Real-time monitoring of controls & power flow on 2x400MVA 230kV Phase-Shifting Transformer using PMU

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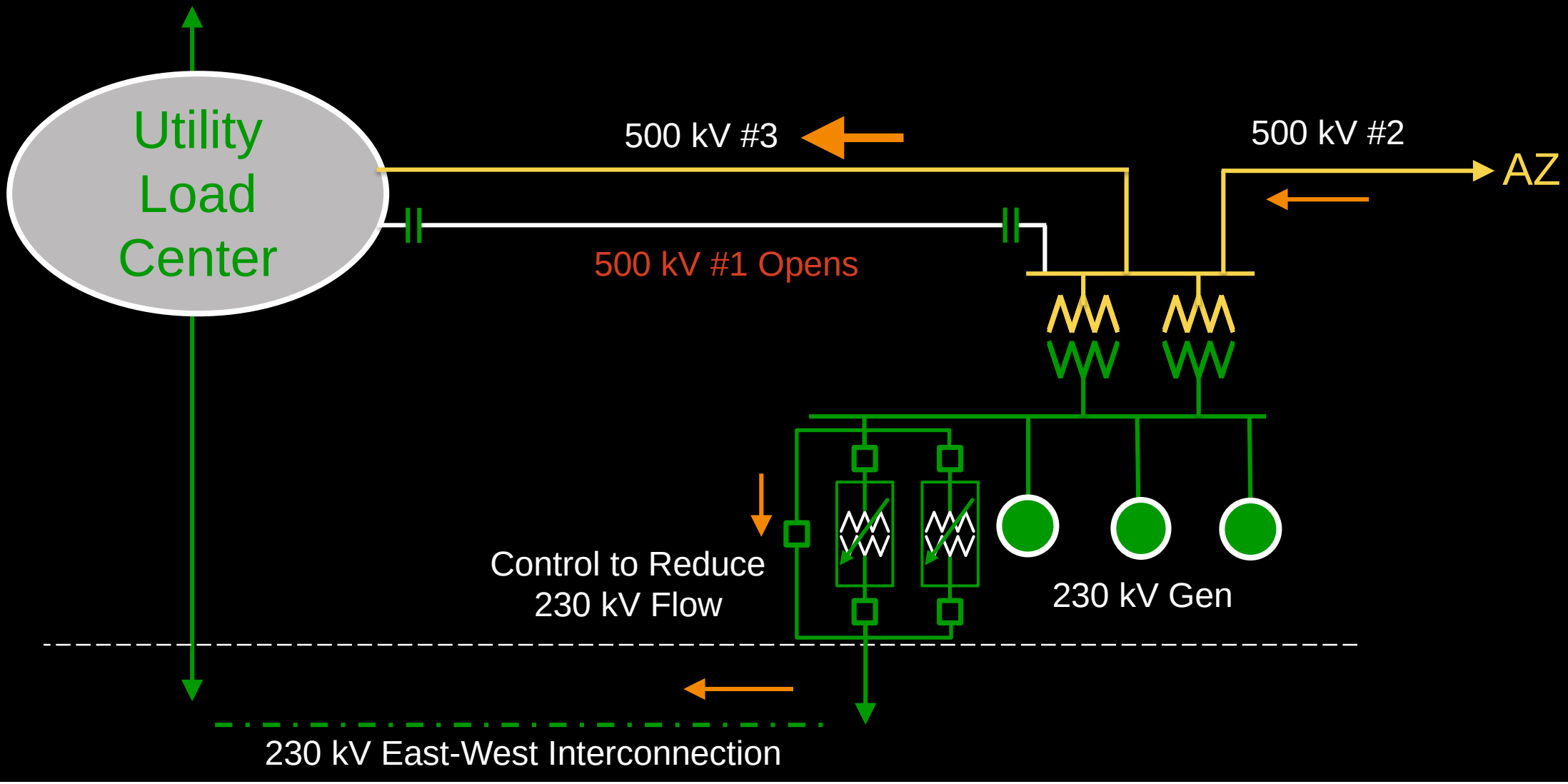
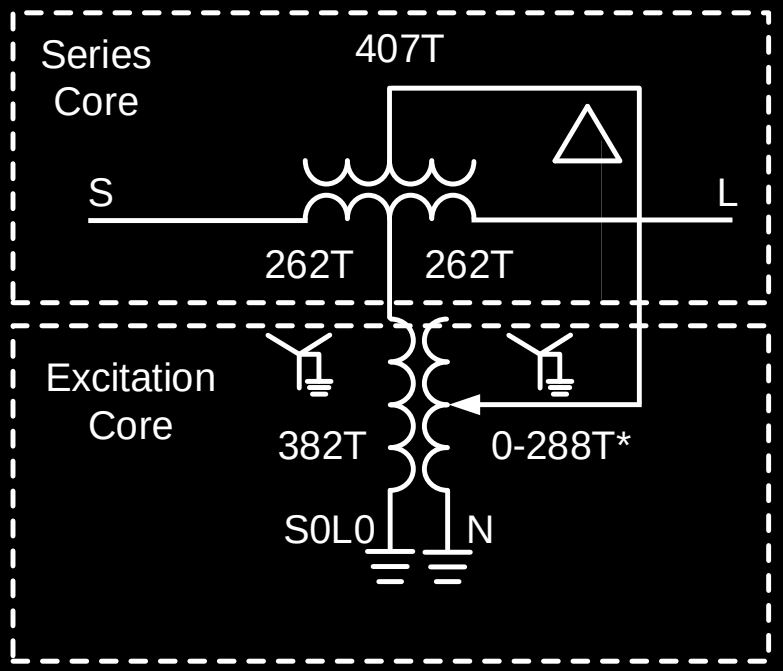
PST 1 at Imperial Valley

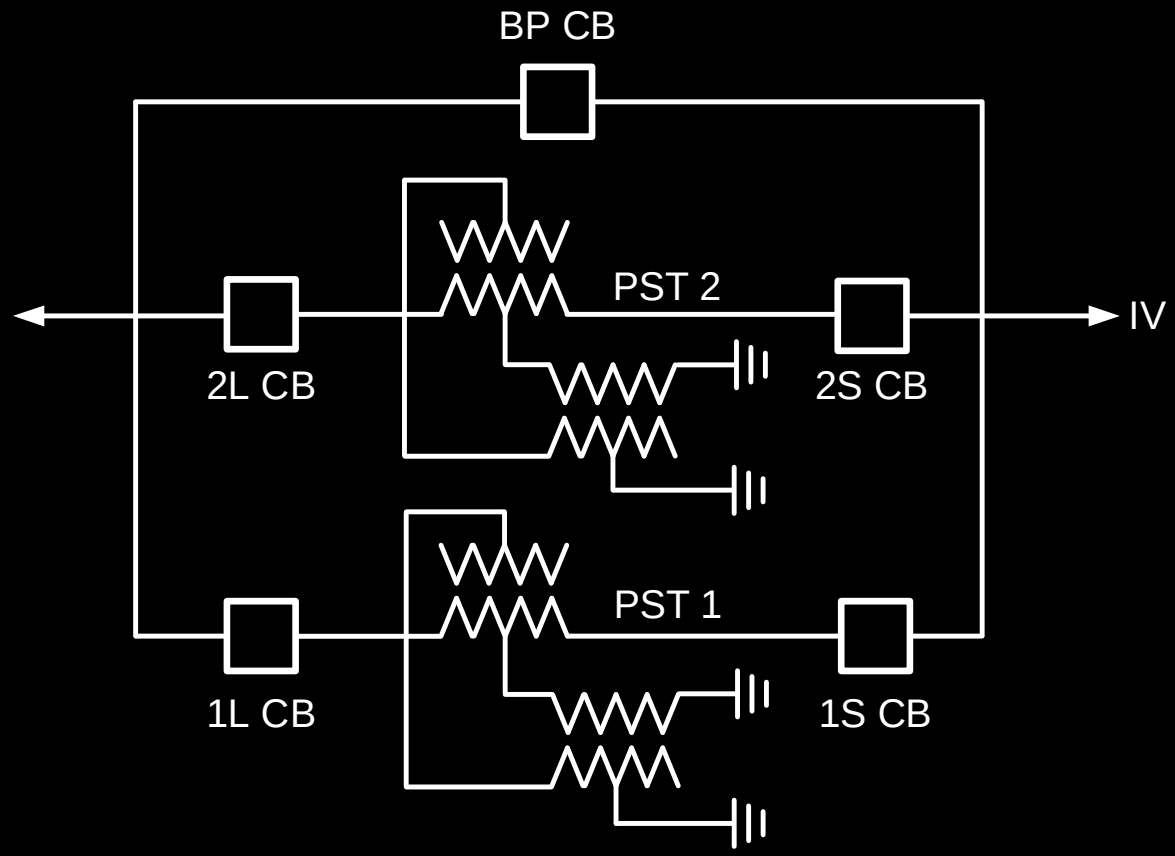
PSTs Provide Flow Control During Line Outage



Two-Core PST



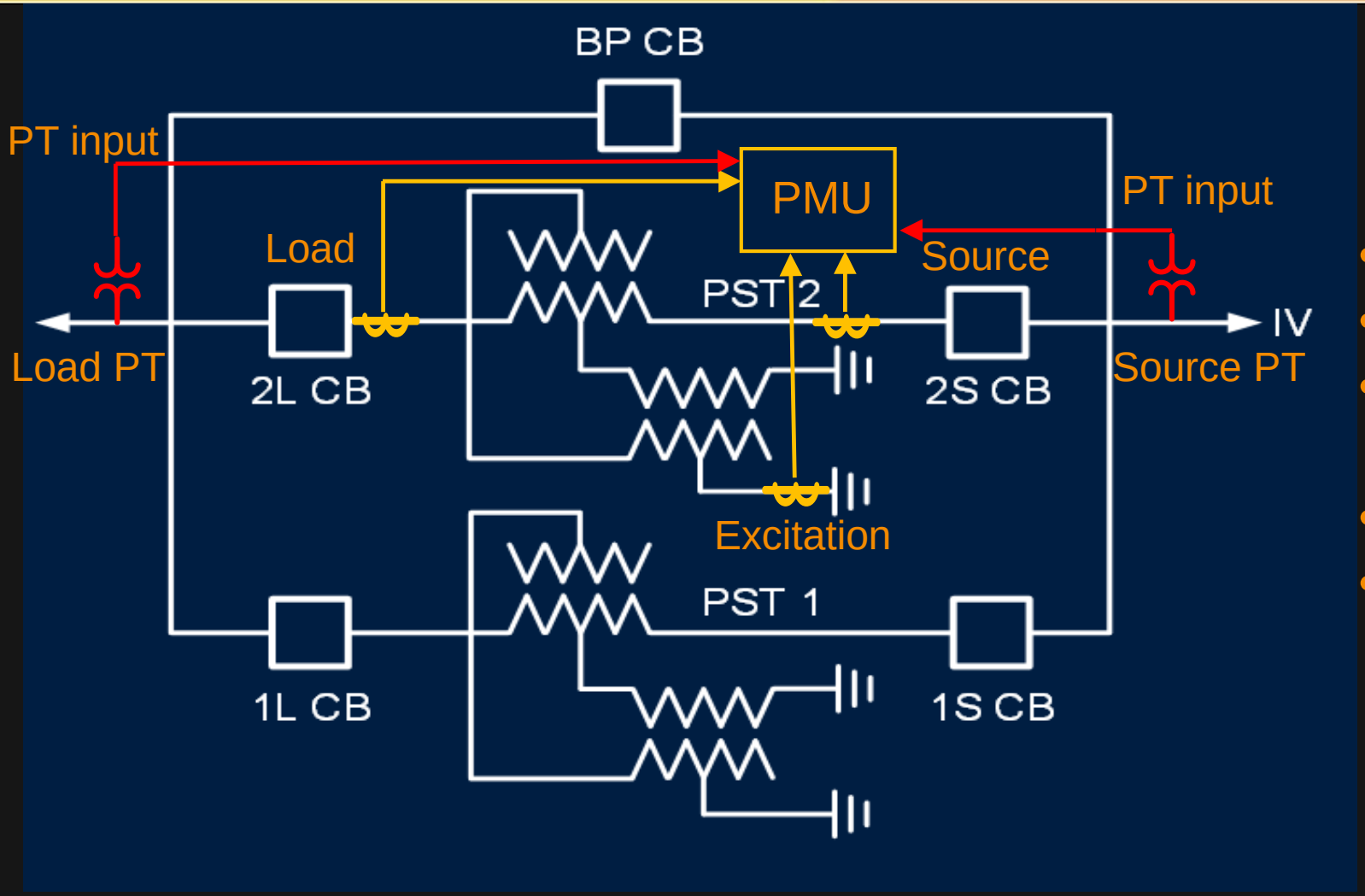
* Variable with tap position and ARS.
(Excitation secondary includes coarse, fine, and booster windings.)



Tap Changer Control Specifications

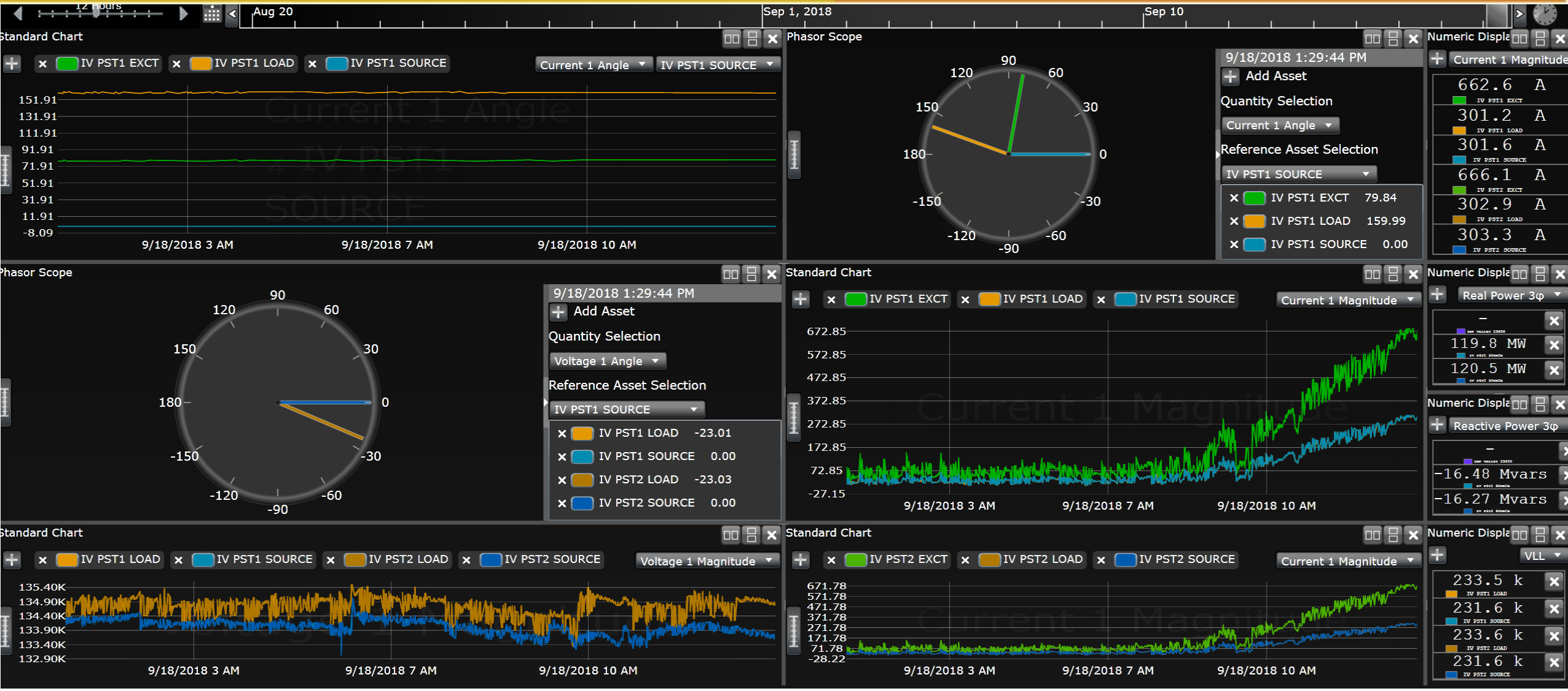
- Control of tap-changer
  - Independent-Master-Follower
  - Automatic / Manual / Off
  - Local / remote
- SCADA interface
- Two modes of automatic regulation
  - SETPOINT mode
  - N-1 OL
- Paralleling control

PST 2 - PMU Outputs



- Source current
- Load current
- Excitation current
- Source voltage
- Load voltage

Synchrophasors: PST LTC Position –10



Calculation of LTC Setpoint

$$\text{Tap position} = \frac{\text{PST Load angle} - 180}{2} = \frac{159.99 - 180}{2} = \frac{-20.01}{2} \approx -10$$

$$\text{Tap position} = \frac{\text{PST Excitation angle} - 90}{1} = \frac{79.84 - 90}{1} = \frac{-10.16}{1} \approx -10$$

Synchrophasors: PST LTC Position +9

Calculation of LTC Setpoint

$$\text{Tap position} = \frac{\text{PST Load angle} - 180}{2} = \frac{-162.2 - 180}{2} = \frac{-342.2}{2} = +8.9 \approx +9$$

$$\text{Tap position} = \frac{\text{PST Excitation angle} - 90}{1} = \frac{98.82 - 90}{1} = \frac{+8.82}{1} \approx +9$$

Real-time Tap position display

Questions?