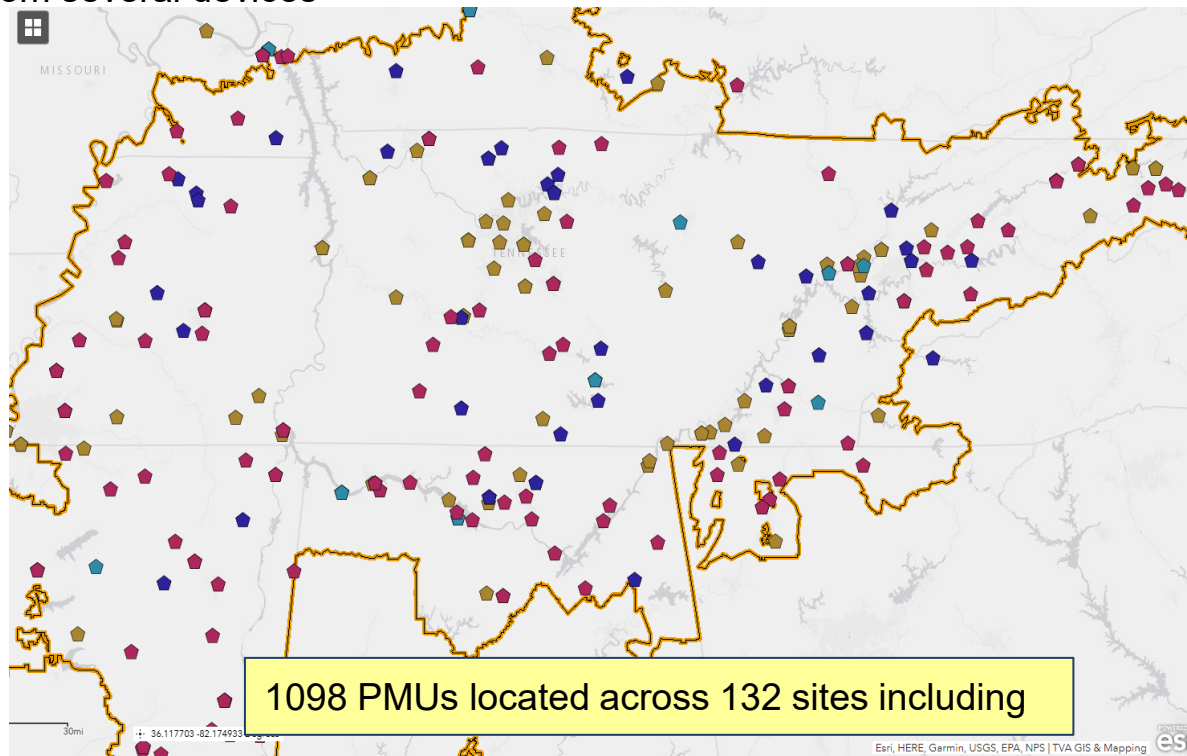

TVA's Thoughts on PMUs in the Control Room

TVA PMU Locations

Streaming Synchrophasor data from several devices

- Stand-alone PMUs
- Digit Fault Recorders (DFRs)
- Relays
- Power Quality Monitors

Primary focus has been at generating facilities and tie-lines



TVA Operations Using PMUs In The Control Room



Reliability Coordinators

Primary focus has been generating facilities and tie-lines with high magnitude or long duration oscillations

Engineering

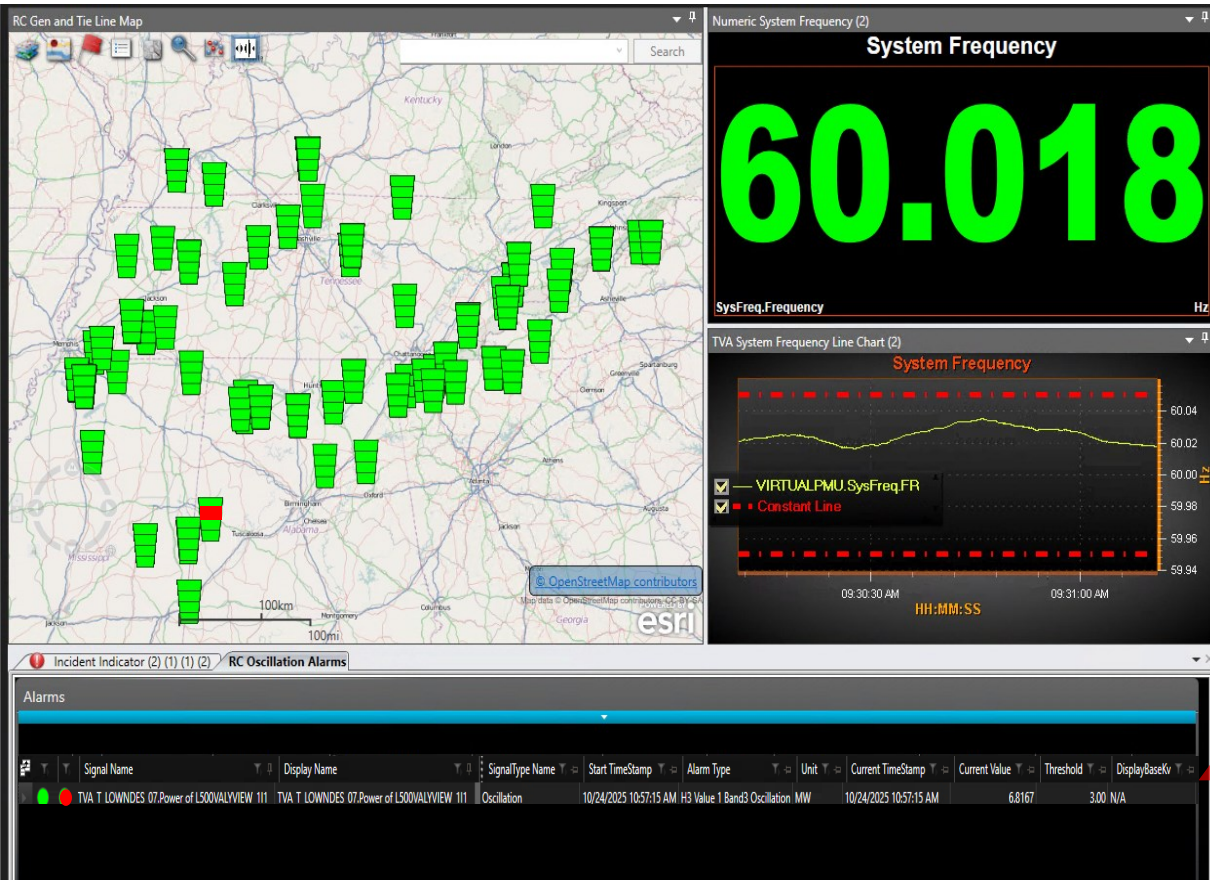
Primary focus has been upfront oscillation mitigation and equipment failure

Transmission Operators

Primary focus has been real time operating values

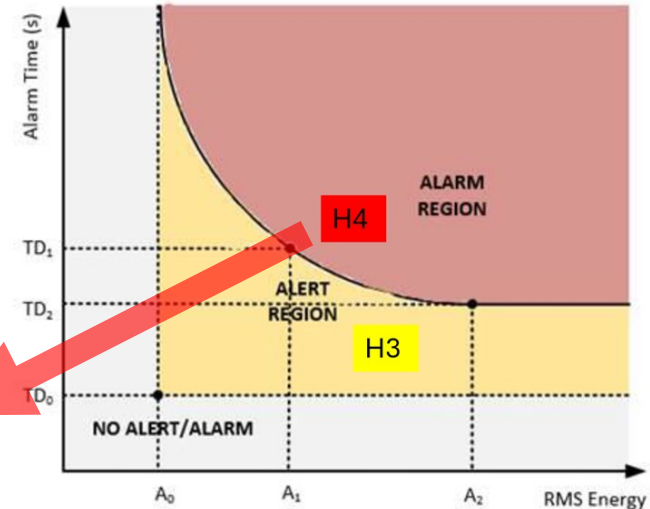
Control Room Use for RCs

Real Time RC Oscillations Monitoring

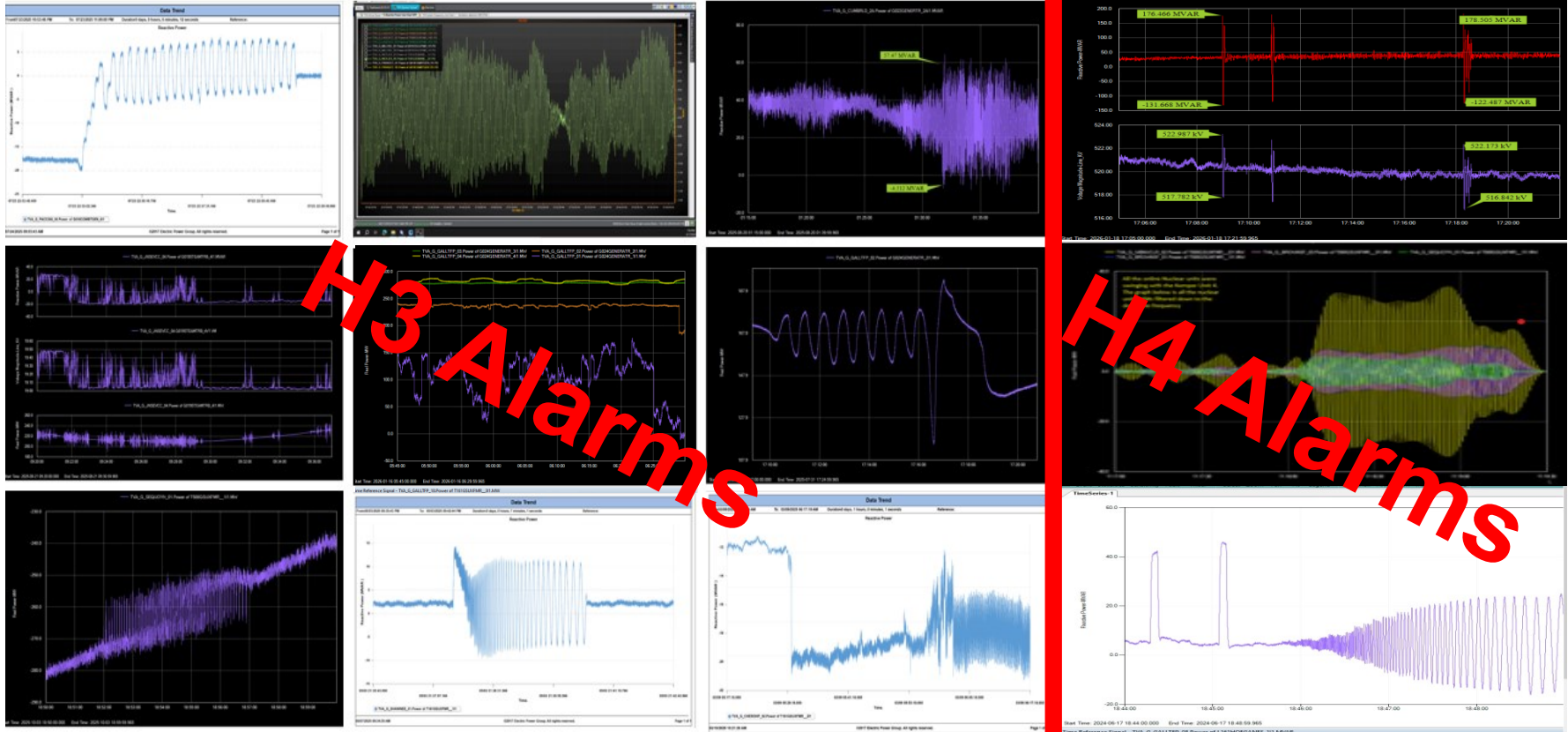


- H3 Alarms are Engineering alarms and will not show up in the bottom box but will show up on Map. Oscillation must exist at least 45 seconds.
- H4 Alarms are for Operators and should be addressed until cleared.

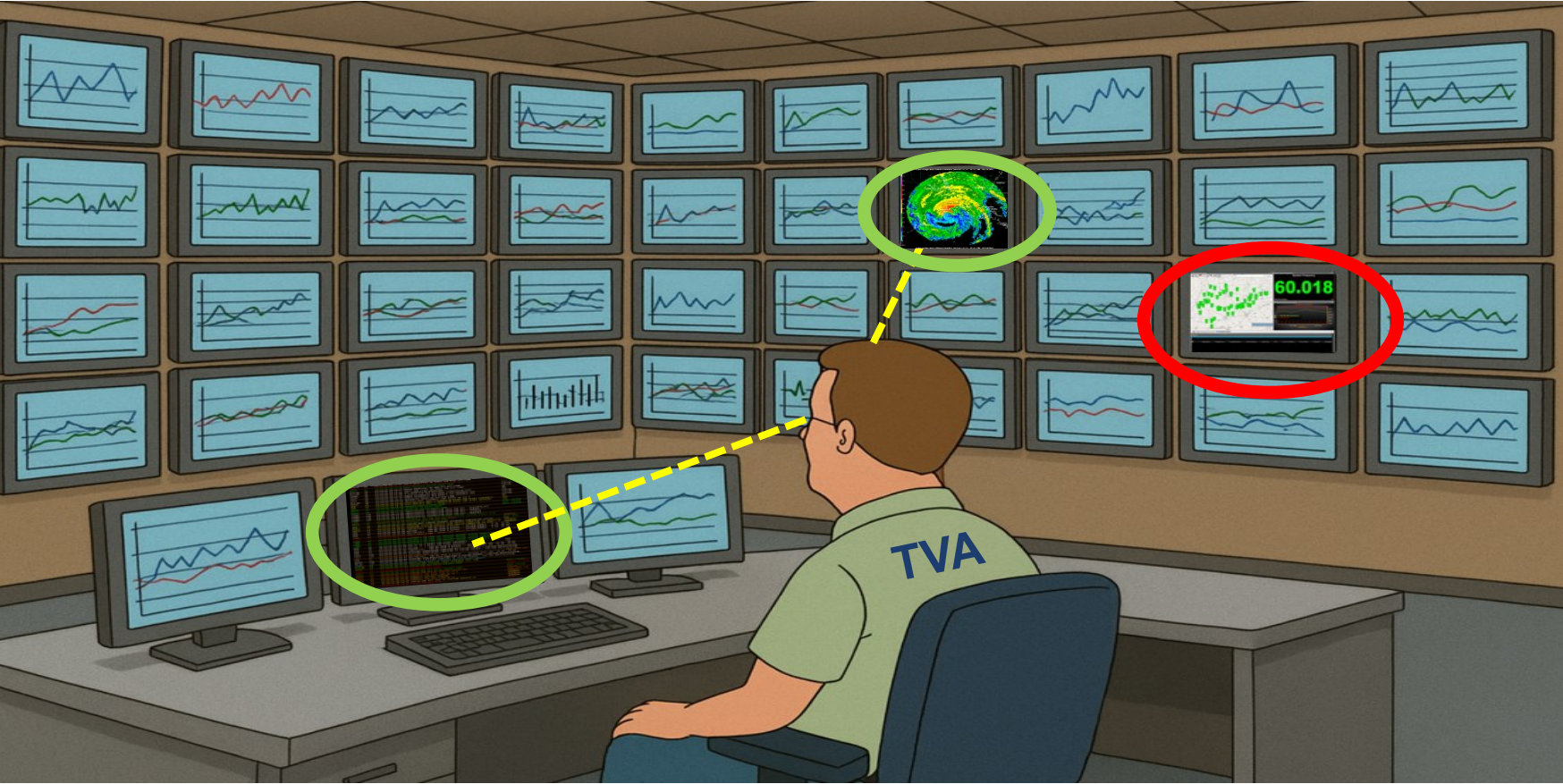
Inverse Time Curve



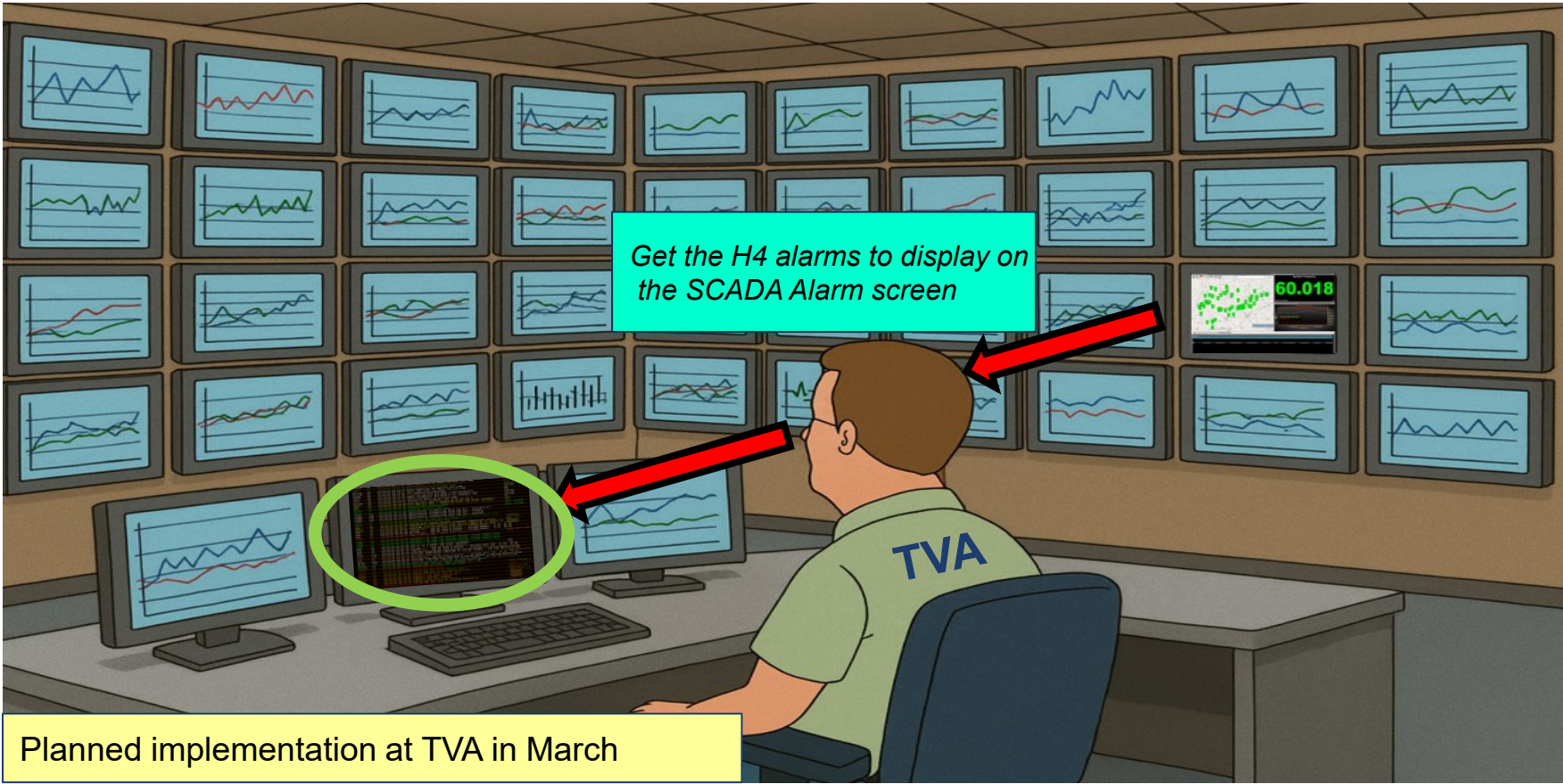
Benefits Of Separating The Alarms



Main Problem for RCs in Operations

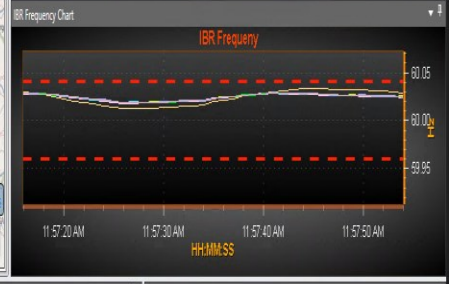
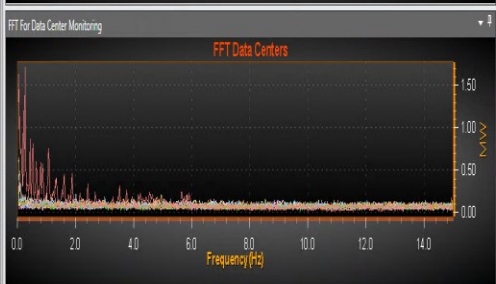
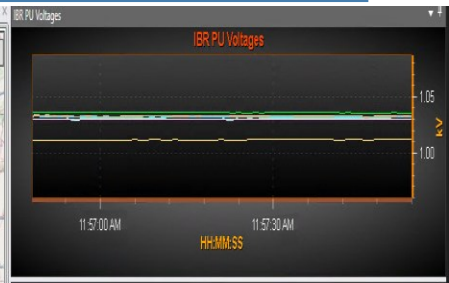
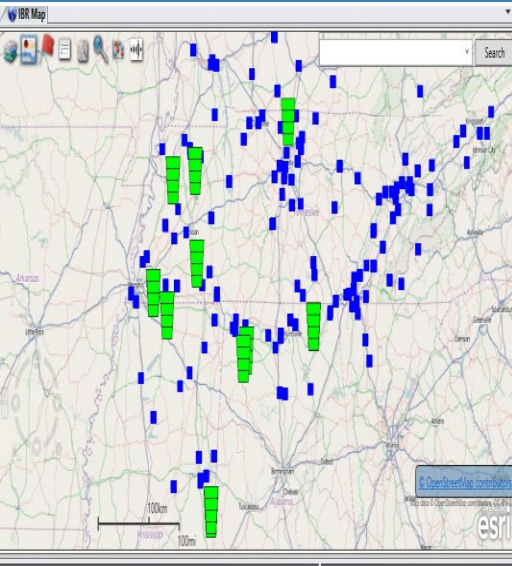
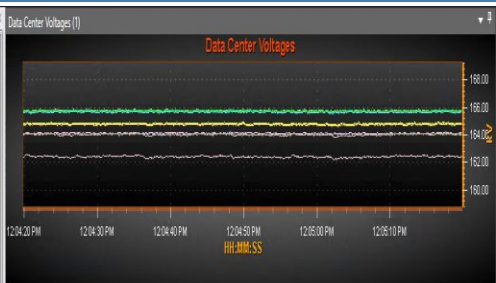
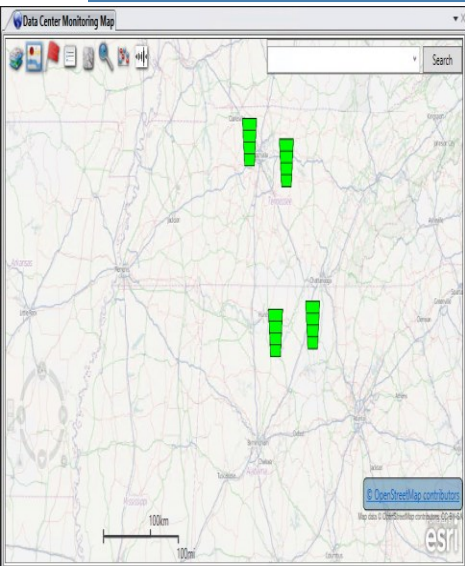


Potential Solution



Control Room Use for Engineering

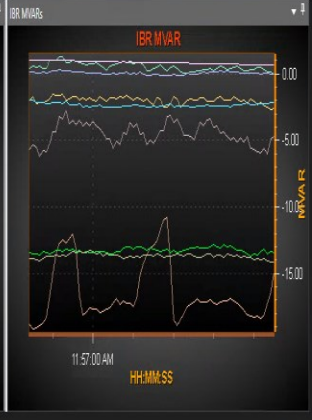
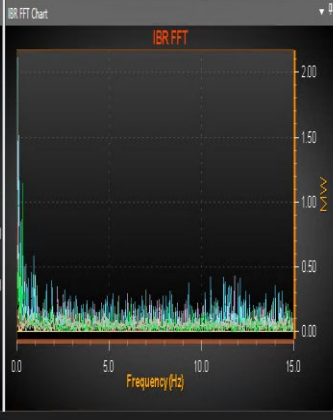
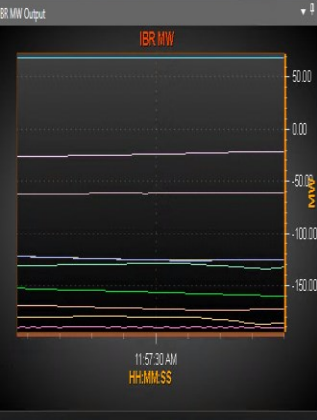
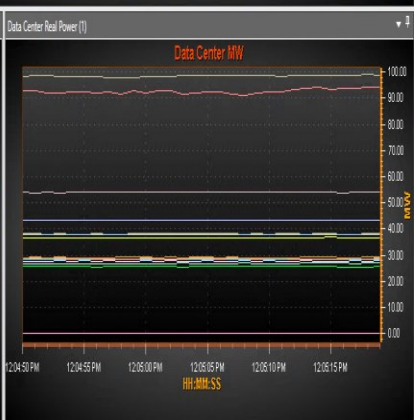
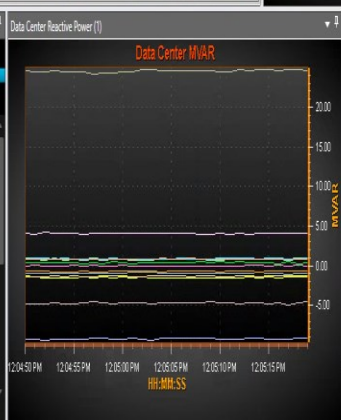
Engineering Oscillation Monitoring Page



Data Center Tabular (T)

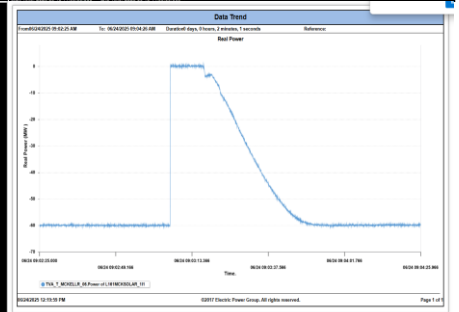
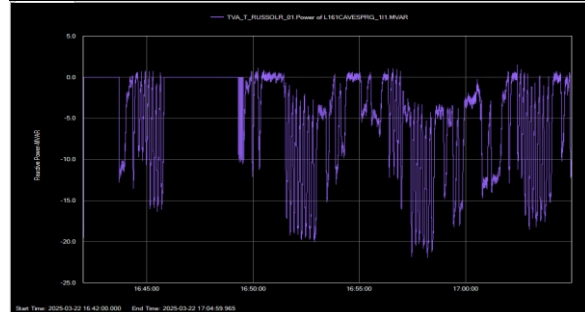
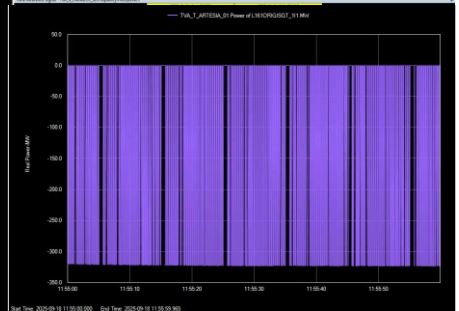
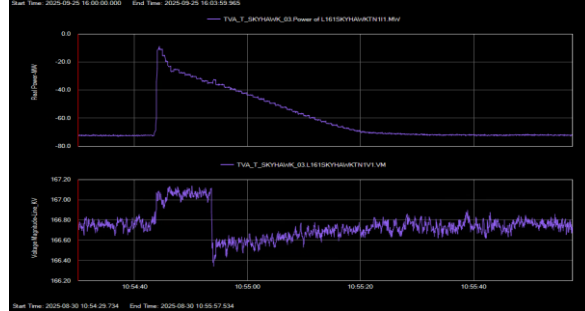
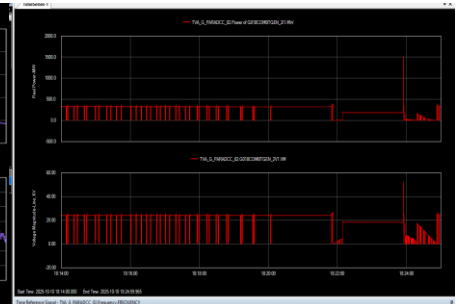
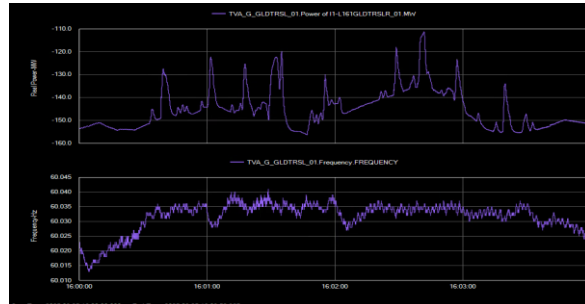
Data Center Loads

Signal Name	Signal Value	Unit
TVA_T_MONTEGM_0T	988111	MW
TVA_T_MANDOP	941088	MW
TVA_T_MONTEGM_1S	542937	MW
TVA_T_MONTEGM_1T	433424	MW
TVA_T_NGALLTN_03F	382191	MW
TVA_T_BATTHL_06Pc	378978	MW
TVA_T_BATTHL_04Pc	367239	MW
TVA_T_NGALLTN_05F	231473	MW



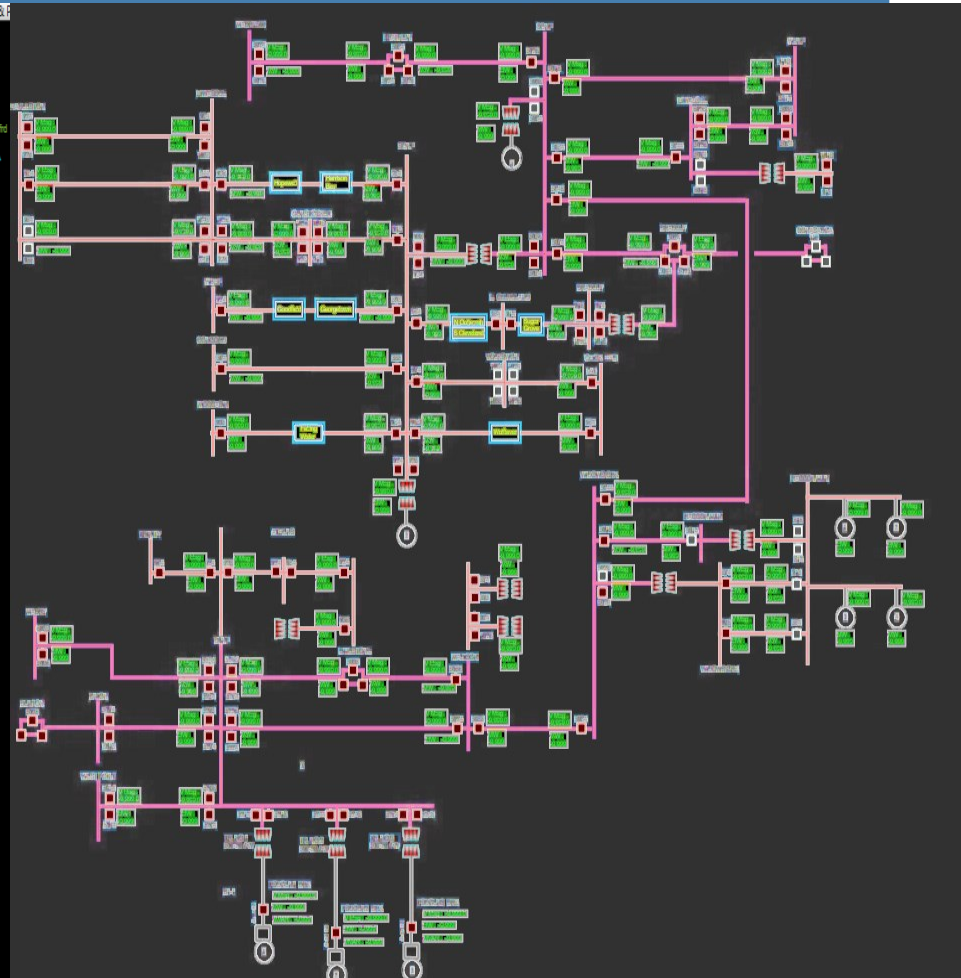
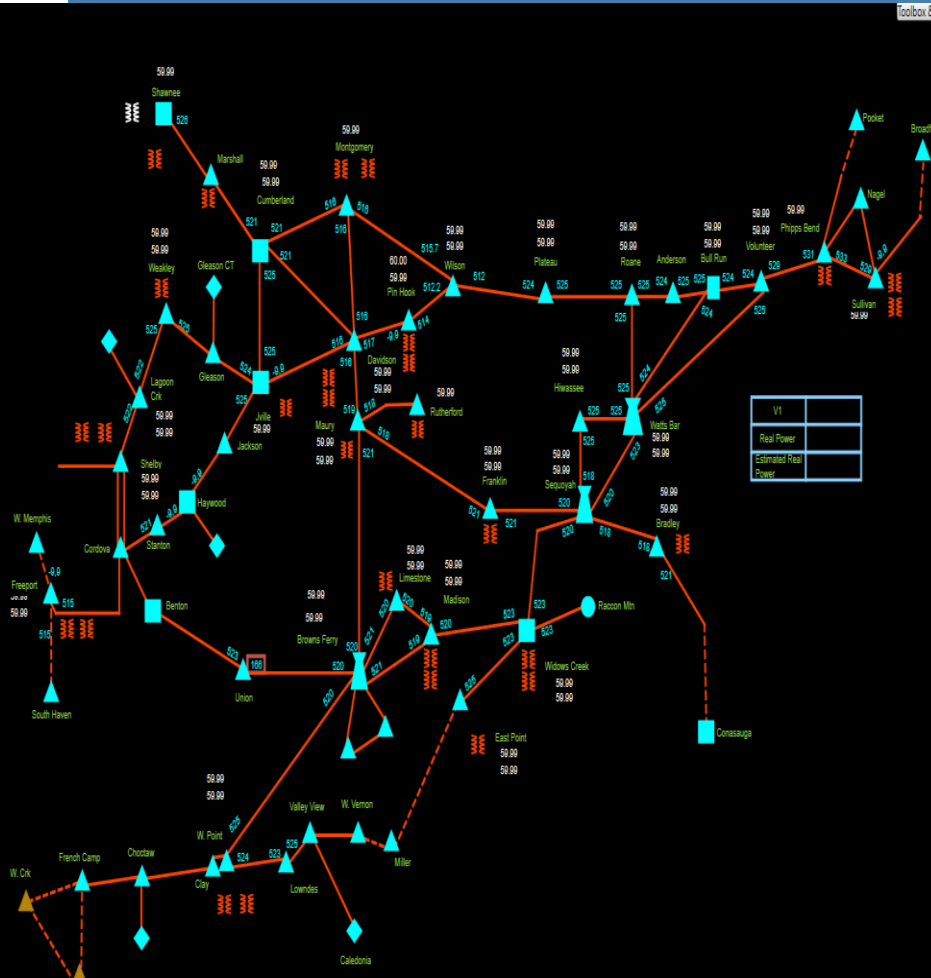
Engineering Findings

- Identify failing/improperly connected DFRs around the system
- Multiple improper IBR response to momentary system events.
- Switches not making connections
- Failing CTs and PTs

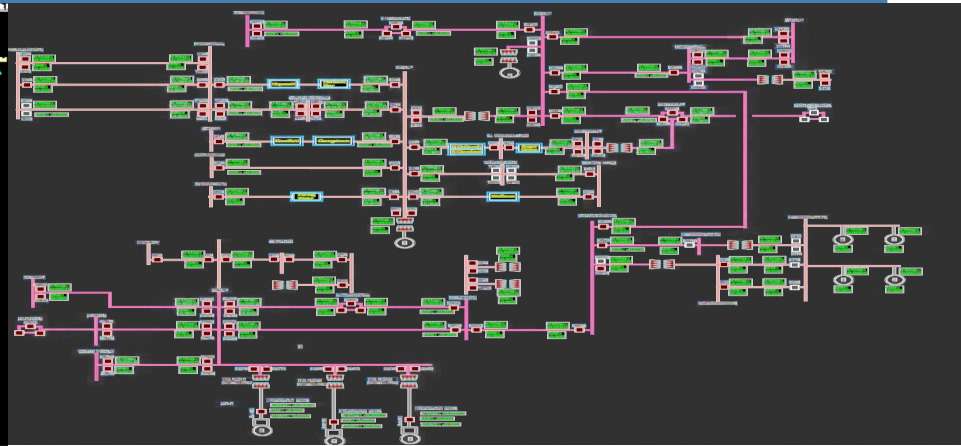
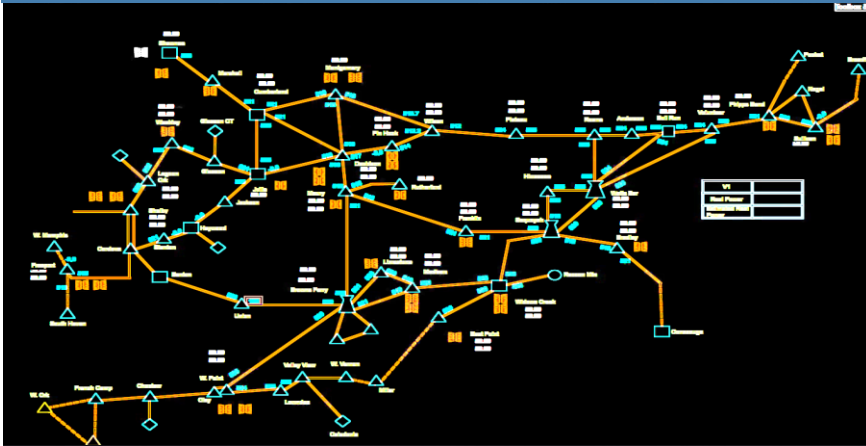


Control Room Use for TOs

TOPs Real Time One lines/SCADA Outage Page



TVA TOPs Desired Backup PMU Page

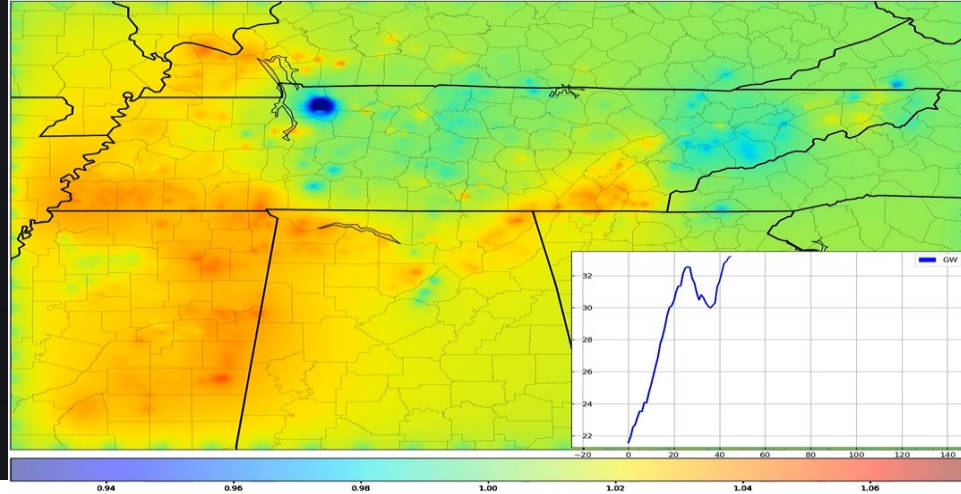


ALARM

STATUS
10:25:40

Breaker Status Change

- 10:25:33 Breaker 5 closed to open
- 10:24:57 Breaker 1 open to closed
- 10:23:02 Breaker 3 open to closed
- 10:22:17 Breaker 8 closed to open
- 10:21:46 Breaker 7 closed to open
- 10:20:51 Breaker 2 open to closed



TVA

**TENNESSEE
VALLEY
AUTHORITY**