NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Frequency Response Technical Conference

Frequency Response & Frequency Bias Setting

Howard F. Illian, President, Energy Mark, Inc.

RELIABILITY | ACCOUNTABILITY

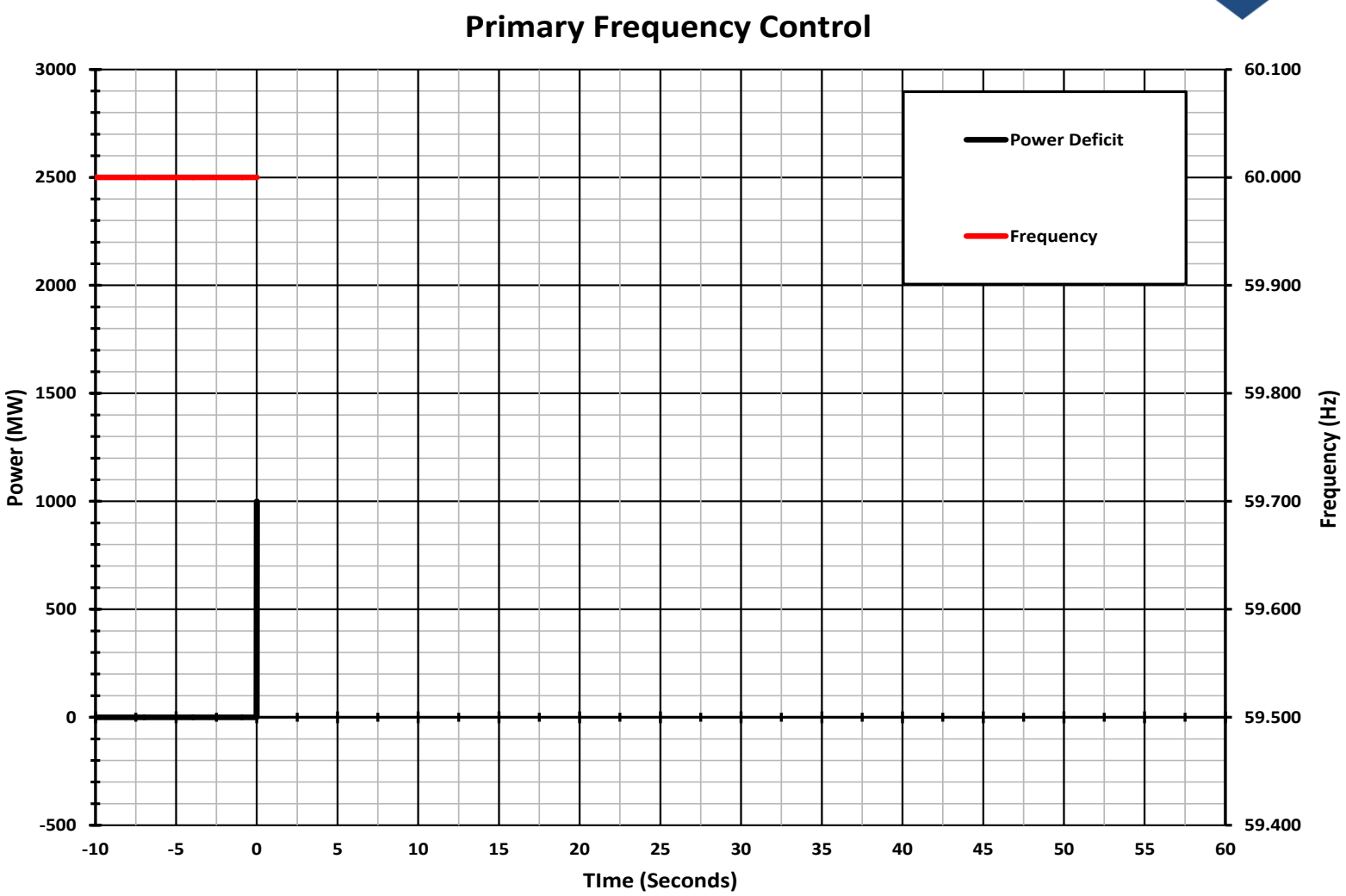
Overview

- Primary Frequency Control (PFC)
  - Disturbance Event
  - Inertial Power & Load Damping
  - Governor Response
  - Arrested Frequency Response
  - Post Disturbance Transient
  - Settled Frequency Response

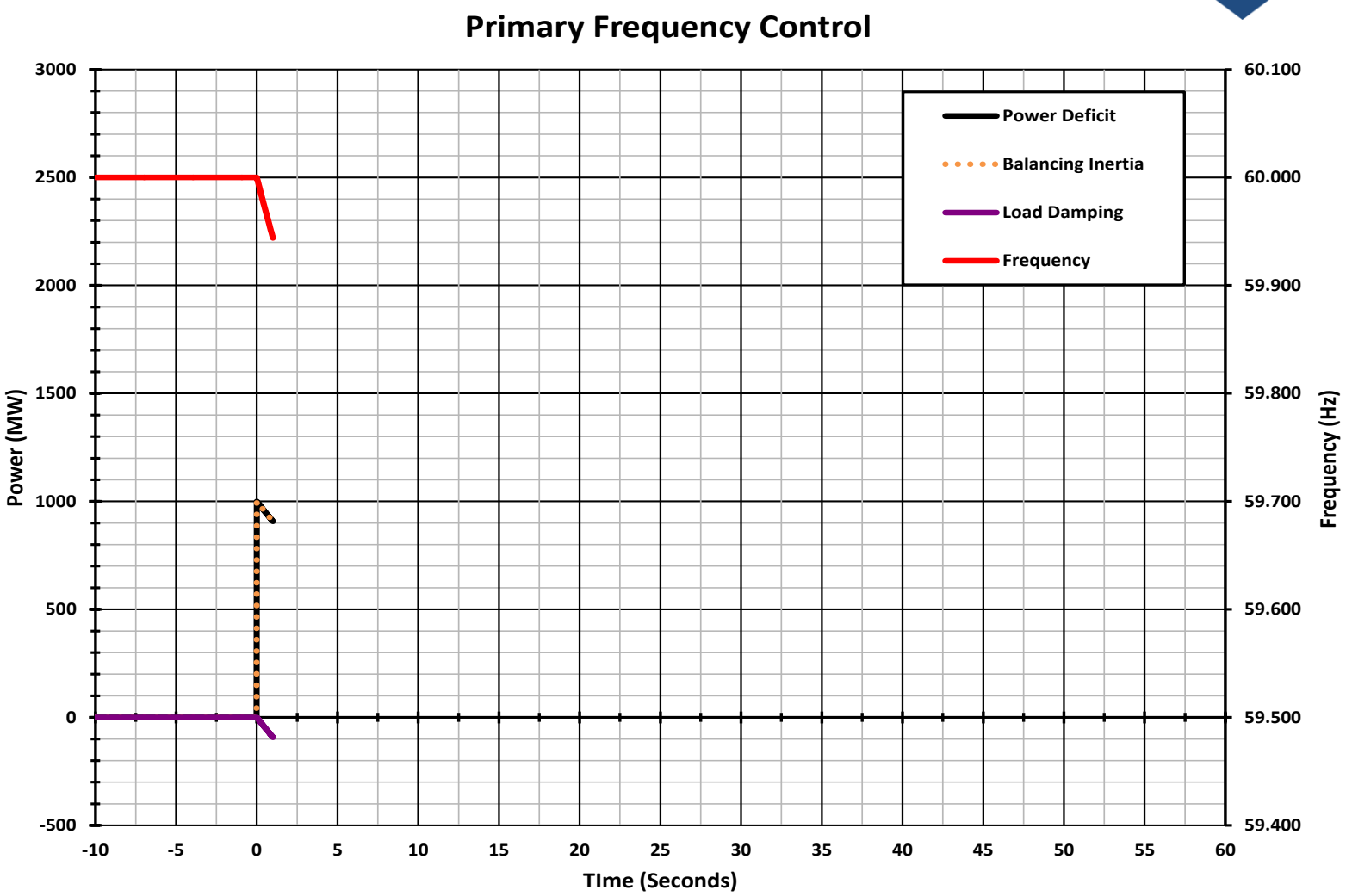
Overview (Cont.)

- Frequency Response Measurement
  - Interconnection Level
  - Balancing Authority Level
  - Individual Provider Level
- Frequency Bias Setting
  - Based on Timing of Secondary Control
  - Best Estimator: Settled Frequency Response
  - Reason for inclusion in ACE and AGC

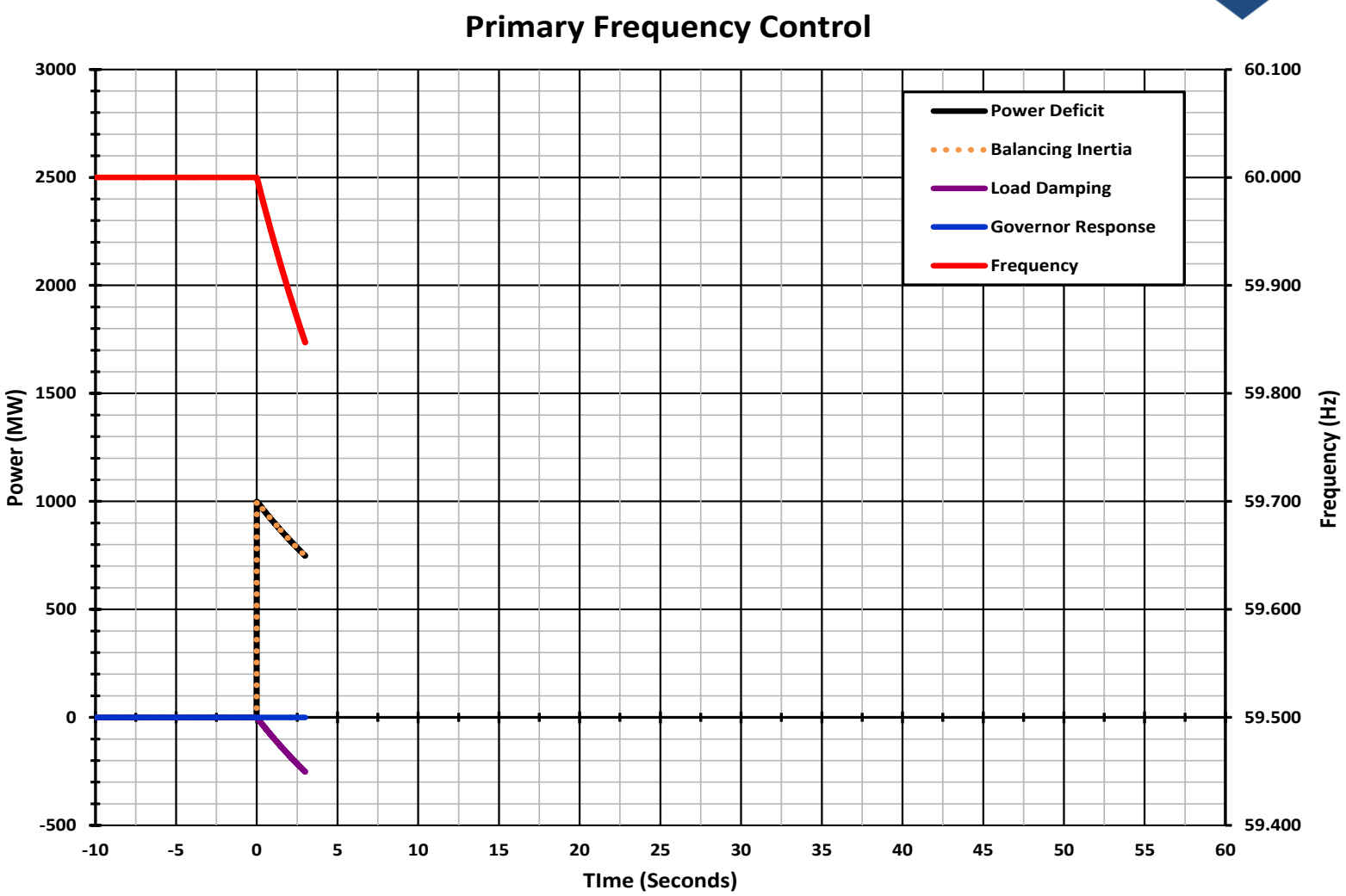
Disturbance Event



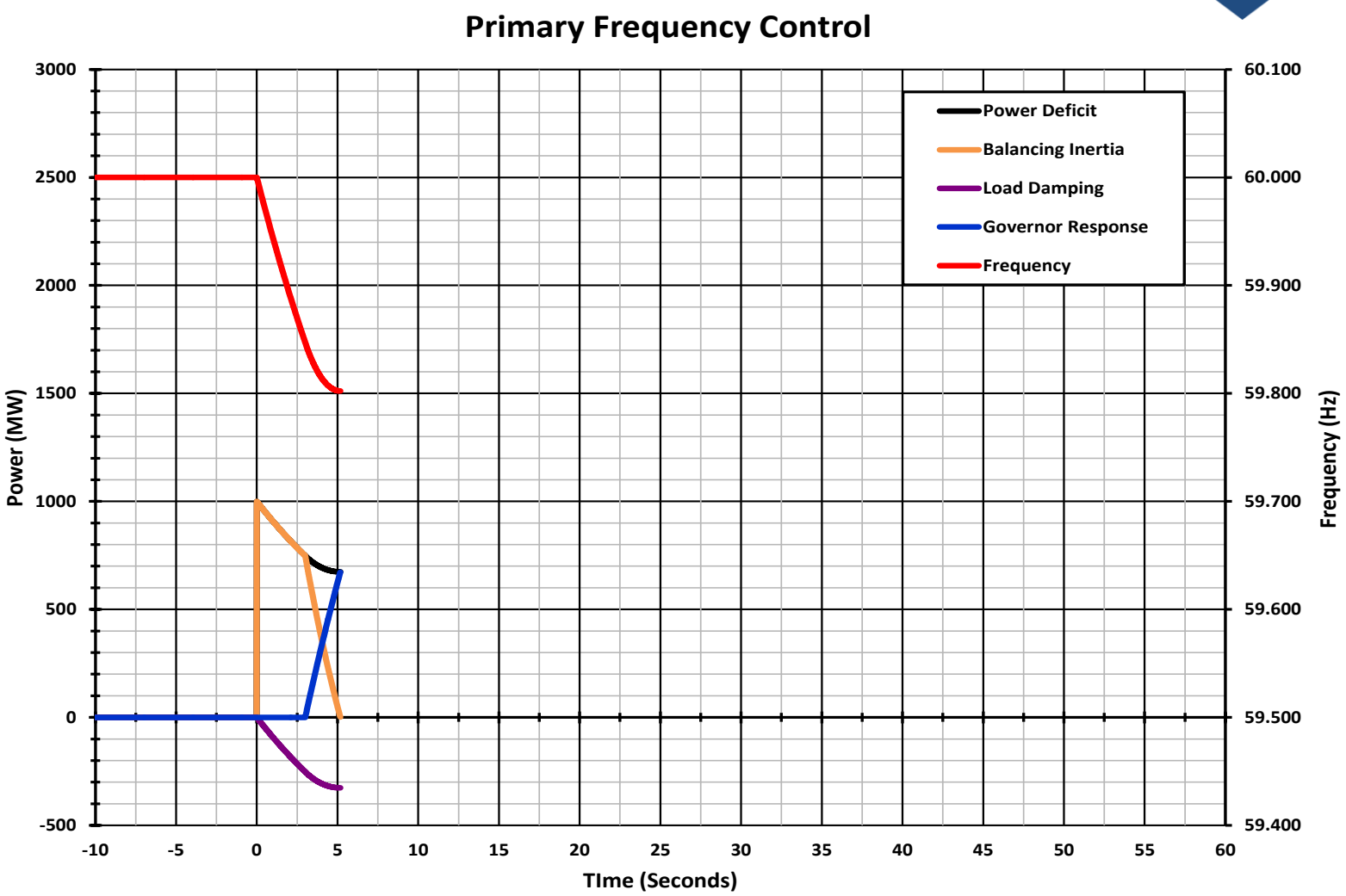
Inertial Power & Load Damping



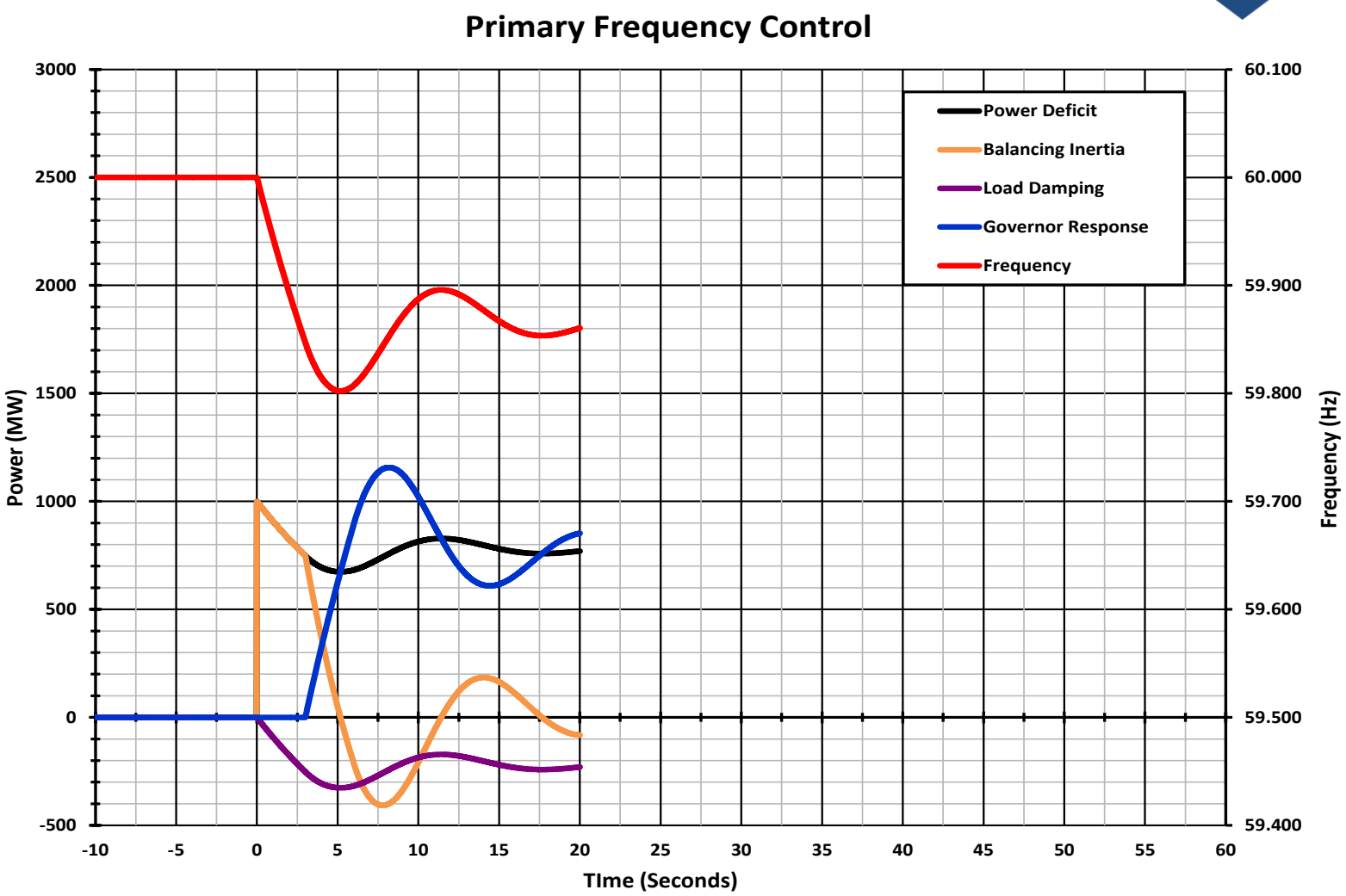
Governor Response



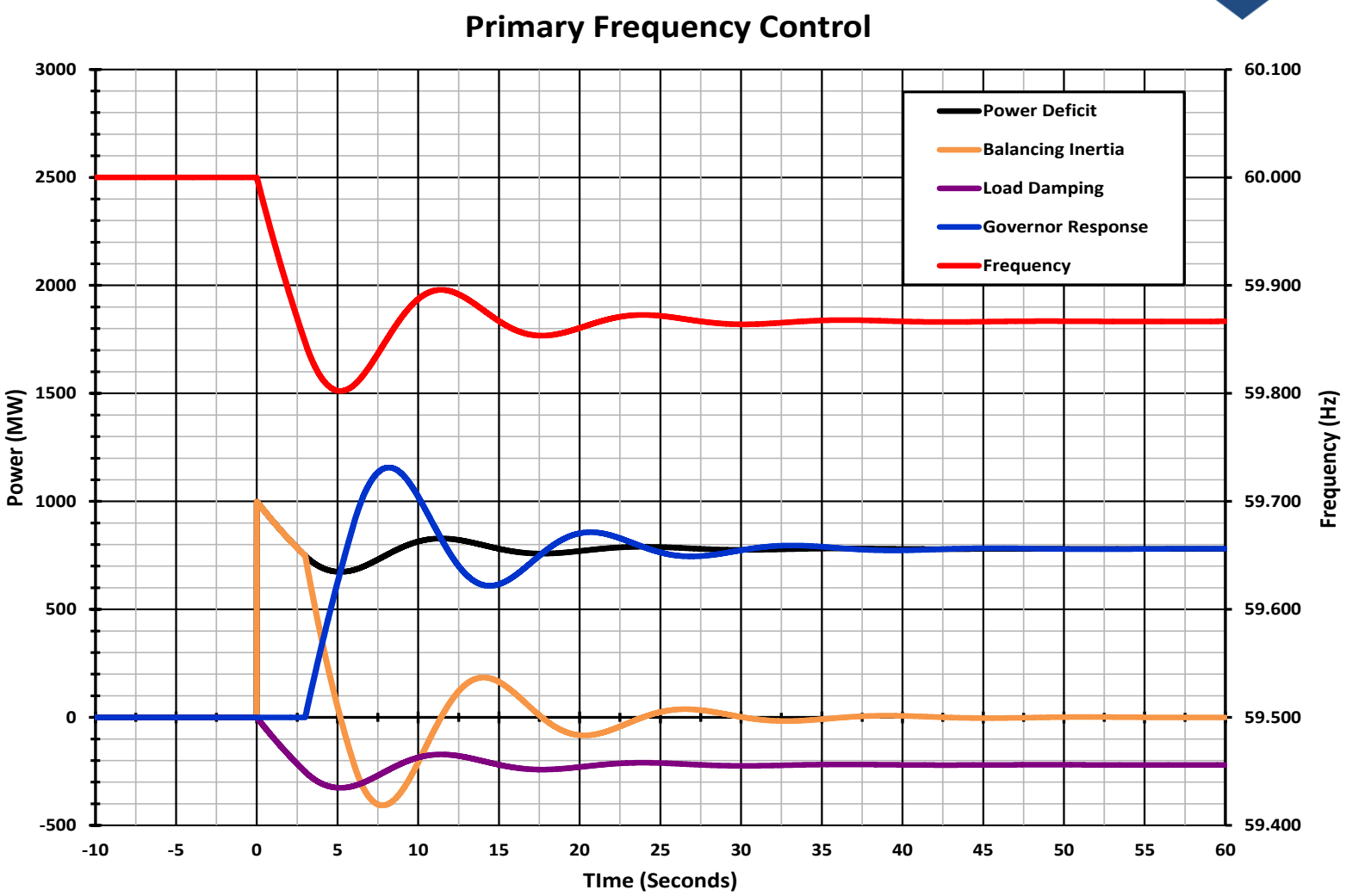
Arrested Frequency Response



Post Disturbance Transient



Settled Frequency Response



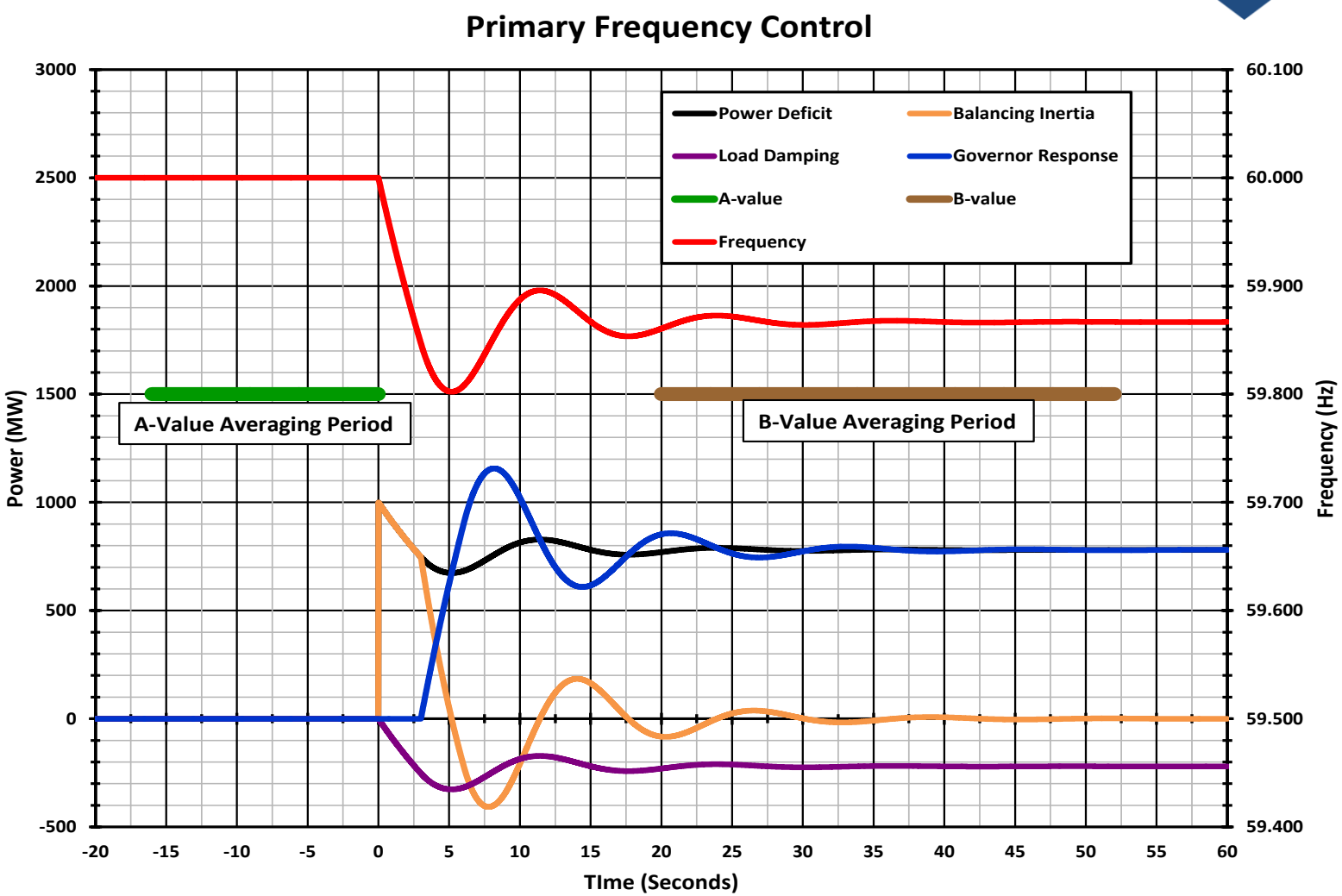
Questions

Response Measurement

- All Frequency Responses are measured as a "Change in Power (MWs)" divided by a "Change in Frequency (Hz)"
- Averaging Periods are standardized for both the Pre-disturbance period (A-Value) and the Post-disturbance period (B-Value) by scan rate*
- Frequency and Power averages use the same averaging periods for measuring a single BA response, about* -16 to 0 seconds before and +20 to +52 seconds after a disturbance

* Averaging periods vary with EMS scan rate

A & B Averaging Periods



Change in Power (MWs)

- Interconnection Level: "Sudden Change" in Generation or Load power as measured from meters local to the disturbance event
- Balancing Authority Level: Change in Actual Net Interchange (ANI) as measured with the sum of the tie-line flows from ACE
- Individual Provider Level: Change in Net Power at the point of interconnection
- Standard Averaging Periods used to calculate A-Value average & B-Value average

Change in Frequency (Hz)

- Average frequency is the same for all regions of an Interconnection for time averages greater than a few seconds
- Change in Frequency (Hz) measured value is similar for measurements at all levels
  - Interconnection
  - Balancing Authority
  - Individual Provider
- Standard Averaging Periods used to calculate A-Value average & B-Value average

Measurement Limitations

- Arrested Frequency Response
  - C-Value can vary from region to region
  - Maximum 6 second scan rate for EMS
  - EMS cannot measure C-value accurately
  - Estimate Arrested Frequency Response from Settled Frequency Response (A-C/A-B ratio)
- Settled Frequency Response used to:
  - Estimate Frequency Response Measure
  - Determine Frequency Response Obligation compliance
  - Estimate Frequency Bias Setting

Frequency Bias Setting

- Based on Secondary Control Timing
  - Begins after Primary Control Transient (+20 seconds)
  - Early Secondary Control risks Frequency Instability
- Settled Frequency Response
  - Used to estimate Frequency Bias Setting
  - Biases the ACE for Dispatcher Situational Awareness
  - Discourages withdrawal of Primary Control by AGC

Questions