

Transmission Outage Economic Analysis using Market Simulation Software



FERC Staff Technical Conference on Increasing Real-Time and Day-Ahead Market Efficiency through Improved Software

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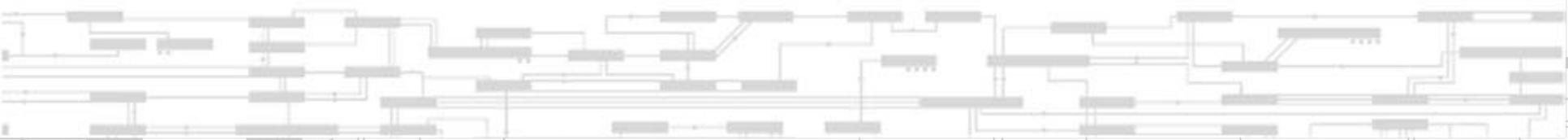
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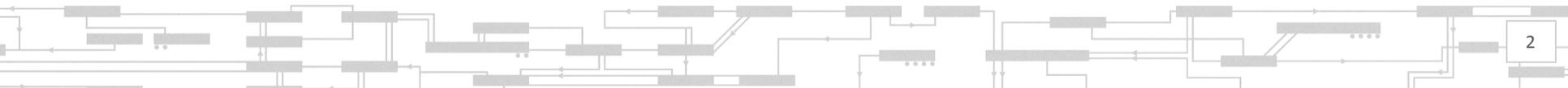
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Need for Economic Analysis Program

- ISO New England (ISO) recognized need for better coordination of outages when markets are affected.
 - Heavy congestion and/or high LMPs in Day Ahead market
 - Negative congestion fund balance when short term outages are not coordinated in Financial Transmission Right (FTR) auctions
- Transmission Owners (TO)/Load Serving Entities recognized need for cost analysis
 - Responsible to state regulators and ratepayers for keeping transmission costs down



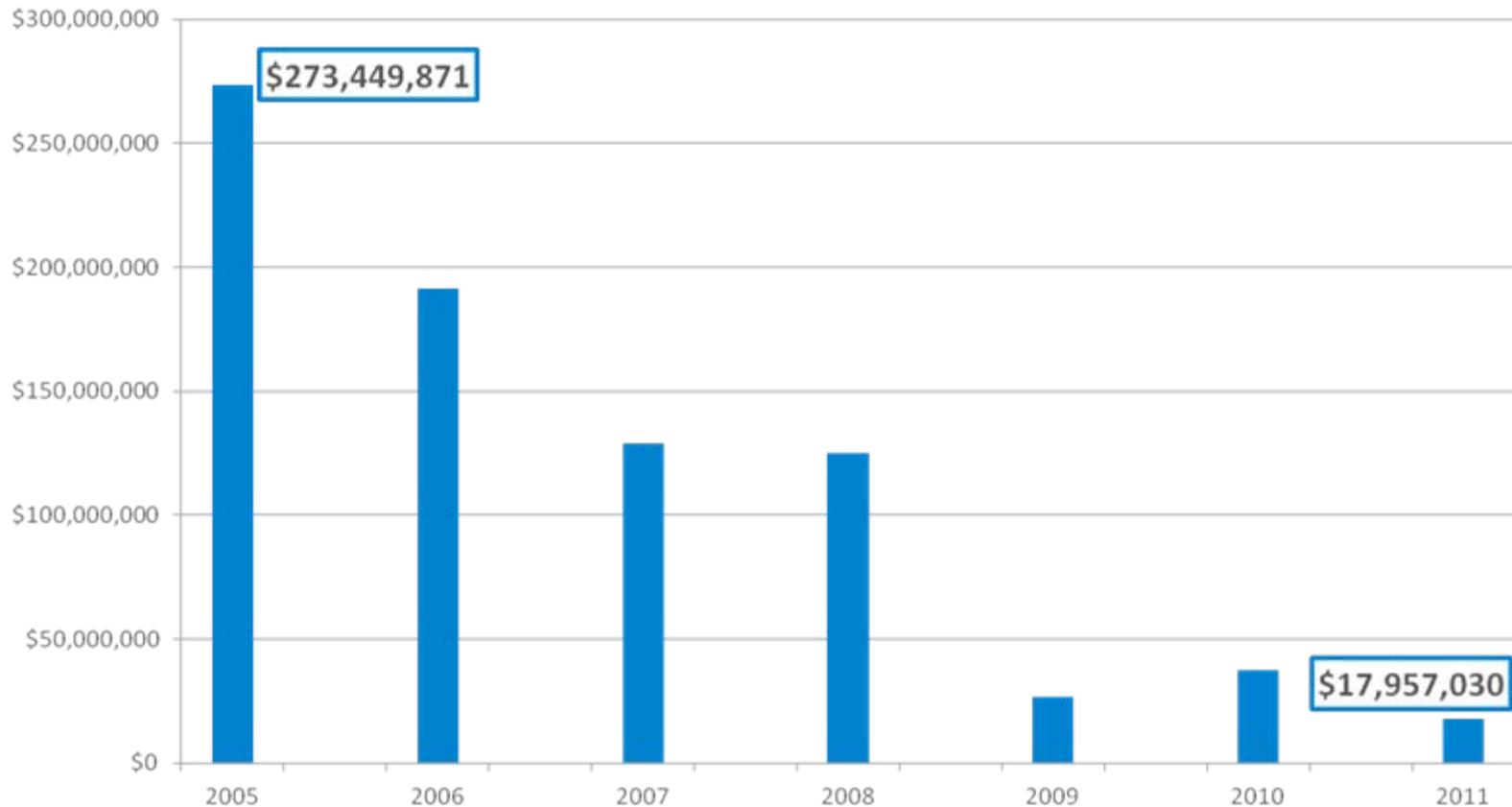
Background

- In 2005, ISO New England:
 - Was designated as a Regional Transmission Organization, broadening its authority over the operation of the region’s high voltage transmission system
 - Outage coordination role is expanded to include economic evaluations
 - ISO and stakeholders finalize Transmission Operating Agreement
 - ISO given central authority for congestion management
 - Participating Transmission Owners responsible for working with ISO on congestion management
 - Applicable Market Rules*
 - ISO has authority to deny or reposition transmission outages if they can result in “significantly reduced congestion costs”
 - Threshold set at \$200,000 per week

* Section III, Market Rule 1 – Appendix G

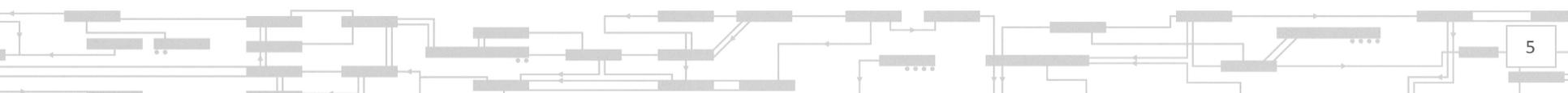
Economic Analysis in Outage Coordination has Helped to Reduce Congestion

Day-Ahead Congestion Revenue



ISO's Economic Analysis – the Early Years

- Initial Economic Analysis studies used simple generator economic-minimum hourly-energy over minimum run-time cost-calculation.
- Desire for more accurate analysis resulted in developing a study-time environment where the production Day Ahead market software could be run.
 - Slow: 45 minutes per market run
 - Inflexible: market parameters not easily changed
 - Manual commitment decisions (due to binding constraints): required many corrections and re-runs
 - Single day analysis only: extrapolation needed for multi-day outages

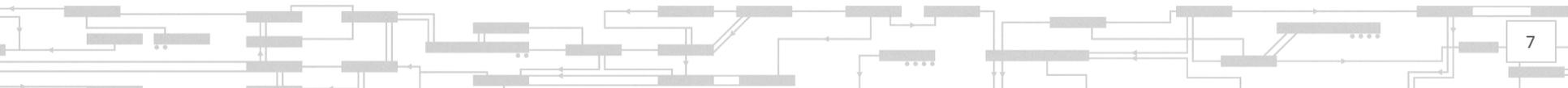


ISO's Current Economic Analysis

- Outage Coordination Economic Analysis Tools (OCEAT)
 - ISO issued requests for proposal to vendors of market simulator products
 - PowerGEM PROBE market simulator chosen in 2008
- PROBE features:
 - Fast: 1 minute per one-day market simulation run
 - Flexible: input parameters easily changed
 - Proven Security Constraint Unit Commitment (SCUC) engine

PROBE Market Simulator

- Designed and customized to closely replicate the ISO's Day Ahead market
- Full EMS network breaker/node model
 - Detailed hourly models accounting for intra-day outages
 - Full scale contingency analysis for all N-1 and selected N-2 interfaces
- Detailed modeling of all DA bids and market rules
- Advanced features
 - Limited Energy Generator model
 - Ancillary Services co-optimization
- Batch-mode automation allows execution of multiple days/scenarios
- Developed automated interface to production environment

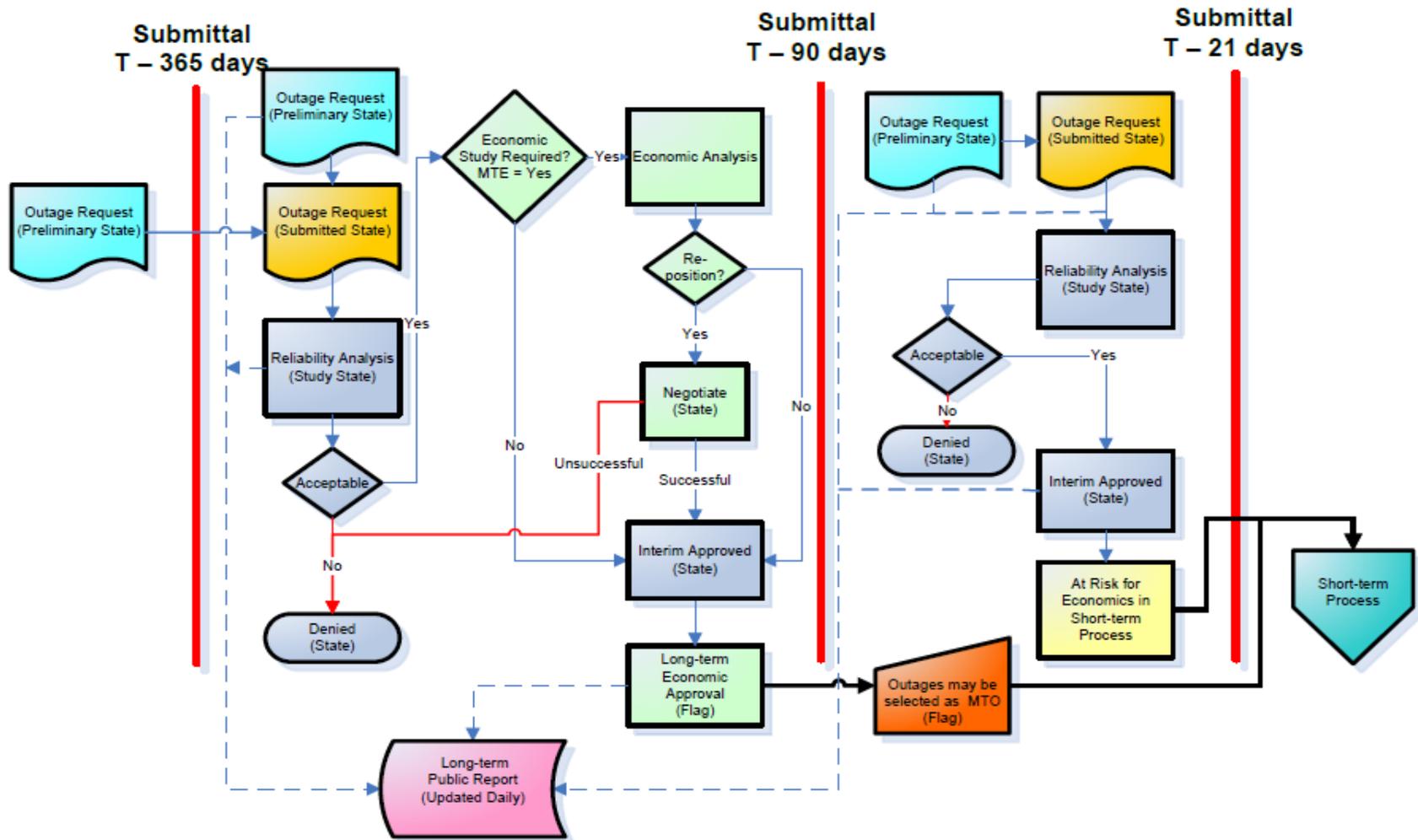


Long-Term Outage Economic Analysis

- Evaluates transmission outages submitted at least 90 days in the future
 - Major transmission elements (i.e. 345KV and 115KV lines that affect generation or internal and external interfaces, etc.)
- Purpose:
 - Identify expensive or conflicting outage applications so they can be adjusted for cost savings
 - Move start/end dates
 - Coordinate conflicting transmission/generator outages
 - Provides economic approval
 - Provides relative certainty to Line owner that outage will proceed as scheduled even if conflicts occur in the short term.
 - Enables Market Administrators to confidently select the outage for inclusion in a monthly or annual FTR auction
 - Enables Long Term Outages Coordinators to confidently select the outage for monthly Forward Capacity Market reconfiguration auctions

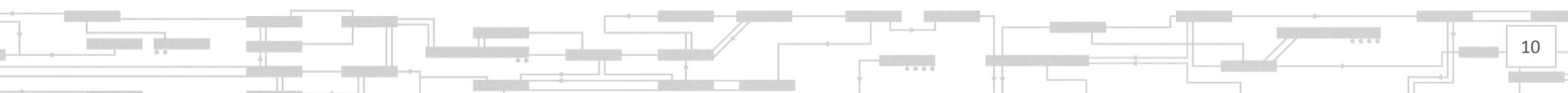
Long Term Process

Long-term Process



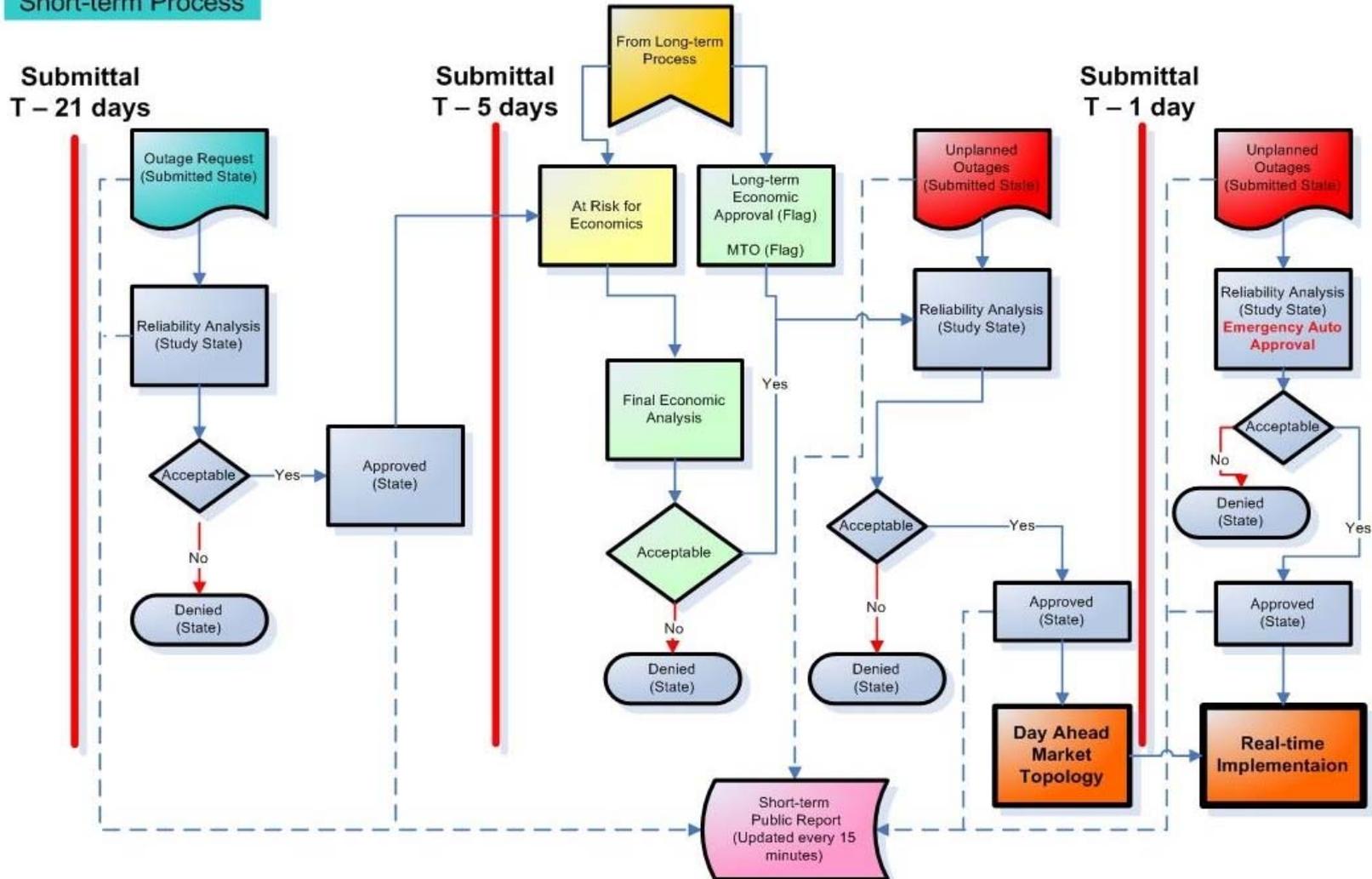
Short-Term Outage Economic Analysis

- Evaluates transmission outages 3-5 days prior to operating day
 - All transmission elements
- Purpose:
 - Identify expensive or conflicting applications
 - Prior to Day Ahead Market runs and Real Time Operations
 - Coordinate cost saving options with Transmission Owners
 - Move start/stop dates
 - Identify compensatory measures
- Outages with long-term economic approval or taken in FTR auction generally not considered
 - Conflicting outages with later timestamp evaluated and coordinated instead



Short Term Process

Short-term Process



PROBE Inputs and Assumptions

- All transmission and generation outages for study day populated to create 24 hourly models; approx. 13,000 buses.
- All interface and external tie limits enforced.
- Security Constrained solution
 - 1st Contingencies: approx. 1,500 total
 - 2nd Contingency in certain areas
- Actual bids/offers (including external transactions) from markets database, from very recent past day used.
- 7-day load forecast used for short term; 50/50 load forecast for long term.

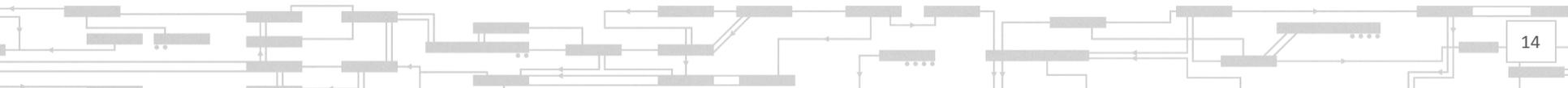


How ISO uses PROBE

- Provides single-day or multi-day (hourly solution granularity)
- Day-Ahead style market run with following differences:
 - Forecast loads loaded (as opposed to price-sensitive demand and virtual bids)
 - Reliability commitments forced, if necessary
- Incremental production cost identified for each outage of interest
- Applications with more than \$200,000 (per week) production-cost noted and reviewed with ISO supervision and affected Transmission Owners.

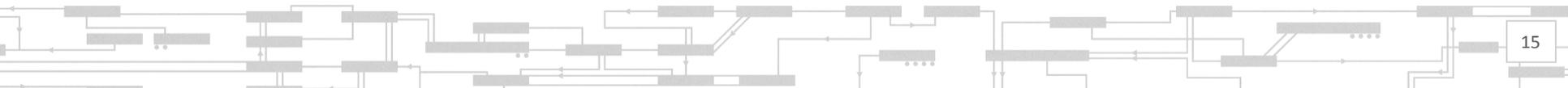
PROBE Outputs

- Incremental production cost represents:
 - Reliability-committed generation incremental costs
 - Reliability-committed generation startup and no-load costs
 - Expensive units dispatched out-of-merit due to transmission constraints causes by outages
 - Generation cost-savings of units displaced by reliability commitments
 - Cleared External Transaction differences due to different commitment/LMPs and transmission constraints



Benefits of OCEAT Process

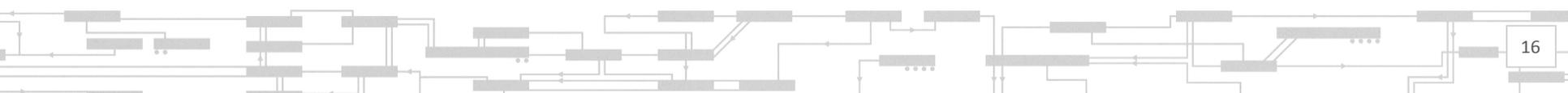
- Ability to study more outage scenarios and outage combinations
- Flexible and simplified method to setup case assumptions
- Provides market solution information (binding constraints) earlier to enhance outage coordination
 - Greater awareness of cost by TOs; better scheduling
- Significant data availability to study additional impact of outages
 - FTR funding
 - Uplift
 - Total load payments
 - LMPs
 - Ability to export future models for more detailed AC and stability analysis



OCEAT Process has Resulted in Significant Savings

	Long-Term Savings	#LT Outages Repositioned	Short-Term Savings	#ST Outages Repositioned	Total Transmission Outage Applications
2008	\$71,049,025	6	\$1,588,711	2	6,153
2009	\$7,160,833	5	\$4,297,314	1	5,729
2010	\$2,946,482	5	\$667,096	3	6,026
2011	\$5,395,045	1	\$552,900	2	5,818
2012*	\$2,690,280	1	\$425,491	2	2,563
Total Savings to Date: \$96.77 million					

* Through May 31, 2012.



Future Considerations

- Is Bid Production Cost (BPC) the best parameter for evaluating the cost of transmission outages?
 - BPC is the most conservative measure
- Other options for BPC:
 - Congestion fund payments
 - Uplift
 - FTR funding adequacy
 - Total load payments
- Anticipated future software efforts at ISO New England
 - Weekly (i.e., 168-hour) unit-commitment optimization
 - Methods for determining reposition dates for outages denied in cost

Questions

