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Multi-Settlement Simulation of Dynamic Reserve Procurement: Project Update

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Outline

- Introduction
- 2008 – 2010 Contributions
- Project Plan and Status
- Realistic Simulation of Reserve Determination
- Reserve Determination Case Study
- Summary

Introduction
Importance

Traditional reserve procurement may not be efficient or sufficiently reliable under future system conditions

- We need methods to dynamically procure reserve in anticipation of dynamic system conditions
  - Wind ramping
  - Uncertain production and demand
- Stochastic modeling offers hope of accomplishing this
  - A drawback is lack of transparency
- Use dynamic reserve requirements from an *off-line* calculation fed into current operating practice

This offers augmentation with minimum disruption

Introduction
Progress

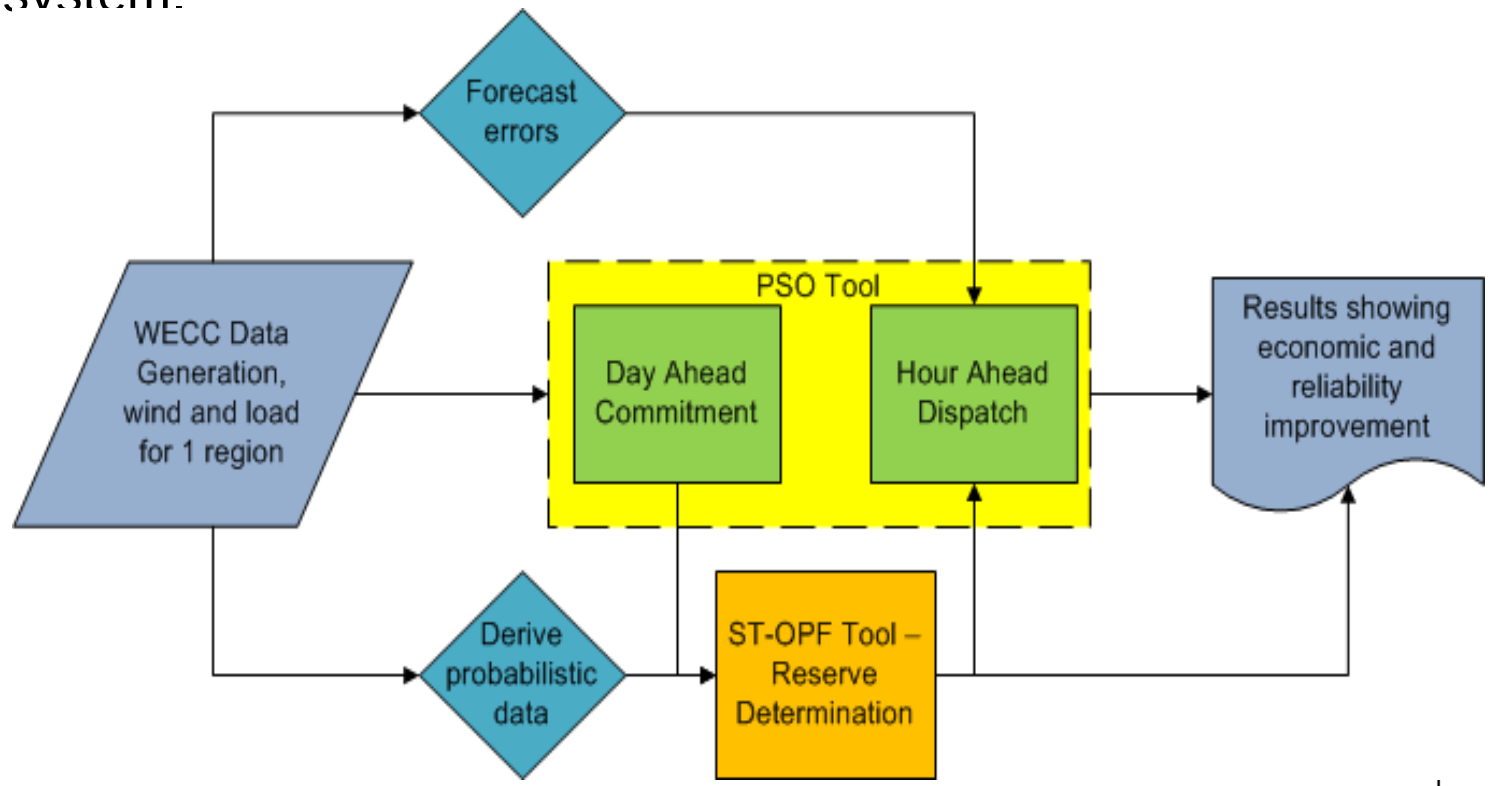
- We include realism of multiple decision cycles
- We continue work in 2012
  - Include impacts of transmission congestion
  - Include multiple types of dynamic reserve and rules for deploying them for power balance
  - Assess the right time frame for dynamic procurement
- Work with members to make sure it is deployable with the goal is to have an operator assess its true usefulness

This is a work in progress with increasing realism

P173.005 – Applications of Stochastic Optimal Power Flow for Integrating VG & DR (cont.)

Project Foundation & Relation to Other Industry Work:

- Continuation of EPRI 2011 project [P173.005]
  - Realistic, detailed multi-settlement simulation for reduced Western system.



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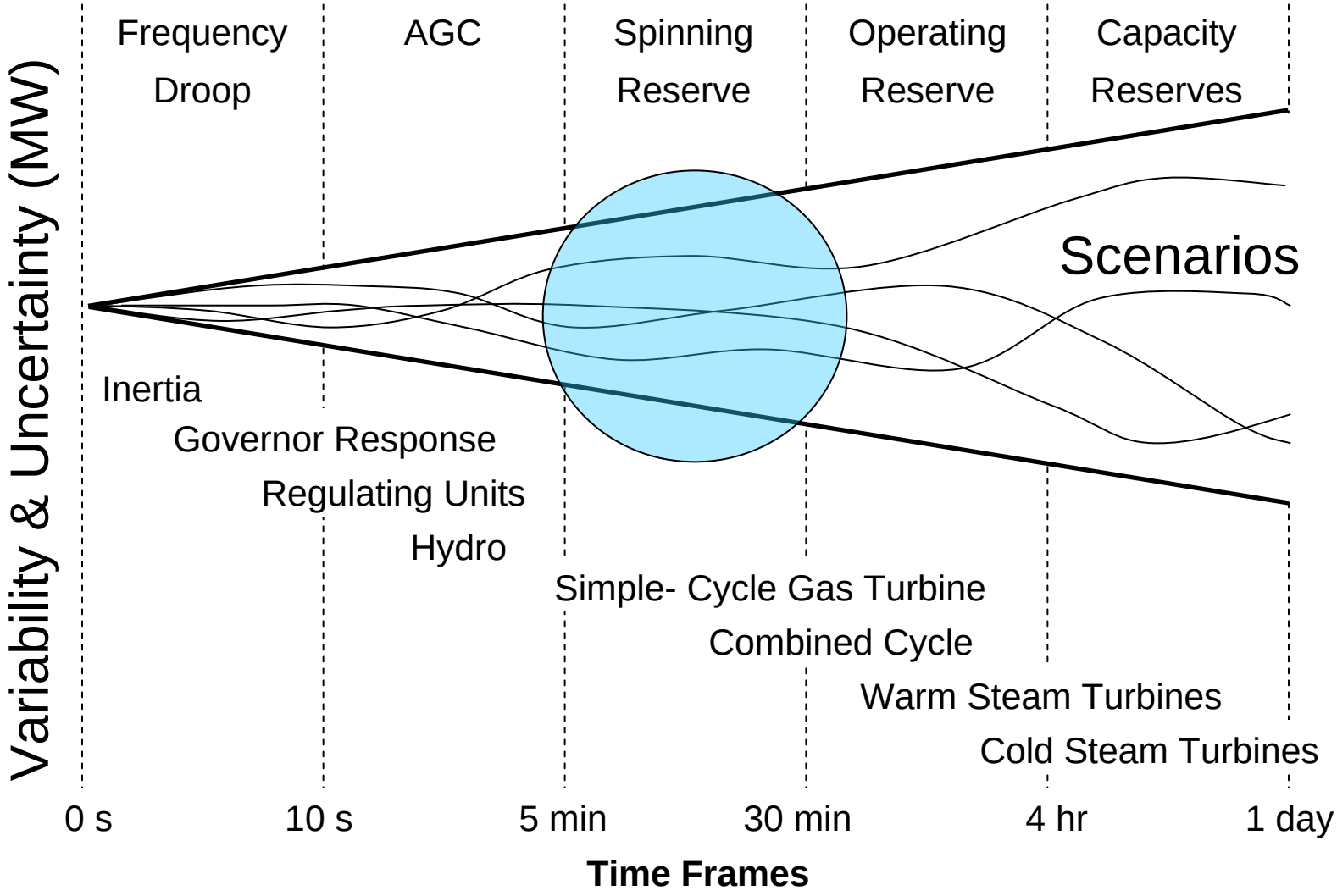
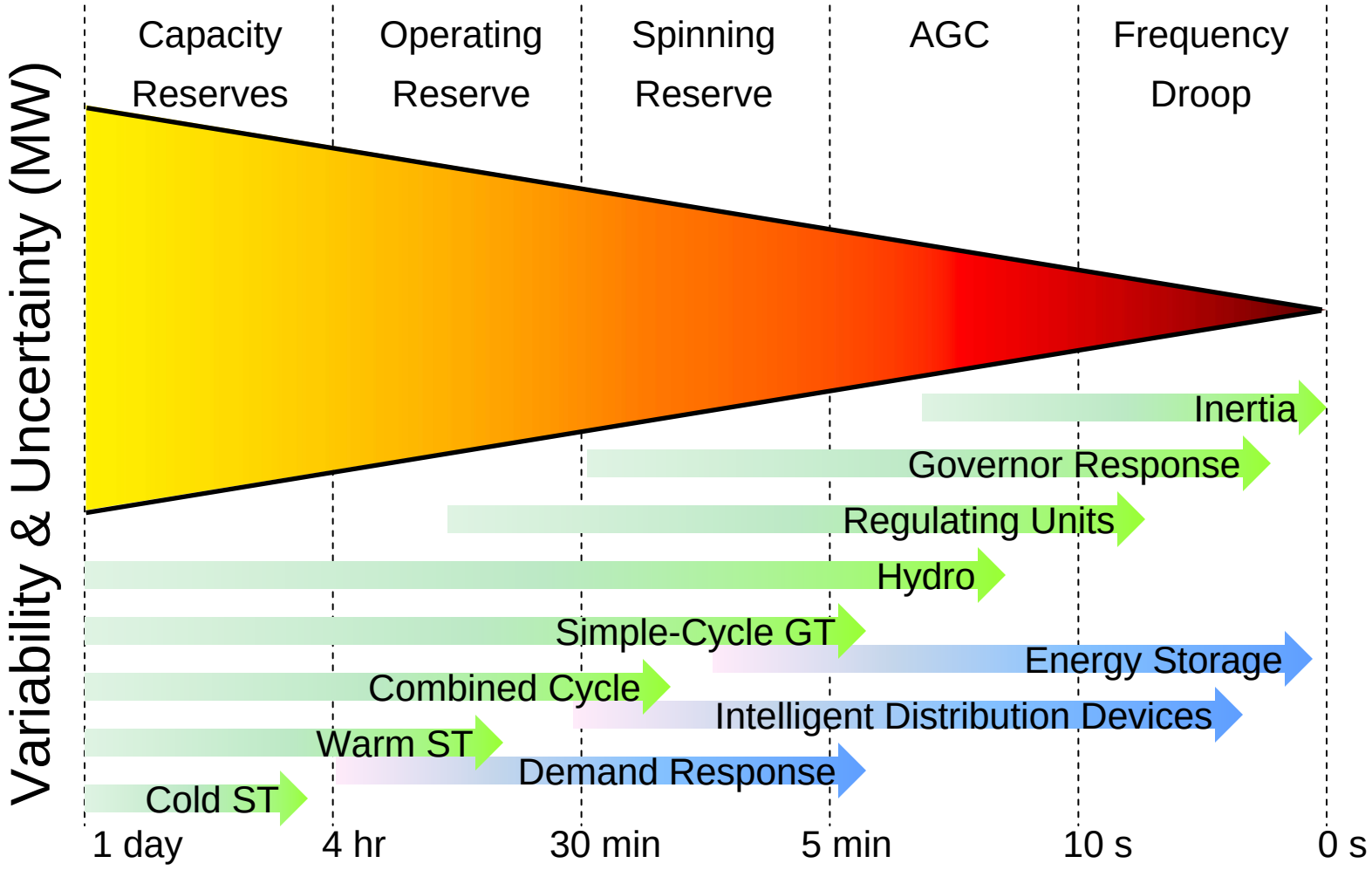
Realistic Simulation
Layers Time Frames



Source: Russ Philbrick, PES General Meeting, Detroit, July 2011

Realistic Simulation

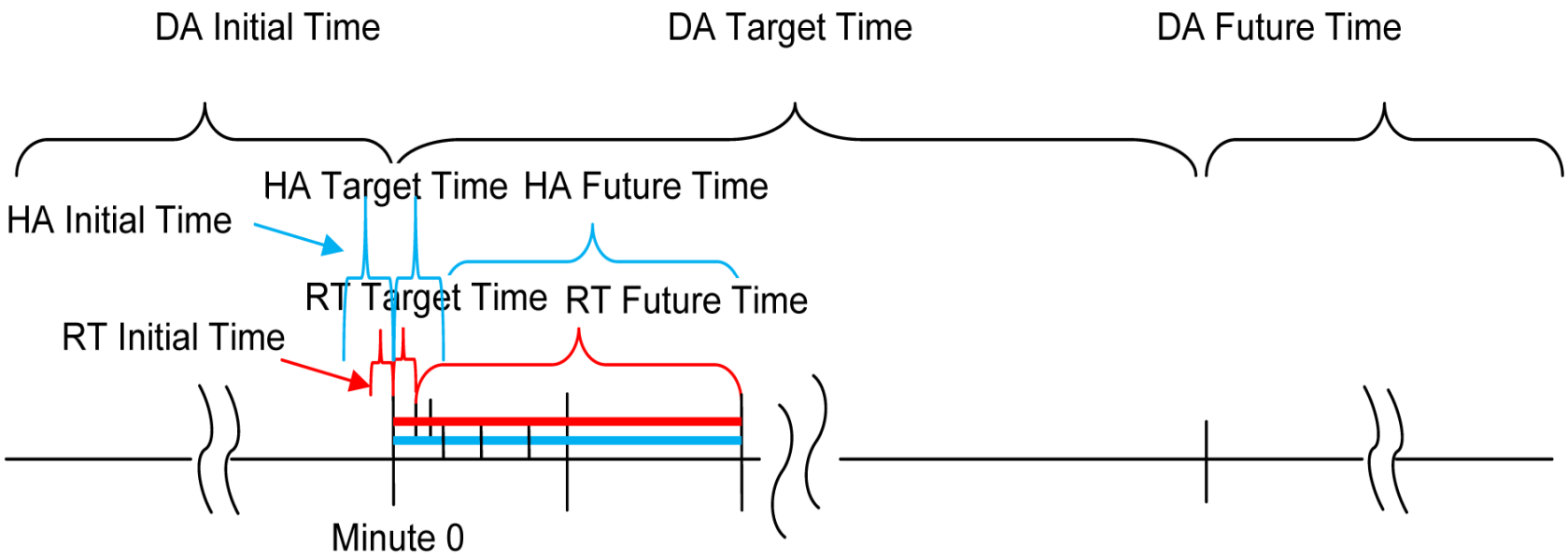
Resolves Uncertainty & Responds to Variability



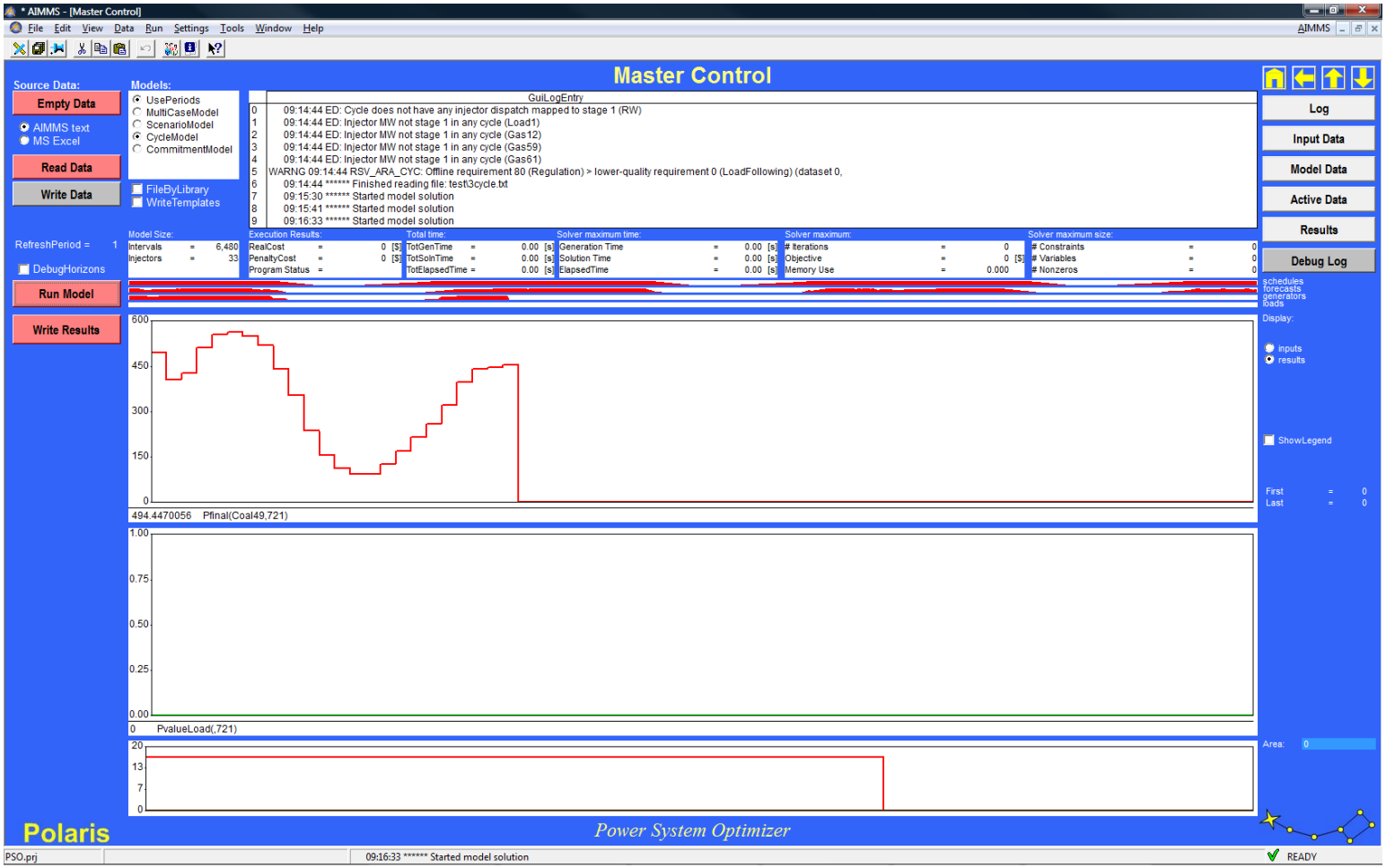
Source: Russ Philbrick, PES General Meeting, Detroit, July 2011

Realistic Simulation

Time Frames of the Multi-Cycle Model

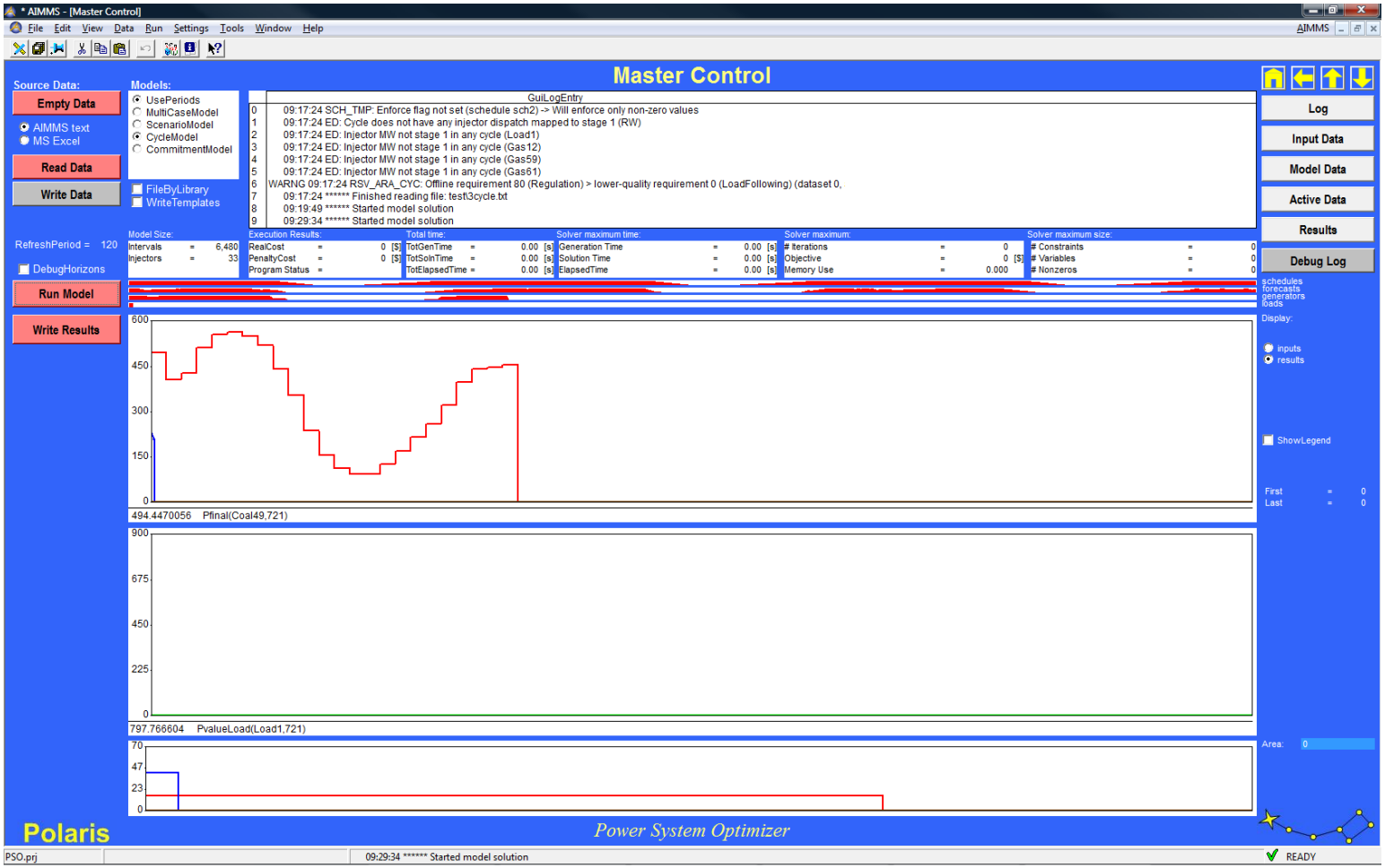


Realistic Simulation
Visualization 1

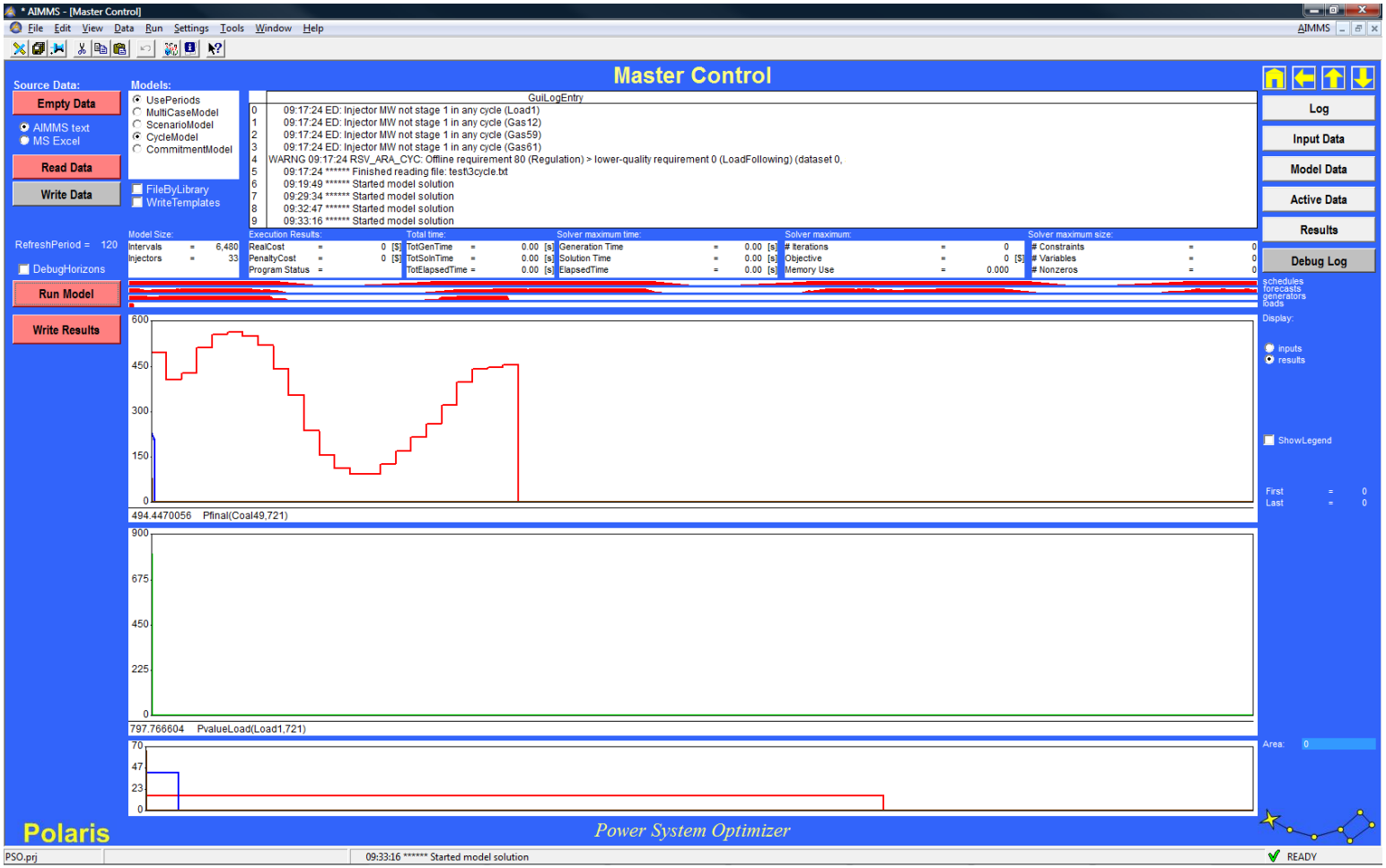


Realistic Simulation

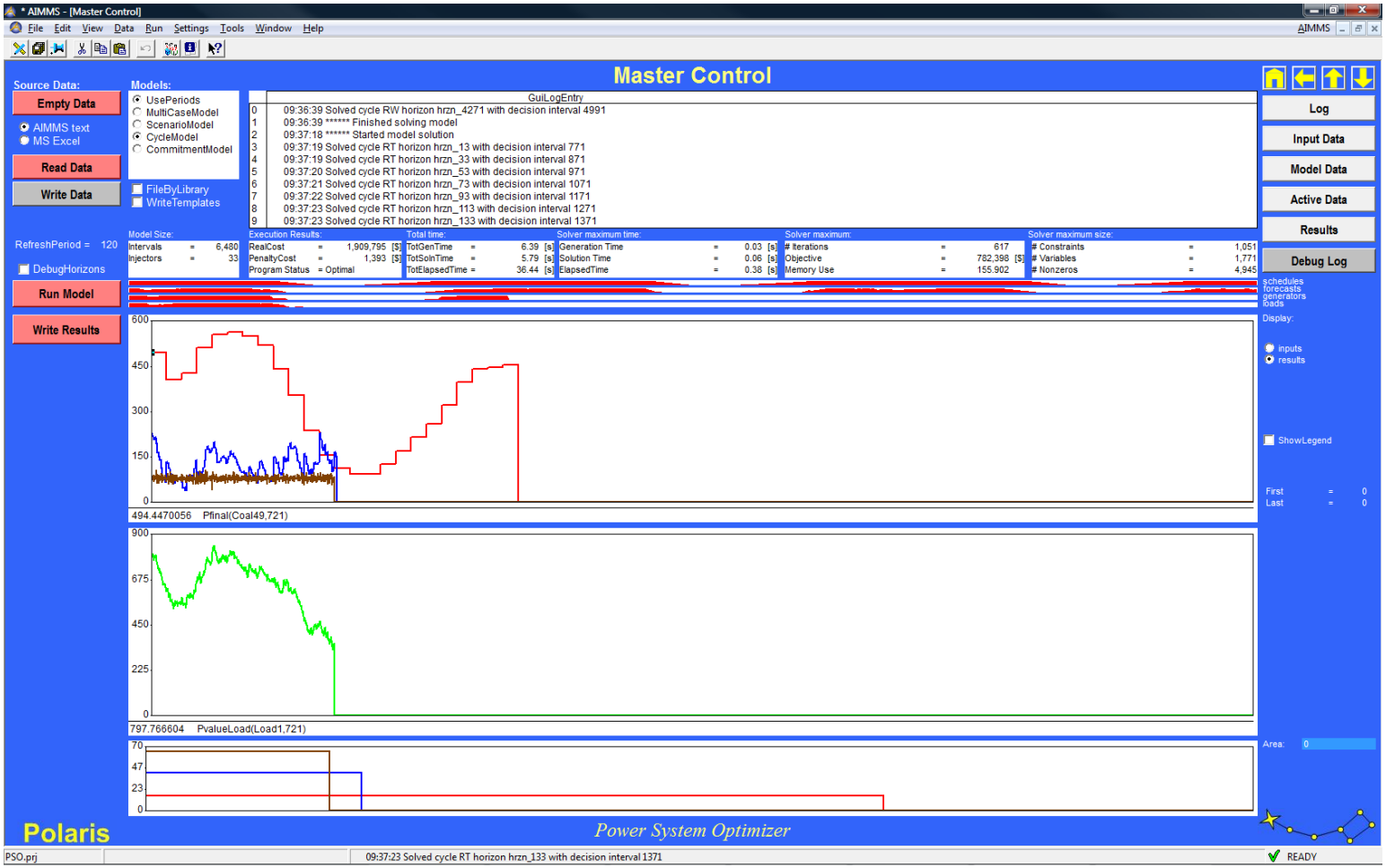
Visualization 2



Realistic Simulation
Visualization 3



Realistic Simulation
Visualization 4



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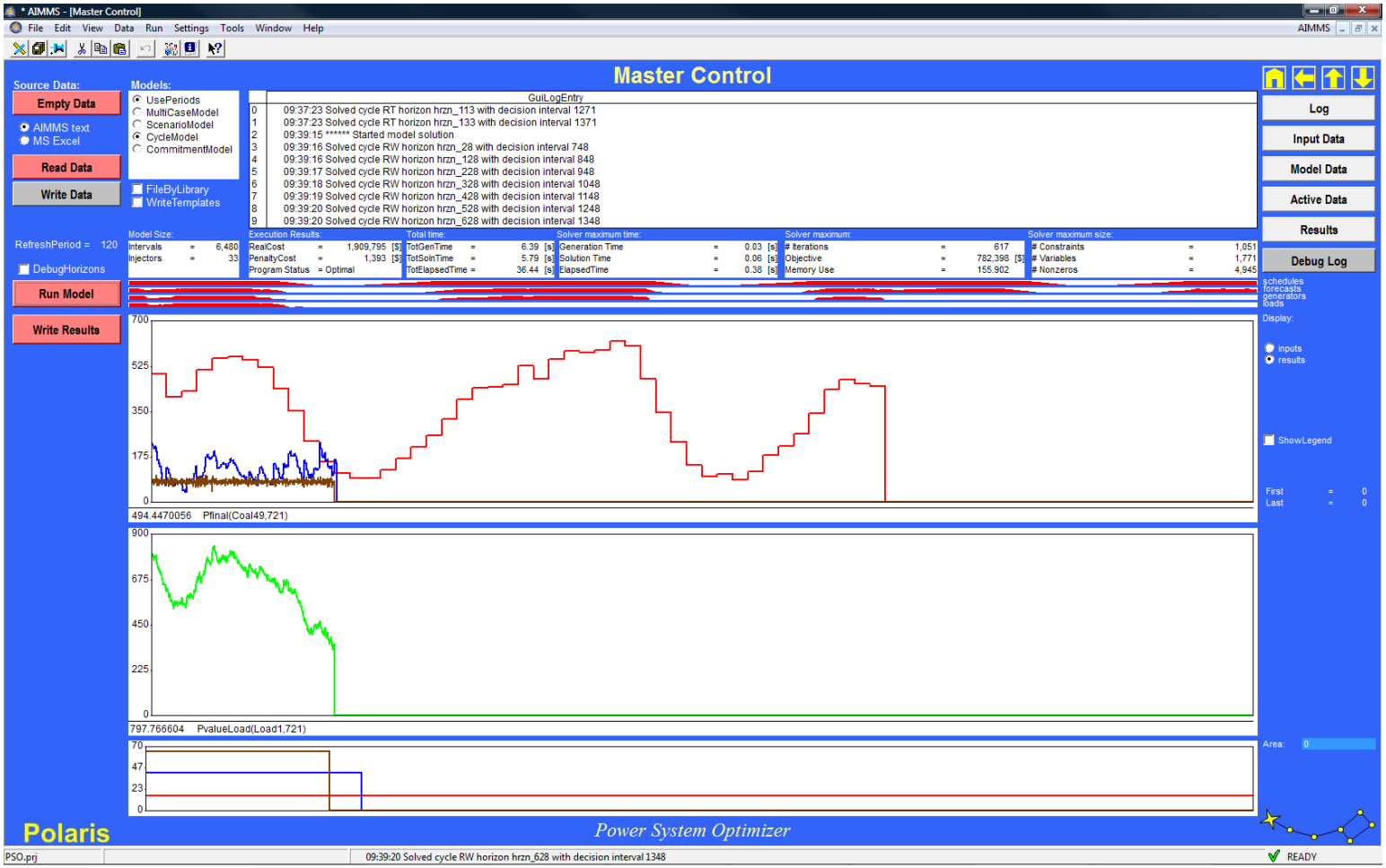
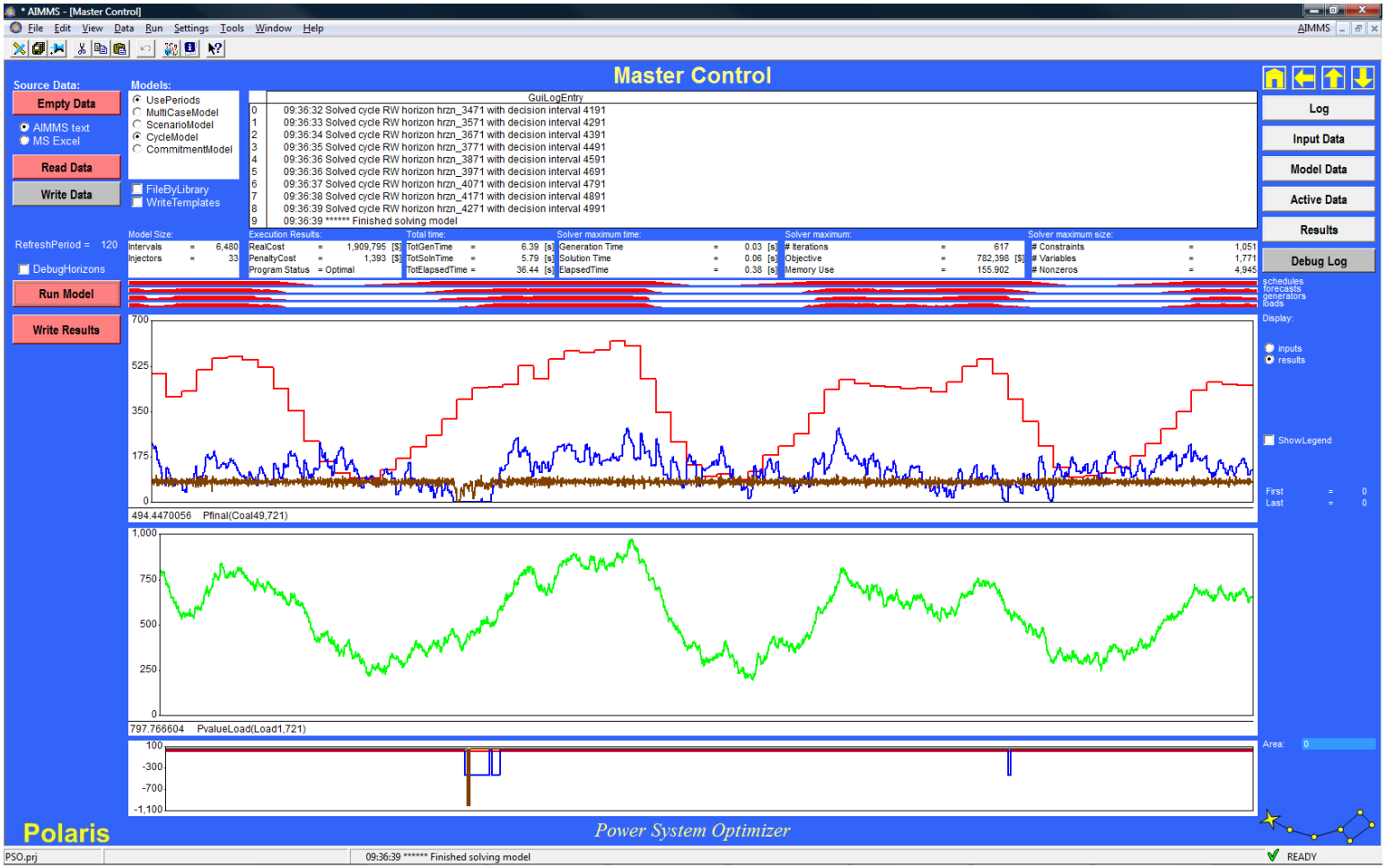
Realistic Simulation
Visualization 5



Realistic Simulation

Visualization 6



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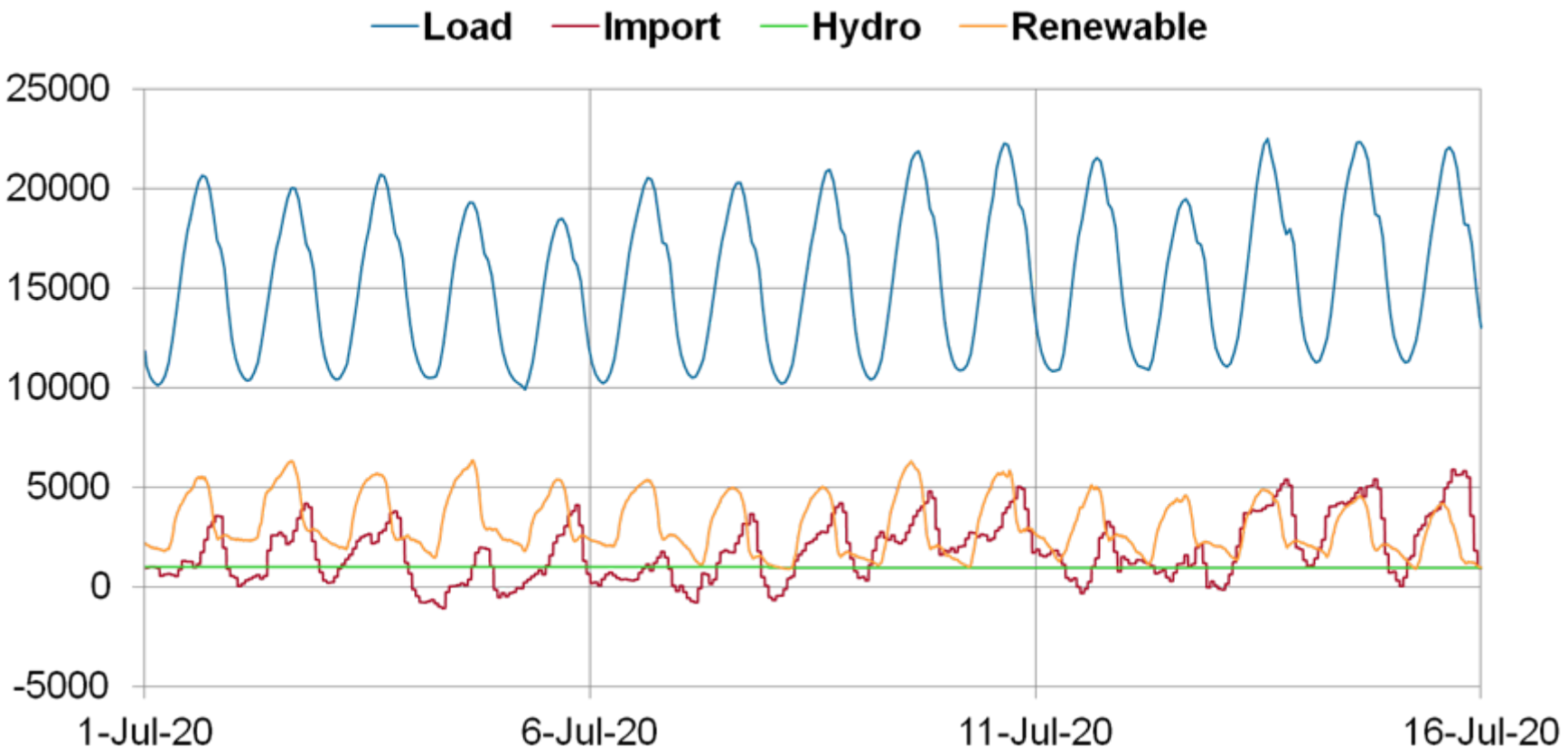
Reserve Determination Case Study
Load, Imports, Hydro and Renewable Inputs

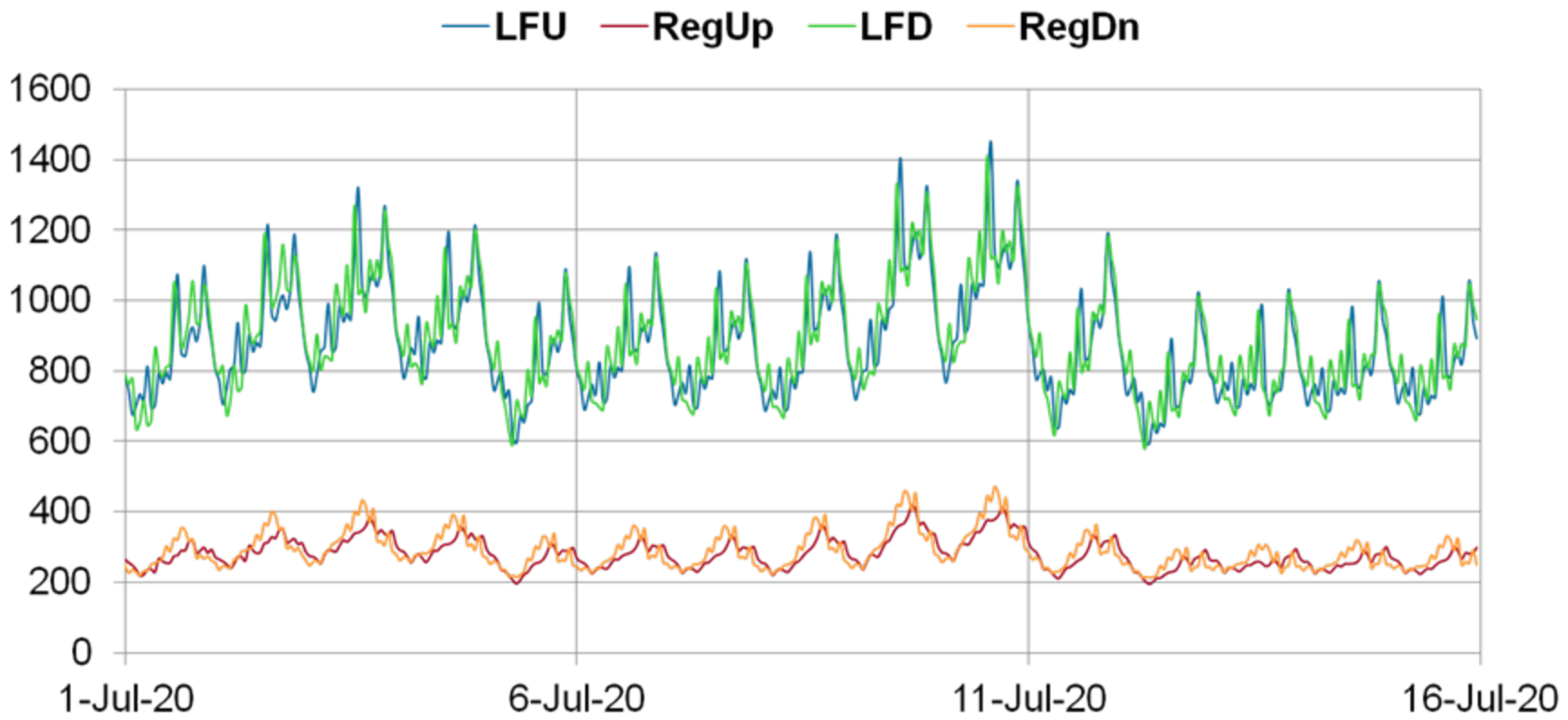


CAISO 33% Renewables Study

- Focus on SCE area without transmission congestion
- Additional data represents renewable uncertainty

Reserve Determination Case Study

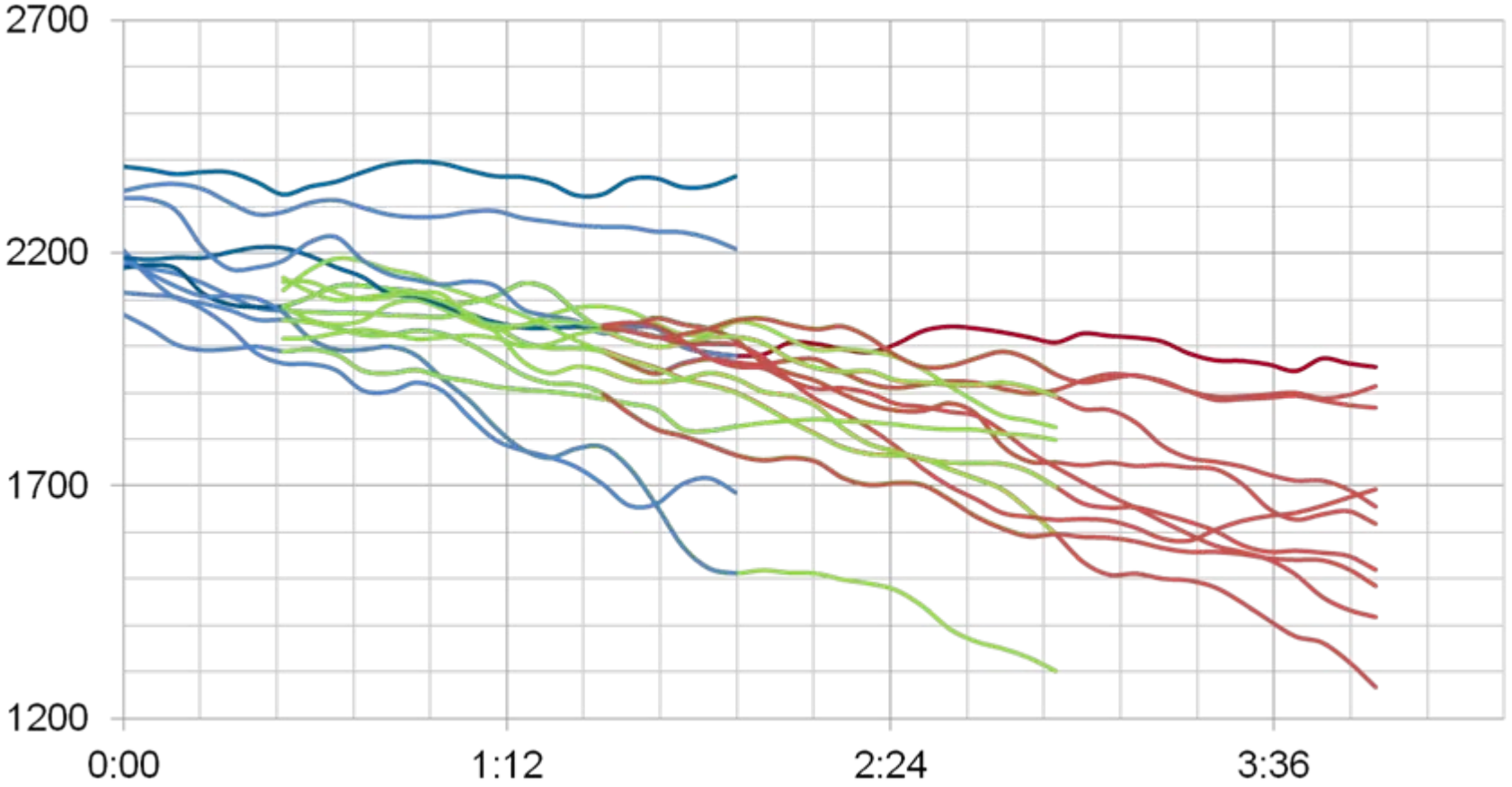
Pro-Rated Reserve Requirements



- LFU – Load Following Up
- RegUp – Regulation Up
- LFD – Load Following Up
- RegDn – Regulation Down

Pro rated requirement for SCE area, may overestimate need

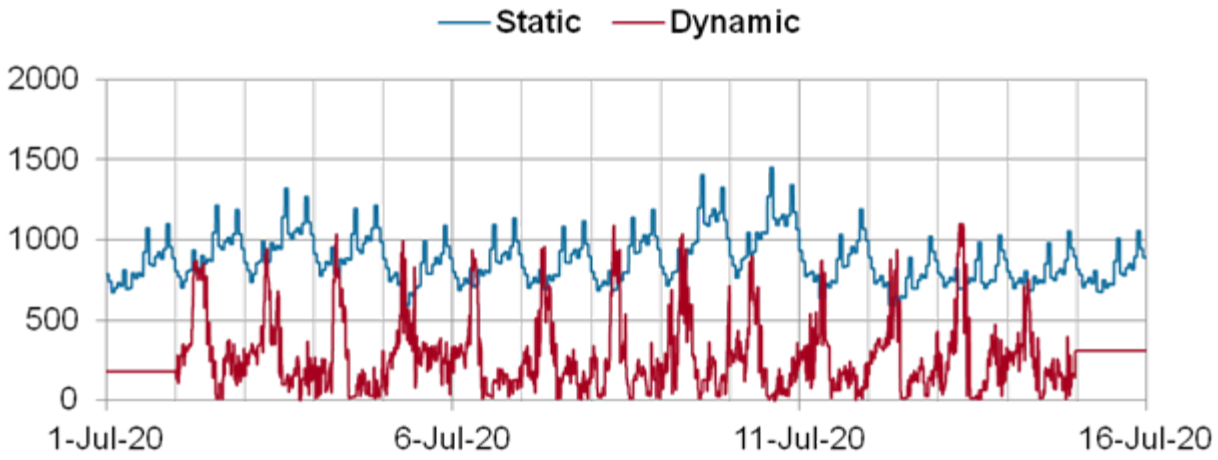
Reserve Determination Case Study
Random Renewable Generation Schedules



- Uncertainty of renewable generation included in the pre-dispatch cycle
- Only LFU is procured dynamically

P173.005 – Applications of Stochastic Optimal Power Flow for Integrating VG & DR (cont.)

– Simulation Results and Conclusions

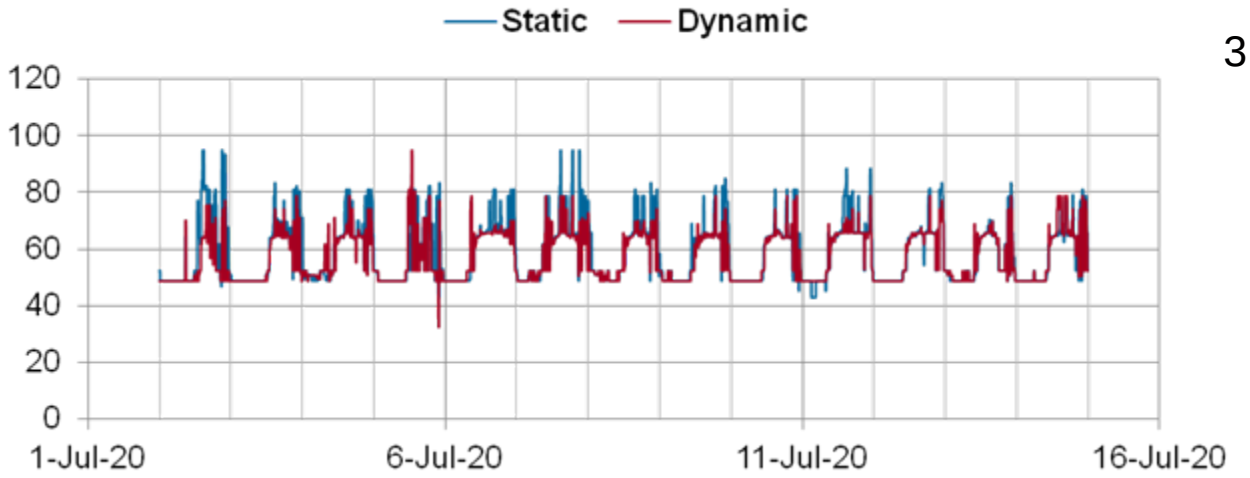


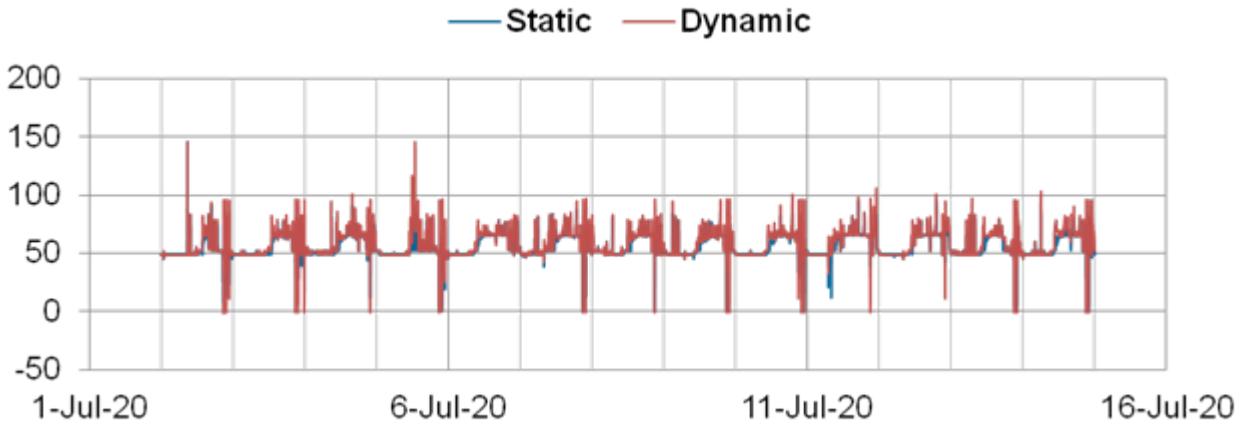
Static Requirement	Dynamic Requirement	Delta Cost	% of Saving
126,014,101	114,703,621	-11,310,479	-9.0%

1. Comparison of the LFU procurements between the traditional static method and the STOPF dynamic method suggests that the traditional procurement may be over procured in most of the time, but insufficient in some time during the period of load pull.
2. For the system conditions studied, Dynamic Reserve Determination reduces LFU costs by 9%

P173.005 – Applications of Stochastic Optimal Power Flow for Integrating VG & DR (cont.)

– Simulation Results and Conclusions (cont.)





3. Dynamic LFU procurement in the pre-dispatch cycle

   ✓Shows no Pre-Dispatch energy deficiency

   ✓Fewer energy price spikes

4. Real time dispatch with dynamic LFU

   ✓Shows no Real Time Energy deficiency

   ✓Prices vary more, because of reduced LFU procurement

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Reserve Determination Case Study
Summary of Results

- Dynamic Reserve Procurement can be inserted into the current market pre-dispatch process for better management of reserves
- Total production costs are reduced.
- Reliability is not adversely affected, for the given range of random scenarios.
- May be a need for more realism in the Pre-Dispatch cycle

OR

The current static requirements may inefficiently procure reserves for some conditions

Reserve Determination Case Study
Next Steps

- Engage utility staff to validate methodology and prioritize
- Improve decision cycles to capture formal and informal decision processes
- Include locational impacts of transmission congestion
- Impacts of random generator outages, transmission deratings, load forecast errors, etc.
- Improved forecasting and scenario creation

Reserve Determination Case Study
Next Steps

- Modeling enhancements
  - Dynamically procure multiple reserve types in other decision cycles
  - Facilitate calling reserves for different reasons, like ramping, contingencies, etc.
  - Assess the best time to procure dynamically