PMU Signal Validation – Needs and Ongoing Efforts

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WECC RC
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Today’s Objective

• Discuss the need for PMU data validation;
• Provide some real-life examples of bad data and what is being done to make it usable in operations; and
• Describe methods being used to measure signal quality
Quality Data Need

• Data must be reliable and available prior to operating staff trust and accept
• Applications are dependent on “good data”
  o Oscillation Detection
  o Mode Meter
  o Voltage Stability Analysis
  o State Estimator
WECC RC Phasors

- RC collaborates with entities to set-up
- Nearly 1,000 phasors ready for evaluation
  - From 15 entities
- RC analyzes each phasor
State Estimator Example

- Angle integration provides a much more consistent angle solution
State Estimator Example

- Angle measurements need application level validation through reasonability checks
Systems in PMU set-up

- There are five general types of systems involved in data transfer:
  - Measurement units (PMUs);
  - Signal collection units (PDCs);
  - PMU data analysis and display (VSA, WAV, PP, eTV);
  - Network infrastructure (WAN); and
  - Data archive and configuration (PI, Registry).
Data Error Examples - Spikes
Data Error Examples – Missing Frames
Data Error Examples – Angle Error
Collaborations

• The setup process involves these roles:
  o Entity participant users;
  o Modeling engineers;
  o Application Support engineers (ASE);
  o EMS support engineers; and
  o Harris Corporation network engineers (WAN connectivity).
Phasor Validation

• First validation test includes:
  o Naming Convention
  o Latency
  o Missing Frames
  o Positive Sequence
  o No analog or digital signals
  o Flat line
  o Spikes
Phasor Validation

• Reasonability Check
  o Phasors are polar
  o Voltages are volts
  o Currents are amps

• Second validation test includes:
  o Names align with actual equipment being metered
  o Within a tolerance of SCADA or SE values
  o Angles align with interconnection
SCADA vs PMU
### Data Validation Tools

- **PhasorPoint**

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PDC Data Dashboard

-Disconnected PDCs
-Flatlined signals
-PMUs in Error State
PDC Data Dashboard

Individual PMU details include:
- Manufacturer
- Signals
- Owner
- Substation
PDC Data Dashboard

- Export csv

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<th>Acronym</th>
<th>Station Name</th>
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Excel and PI

- Calculates statistics only on application signals
  - Phase Angle Difference monitoring, Mode Meter, and VSA

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VBA and PI with Excel Interface

- Utilizes VBA to run multiple loops through both Phasor and EMS PI historians
Challenges

• The massive amount of data and the collaboration involved requires new tools and processes

• Send results to entities
  o Verify results on their end
  o Work together to correct issues

• What is “good data”?  
  o What values should be used for tolerances?
Questions?

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