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Operational Modeling and Model Inputs

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RELIABILITY | ACCOUNTABILITY




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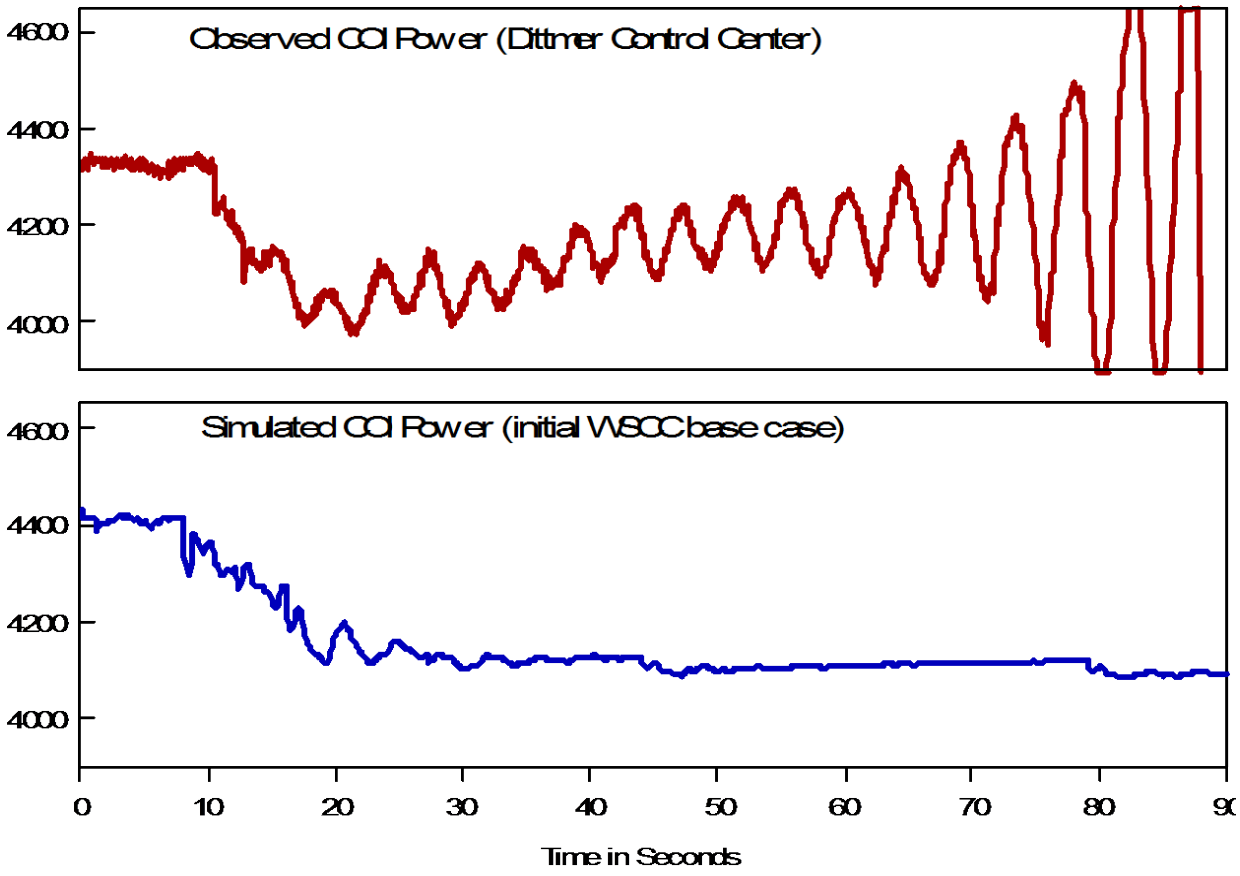
Importance of Modeling

- If something in not modeled, how can you predict system behavior or the interaction of components?
- Bad modeling can give a false sense of security
- Bad Modeling ➔ Bad Decisions
  - Planning – wasted money
  - Operations – unknowingly operating in insecure states

August 10, 1996 WSCC Outage

Real event

Dynamic simulations



No confidence in dynamic database

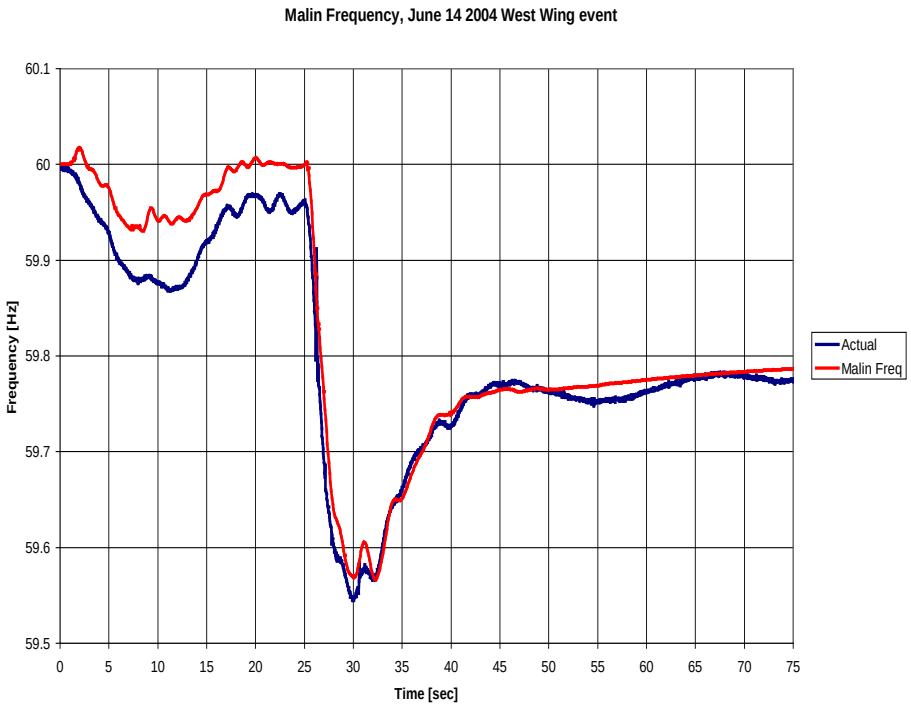
WSCC Actions Since 1996

- Aggressive testing of generating units
  - 80% of units directly tested
- Validation by Observation adopted
- System probing testing
  - Pacific DC Tie (PDCI) signal injection (ongoing process)
  - Chief Joseph Braking Resistor (1,400 MW) insertion
- Validation by system disturbance PMU recordings
  - Ongoing for significant system events
- Identified 12 discreet inter-area oscillatory modes
  - Identified mode shapes and participating generators
  - Tuned generator controls and Power System Stabilizers

What We Must Achieve

WECC Confidence today

- grid frequency



System simulations of June 14, 2004

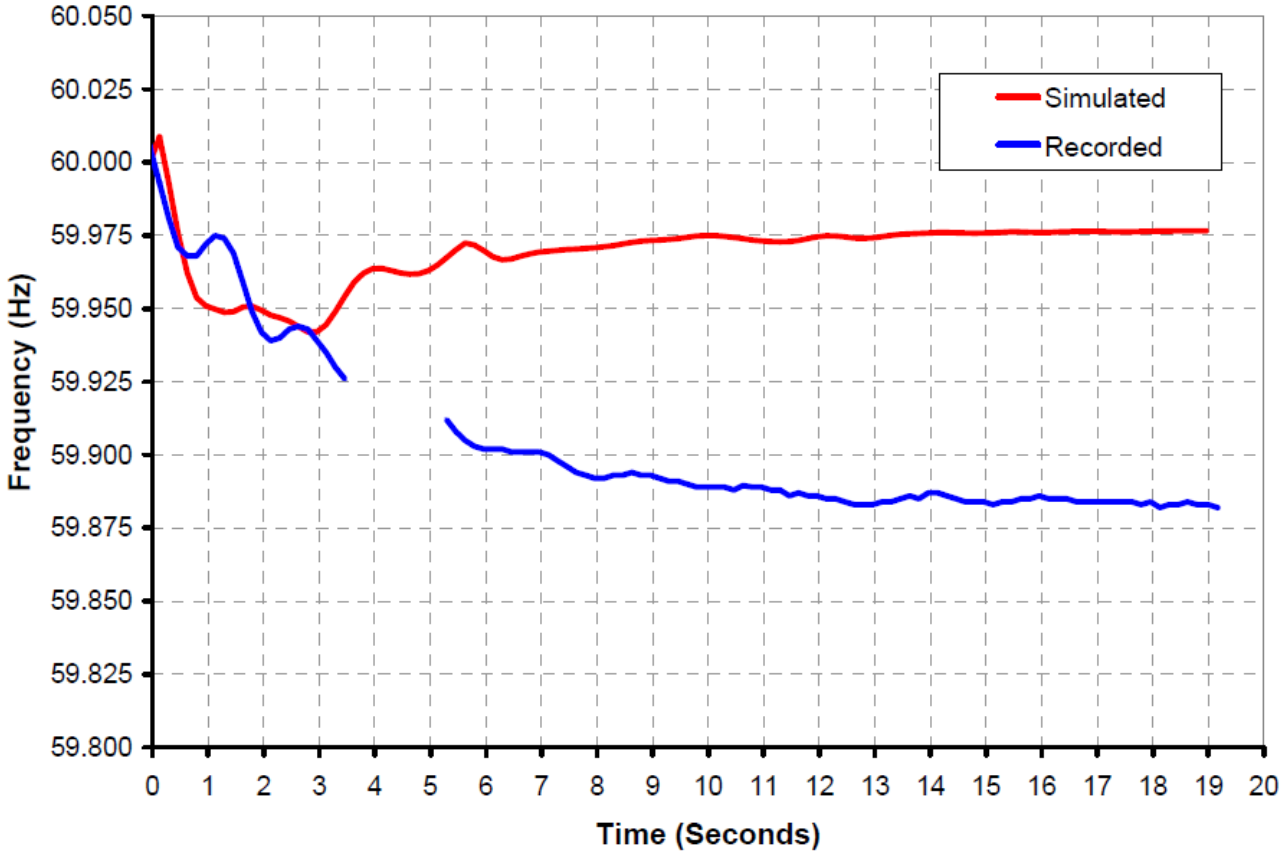
- COI power

Real event

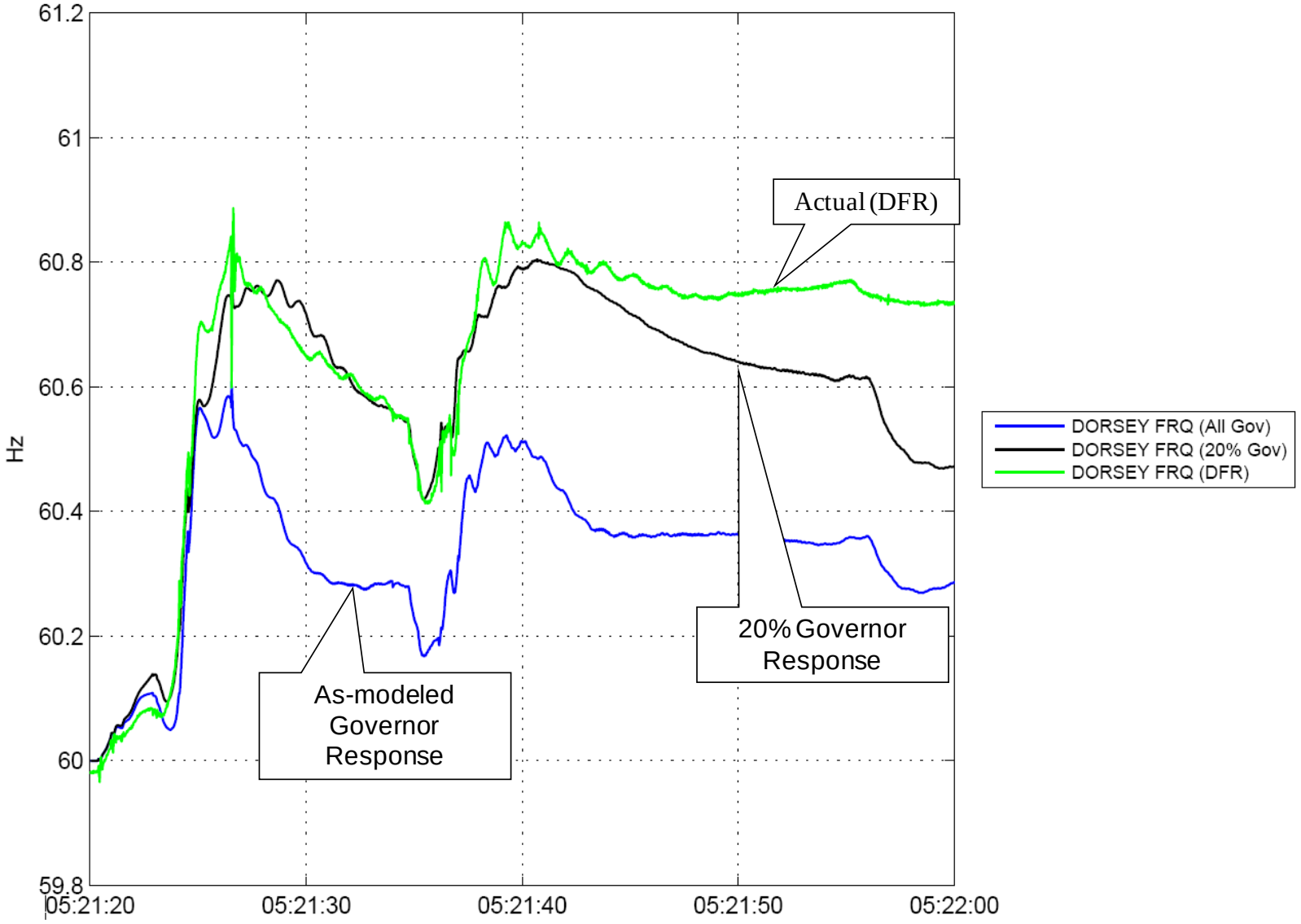
Simulations

Unable to Simulate EI Frequency Response

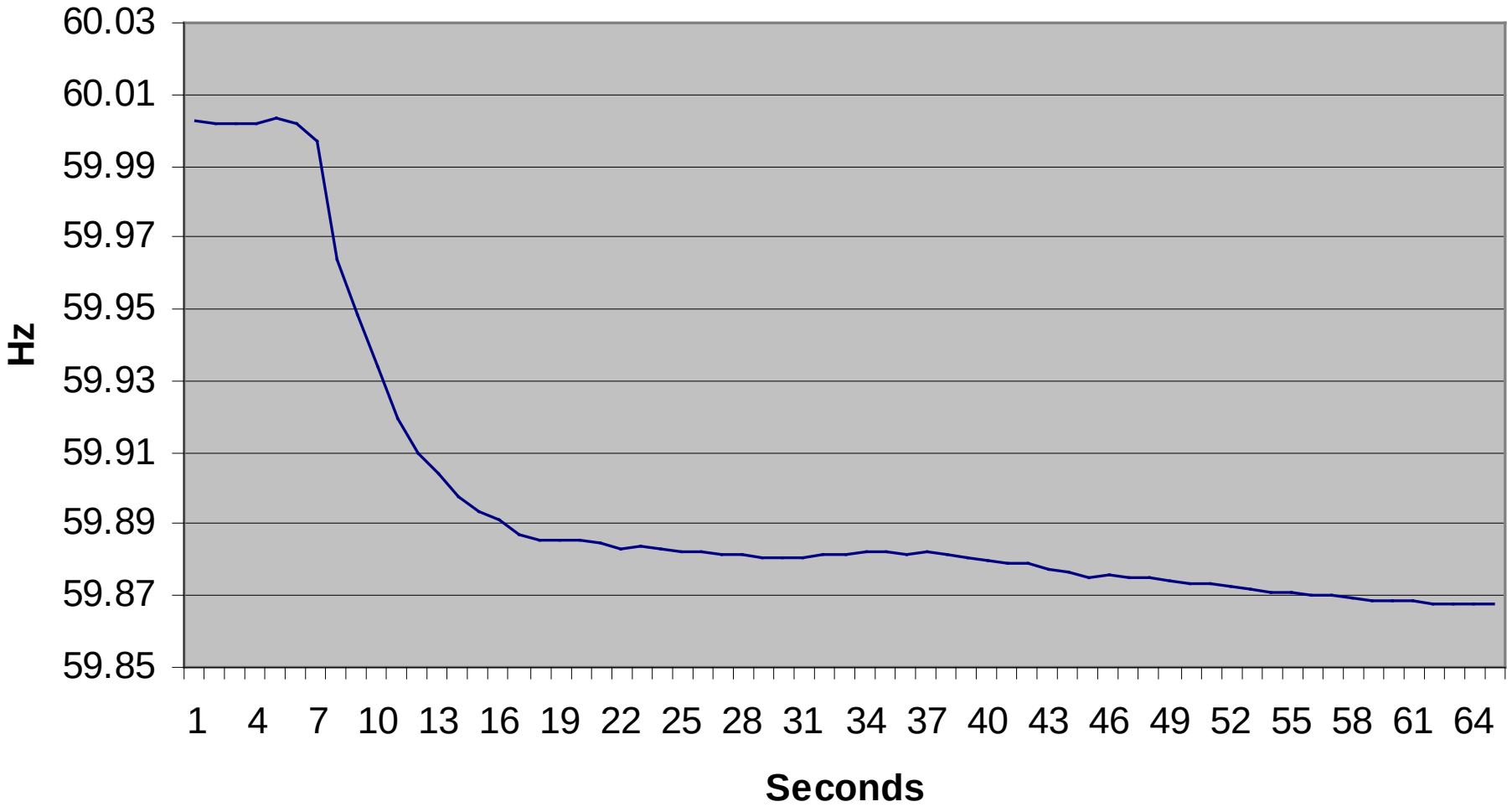
Highlighted in December 2011 FERC report "…simulation predicted significantly greater frequency response than was, in fact, recorded by monitoring equipment."



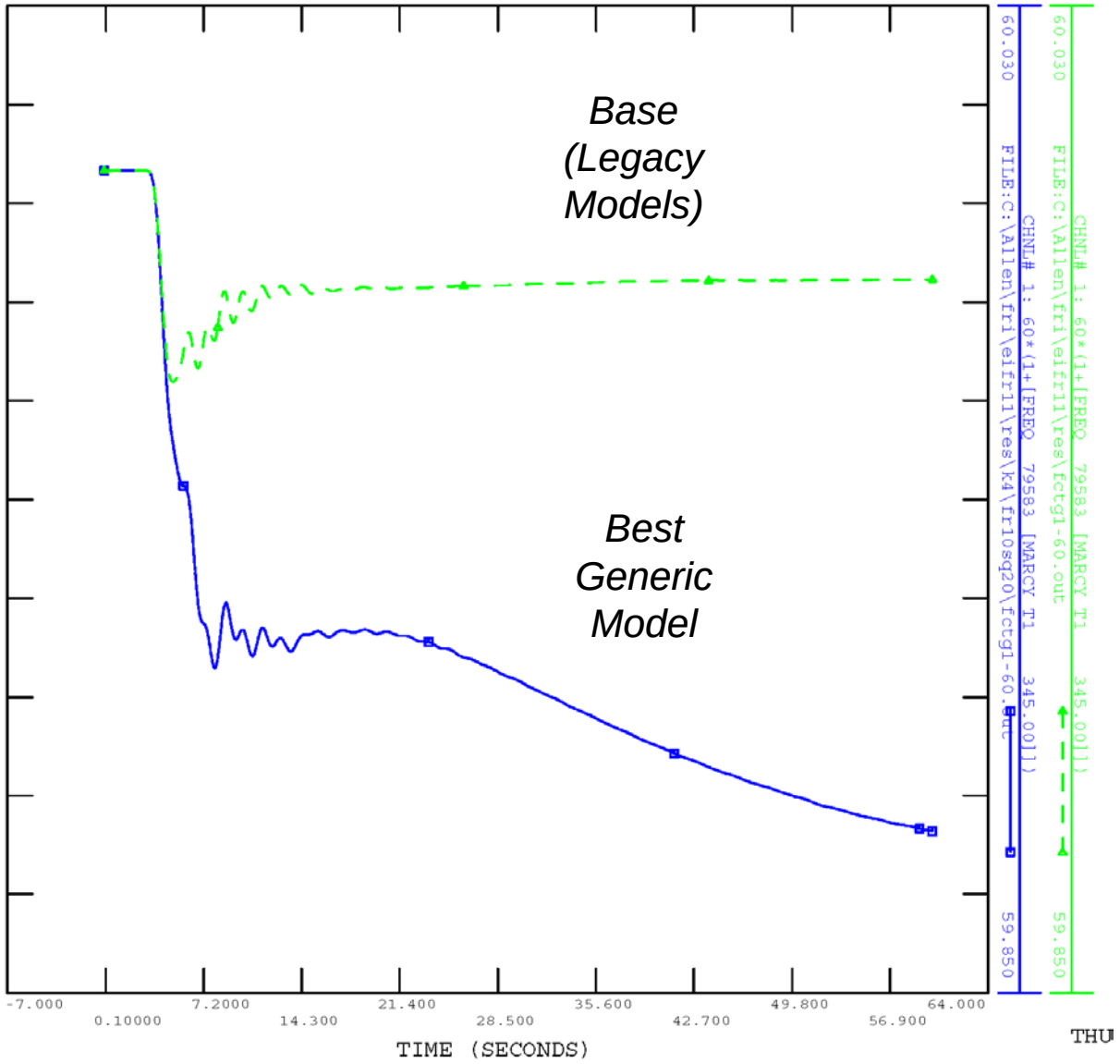
MRO Disturbance Sept. 18, 2007



Actual Aug. 4, 2007 Frequency



Governor Modeling



Un-modeled Generation Behavior

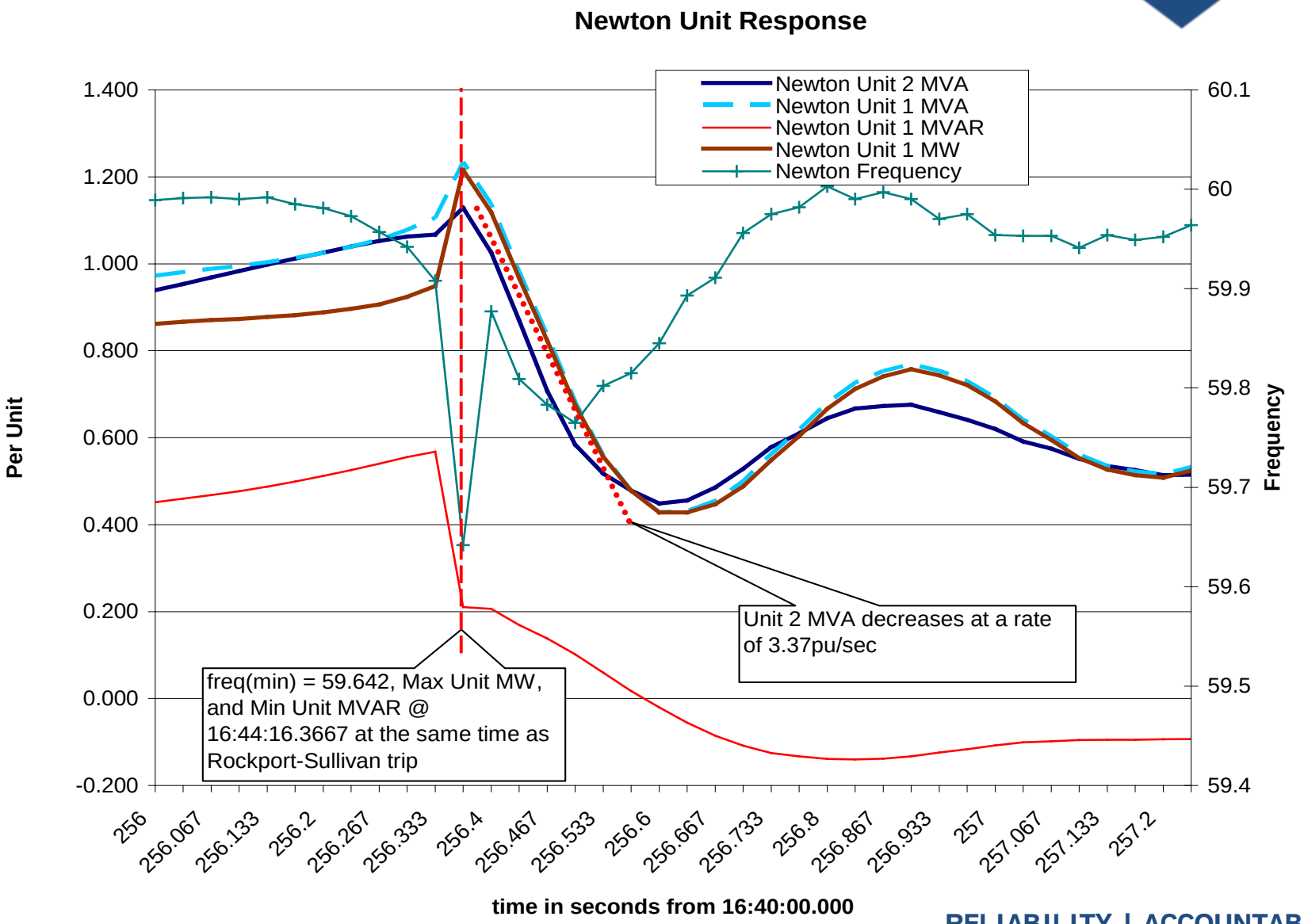
Shakespearean generation

- How can I trip thee, let me count the ways

In 133 system disturbances examined:

- Unexpected Gen. Turbine Control Action (35 times)
- Voltage sensitivity of gen. aux. power systems (13 generators tripped)

Power-Load Unbalance Control Function



Modeling Initiative

- Improved and validated powerflow and dynamics models
  - Benchmarking against actual system performance
- Library of standardized component models for generators and other electrical equipment
- Composite load modeling
- Move toward node-breaker modeling
- Tie to protection setting databases
- Interaction of System Protection and Turbine Controls
- Modeling Guideline – industry technical reference

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Modeling Gap Analysis

1. Generator Dynamics – Eastern Interconnection governor and exciter models are suspect
2. Load Behavior – load composition changing Use of composite load models necessary
   - More air conditioning load
   - CFL and LED lighting – not like incandescent
   - Variable speed drives
3. Frequency Response – EI dynamics models not capable of simulating primary frequency response

Modeling Gap Analysis

4. Inter-Area Oscillations – EI models not capable of predicting
5. Equipment Modeling – lack of standardized system component models
   - Creating standardized component model library
6. Modeling Errors – data errors, wrong component models
7. Modeling Consistency – varying understanding of models and parameters

Modeling Gap Analysis

8. Model Compatibility – data exchange problems between platforms and programs
9. Approaches to Modeling – operational node-breaker models / Planning bus-line models
10. Special Protection Systems/Remedial Action Schemes – must model to predict interaction
11. Protection Systems – better modeling of protection systems needed
12. Turbine and Boiler Controls – research starting on what should be modeled

Questions?