

# CARIS Procedure Development and Simulation Model Evaluation

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# Evaluations of Market Simulation Models for Economic Analysis

## ***Topic:***

- 1. Software Features***
- 2. Benchmarking***
- 3. Simulation Results and Output Reports***
- 4. Maintenance of Future Database***

◆ ***The Study Year is 2007***

◆ ***GridView and GE MAPS will be benchmarked against the actual 2007 market data and/or 2007 PROBE data***

# 1. Software Features

	Grid View	MAPS
<p><b><i>Transmission Model</i></b></p> <ul style="list-style-type: none"> <li>◆ <i>PSSE Format - Version 16, 17, 21....</i></li> <li>◆ <i>PSLF Format</i></li> <li>◆ <i>IEEE</i></li> </ul> <p><b><i>Load Model</i></b></p> <ul style="list-style-type: none"> <li>◆ <i>ISOs &amp; RTOs modeled as Regions or Markets</i></li> <li>◆ <i>ISOs &amp; RTOs contains a number of Areas (ex. 11 internal areas in NYISO)</i></li> <li>◆ <i>Hourly Load Profile for individual Area from annual load shape and total NYISO Gold Book forecast</i></li> <li>◆ <i>Efficiency and Conservation Programs as Base Cases or Scenarios</i></li> </ul>		

# Software Features *continued*

	Grid View	MAPS
<p><b>Generator Model</b></p> <ul style="list-style-type: none"> <li>◆ <i>Bids</i></li> <li>◆ <i>Existing units – heat rates, forced outage rates, start up costs, ramp up date, and rate down rates</i></li> <li>◆ <i>Retired units</i></li> <li>◆ <i>Variable operations and maintenance (O&amp;M) values</i></li> <li>◆ <i>Penalty factors</i></li> <li>◆ <i>Unit maintenance</i></li> <li>◆ <i>Forced outage rates (EFOR)</i></li> <li>◆ <i>Emission costs</i></li> <li>◆ <i>Combined cycle model</i></li> <li>◆ <i>Hydro and pump storage model</i></li> </ul>		

# Software Features *continued*

	Grid View	MAPS
<p><b><i>Operating Reserves Model - Ancillary Services</i></b></p> <ul style="list-style-type: none"> <li>◆ <i>Regulation Up</i></li> <li>◆ <i>Regulation Down</i></li> <li>◆ <i>Spinning Reserve - 10 min.</i></li> <li>◆ <i>Non-Spinning Reserve - 10 min.</i></li> <li>◆ <i>Non-Spinning Reserve - 30 min.</i></li> <li>◆ <i>Cascading rules for each of the AS types</i></li> <li>◆ <i>Co-optimization of Energy and Reserves</i></li> </ul> <p><b><i>Loss Model</i></b></p> <ul style="list-style-type: none"> <li>◆ <i>Single Reference Bus</i></li> <li>◆ <i>Distributed Reference Bus</i></li> </ul>		

# Software Features *continued*

	Grid View	MAPS
<p><b>Renewable Resources</b></p> <ul style="list-style-type: none"> <li>◆ <i>Hourly resources load modifiers (wind, geo-thermal, solar...)</i></li> <li>◆ <i>Spillage</i></li> </ul> <p><b>Fuel Model</b></p> <ul style="list-style-type: none"> <li>◆ <i>Oil price forecast</i></li> <li>◆ <i>Coal price forecast</i></li> <li>◆ <i>Natural gas forecast</i></li> </ul> <p><b>Monte Carlo Simulation</b></p> <p><b>Transmission Congestion Contracts (TCCs) Model</b></p>		

# Software Features *continued*

	Grid View	MAPS
<p><b><i>Security Constraint Model</i></b></p> <ul style="list-style-type: none"> <li>◆ <i>Base case conditions</i></li> <li>◆ <i>Contingency/pair for SCUC/SCED</i> <ul style="list-style-type: none"> <li>◆ <i>Tower contingency</i></li> <li>◆ <i>Stuck-Breaker contingency</i></li> <li>◆ <i>Series contingency</i></li> <li>◆ <i>Bus contingency</i></li> <li>◆ <i>Special Protection Schemes (SPS), STE vs. LTE</i></li> </ul> </li> <li>◆ <i>Minimum burn and HEDD days</i></li> <li>◆ <i>Load pockets</i></li> </ul>		

# Software Features *continued*

	Grid View	MAPS
<p><b>External Areas Model</b></p> <ul style="list-style-type: none"> <li>◆ <i>Single market simulation</i></li> <li>◆ <i>Multiple market simulation</i> <ul style="list-style-type: none"> <li>◆ <i>Hurdle rates (external and bilateral transactions)</i></li> <li>◆ <i>Fixed generation and load</i></li> <li>◆ <i>Zero generation and load - use hourly resource as tie lines</i></li> </ul> </li> </ul> <p><b>Environmental Model</b></p> <ul style="list-style-type: none"> <li>◆ <i>Emission types (CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub>, Mercury...)</i></li> <li>◆ <i>Emission rate</i></li> <li>◆ <i>Emission areas</i></li> <li>◆ <i>Emission allowances</i></li> </ul>		

# Software Features continued

	Grid View	MAPS
<p><b><i>PAR Schedule</i></b></p> <p><b><i>DC Lines Schedule</i></b></p> <p><b><i>Study Management</i></b></p> <p><b><i>Change Case Tracking</i></b></p> <p><b><i>System Changes Through Time</i></b></p> <p><b><i>Commitment and Dispatch Options</i></b></p>		

## 2. Benchmarking

- ◆ ***The Study Year is 2007***
- ◆ ***GridView and GE MAPS will be benchmarked against the actual 2007 market data and/or 2007 PROBE data***
  
- ◆ ***Benchmarking variables:***
  - ◆ *Energy dispatch*
  - ◆ *Interface flows*
  - ◆ *LBMP*
  - ◆ *Simulation with and without constraints*
  - ◆ *Turnaround time*

# Benchmarking continued

## **Energy dispatch - annual**

- ◆ Capacity Factor of generating units by fuel type (uranium, gas, coal, hydro, renewables, others)
- ◆ Total MW generation by type (compared to Gold Book)
- ◆ MWh generator output by zone

## **Interface flows – hourly**

- ◆ Transmission lines
- ◆ Interfaces
- ◆ DC lines
- ◆ PARs

## **LBMP**

- ◆ Zonal LBMPs - Max, Min, Avg
- ◆ Hourly load weighted zonal (plots)
- ◆ Annual average (plot)
- ◆ LBMP components (energy, congestion, losses)

## **Simulation with and without constraints (benchmark against PROBE)**

- ◆ Change in Production costs
- ◆ Change in Congestion payments
- ◆ Change in Generator payments
- ◆ Change in Load payments

## **Turnaround time**

# Benchmarking continued

<b>Benchmarking Assumptions:</b>	<b>Data Source</b>		
	<b>GridView</b>	<b>MAPS</b>	<b>2007 Actual Market Data</b>
<ul style="list-style-type: none"> <li>◆ <i>Fuel Forecast</i></li> <li>◆ <i>Load Forecast</i></li> <li>◆ <i>Generating units and parameters</i> <ul style="list-style-type: none"> <li>◆ <i>Existing units – heat rates, start up costs...</i></li> <li>◆ <i>Retired units</i></li> <li>◆ <i>Variable operations and maintenance (O&amp;M) values</i></li> <li>◆ <i>Penalty factors</i></li> <li>◆ <i>Unit maintenance</i></li> <li>◆ <i>Forced outage rates (EFOR)</i></li> <li>◆ <i>Emission costs</i></li> </ul> </li> <li>◆ <i>Power flow case</i></li> <li>◆ <i>Commitment and Dispatch hurdle rates</i></li> <li>◆ <i>Operating Reserve Requirement</i></li> <li>◆ <i>Contingencies and monitored elements</i></li> </ul>			

# Evaluations of Market Simulation Models for Economic Analysis continued

## ***3. Simulation Results and Output Reports***

- ◆ *Output reporting features – reports, plots*
- ◆ *Contour maps*

## ***4. Maintenance of Future Database***

The New York Independent System Operator (NYISO) is a not-for-profit corporation that began operations in 1999. The NYISO operates New York's bulk electricity grid, administers the state's wholesale electricity markets, and provides comprehensive reliability planning for state's bulk electricity system.

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***[www.nyiso.com](http://www.nyiso.com)***