PJM PROMOD Overview

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Market Analysis Software PROMOD

• PROMOD is a fundamental electric market simulation solution
  – It incorporates future demand, generating unit operating characteristics, transmission grid topology and constraints
  – It produces a unit commitment and security constrained economic dispatch while optimizing bid production costs

• For over 40 years, energy industry relied on PROMOD for a variety of applications
  – Locational Marginal Price (LMP) forecasting
  – Financial Transmission Right (FTR) analysis
  – Transmission Congestion Analysis.
• LMP forecasting for selected nodes, user-defined hubs, or load-weighted or generator-weighted zones.

• Financial Transmission Right (FTR) valuation for quantifying market prices, identifying binding constraints, and evaluating the economic impacts of constraints significant to the business.

• Economic Transmission Analysis to quickly evaluate the economic benefit/cost, the increase/decrease in hourly/monthly congestion, and the increase/decrease in reliability metrics associated with transmission expansion and outage scheduling.
PROMOD analysis is a critical component of the PJM Regional Transmission Expansion Process (RTEP):

- It drives the Market Efficiency RTEP Planning Component

- Over 2,400 PROMOD simulations performed during the 2014/15 RTEP window (~50,000 hrs. computer run time)
• In 2014, PJM studied PROMOD congestion simulation data against actual congestion
  – On average PROMOD congestion was ~90% of the actual congestion from 2009-2013

• Recently PJM compared its PROMOD congestion results against most recent FTR annual auction results and they aligned reasonably
PROMOD Inputs/Outputs

**Inputs**
- Generation data
- Demand & energy
- Fuel forecasts
- Environmental costs
- Power flow case
- Monitored flowgates
- Other information: reserve requirement, market territory, etc.

**Outputs**
- Hourly LMP of buses and hubs, include energy, loss and congestion components
- Hourly unit generation and production cost
- Hourly binding constraints and shadow prices
- Hourly line flows
- Hourly company purchase/sale
- Environmental emissions
- Fuel consumption
## Overview Market Efficiency Base Case Inputs

### PROMOD SCED Simulation
- Generation Expansion Plan (ISA/FSA)
- Intermittent resource hourly shapes
- Fuel Price Forecast: Natural Gas, Coal, Oil-H, Oil-L
- Emissions Price Forecast: CO2 (National, RGGI), SO2, Nox (seasonal,annual)
- Demand Forecast: Annual Peak Load and Energy, Hourly shapes
- Demand Response Forecast
- Transmission Topology (As-Is, RTEP)
- Topology Mapping: Bus-Area, BusLoad-Demand, Gen-Bus (As-Is, RTEP)
- Reactive Interface PV Analysis
- Monitored lines and contingencies, interfaces and nomograms, PARs

### Interregional Inputs
- MISO and NY Updates: GenExp, load forecast, wind profiles, major upgrades, flowgates, transactions with SPP/MRO, imports Canada
- Pool Interaction Modeling: M2M flowgates, pseudo-ties, DC schedules, hurdle rates, import/export limits, inactive pools

### Reporting Inputs
- RTO Weighted Average Cost of Capital
- RTO Fixed Carrying Charge Rate
- ARR Source Sink Paths and Cleared MW
- Project Cost and ISD
Market Efficiency Inputs Update Process

1. PROMOD NERC Data Annual Release
2. RTEP Power Flow Update
3. External Model Updates (MISO and others): load, gen, flowgates

- Assumptions Analysis
- Bus to Load Zone mapping
- Flowgate model

- PJM Load Forecast Update
- PJM Generation Queue Update
- Reactive limits (PV Analysis)

- ME Base Case
Appendix 1 – Operating Agreement & Manual
References
References

• Scope, PJM requirements & Member requirements
  • http://www.pjm.com/about-pjm/member-services.aspx

• PJM Manual 14B, Section 2.6:
  http://www.pjm.com/~/media/documents/manuals/m14b.ashx

• PJM Operating Agreement, Schedule 6, Section 1.5.7: