

# Dealing with Modeling Uncertainty

Grid Transformation Workshop

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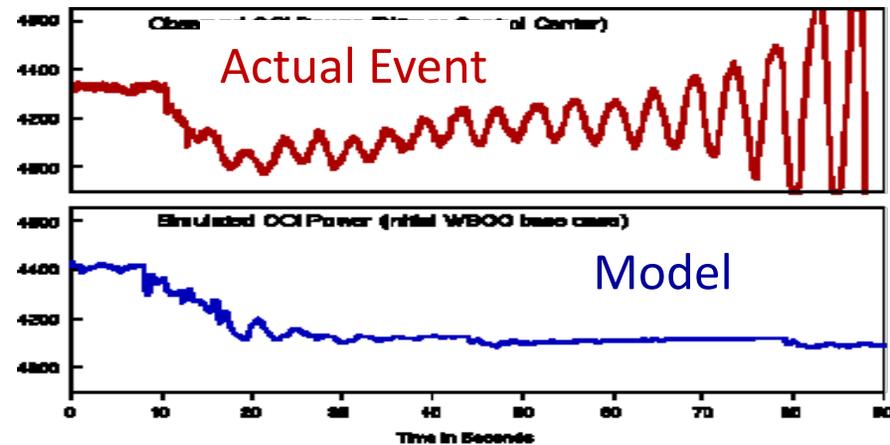
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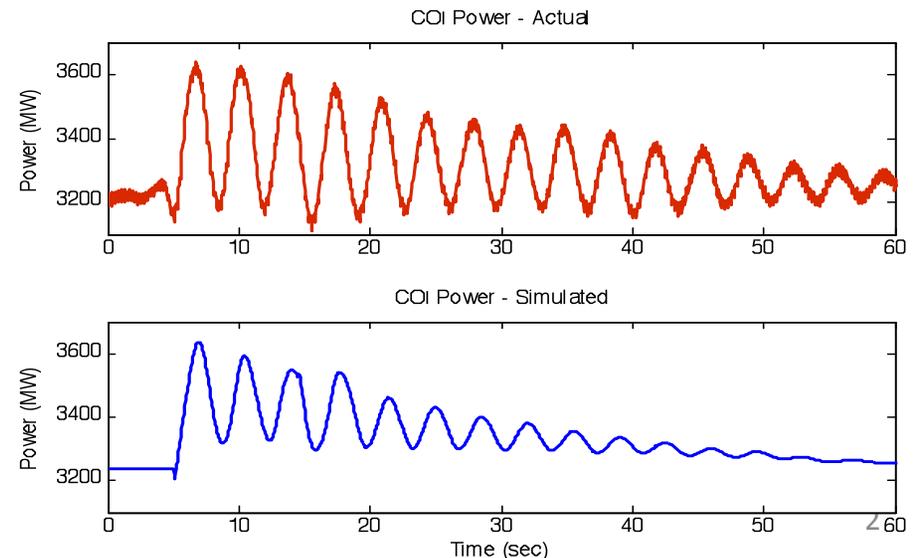
# Power System Models

- Power system models can be tuned to reproduce accurately the events in the past, e.g. August 10, 1996, September 8, 2012
- This does not mean that the model can accurately predict details of what can happen in the future.
- The best we can expect is to predict response in principle, not in detail
- Sensitivity analysis and what is appropriate study margin

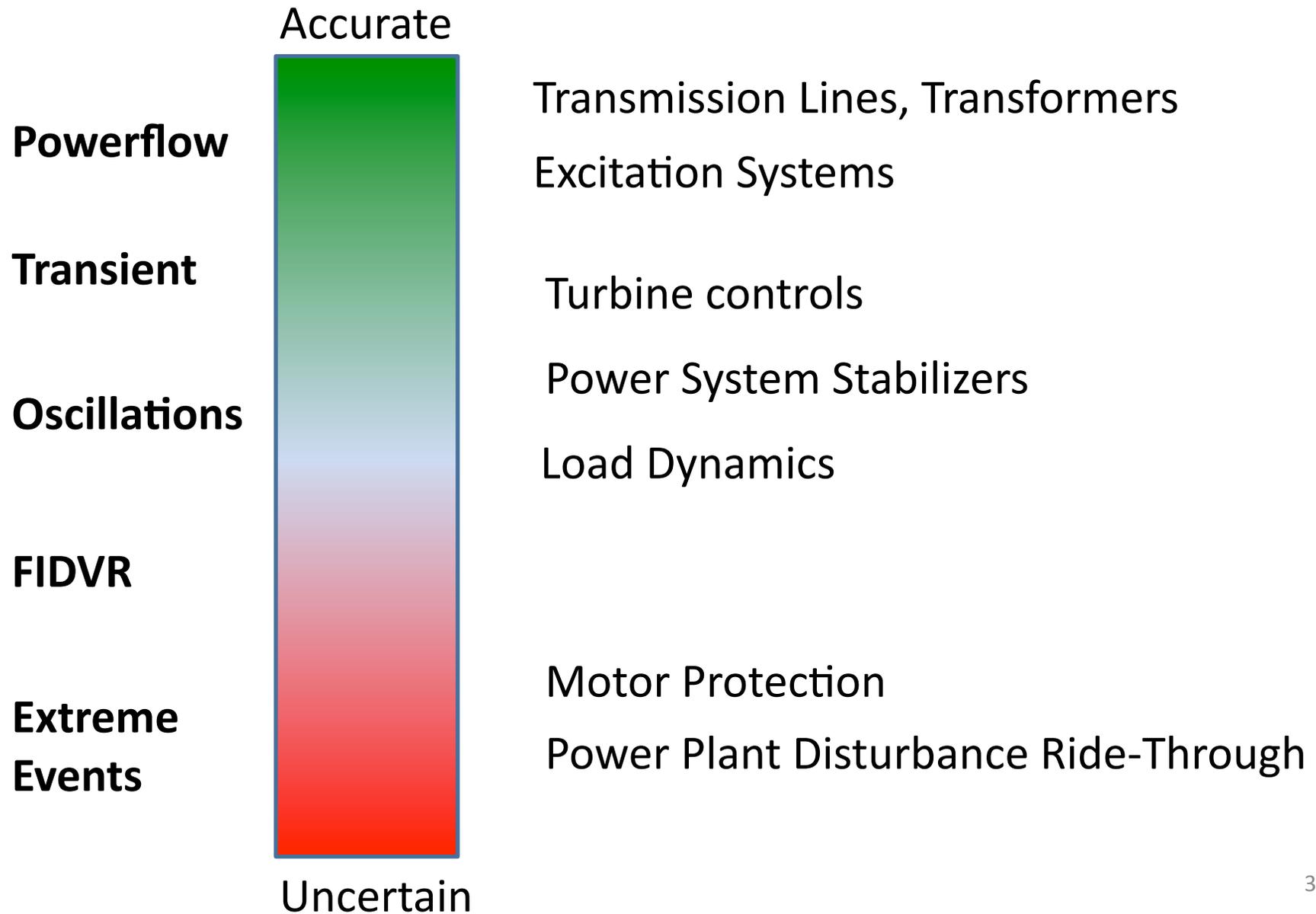
**August 10, 1996**



**August 4, 2000**



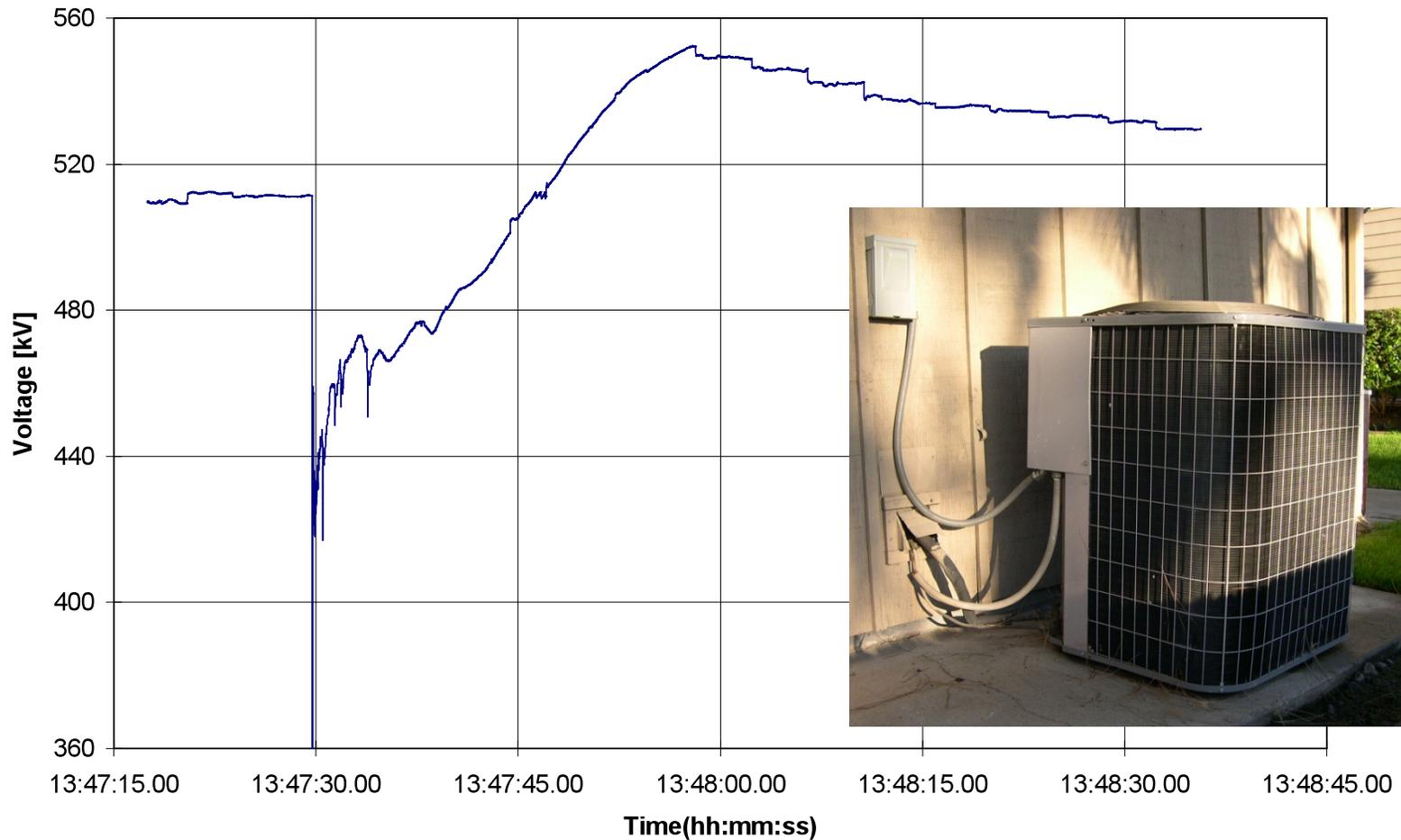
# Power System Models



# FIDVR

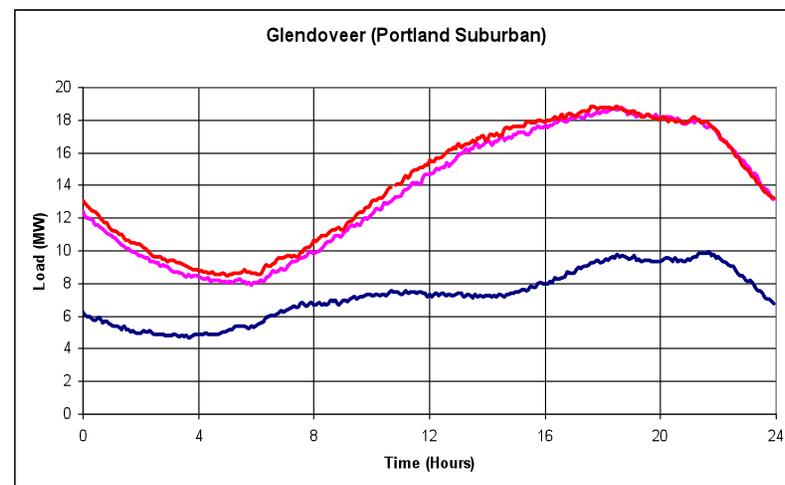
## Fault Induced Delayed Voltage Recovery

Adelanto 500kV Bus Voltage



# FIDVR in Portland Metro

- No historic records of FIDVR occurrence
- Air-conditioning has been increasing
- Whether air-conditioners stall is very sensitive to assumptions on load composition
  - Looks like temperatures need to be > 92 F, which is only a few hours a year
- Should we have an area-wide stalling, results look grim
  - UVLS operate for N-1 events
  - PDCI blocking
- Multiple SVCs (very costly) improve recovery, but do not solve the problem completely
- What is the appropriate risk tolerance ?
- What is the appropriate investment and control strategy ?



# Defense in Depth Approach

- **Primary:** Reliability starts with good planning
  - ... But actual system conditions are often different from what is planned ...
- **Secondary:** State estimator based real time contingency analysis
  - ... But, your model may be wrong (model errors, control failures, etc) ...
- **Tertiary:** Intrinsic indicators > operating alarms and safety nets
- **Safety nets:**
  - Designed to protect against extreme unplanned events or FIDVR-type events when model is not certain
  - Could be viewed as a liability (poorly designed scheme can cause unnecessary loss of load, NERC CIP paperwork, etc)
  - What is the place for safety nets?
- **Wide Area Control Vision**

# Wide Area Controls Vision

