

Cluster Analysis of Reactive Zones in ERCOT

International Synchronphasor 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 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.**

ERCOT Research Initiative - Reactive Zones

- **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

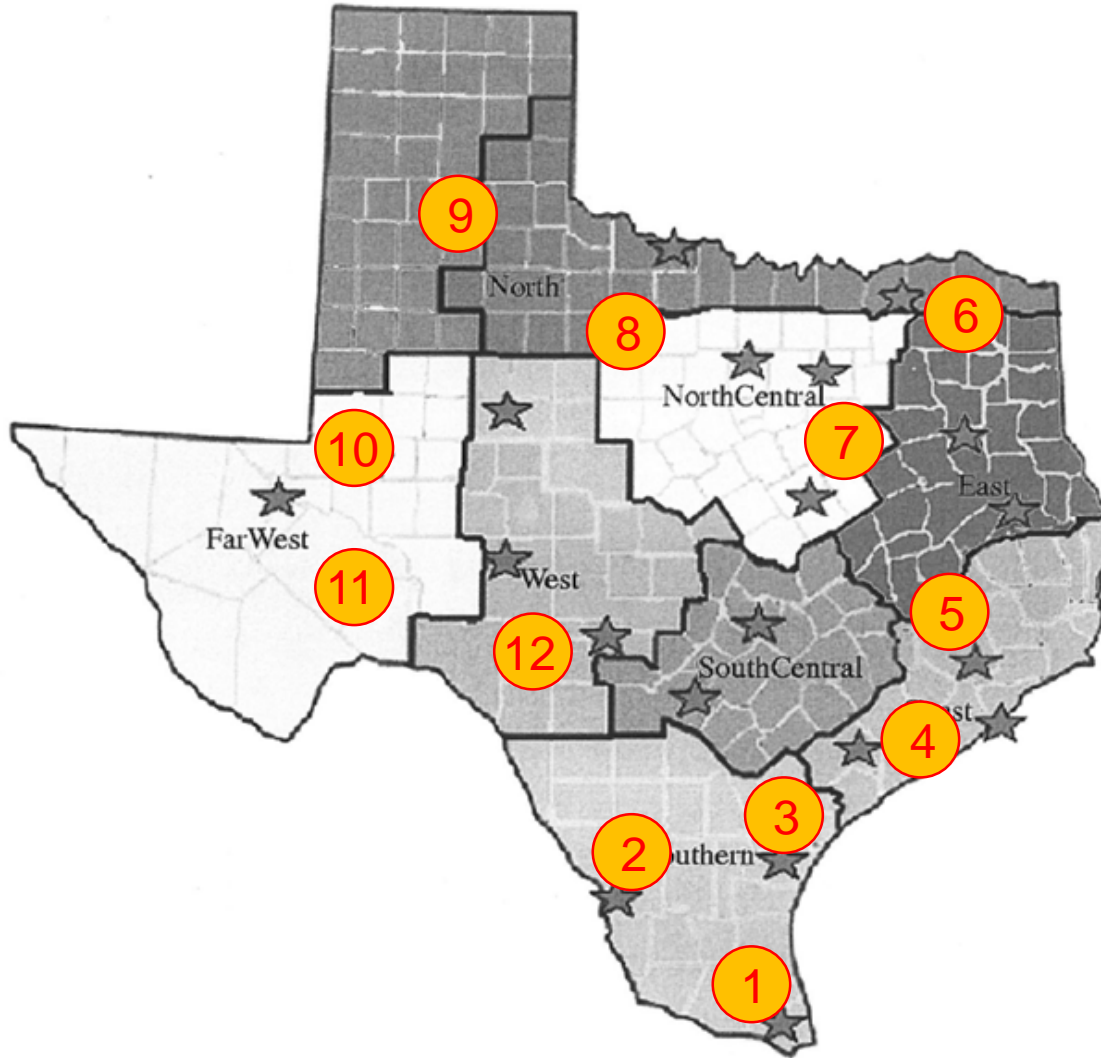
- **Step 1:** Select critical 345kV buses nearby major generation and load pockets

- **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

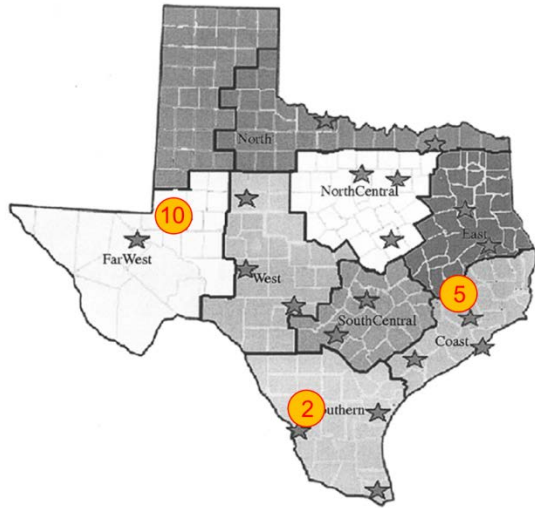
- **Step 4:** Identify Reactive Zones for continuous real-time monitoring
 - > Establish a criteria to identify a manageable number of reactive zones for real-time monitoring

Location of 12 Reactive Zones Using SE data

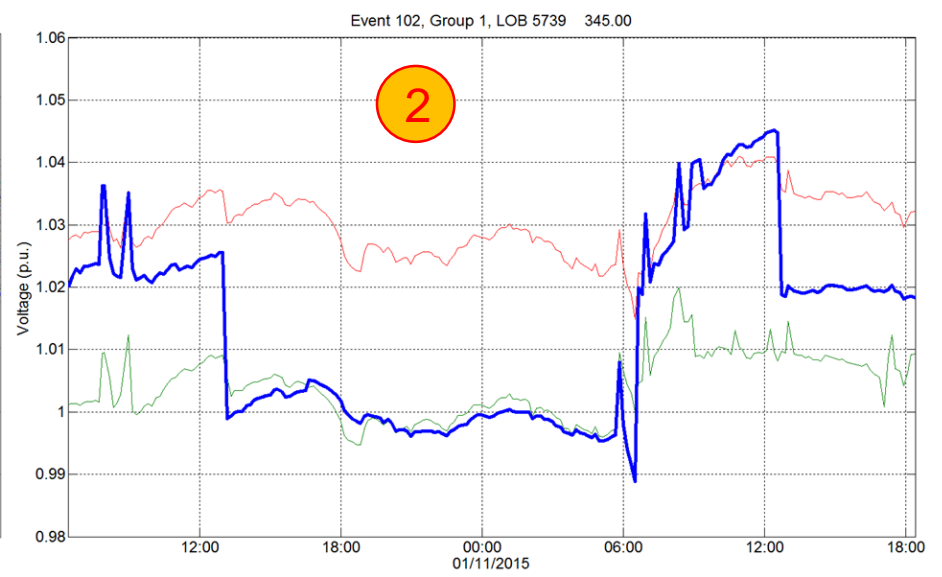
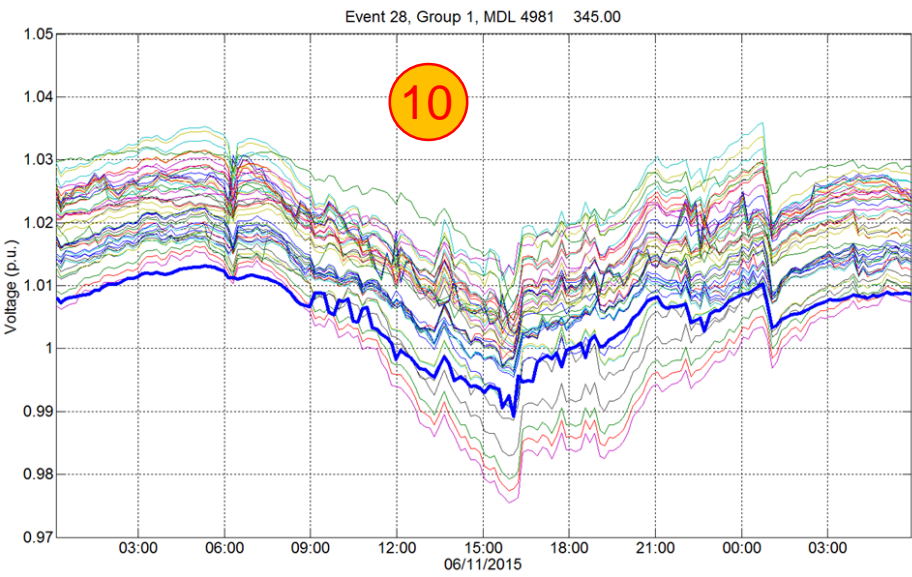
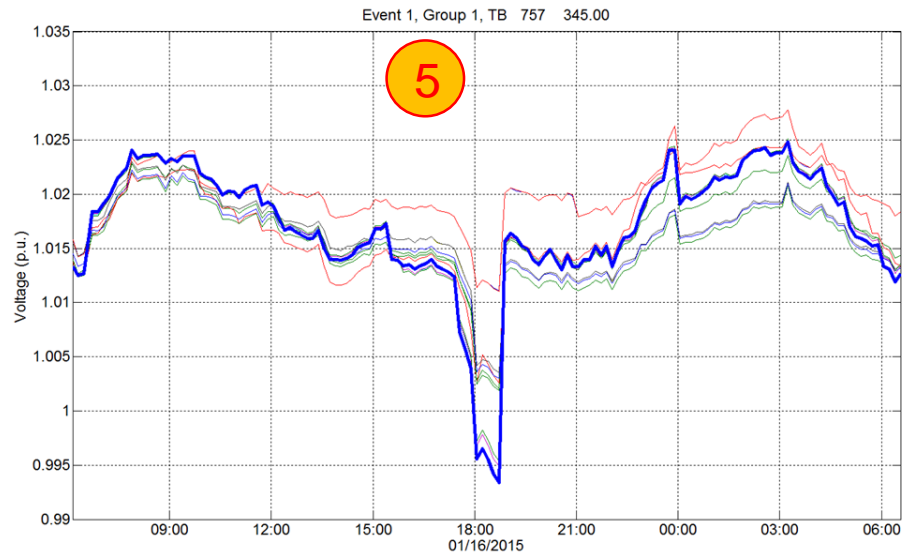


Source: ERCOT

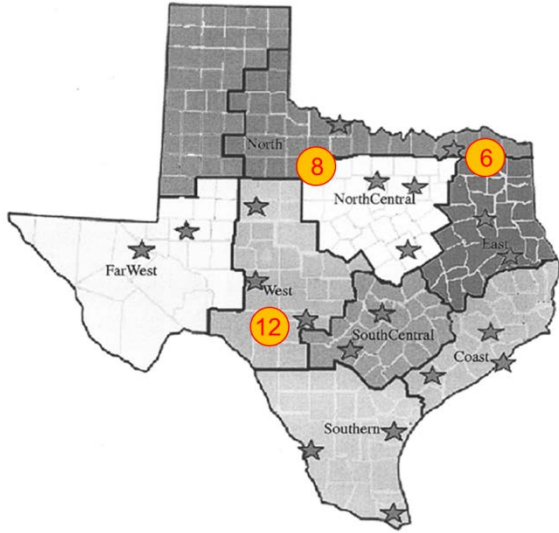
Bus Clusters in Coast, Southern & Far West



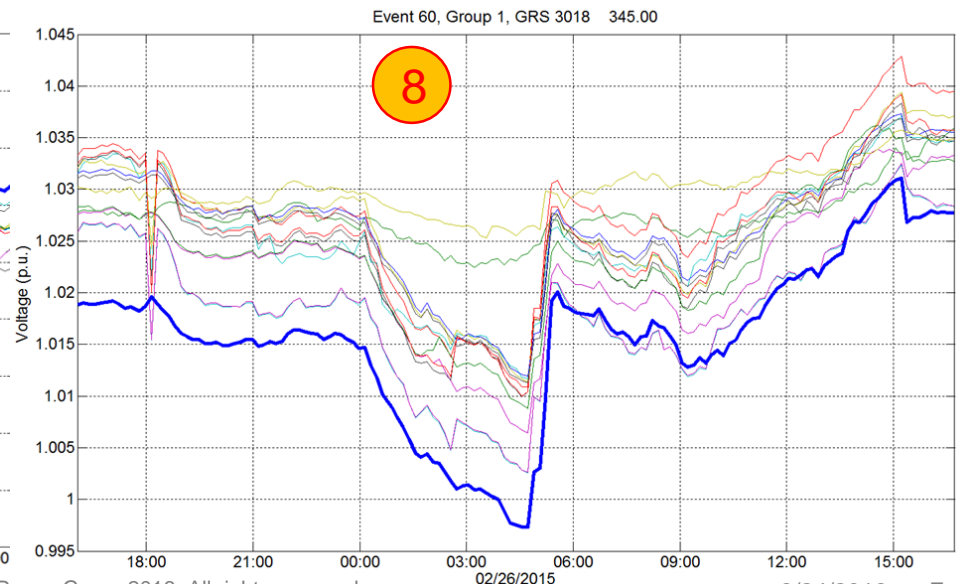
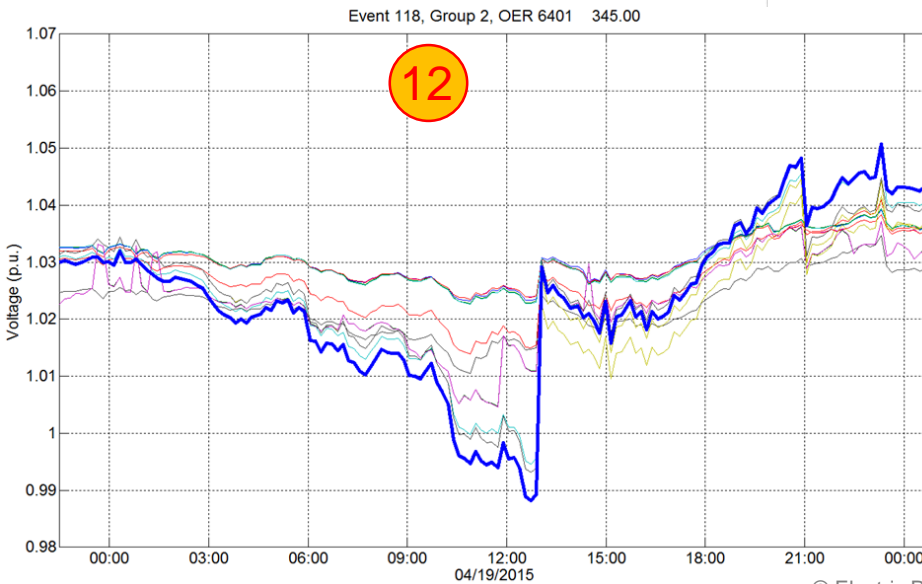
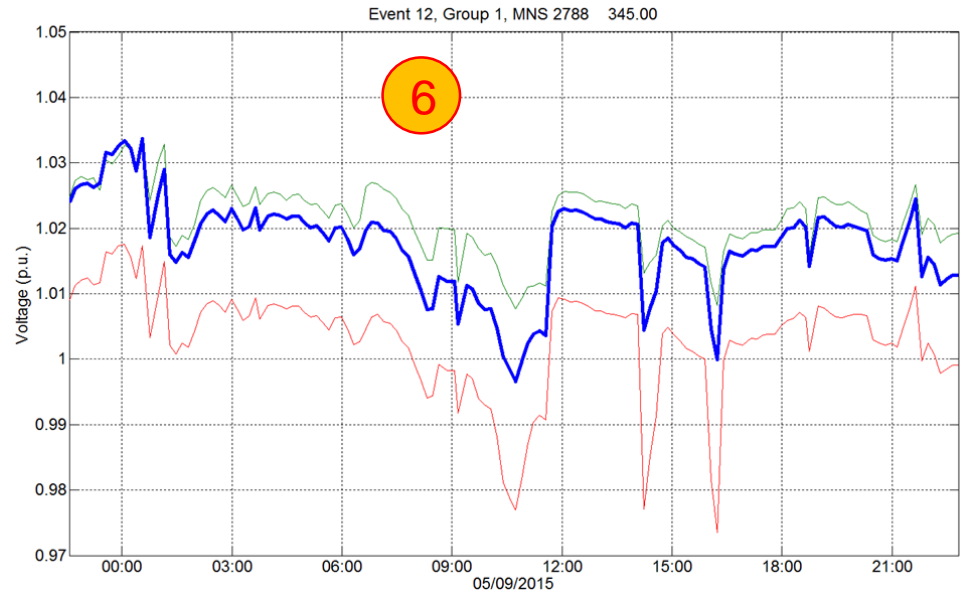
Source: ERCOT



Bus Clusters in East, North Central & West



Source: ERCOT



Study Approach - Next Steps

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