic Simulator

Arthur Mouco Ph.D.



Brazilian ISO Challenges



Fifth largest country by area

- 8.5 million km²

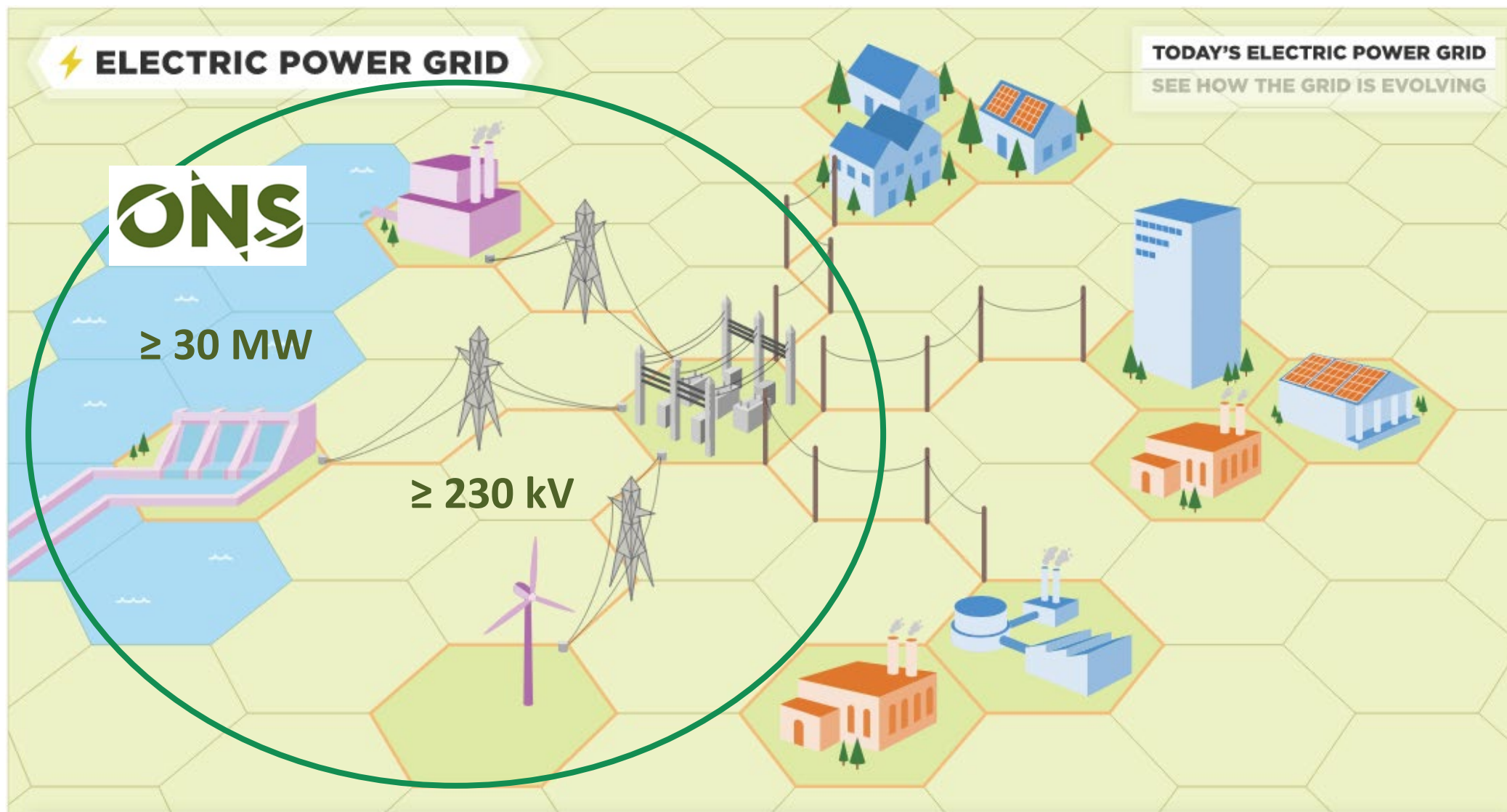
Sixtieth most populous

- 213 million people

Country Size Comparison

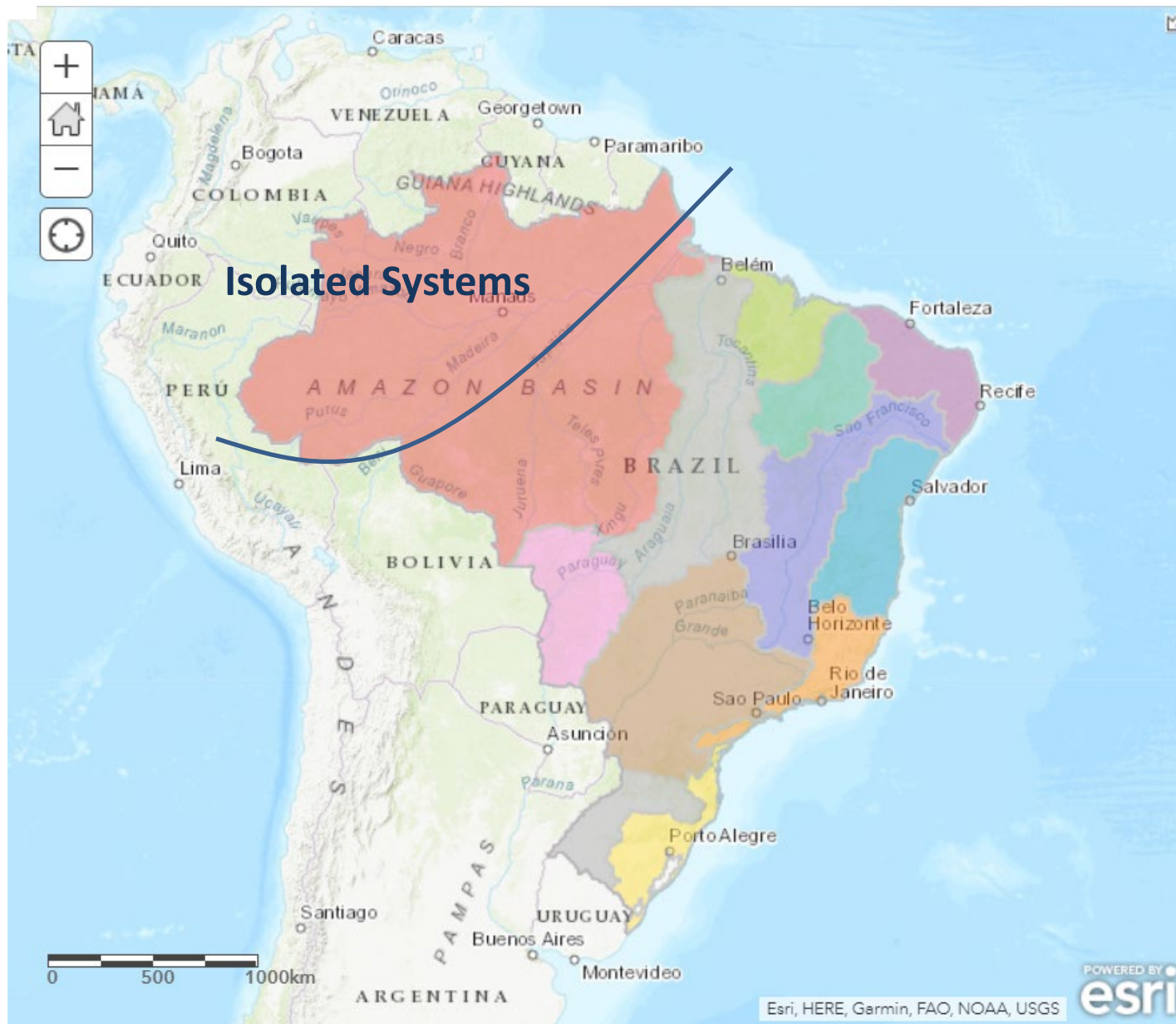


<https://thetruesize.com/>



Source: www.epa.gov

Brazilian ISO



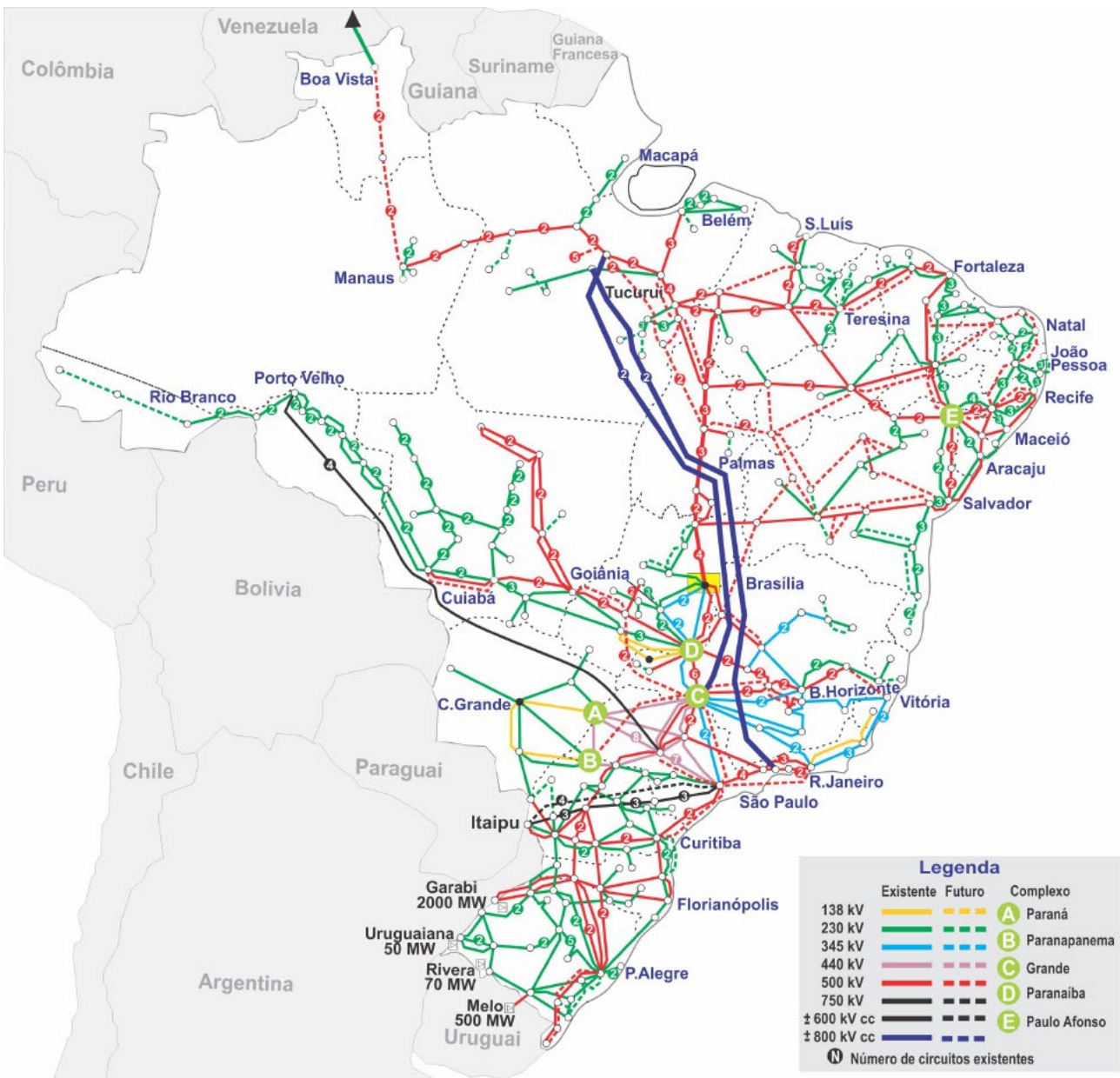
99% Brazilian Load

Isolated Systems

≈ 300 cities

Small thermal power plants

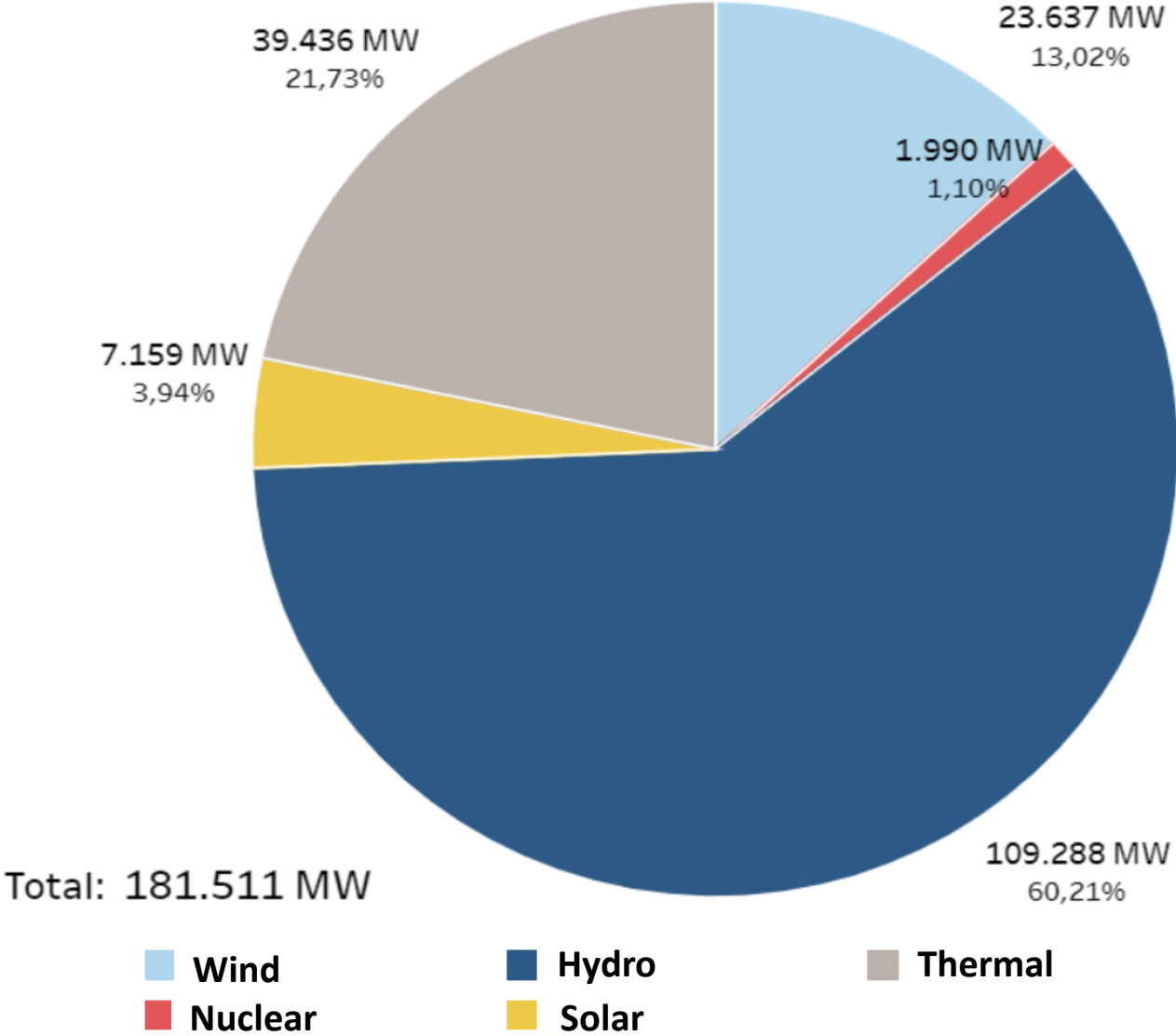
Transmission System



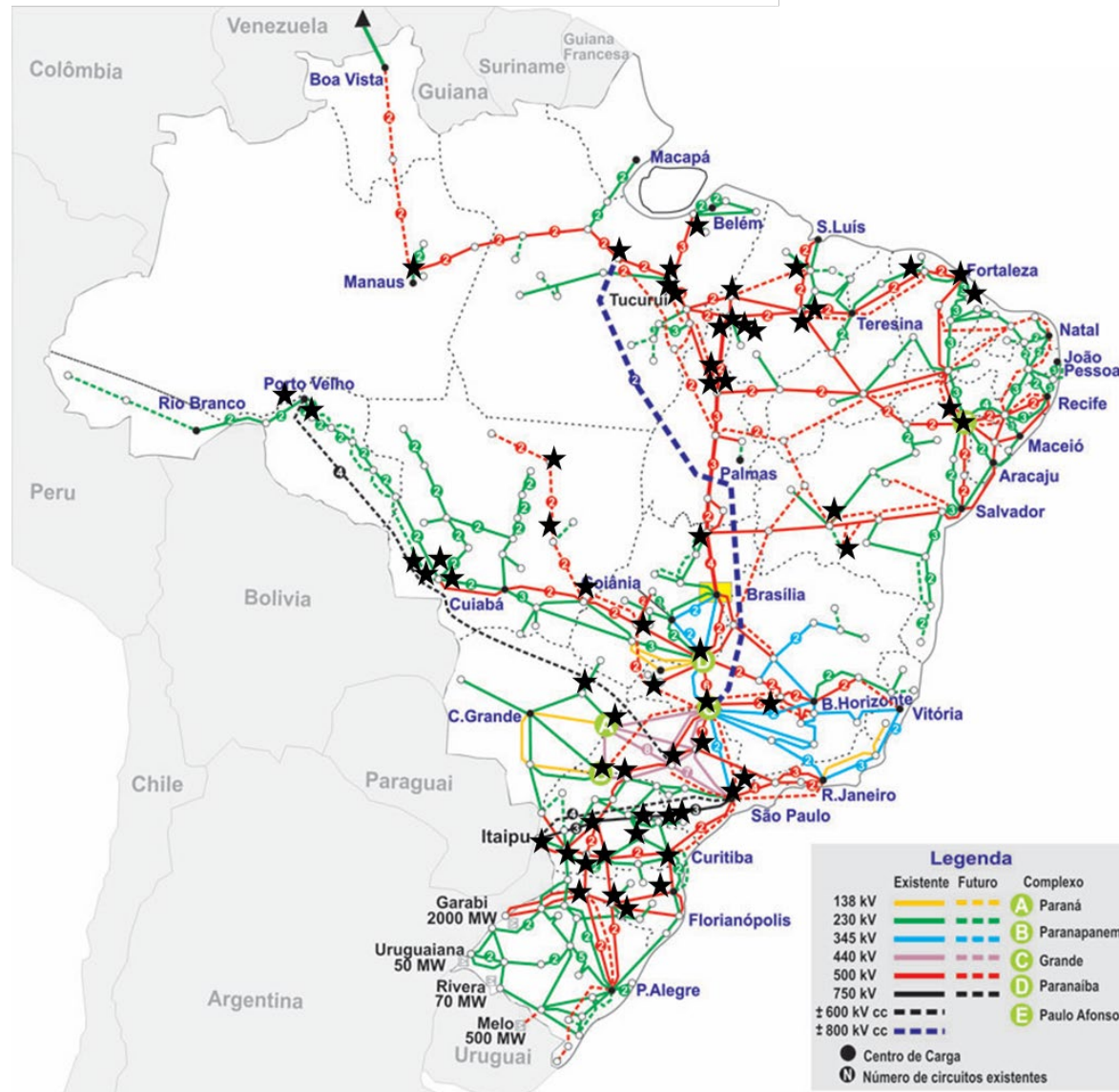
2022
179 311 km

2027
270 558 km

Energy Matrix



PMU Deployment



Status

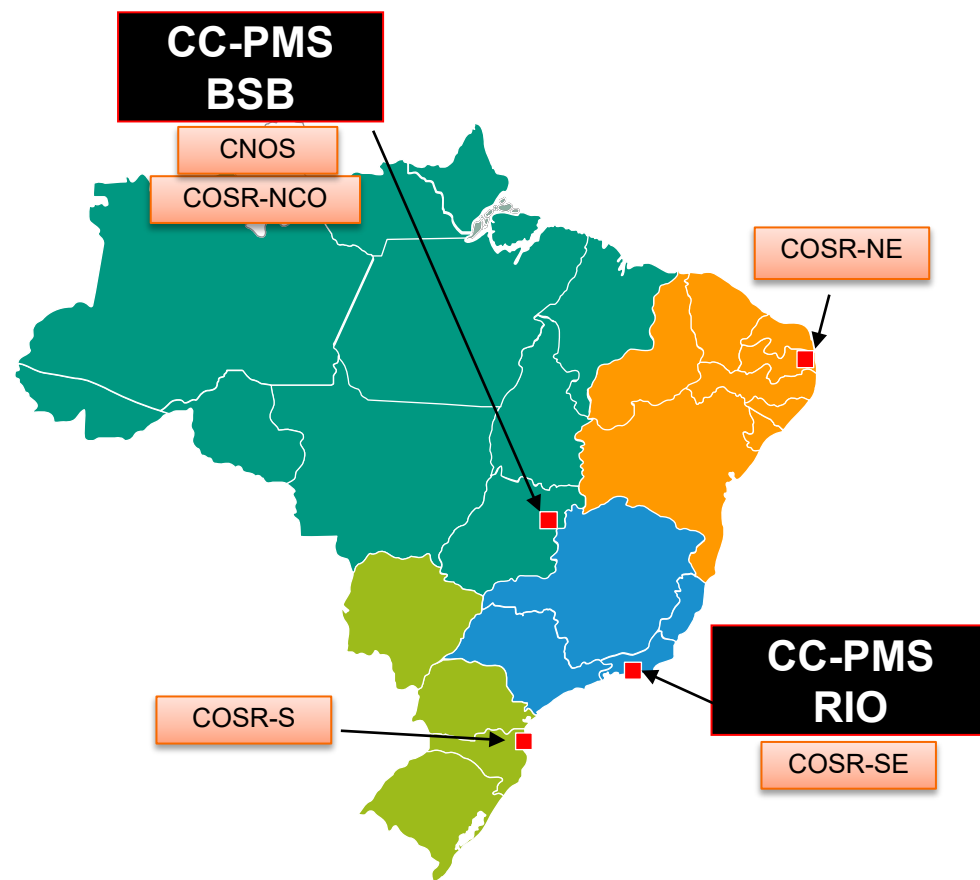
- 350 PMUs in OP
- Data Quality ~ 80 % good
- Data Availability ~ 85 %

1000
6000
2000
10000

PMUs
phasors
Add. Meas.
Digitals

at 60 fps

CC-PMS - Layout



SCS - Supervision & Control System (4 sites)

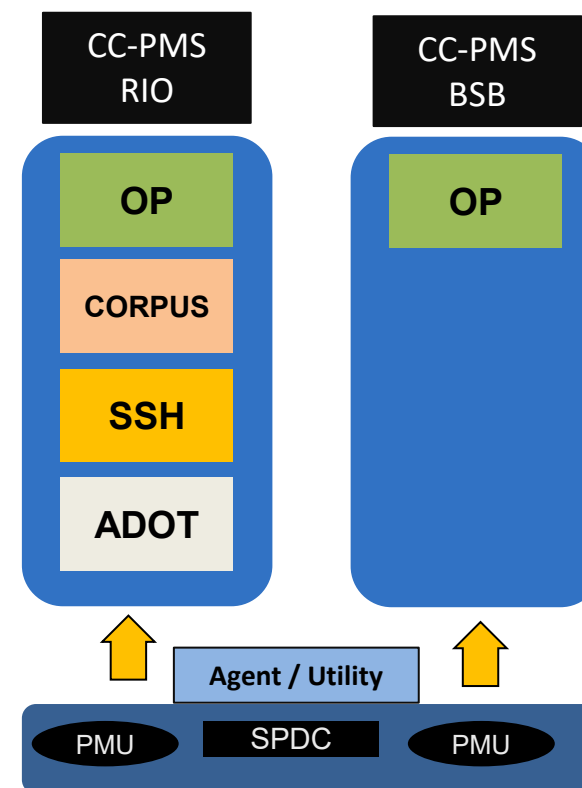
CNOS - National Control Center

COSR-NCO - North Central-West Regional Control Center

COSR-NE - Northeast Regional Control Center

COSR-SE - Southeast Regional Control Center

COSR-S - South Regional Control Center



OP - Operation Production

CORPUS - Corporate User System

SSH - System Staging & Homologation

ADOT - Application Development &

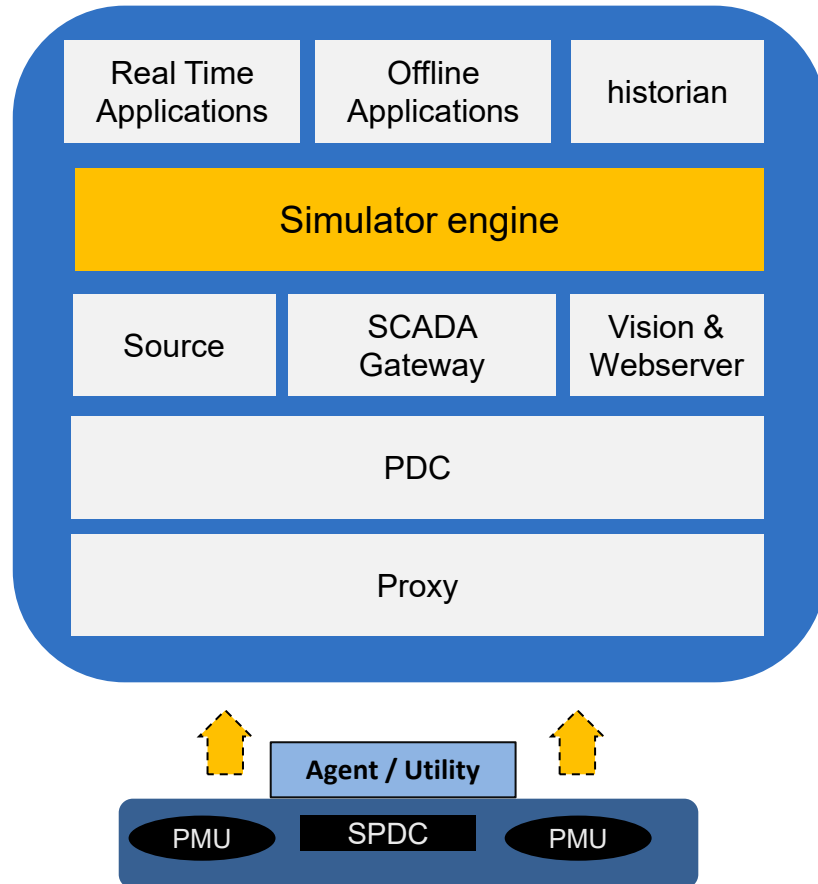
Operator Training

Real Time

Alarm Management
Composite Alarms
Oscillation Monitoring
F, V&I, Power Flow Monitoring
System Disturbance
Islanding & Restoration
Dynamic Stability Assessment

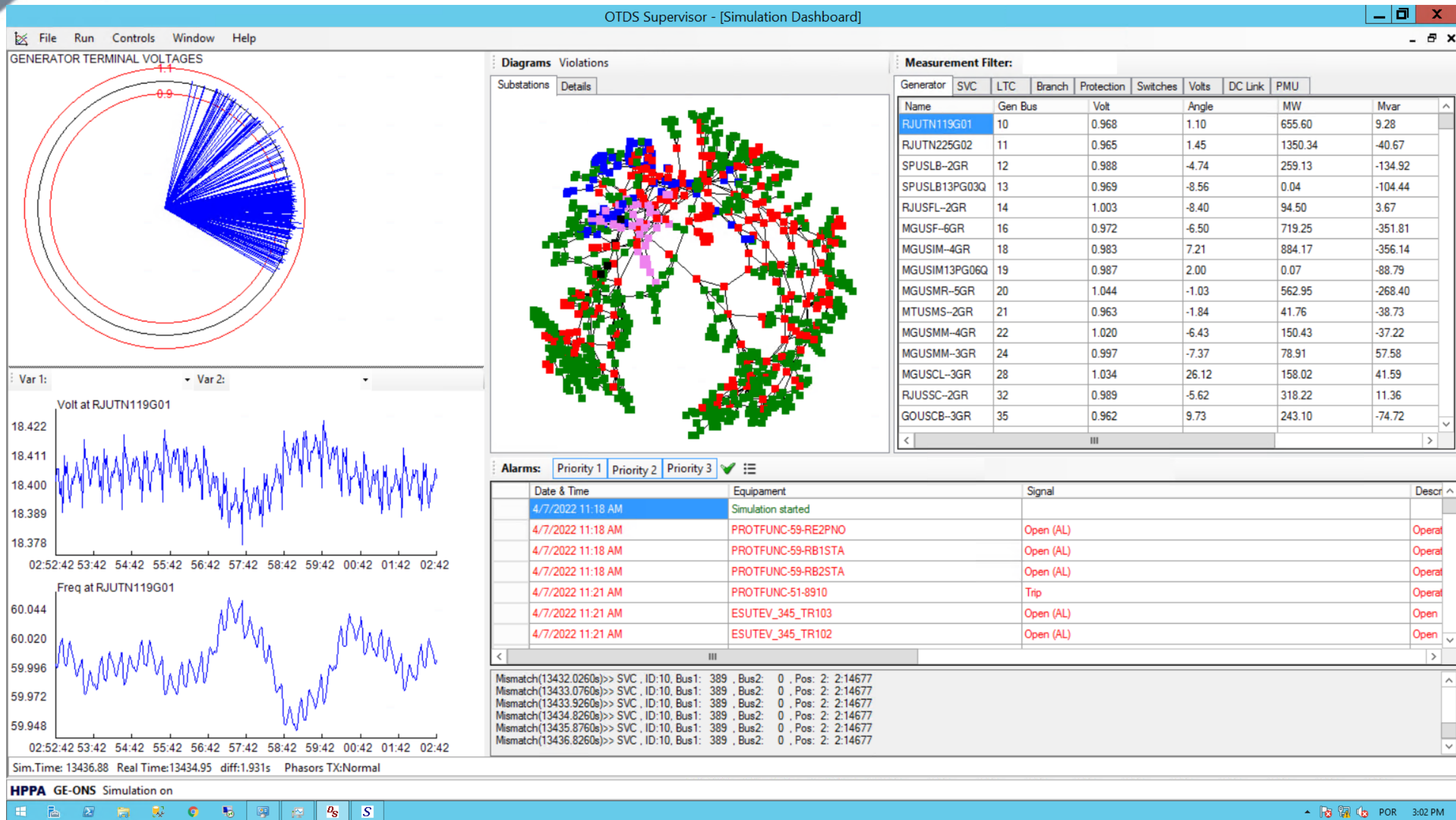
Offline

User Calculations
Spectral, Modal & Event Analysis
Reporting capability
Training Environment
Historical Event Storage

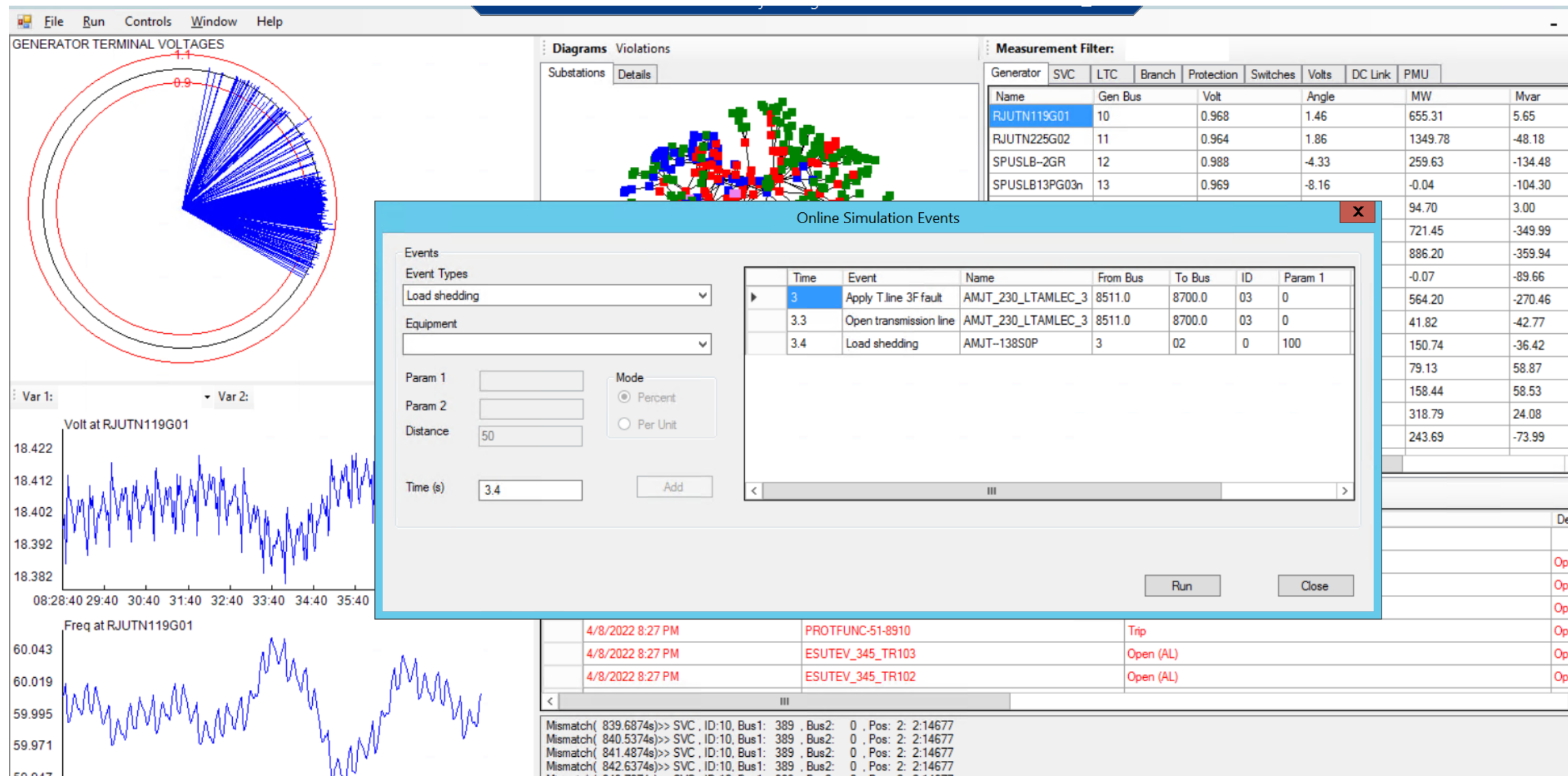


Special characteristics:

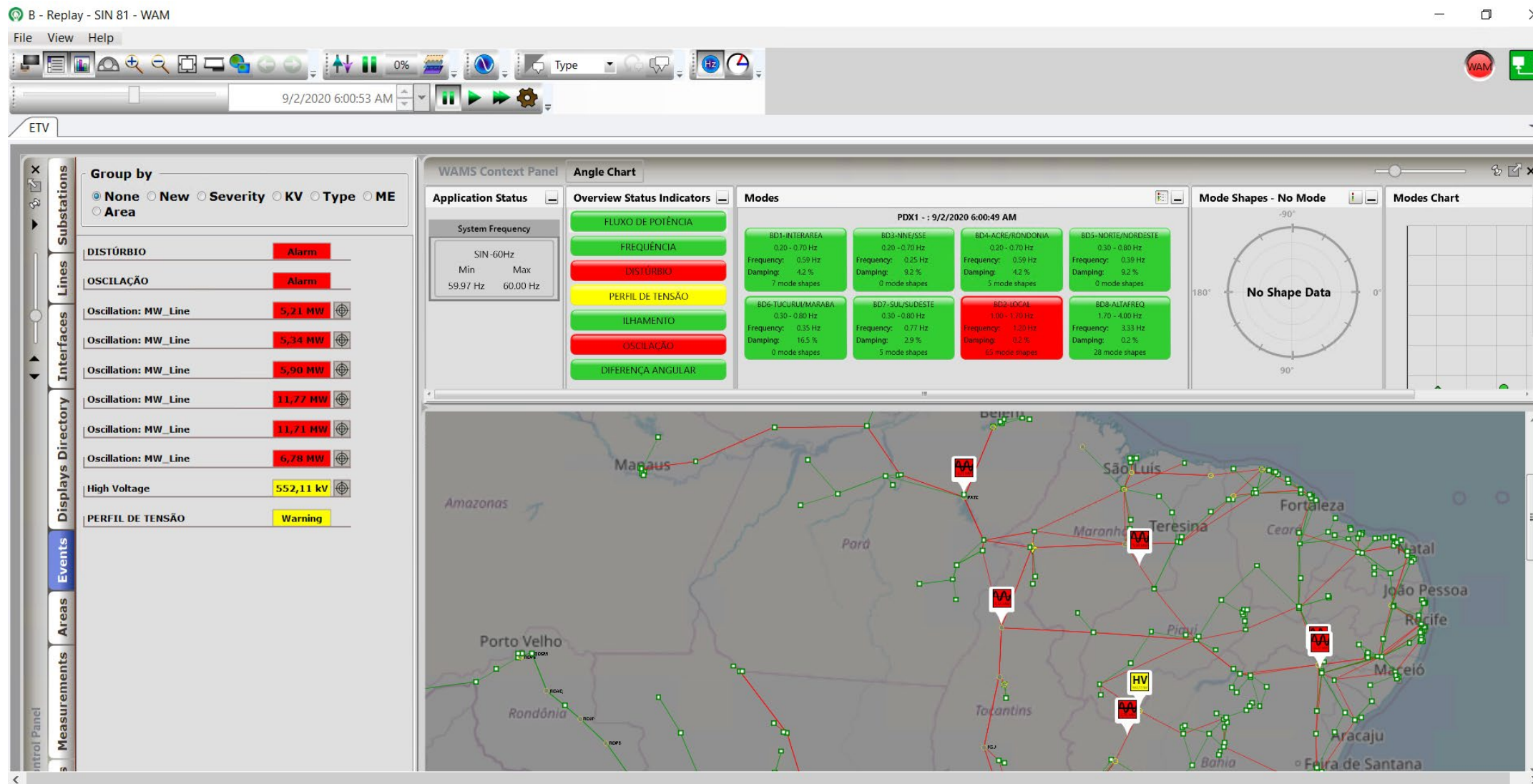
- Simulator – generates current and voltage phasors based on fully electromechanical models. These phasors are sent to PDCs at a rate of 60 ftp using the IEEE C37.118 protocol and then sent to be consumed by applications in real time and offline. The simulator allows you to do:
 - Start / stop the simulation
 - Changing generation & load
 - Open & close equipment's (LT / TR / SC / EC / RE / CA)
 - Separate & reconnect bus bars
 - Generate errors in loads and phasor measurements
- The dynamic models are the same as those used by the planning and engineering teams and benefit from the evolutions made in the database of dynamic models by these teams.
- Supported models: hydraulic generators, wind generators, thermal units, HVDC, different load models, protection schemes. All lines and transformers receive standard protection automatically (zone protection, bus protection, etc.)



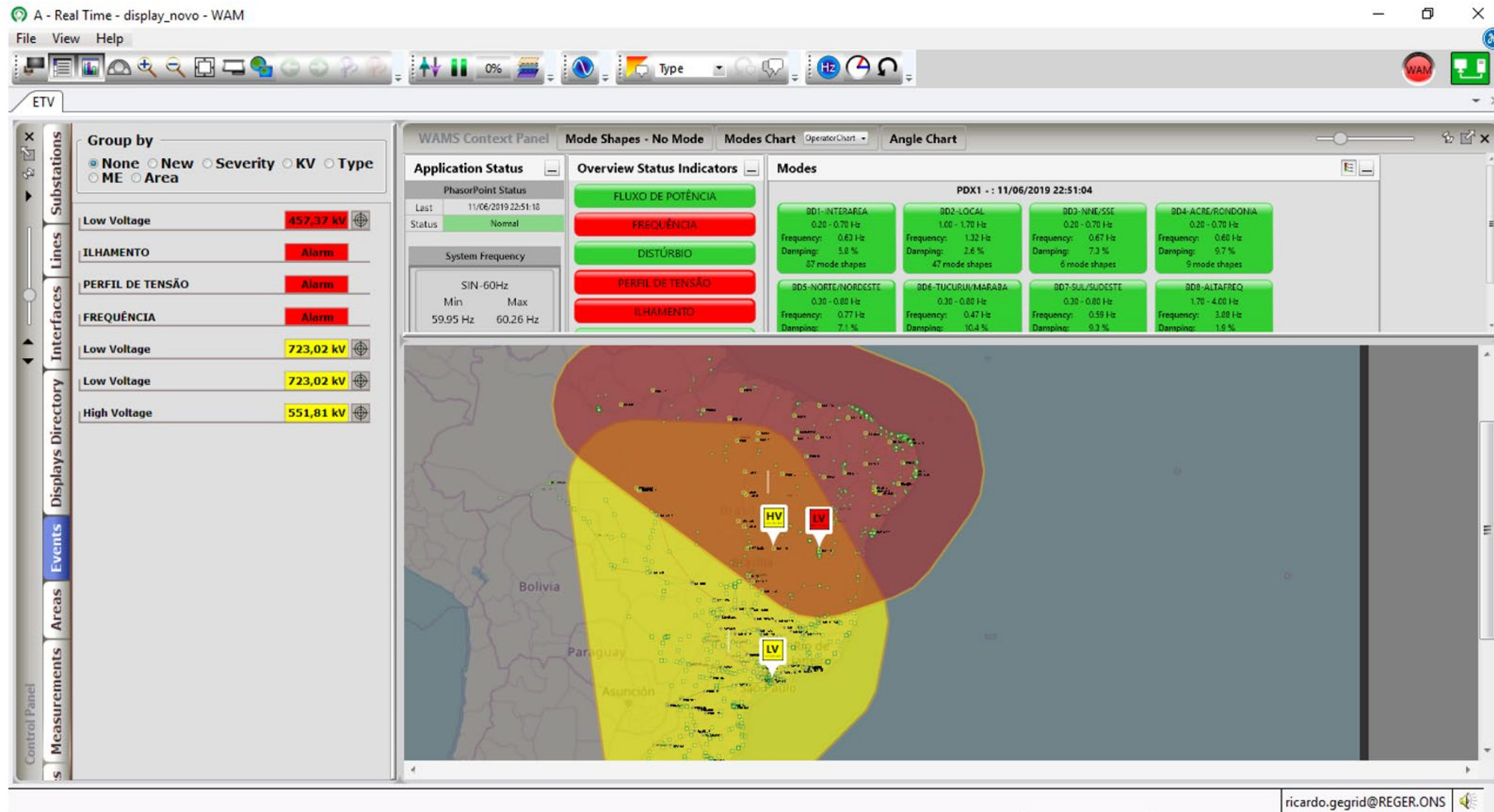
Simulator



Simulator Output



Simulator Output



CC-PMS – Simulator Characteristics

Real-time Environment – What was observed by a PMU near the problem

Simple to use - get a pre-fault base case from State Estimator, start a simulation, and reproduce the disturbance.

Simulator – What was observed by the same PMU



Team



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Thank You!



Questions?

