SYNCHROPHASOR DATA QUALITY - DOE SPONSORED STUDY

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What is Data Quality?

- Means different things to different people
- Generally can be defined:

Data Quality is any aspect of data that bears on its ability to satisfy a given purpose*

- Quality requirements depend on the application
- Challenging when used by multiple applications

** from Wikipedia*

Addressing Data Quality

- **How should data quality be approached?**
- Build a system that will produce good data
  - Planning and design
  - Validate installation
- Take measures to assure we are using good data
  - Validate data
  - Correct/improve data where possible
- Ongoing monitoring

Introduction

- Data Validation and Conditioning Project
  - Sponsored by US Department of Energy
  - Started in December 2012 and completed December 2014
- Principal objective:

  Develop, test and prototype various methods for conditioning and validating real-time synchrophasor data
- Three phases
  - Phase 1 – survey, study, & prototype development
  - Phase 2 – prototype demonstration
  - Phase 3 – prototype functional specifications

Best Practices Development

EPG approach:

- Study systems based on current experience & practice
- Focus on modeless error detection algorithms

Initial Activity – Industry survey:

- Survey companies with SGIG projects and other companies with significant synchrophasor initiatives
- Review literature-sources – NASPI, IEEE, etc.

Best practice recommendation document:

- From survey results
- EPG experience with synchrophasor systems

Best practices report

- Major chapters:
  - Administration
  - Planning
  - Operation
  - Maintenance
- Supplemental:
  - Appendix A: detailed description of installation validation procedures
  - Appendix B: troubleshooting guideline and procedures

Project administration

- Multi-disciplinary coordination
  - Component operation tightly coupled across disciplines
  - Set policy, resolve issues
  - Coordinate all areas of system management
- Documentation & change management
  - Configuration management
  - Standard company documentation but add system aspects
  - Troubleshooting guide and history
- Problem resolution support
  - Troubleshooting, recommendations for system modification

System implementation

- Application requirements drive specifications
  - PMU locations, signals measured, measurement details
  - Communication requirements
  - Application & data storage needs
- System design – to meet specifications
- Equipment selection & procurement
  - Specifications & compliance
  - System operation testing (mockups)
  - Calibration
- Coordination with other participants
  - May include other utilities

System validation

- Comparisons in the substation
  - Installed instruments (limited accuracy, good reference)
  - Portable test instruments (high accuracy, basic signals)
- Validation at TO control center
  - Comparisons with SCADA or other metering
  - Validate against other substations
  - Compare with state estimator (power flow, angles)
- Validate at RTO/ISO control center
  - Same as at TO CC, but wider scope
  - Inter-area phase angles (regional phasing)
  - Data identification

System operation

- On-line data validation
  - Checks on data flags & data cross checks
  - Live & historical performance information, alarms
- Off-line data validation
  - Look at data regularly!
  - Event analysis using measurement data
  - Measurement dynamic comparisons such as with DFR
- Analyze disturbance data
  - Monitor dynamic responses

Maintenance

- Routine maintenance program
  - Use established practices (substation equipment, communication system, IS servers, etc.)
  - Analog signal sources & PMU A/D (nothing else degrades)
- Trouble maintenance
  - Tools and procedures
- Configuration and document management
- Replacement program planning

Summary

- **Data quality:**
  - Depends on the actual intended use of the data
  - Can be broken down into 6 data categories: loss, corruption, accuracy, precision, identification, and delivery delays
- **Issues are addressed by:**
  - System planning and design
  - Installation and validation
  - Monitoring and maintenance program

Thank you

Questions?