DOE/OE Transmission Reliability Program

Data Validation & Conditioning

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Consortium for Electric Reliability Technology Solutions

The Problem

- Phasors are well known to engineers …
  but synchrophasors are not
- Synchrophasor value dependencies
  - Precise timing source, algorithms, & hardware
- Systems dependent on real-time communications
  - Delay (latency), bandwidth, errors, & dropouts
- Need comparability with established systems (SCADA)
- Wide area, high-speed – faster actions

➡ Need assurance measurements are correct and…

➡ Detect and fix data problems

Introduction

- Data Validation and Conditioning Project
  - RFP issued in June 2012
  - 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

- Data validation based on
  - Flags in data
  - Data relations & logic
  - Comparisons – EMS/model
- Issues go deeper than data
  - Equipment selection & compatibility
  - System design
  - System administration
  - Operation and maintenance
- Plan to tie all aspects together

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 November 2013

PHASE 2

- Prototype Demonstration
- Develop Error Simulation Utility
  Completion February 2014
- Data Validation Prototype Demonstration
  Completion April 2014

PHASE 3

- Functional Specifications of the Data Validation System
- Document Key Lessons Learned
  Completion May 2014
- Functional Specification
  Completion July 2014

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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

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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
- Management focused 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 CC)→PDC (ISO CC)
- Basic system with no redundancy to full redundancy
- Monitoring locations: Key substations, tie-lines, generators, wind farms, HVDC lines, etc.

PMU Selection & Deployment

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

Comments & conclusions

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

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System & Data Validation

Installation Validation

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

On-line data Validation

- On-line data validation by vendor applications
  - PDC, Real-time visualization & data analysis
- Data Validation not done consistently

Operation Problems

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

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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

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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

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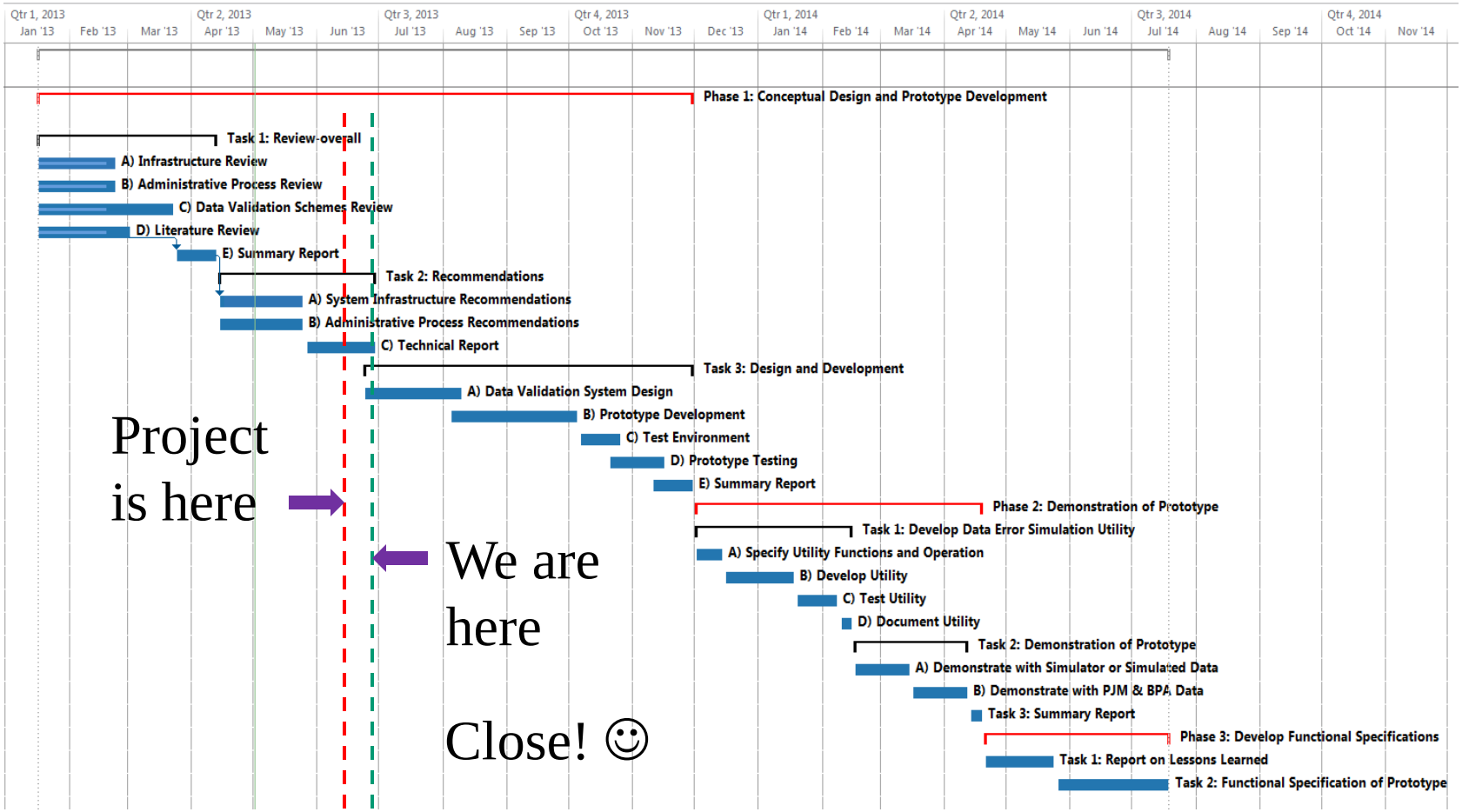
Project status

- Phase 1, Task 1 complete
- Phase 1, Task 2 under way
  - Survey did not yield much operational information
  - Systems are new, little experience past implementation
  - Best practices focus on installations
- Phase 1, Task 3
  - Conceptual work under way

Overall project schedule



EPG Project Team

Principal Investigators

- Ken Martin
- John Ballance

Engineers

- Iknoor Singh
- Prashant Palayam
- Xuanyu Wang
- Chen Sun

Software architect

- Simon Mo

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Risk Factors

- Some key SGIG grantees did not participate in survey
- Implementation & operation practices not universal
  - Utility procedures & work rules differ
- Real-time data validation
  - Different interpretation of data flags
  - Data dependencies definable but vendor differences
  - Data comparisons require interface to operational systems
- Algorithms may not adapt to all systems
- Test systems & data difficult to access

Questions?