Strategic Midwest Area Renewable Transmission (SMART) Study

October 06, 2009

Agenda/Objectives for Today's Meeting

- Introductions
- Project Overview
  - Key Drivers
  - Project Sponsors
  - Project Contractor
- Phase one – Identifying the Alternatives
  - Assumptions and Input Data
  - Metrics
  - Futures
  - Sensitivities

SMART Study - Project Overview

- Comprehensive study of the transmission needed in the Upper Midwest
- Support renewable energy development and transporting that energy to consumers throughout the study area to other users in the rest of the US
- Not in competition with any another study
- Review existing studies and use their results as appropriate
- Study focus is 20 years into the future
- Transcends traditional utility and regional boundaries

SMART Study - Objectives

- Development of EHV overlay alternatives that ensures reliable service for sponsors' communities, is environmentally friendly, and supports national energy policy
- A reliability analysis and recommendation for technically sound solutions for integration of extra high voltage transmission into the existing transmission system
- An economic analysis of those solutions identified in the technical analysis showing the benefits of extra high voltage transmission to the study regions

SMART Study - Key Drivers

- Open and Transparent Process
- Steering Committee with Project Sponsors
- Stakeholder Input
- Multi-Regional Transmission Focus
- Consistent with National, Regional, and Local Energy Policies
- Technical and Economic Based Alternatives

SMART Study - Project Sponsors

- American Transmission Company (ATC)
- Electric Transmission America, LLC (ETA)
  - American Electric Power (AEP)
  - MidAmerican Energy Holdings Company
- Xcel Energy
- Exelon Corporation
- MidAmerican Energy Company
- NorthWestern Energy

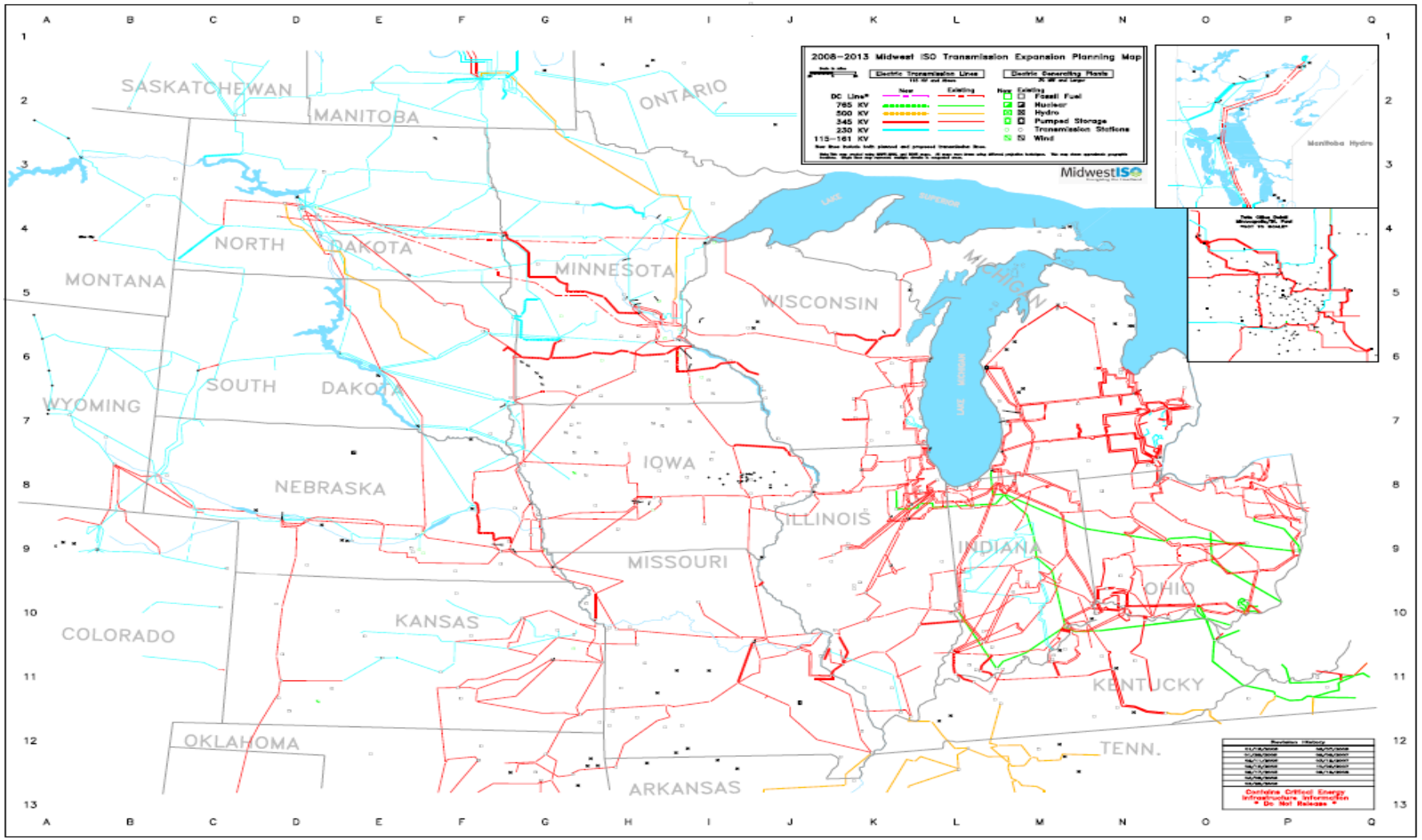
SMART Study – Project Contractor

- Quanta Technology
  - Independent consulting arm of Quanta Services
  - Many industry-renowned experts
  - Headquarters in Raleigh, NC and regional offices in MA and CA
- Our Mission is to Provide business and technical expertise to solve strategic and operational problems for energy utilities and industry
- Significant planning experience

Quanta Technology Planning Experience

- **SPP EHV Overlay**
  - Develop a 20 year vision of the future
  - Support for significant investment in renewable energy resources
  - Support for emerging energy markets
  - Provide insight into near term transmission projects
- **Midwest ISO (MISO) – Interconnection System Impact Studies:** Biomass & Natural Gas,780MW Natural Gas, 500MW Wind Farm, etc
- **Exelon Commonwealth Edison -** Generator to Transmission Interconnection Support
- **Direct Energy - ERCOT Reliability Assessment** - objective was to increase ERCOT West-North transmission capability
- **California Energy Commission -** Intermittent Wind Generation Report of Impacts on Grid System Operations

SMART Study – Geographical Area of Interest



Primary Focus Areas - North Dakota - South Dakota – Iowa – Nebraska – Indiana – Ohio – Illinois – Minnesota – Wisconsin – Michigan

SMART Study – Two Major Phases

- Phase One: Identifying the Alternatives
  - Steady State Analysis
  - Develop several alternatives
  - Develop performance metrics
  - Identify top performing alternatives
- Phase Two: Societal Benefits Evaluation
  - Security Constrained Economic Dispatch
  - Develop Societal Benefits Metrics
  - Evaluate top performing alternative
  - Provide final ranking

Assumptions and Input Data for Phase 1 (con't)

- Time Frame
  - 20 year focus
  - Summer peak case - 2029, 2024, & 2019
  - Light load case - 2029, 2024, & 2019
- Upper Midwest Focus
  - North Dakota, South Dakota, Iowa, Nebraska, Indiana, Ohio, Illinois, Minnesota, Wisconsin and Michigan
- Extent of network modeled
  - Full Eastern Interconnection as outlined in the 2019 MISO case
- Future annual load growth from 2019
  - .85% for AEP service area
  - 1% for MidAmerican service area and MN
  - 1.4% other areas

Assumptions and Input Data for Phase 1 (con't)

- Geographic distribution of wind farms for updated EHV study
  - Since the precise data of wind farms MW and location for 2029 is not available, we will use appropriate amount of wind generation based on:
    - EIA, MISO, PJM, and other published resources
    - Each Project Sponsor
    - In addition, wider range of wind generation will be studied in sensitivity studies
- Wind energy contribution of wind farms at peak
  - 20% for on-peak and 90% for off-peak
  - MISO uses 20% for on-peak and 90% for off-peak

Assumptions and Input Data for Phase 1 (con't)

- Generation additions – assumed mix
  - Known generation additions in queue will be included, if any
  - Proxy generation will be added based upon an agreed upon mix. A 50/50 mix of gas and conventional steam is assumed
    - MISO uses a 41,000MW high wind case which is made up of 21,000MW wind and 20,000MW other generation (50% natural gas CC and 50% conventional steam)
- Generation Retirements
  - Known retirements will be included, if any
  - Coal plants >= 40 years in 2009 will be run as a sensitivity in one or two levels; 100MW or less and/or 250MW or less
- Dispatch merit order
  - Provided by ISOs/RTOs and used for off-peak gen profile

Assumptions and Input Data for Phase 1 (con't)

- Reactive load support in 2029
  - The process is to scale up the load at constant PF and add capacitors to the lower voltages
- Contingencies
  - All N-1 contingencies with additional contingencies supplemented by each company
  - Initially start with the PJM and MISO 2019 contingency list
  - Contingencies will be performed down to the 345kV level and facilities 200kV and above will be monitored

Assumptions and Input Data for Phase 1 (con't)

- Reliability standards, policies and criteria that govern the area of study
  - NERC TPL 001 through 003 standards
  - More stringent regional and local standards
- EHV Voltage Criteria
  - ISOs/RTOs and each company will supply values for normal and contingent operations

Metrics for Phase 1

- Total alternative cost
- Total transmission circuit miles
  - Circuit miles is a key driver in Total Cost. Proxy metric to assess land owner issues
- Total new stations
- System Losses
  - Capacity Impact from On-Peak Analysis
- Number of Lines
  - Number of Lines is also a key driver in Total Cost. Proxy metric to assess community concerns

Metrics for Phase 1 (con't):

- FCTTC Imports & Exports in MW
  - Computed from load flow program based on specific network design
  - FCTTC – First Contingency Total Transfer Capability
- Project cost normalized by import and export capability ($/MW)

SMART Study – Generation Futures & Sensitivities

- Generation Futures
  - Base future
  - High Gas future
  - High Hydro future
  - Low carbon future
- Sensitivities
  - Higher than forecasted load growth
  - Lower than forecasted load growth
  - Plant retirements – Coal plants >=40 years old - 100MW or less and/or 250MW or less
  - High wind capacity
  - Low wind capacity
  - High wind import and export SPP

QUESTIONS?

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