

# Voltage Stability Applications

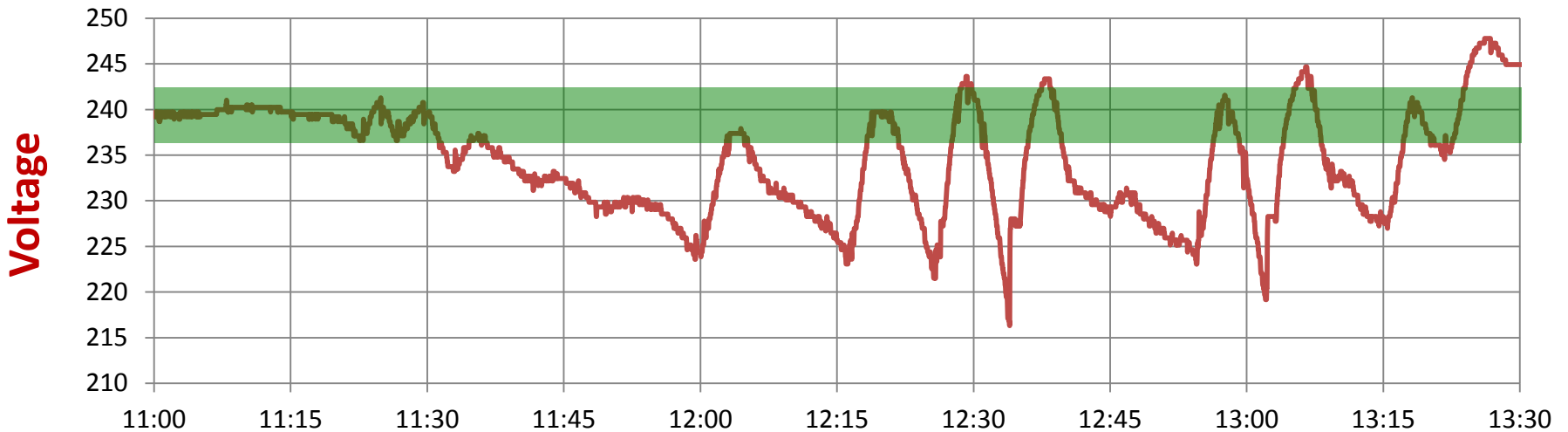
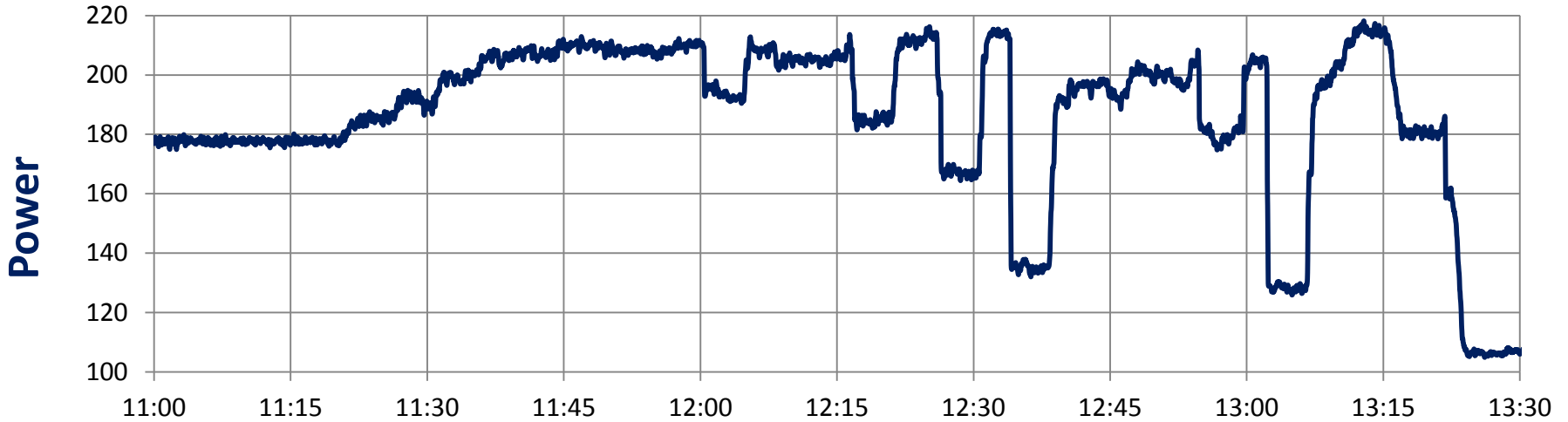
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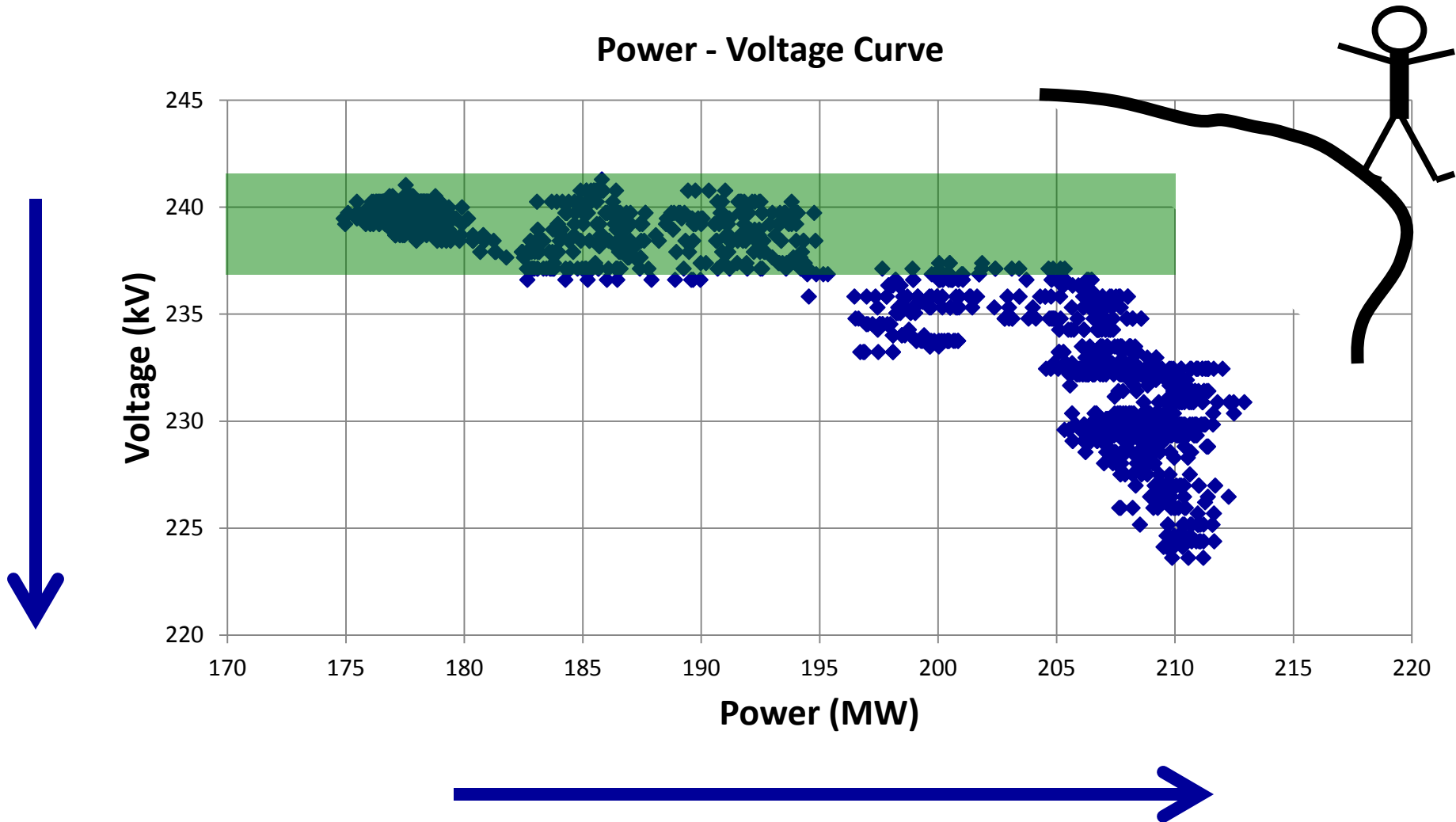
NASPI Meeting

June 2012

# This is what actually happened



# Understanding what happened



PV-curve is often used to measure voltage stability margin

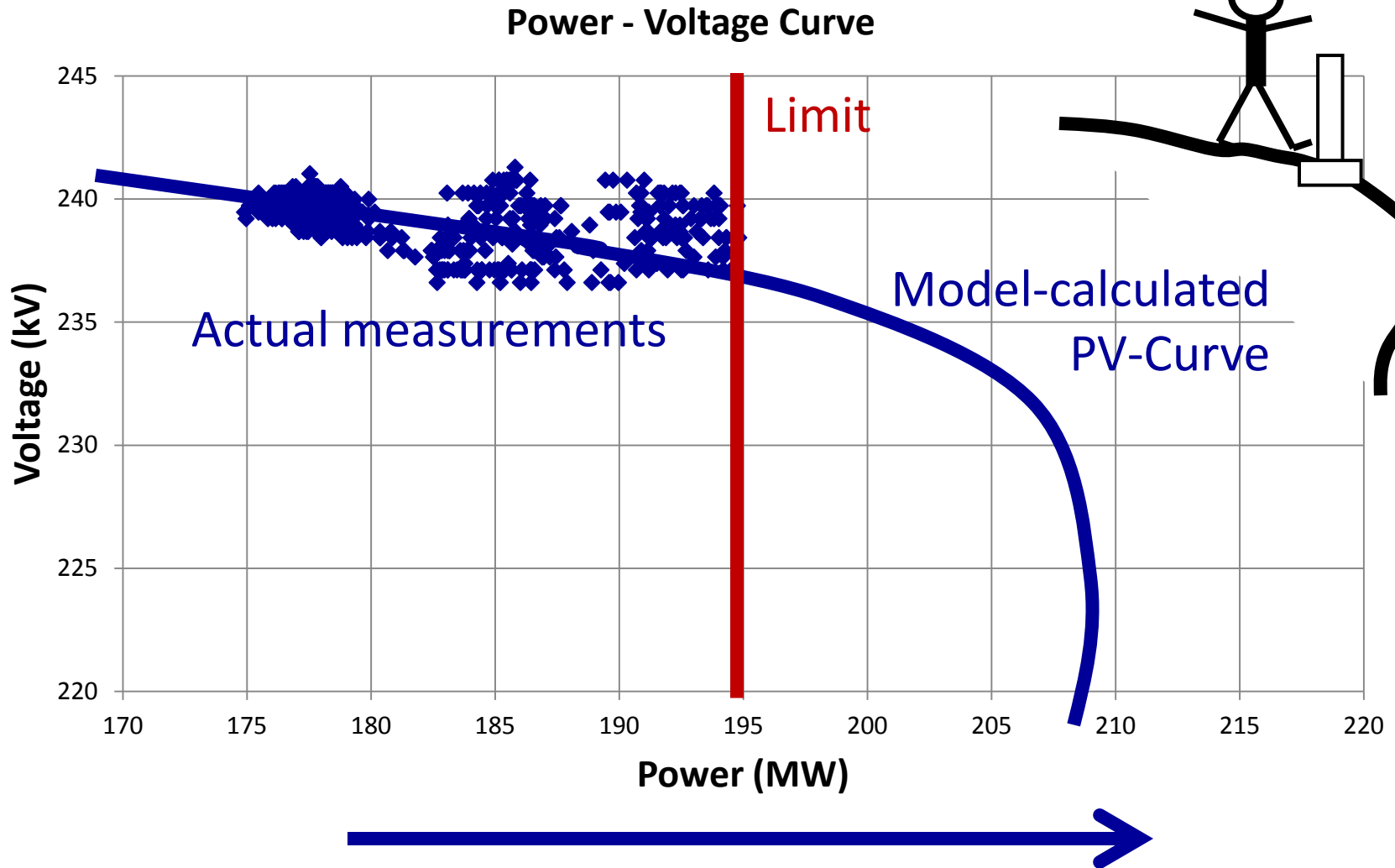
# Voltage Stability Planning

- **Reliability starts with good planning**
  - Understand voltage stability risks
  - Make appropriate grid investments
  - Develop proxy metrics for voltage stability margins
    - E.g. dynamic reactive reserves in lower Columbia, operating procedures
  - Time sequence powerflow tools are needed to study voltage stability risks during wind ramps
  - Planning studies do not cover all operating conditions (or controls)
    - On-line voltage stability assessment is required ...

# On-line Model-Based Voltage Stability Analysis

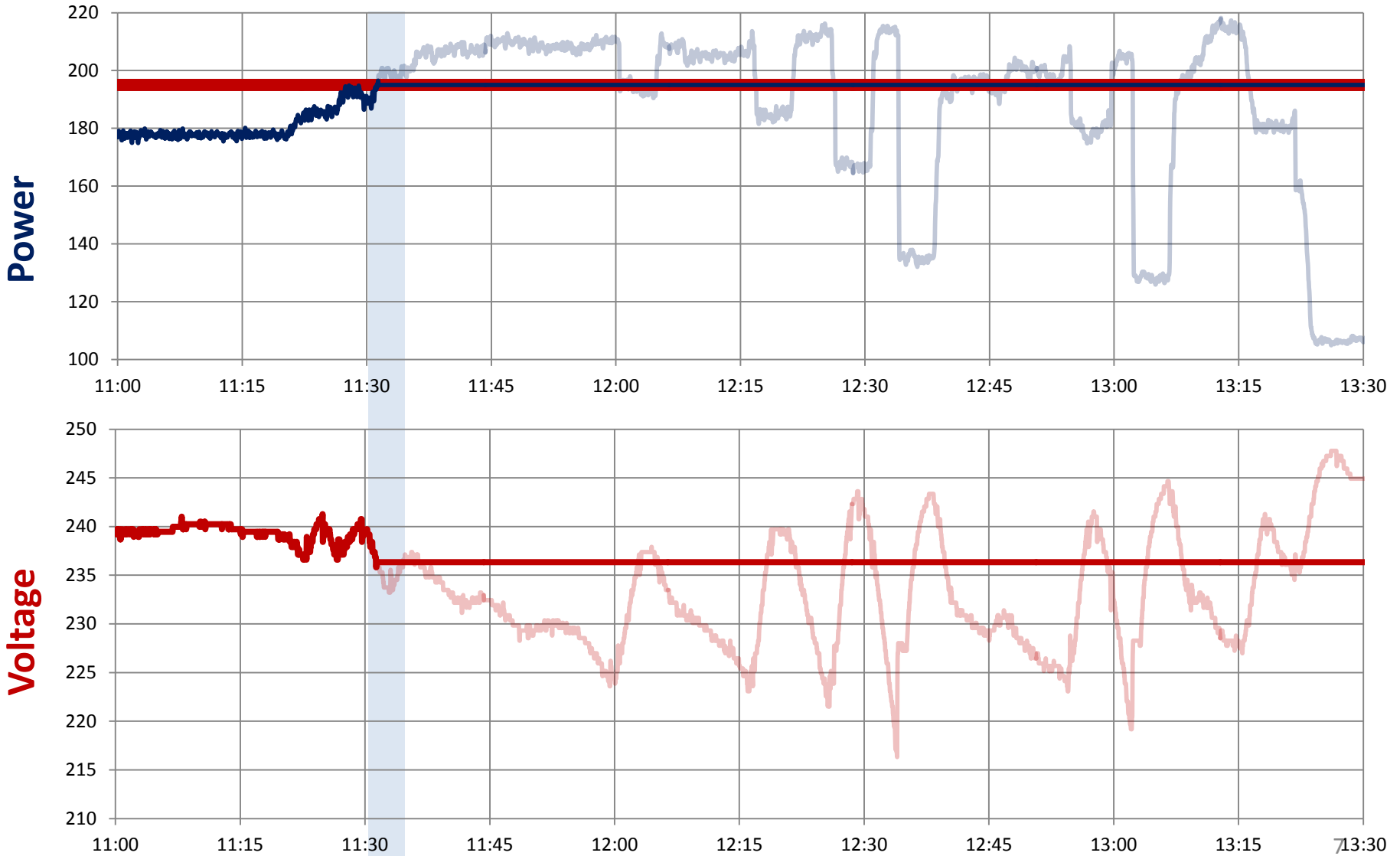
- On-line model-based voltage stability analysis
  - Get a state estimator powerflow case
  - Conduct voltage stability studies for the current system state
  - Set operational limits hour ahead

# On-Line Model-Based Voltage Stability Assessment



Limits are set using model-based stability analysis

# On-Line Model-Based Stability Analysis



# On-line Model-Based Voltage Stability Analysis

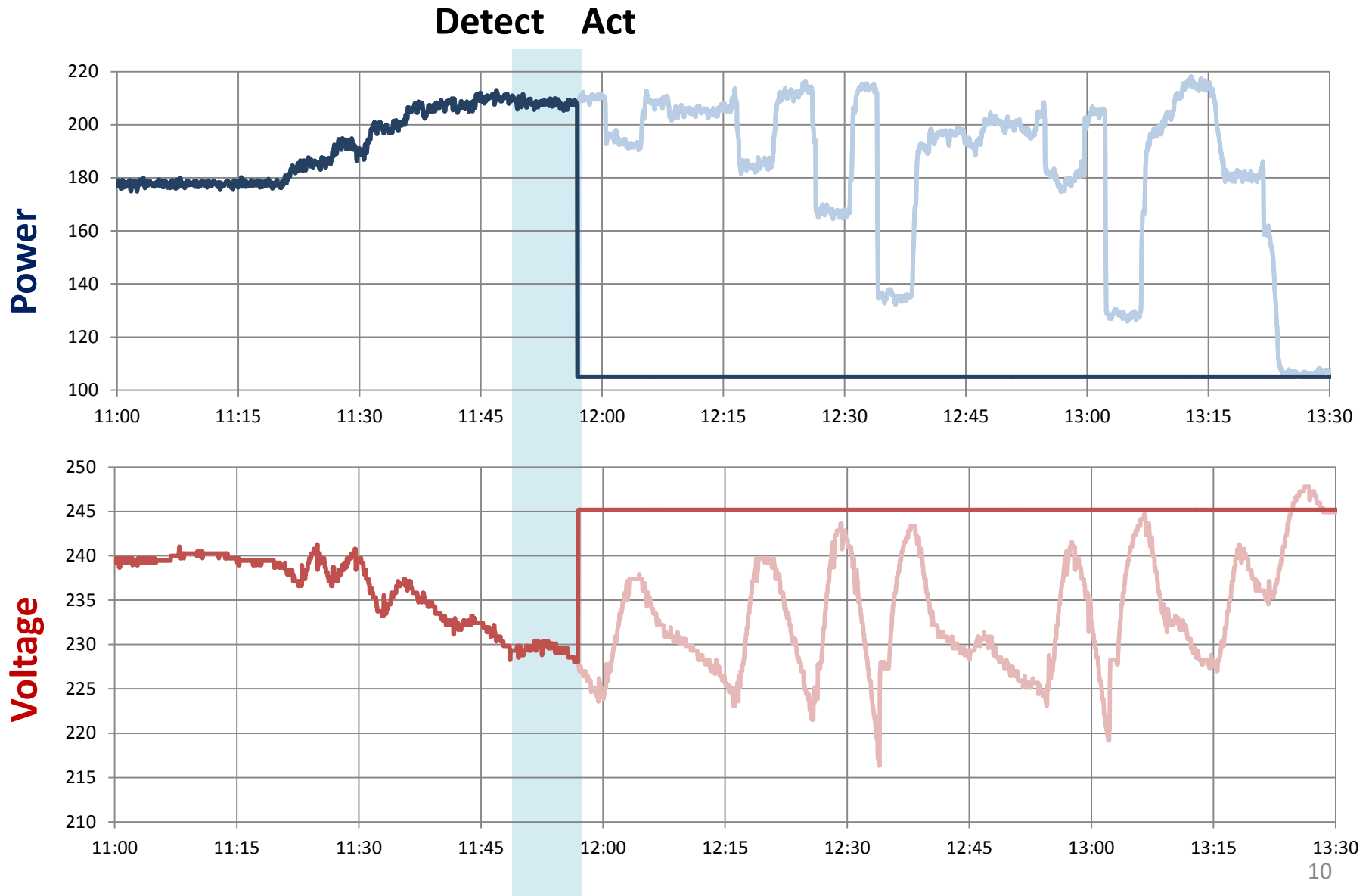
- Absolutely the right thing to do, but not the only thing to do
- Your model may be wrong
- Generator controls may operate differently or have unmodeled operational limitations
- Therefore, the model-based VSA limit could be wrong
- In fact, model-based VSA would not have predicted the above event



# Measurement-Based Situational Awareness

- Measurement-based situational awareness is a critical component of the voltage stability strategy
  - Alarms
  - Trend displays
  - Operations procedures

# Had we had trend monitoring



# Voltage Stability – Defense in Depth

- **Reliability starts with good planning** – understand risks, make appropriate investments, develop operating metrics (e.g. reactive reserves)  
... But operating conditions may be different from what was planned ...
- **Model-based system stability assessment** to set real-time operating limits  
... But your model may be wrong, equipment failures are possible, or unexpected responses to disturbances ...
- **Operator alarms and trend displays**  
... But there will be disturbances too fast for an operator to react timely ...
- **Response-based voltage stability controls**

# Session Overview

- On-line Model-Based Voltage Stability Assessment Applications (15 min)
  - Marianna Vaiman, V&R Energy
  - Saad Malik and Zea Flores, WECC RC
- Measurement-Based Voltage Stability Applications (10 min)
  - Damir Novosel, Quanta Technology
- Integrating Voltage Stability Applications into EMS (10 min)
  - Jay Giri, Alstom Grid
- Q&A Session (15 min)