Cluster Analysis of Reactive Zones in ERCOT

International Synchrophasor Symposium
NASPI & ISGAN

Bill Blevins & Sidharth Rajagopalan – ERCOT
Jim Dyer & Prashant Palayam – EPG
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Topics to be discussed...

- Introduction & Background
- Research Initiative
- Study Approach Used
- Observations so far
- Next Steps
- Study Benefits & Implementation Plan
Introduction & Background

- The ERCOT grid has undergone significant changes in the last few years.
- Analyze the new facilities and update the Control Room awareness of Reactive Zones across the system.
- Determine a manageable number of zones.
- Installing a new EMS and PI system
  - Coordinate the monitoring between EMS, PI, and PMUs.
Objective:
- Identify & Monitor Reactive Zones within ERCOT grid

Purpose:
- Identify Zones with reactive deficiencies
- Monitor Reactive Zones in real-time
- Detection of extended low voltage issues (< 345kV) and avoid possible voltage collapse

Data for Research:
- State Estimator data
- PMU data

Outcome:
- Manageable number of Reactive Zones (5-10) within ERCOT grid

Long Term Plan:
- Update Reactive Zones upon major grid upgrades
Study Approach

- **Step 1**: Select critical 345kV buses nearby major generation and load pockets

- **Step 2**: Scan through State Estimator 2015 data
  - ERCOT 345kV system – Normal Voltage is between 355kV and 360kV
  - Flag events with low voltage (< 345kV) for duration greater than 30 mins
  - Cluster buses that have tighter correlation coefficient (>= 0.7) with flagged event bus
  - Identify 345kV transmission lines that carry MVAR into the clustered region

- **Step 3**: Scan though PMU 2015 data
  - Flag events with low voltage (< 345kV) for duration greater than 30 mins
  - Cluster buses that have tighter correlation coefficient (>= 0.7) with flagged event bus
  - Compare Clusters with Step 2 & Validate

- **Step 4**: Identify Reactive Zones for continuous real-time monitoring
  - Establish a criteria to identify a manageable number of reactive zones for real-time monitoring
Location of 12 Reactive Zones Using SE data

Source: ERCOT
Bus Clusters in Coast, Southern & Far West
Bus Clusters in East, North Central & West

Source: ERCOT

Event 118, Group 2, OER 6401 345.00

Event 12, Group 1, MNS 2788 345.00

Event 60, Group 1, GRS 3018 345.00

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Study Approach - Next Steps

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Study Benefits & Implementation Plan at ERCOT

- Leverages ERCOT and EPG prior baseline analysis.
  - Leverages SE data
  - Leverages PMU data
- Summer 2016 new EMS in service.
- Define reactive zones in new EMS from this baseline report fall 2016.
- Create/modify RTDMS alarms for Reactive Zones based on this analysis Fall 2016.
- Incorporate Reactive Zones in EMS simulator training scenarios in 2017
- Incorporate Reactive Zones in Phasor Simulator training scenarios in 2017
Thank You.

Any questions?

Jim Dyer – dyer@electricpowergroup.com
Prashant Palayam – palayam@electricpowergroup.com
626.685.2015