NASPI North American SynchroPhasor Initiative

Data Validation & Conditioning

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Presentation

- Introduction of project
- Review first report - survey
- Review of second report – recommendations

Introduction

- Data Validation and Conditioning Project
  - Awarded to EPG in December 2012
  - Completion by October 2014
- Three stages
  - Stage 1 – survey, study, & prototype development
  - Stage 2 – prototype demonstration
  - Stage 3 – prototype functional specifications

Principle objective

- **Develop, test and prototype various methods for conditioning and validating real-time synchrophasor data**
  - Applicable to SGIG projects
  - Usable in deployed architectures
  - Include consideration of design & deployment
- Output includes cleaned data & quality flags

EPG Proposal

- Issues go deeper than data
  - Equipment selection & compatibility
  - System design
  - System administration
  - Operation and maintenance
- Ties all aspects together
- Data validation
  - Real-time
  - Data itself

EPG Proposal and Plan

PHASE 1

- Conceptual Design & Prototype Development
- Review Existing SGIG Systems
  Completed May 2013
- Best Practice Recommendations
  Completion June 2013
- Research, Design, Develop and Test Prototype
  Completion March 2014

PHASE 2

- Prototype Demonstration
- Develop Error Simulation Utility
  Completion May 2014
- Data Validation Prototype Demonstration
  Completion June 2014

PHASE 3

- Functional Specifications of the Data Validation System
- Document Key Lessons Learned
  Completion August 2014
- Functional Specification
  Completion September 2014

Phase 1, Task 1

Review Existing SGIG Systems

Approach:

- Survey companies with SGIG projects and other companies with significant synchrophasor initiatives
- Review literature-sources – NASPI, IEEE, etc
- Summarize findings & report

Topics Surveyed:

- System Administration
- System Design and Implementation
- Operational Data Validation Systems
- Current Experience and Future Plans

System Administration

Management structure

- Structure depends upon company size, project needs, experience, etc.
- Small management: 1-2 people
- Large management team: 5-6 people with task area responsibility

Comments & conclusions

- Most management teams worked well
- Focus was on implementation, not O&M (new systems)
- Some desire for more resources (staff) and better training
- Could use clearer procedures

System Design and Implementation

Design, Signal Selection

- Typical design: PMU → PDC (TO)→PDC (ISO)
- Basic system, redundancy from none to full
- Monitoring locations: Key substations, generators, tie lines, etc.

PMU Selection & Deployment

- Convenience, cost, vendor familiarity
- Stand-alone PMUs, dual function relays (DFRs)
- Locations based on available infrastructure

Comments & conclusions

- Would like more bandwidth to substations
- Better latency performance
- Need better processes to address problems

System & Data Validation

Installation Validation

- Substation level - Local meters/Relay test set
- Control Center level - Comparison with EMS
- Equipment installations not always checked/ verified

Data Validation

- On-line data validation by vendor apps
  - PDC, Real-time visualization & data analysis
- Off-line validation – records & snapshots

Operation Problems

- Data Validation not done consistently
- User applications not using error flags, or other data validation indicators
- Alarm/Email notifications not enabled

Current Experience & Future Plans

Current Experience of Respondents

- 90% to 99.96% system reliability
- Maintenance/replacement cycle same as for relays
- Budget constraints

Future Plans as Voiced by Respondents

- Most utilities installing more PMUs than originally planned
- Some new emphasis on sub-transmission and distribution systems
- Many companies have or are planning to integrate phasor data with SE

List of 20 Survey Participants

- Alberta Electric System Operator
- Ameren
- American Electric Power
- American Transmission Company
- Arizona Public Service
- Baltimore Gas and Electric
- BC Hydro
- Bonneville Power Administration
- Dominion Power
- Idaho Power Company
- ISO – New England
- Los Angeles Department of Water and Power
- Manitoba Hydro
- New York Power Authority
- Oklahoma Gas and Electric
- ONCOR
- PEPCO
- PJM Interconnection, LLC
- Salt River Project
- Southern California Edison

Phase 1, Task 2

Best practices recommendations

Approach:

- Identify practices in companies that were reported as being successful
- Combine with EPG experience in working with companies
- Summarize in best practices recommendations

Best Practices Topics:

- System Administration
- System Design and Implementation

Best practices report

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

Project administration

- Individual components managed by traditional department
- Multi-disciplinary coordination team
  - Operation is 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

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

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 location of measurement (line, bus) & scaling
  - Validate against other substations
  - Compare with state estimator (power flow, angles)
- Validate at RTO control center
  - Same as at TO CC, but wider scope
  - Inter-area phase angles (regional phasing)

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

- System maintenance program
  - Follow established practices (substation equipment, communication system, servers, etc.)
  - Analog signal sources & PMU A/D (nothing else degrades)
- Trouble maintenance
  - Tools and procedures
- Configuration and document management
- Replacement program (probably in future)

Project status

- Phase 1, Tasks 1 & 2 complete
- Phase 1, Task 3 under way
  - Conceptual development continuing
    - Flagged error detection & processing algorithms done
    - Data comparison algorithms under way
    - Topology based algorithms under development
  - Software implementations in design stage
- A little behind plan, but within schedule!

Questions?