NARUC

Summer Committee Meetings

Staff Subcommittees on Electricity & Electric Reliability

NARUC

Summer Committee Meetings

Agenda

- **10:00 -11:00 am** — **Tour of the Newtown Creek Biodigester Plant**
- **1:00 – 2:00 pm** — **Frequency Response Decline in the Eastern Interconnect**
  - **Troy Blalock, South Carolina Electric & Gas Co.**
- **2:00 – 2:15 pm** — **Update on the Cause of the April 7, 2015 Outage in Washington DC.**
  - **David Souder, PJM**

Newtown Creek Egg Biodigester Plant, Manhattan New York

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Frequency Response Decline in the Eastern Interconnect

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Troy Blaylock,

Power System Reliability Specialist

South Carolina Electric & Gas Co.

Frequency Response Initiative

NARUC Staff Subcommittee on Electricity and Electric Reliability

Troy Blalock – South Carolina Electric and Gas
NERC Resource Subcommittee – Vice Chairman

July 12, 2015

RELIABILITY | ACCOUNTABILITY

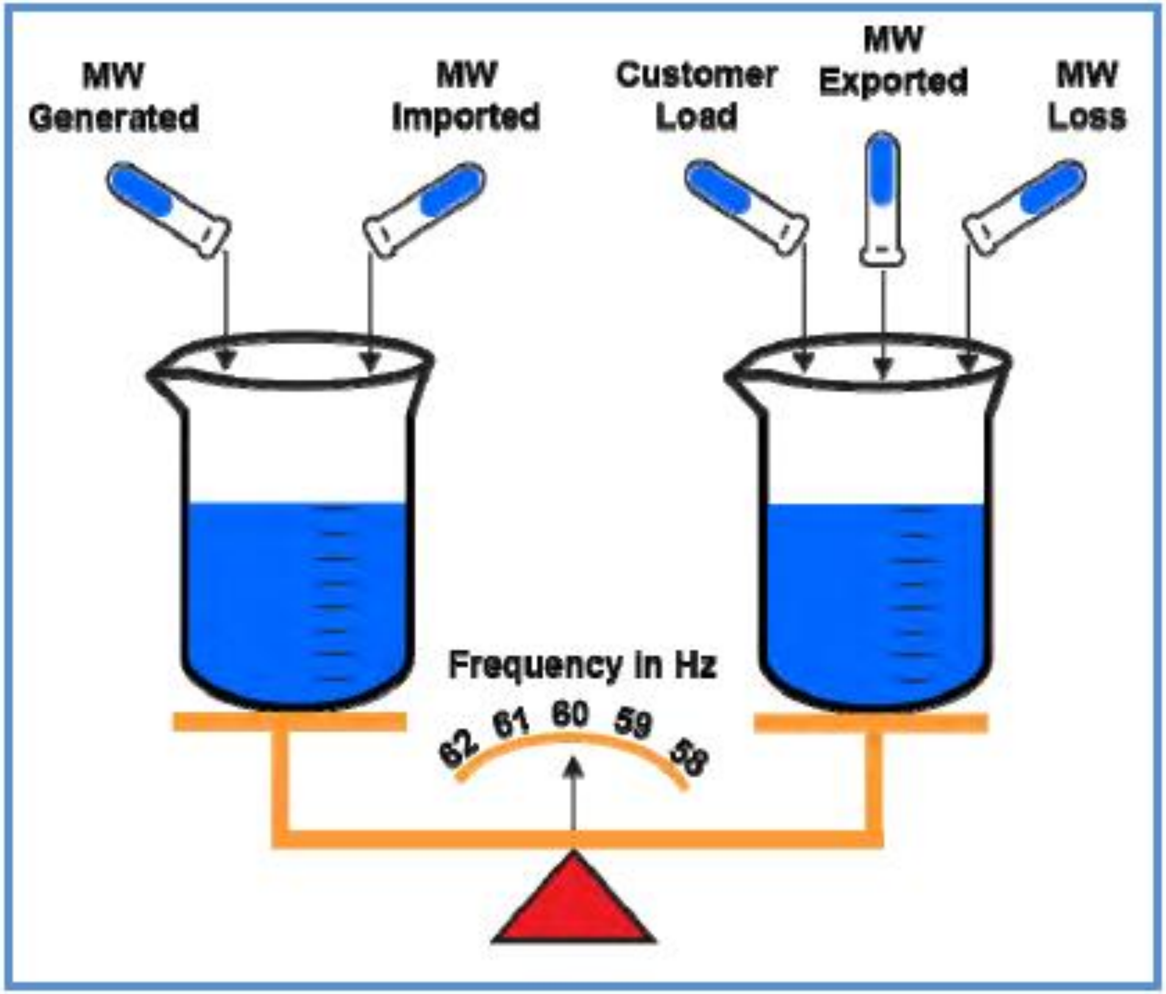
Agenda

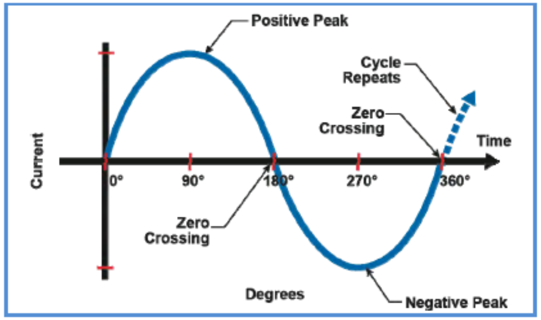
- Why Primary Frequency Response is Important
- Define Primary Frequency Response
- Discuss the NERC Advisory Generator Governor Frequency
- Discuss the Identified Issues
- Next Steps
- Questions

Why Primary Frequency Response Is Important

- Essential for Reliability of the Interconnections
  - Cornerstone for system stability
  - Line of defense to prevent Under Frequency Load Shedding(UFLS)
  - Prevent equipment damage
- Essential for System Restoration
  - Droop response is critical in restoration efforts
  - Hydro units and gas turbines are some of the first units to be restarted
- Compliance with NERC Standards BAL-003-1, BAL-001
  - Prevent future regulations related to generator frequency response performance
- To accurately predict system events (Transmission Models)

Frequency


MW
Generated
MW
Imported
Customer
Load
MW
Exported
MW
Loss
Frequency in Hz
62
61
60
59
58

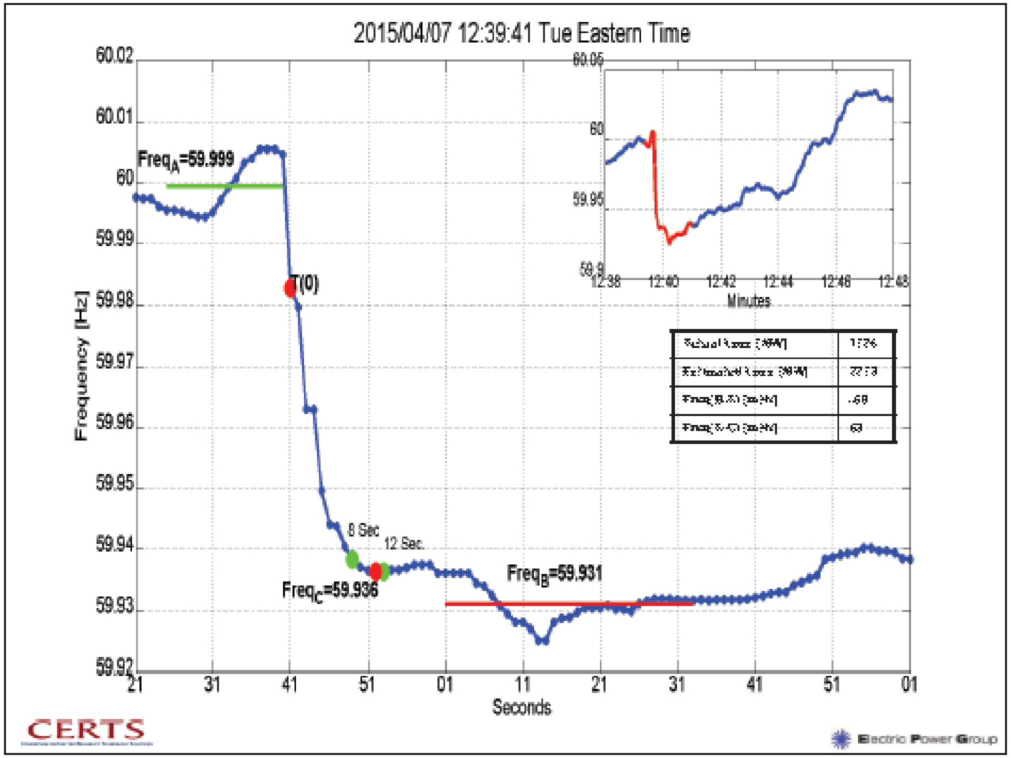

Positive Peak
Cycle
Repeats
Zero
Crossing
Time
Current
0°
90°
180°
270°
360°
Zero
Crossing
Degrees
Negative Peak


60.0000
MENU
PEAK
RESET
ALARMS
Laurel.
WWW.LAURELS.COM

Primary Frequency Response

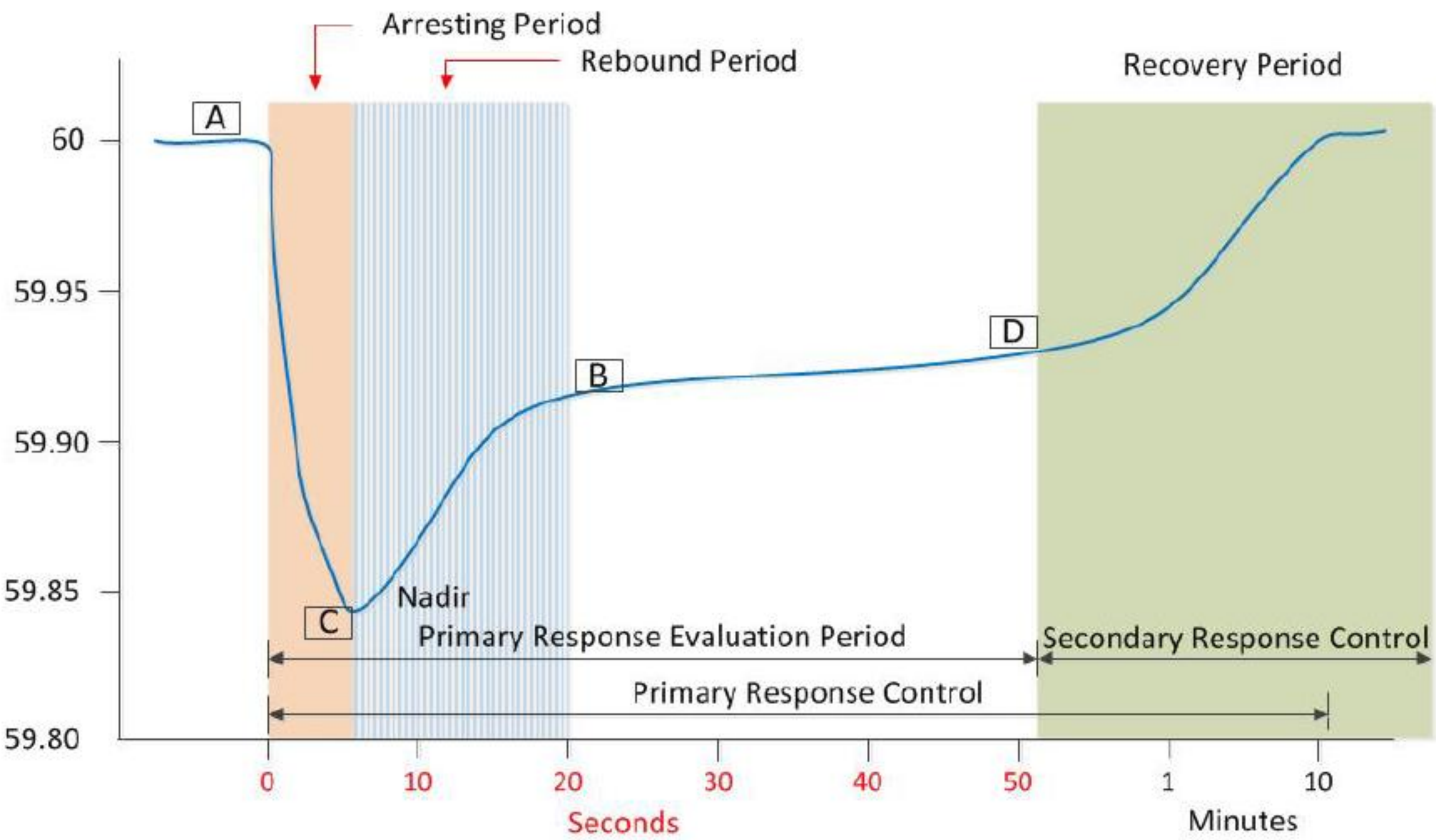
- Primary Frequency Response is the actions to arrest and stabilize frequency in response to locally detected frequency deviations. Primary Response comes from generator governor response, load response (motors) and other devices that provide immediate response based on local (device-level) control.
- Generator Governor Response within 0-10 seconds..

Washington, DC Outage



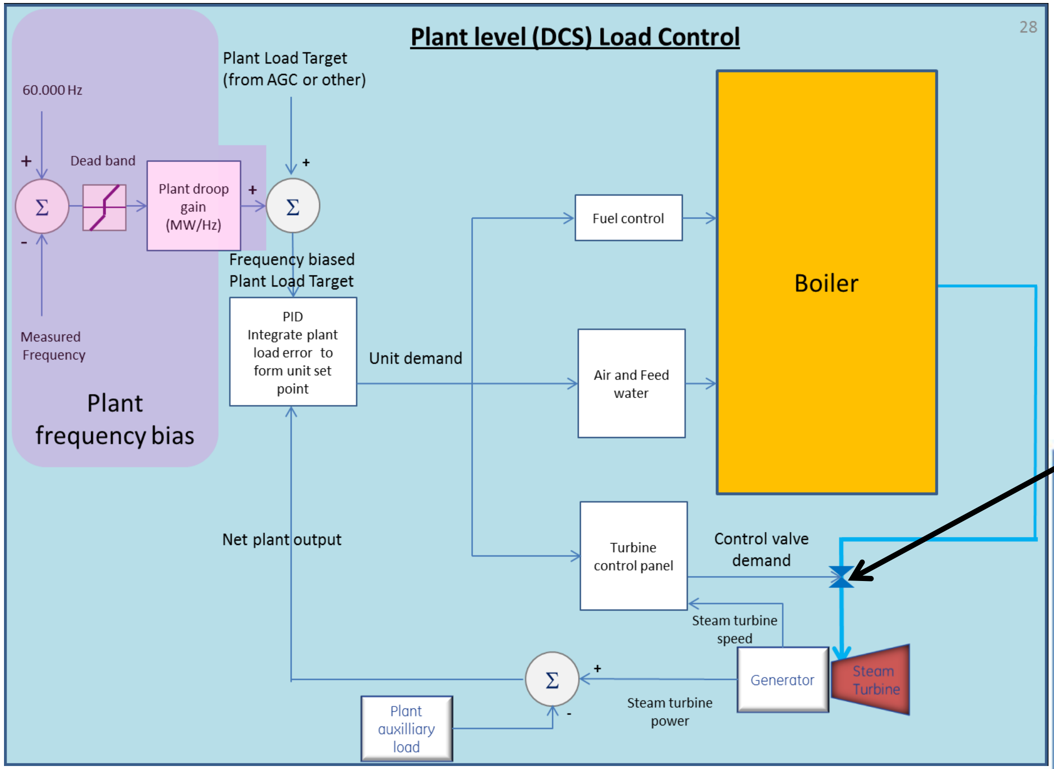
Frequency Point A is the frequency prior to the event
Frequency Point C is the nadir or lowest point
Frequency Point B is the settling frequency

Classic Frequency Excursion Recovery



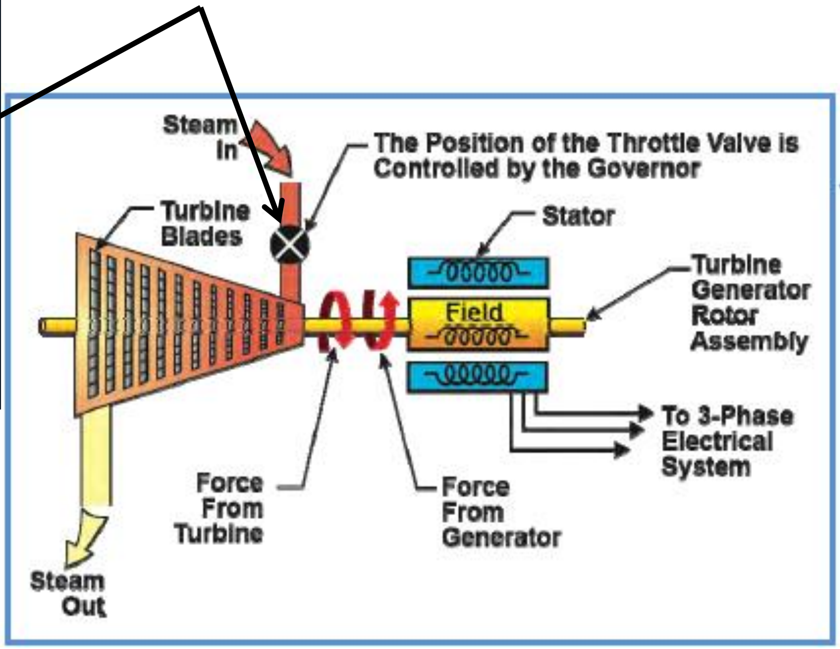
Frequency Response Control Logic

Generator Response

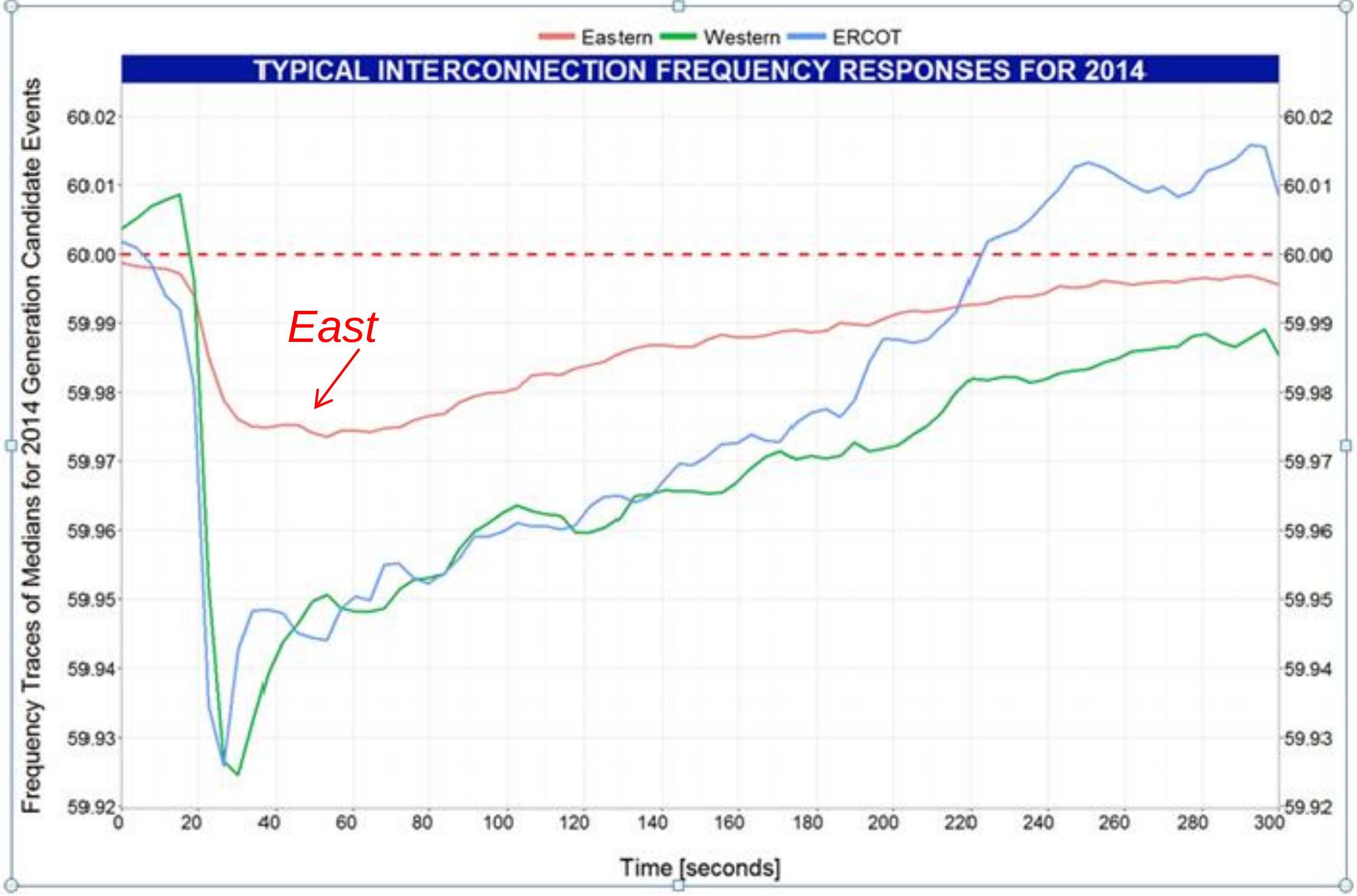


Graphic from GE info bulletin PSIB20150212

Generator turbine governors either mechanically or electronically control the primary control valves to the turbine. Steam, Water or Fuel is what is regulated.



Present Interconnection Profiles

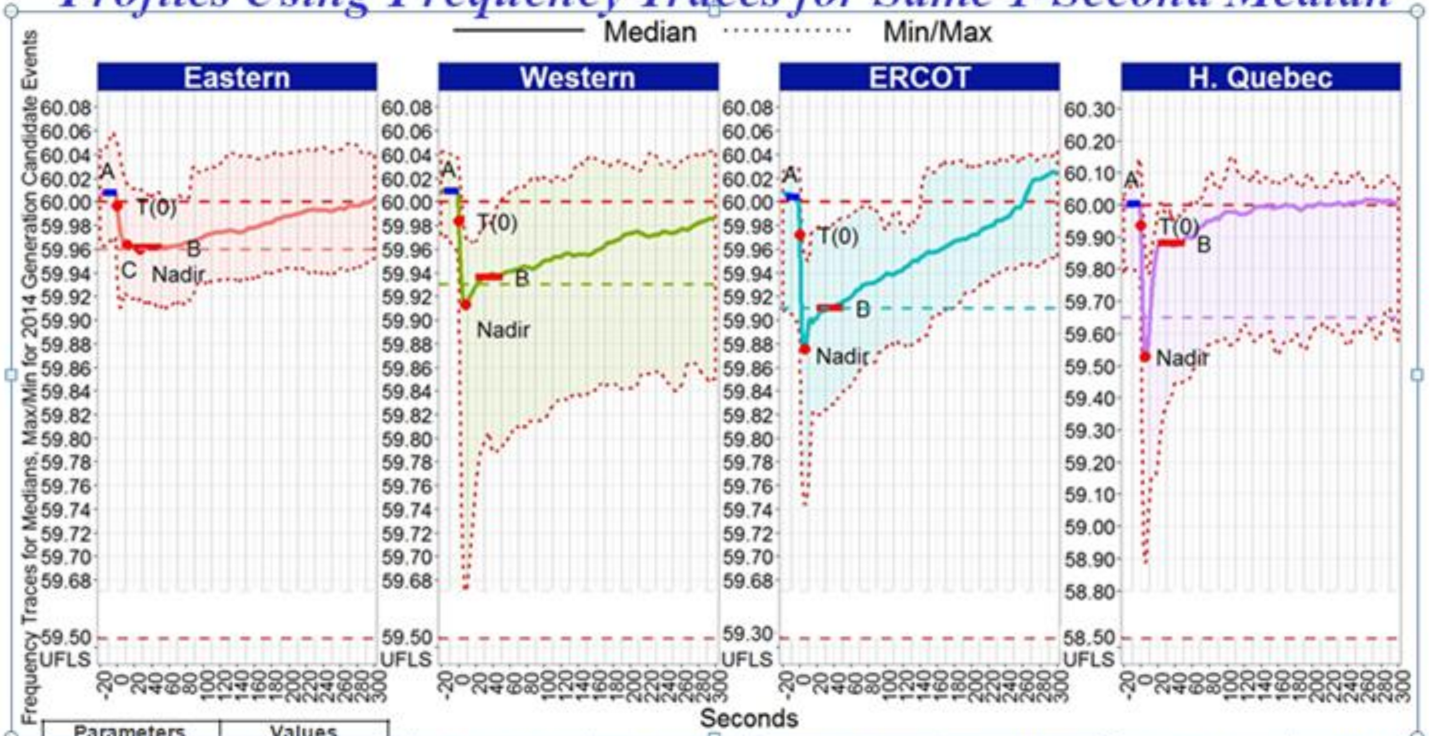


CERTS

ASR Advanced Systems Researchers

Current Interconnection Profiles

BAL-003 Field Test - Interconnections 2014 Candidate Events
Profiles Using Frequency Traces for Same 1-Second Median



Parameters	Values
ValueA	60.007 [Hz]
ValueB	59.961 [Hz]
FreqC	59.963 [Hz]
Nadir	59.960 at 28 Secs
Min-UFLS	409 [mHz]
Risk to Reach ULFS	NA
Generation Events	104

Parameters	Values
ValueA	60.009 [Hz]
ValueB	59.936 [Hz]
FreqC=Nadir	59.913 at 9 Secs
Min-UFLS	171 [mHz]
Risk to Reach ULFS	NA
Generation Events	50

Parameters	Values
ValueA	60.004 [Hz]
ValueB	59.910 [Hz]
FreqC=Nadir	59.875 at 7 Secs
Min-UFLS	444 [mHz]
Risk to Reach ULFS	NA
Generation Events	52

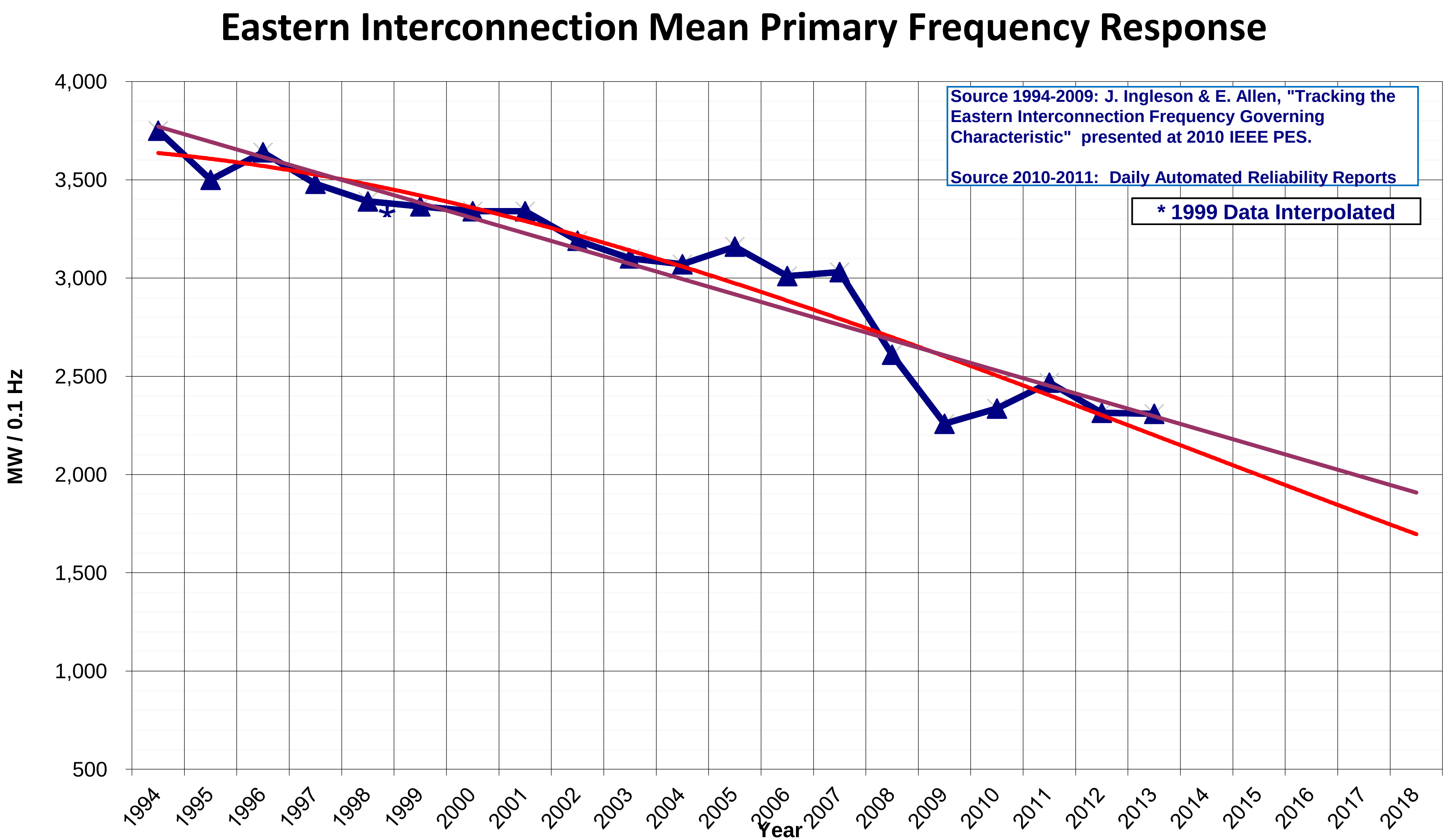
Parameters	Values
ValueA	60.002 [Hz]
ValueB	59.882 [Hz]
FreqC=Nadir	59.529 at 6 Secs
Min-UFLS	388 [mHz]
Risk to Reach ULFS	NA
Generation Events	34

CERTS

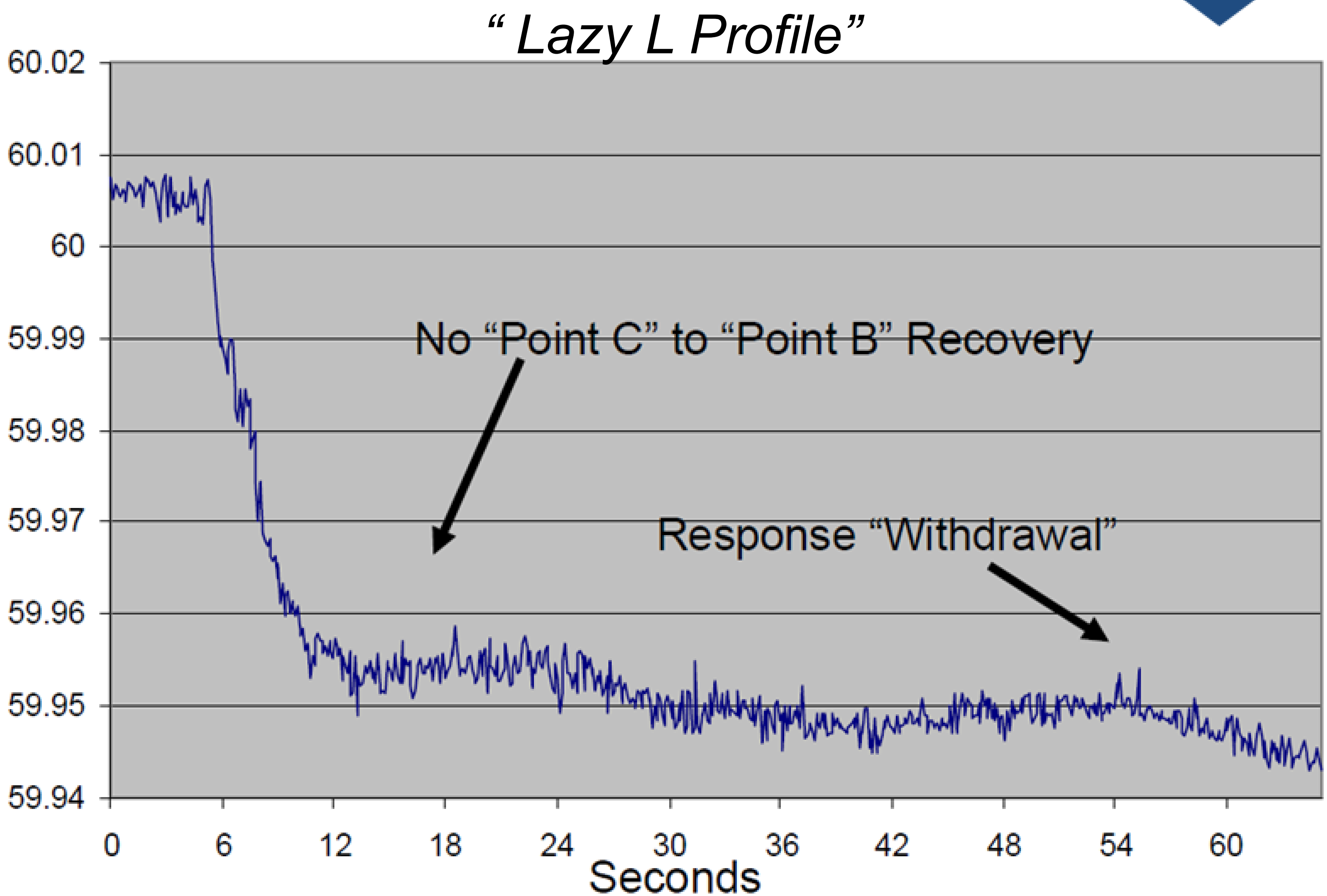
ASR Advanced Systems Researchers

1

Decline in Eastern Interconnection Frequency Response



Present Eastern Interconnection Frequency Response



Generator Governor Frequency Response Advisory

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Industry Advisory

Generator Governor Frequency Response

Initial Distribution: February 5, 2015

As a result of the Eastern Interconnection Frequency Initiative, the NERC Resources Subcommittee has determined that a significant portion of the Eastern Interconnection generator deadbands or governor control settings inhibit or prevent frequency response. While this specific work was based on the Eastern Interconnection, in the absence of more stringent regional requirements the following good practice and guidance is applicable to all interconnections. The proper setting of deadbands, droop, and other controls to allow for primary frequency response is essential for reliability of the Bulk Electric System (BES) and critical during system restoration. Further, the accuracy of Transmission Planning models are impacted by incorrect governor data. The purpose of this Advisory is to alert the industry of recommended governor deadband and droop settings that will enable generators to provide better frequency response to support the reliable operation of the Bulk Electric System.

Why am I receiving this? >>
About NERC Alerts >>

Status:	**No Reporting is Required – For Information Only**
	PUBLIC: No Restrictions More on handling >>
Instructions:	NERC Advisories are designed to improve reliability by disseminating critical reliability information and are made available pursuant to Rule 810 of NERC's Rules of Procedure, for such use as your organization deems appropriate. **No particular response is necessary.** This NERC Advisory is not the same as a reliability standard, and your organization will not be subject to penalties for a failure to implement this Advisory. Additionally, issuance of this Advisory does not lower or otherwise alter the requirements of any approved Reliability Standard, or excuse the prior failure to follow the practices discussed in the Advisory if such failure constitutes a violation of a Reliability Standard.
Distribution:	**Initial Distribution:** Balancing Authority, Generator Owner, Generator Operator, Reliability Coordinator, Transmission Operator, Transmission Planner Who else will get this alert? >> What are my responsibilities? >>

RELIABILITY | ACCOUNTABILITY

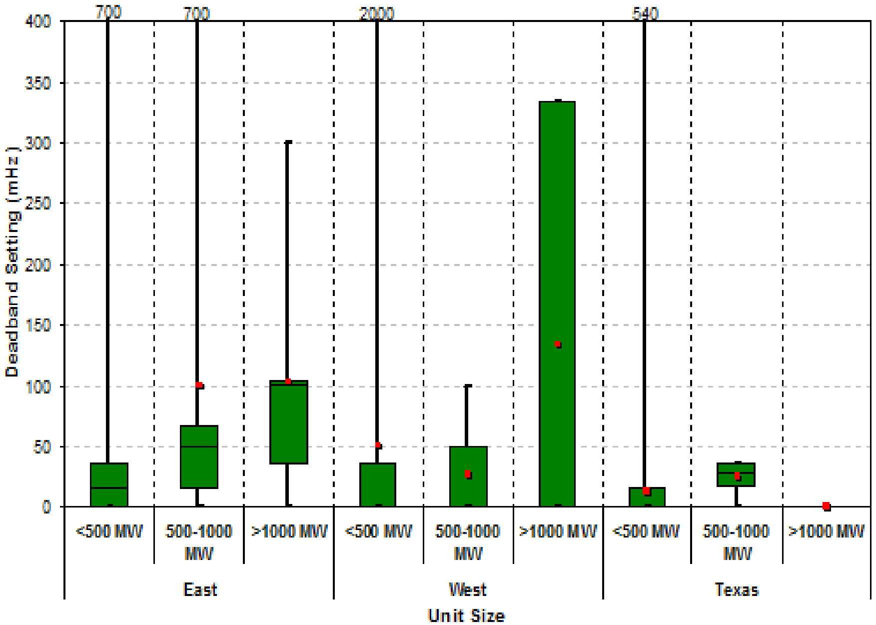
- Advisory issued February 5th
- Initiated by NERC Resource Subcommittee
  - Interconnections frequency response has declined
  - Eastern Interconnection Lazy L profile
  - 2010 and 2013 Generator Survey Data

Generator Governor Frequency Response Advisory

What Has Been Learned: 1) Dead Bands Exceed Recommendations

- Dead Bands Vary
  - Most exceed 36 mHz or 2.16 RPM
  - Large amount of responses reported they did not know
  - Most settings result in NO governor response unless catastrophic event

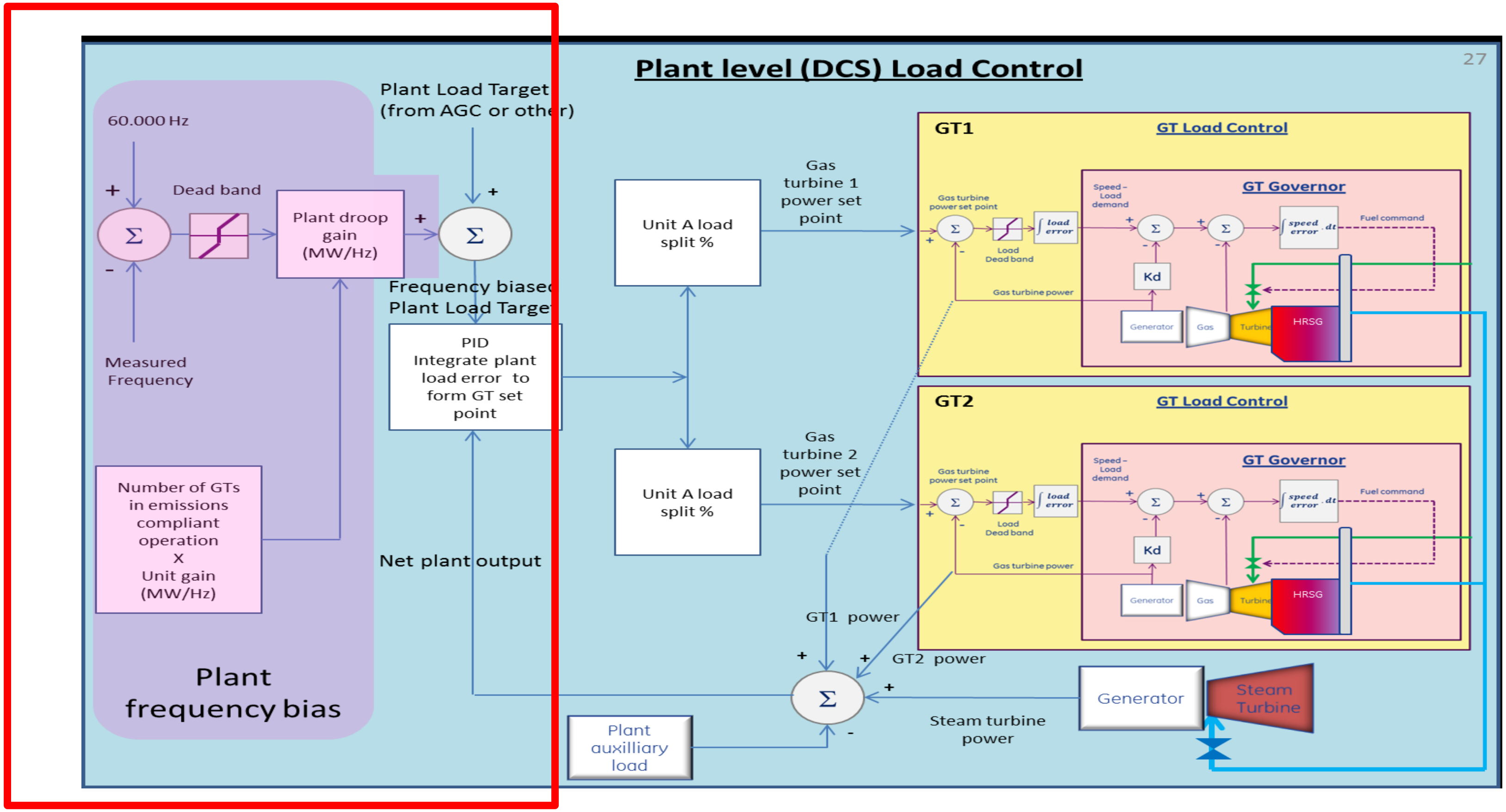
Figure 29: Reported Governor Deadband Settings



NERC Frequency Response Initiative Report - August 2012, Bob Cummings

What Has Been Learned: 2) Unit Response is Squelched or Withdrawn

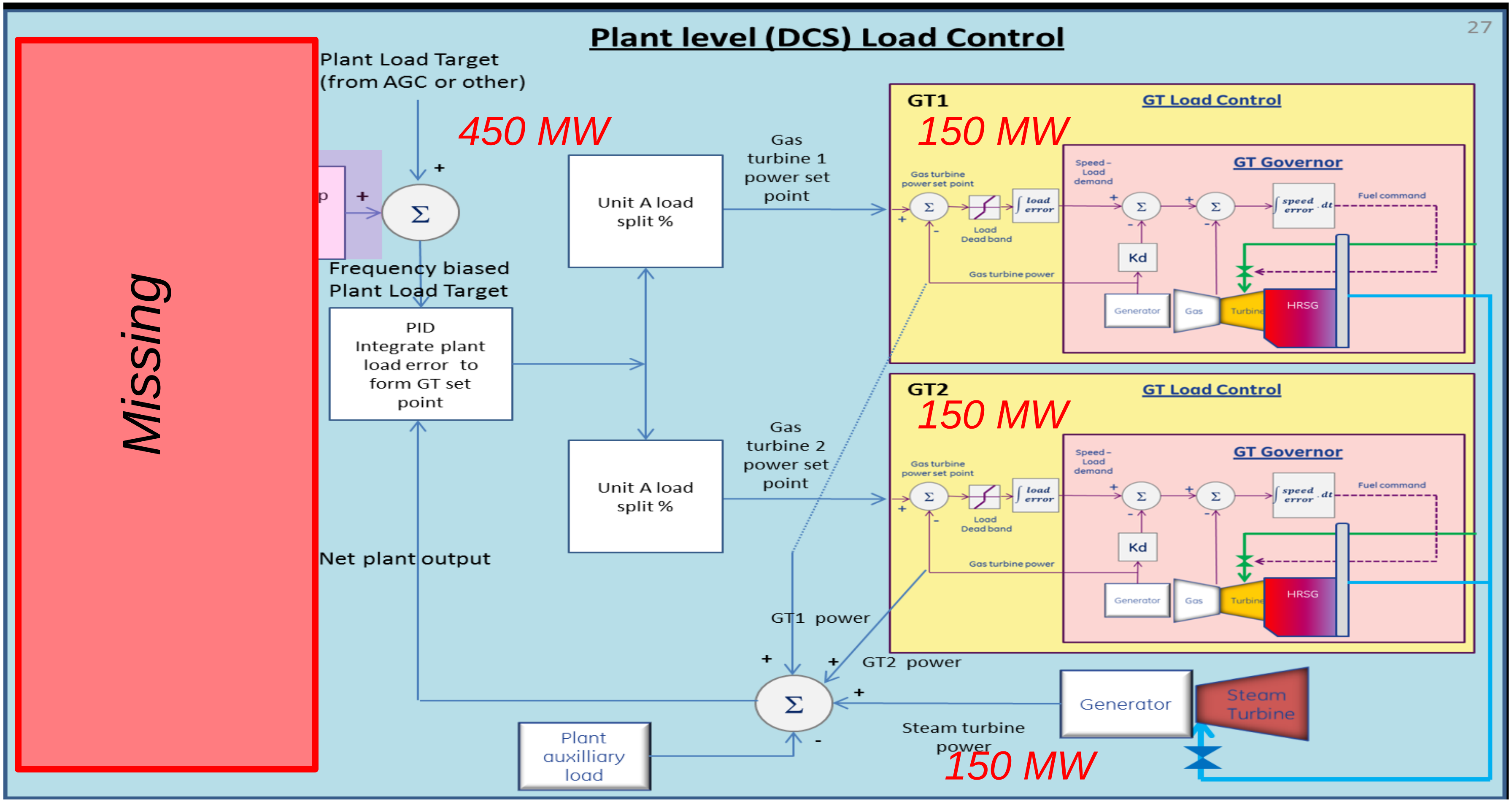
- Coordination with plant Distributed Control System (DCS) is essential when operating in MW Set Point Coordinated Control.



Graphic from GE info bulletin PSIB20150212

Example

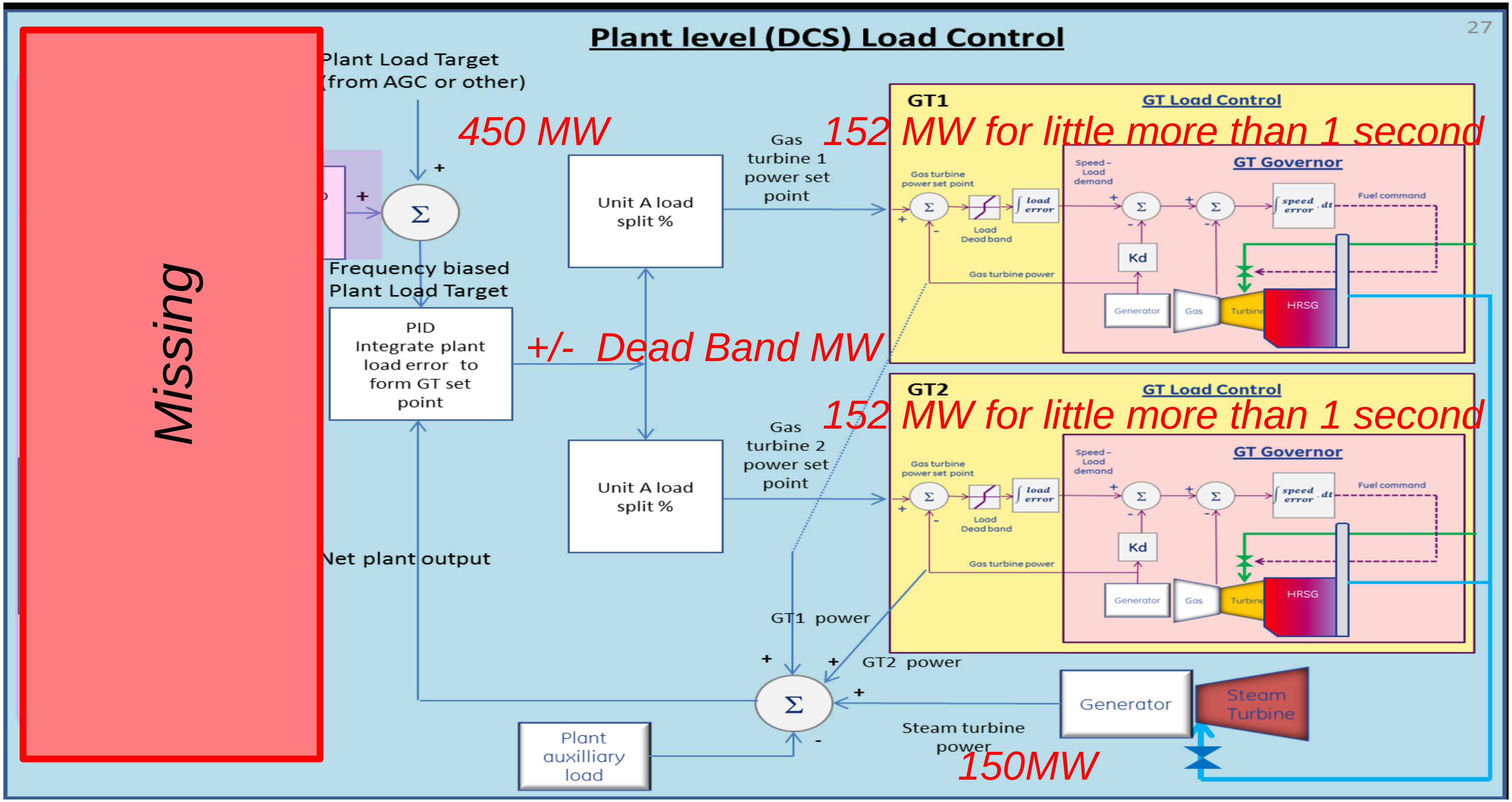
Frequency 60.000 Hz



Graphic from GE info bulletin PSIB20150212

Example

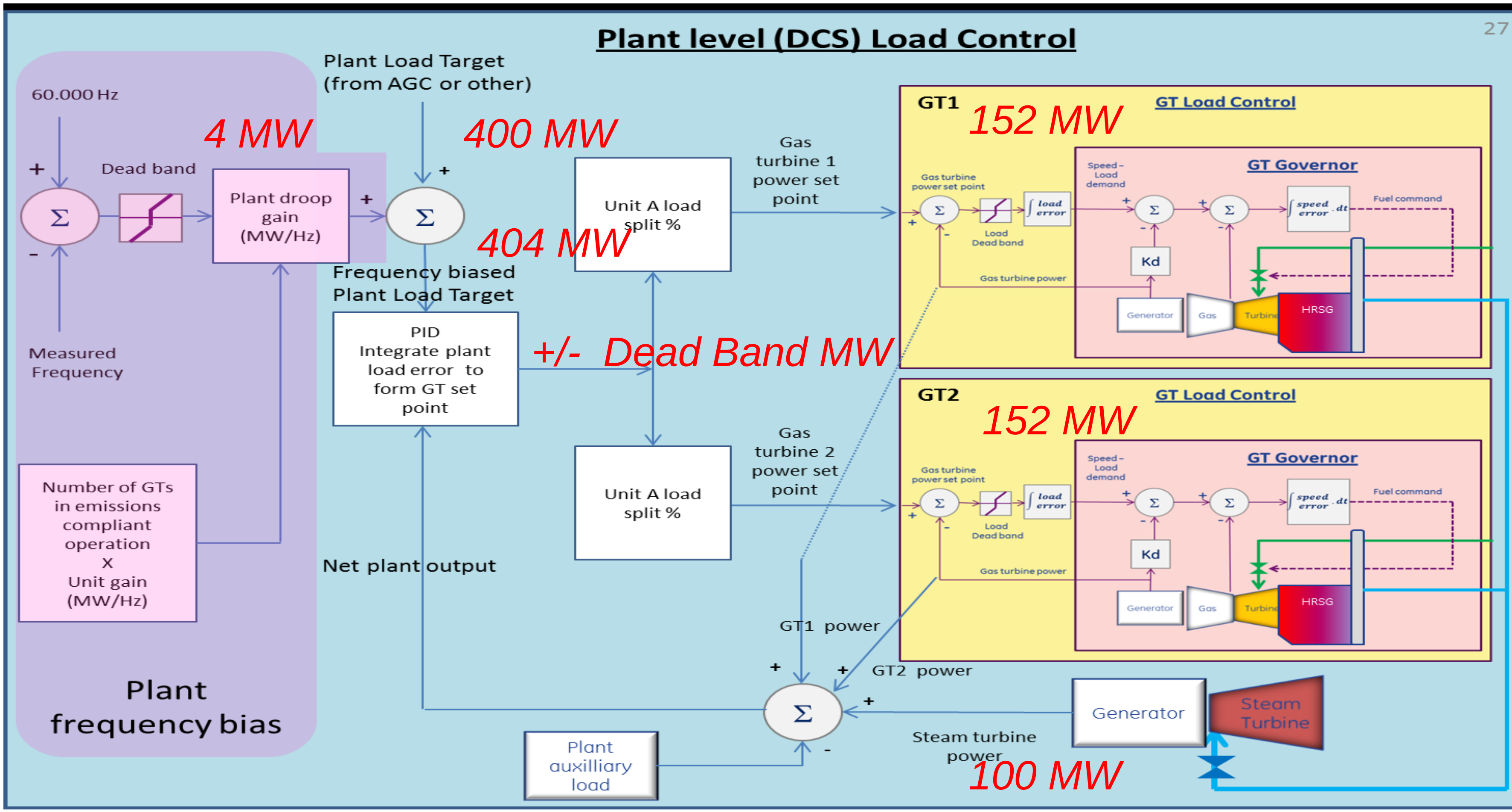
Frequency decline 59.940 Hz



Graphic from GE info bulletin PSIB20150212

Example

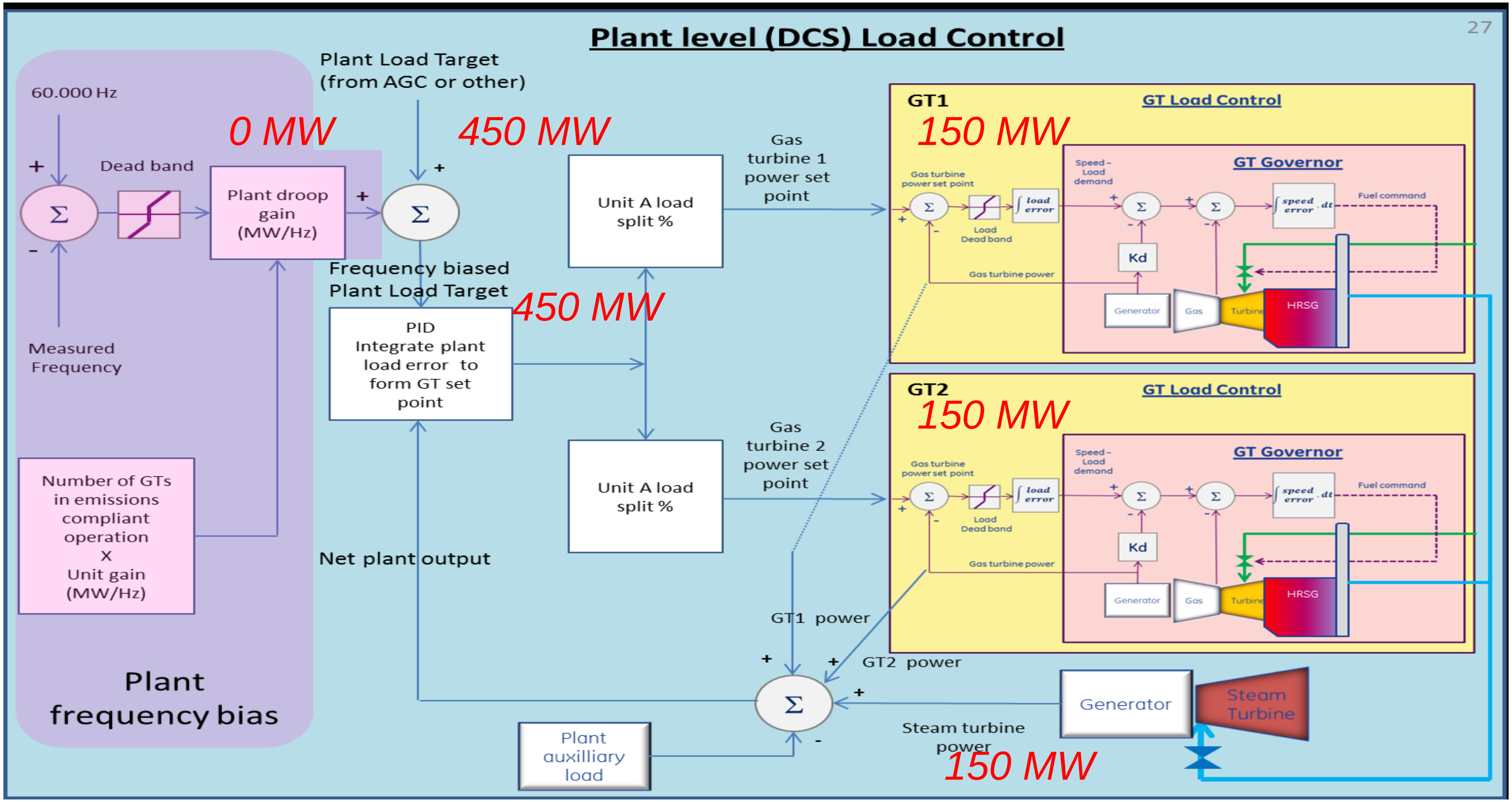
Frequency Decline 59.940



Graphic from GE info bulletin PSIB20150212

Example

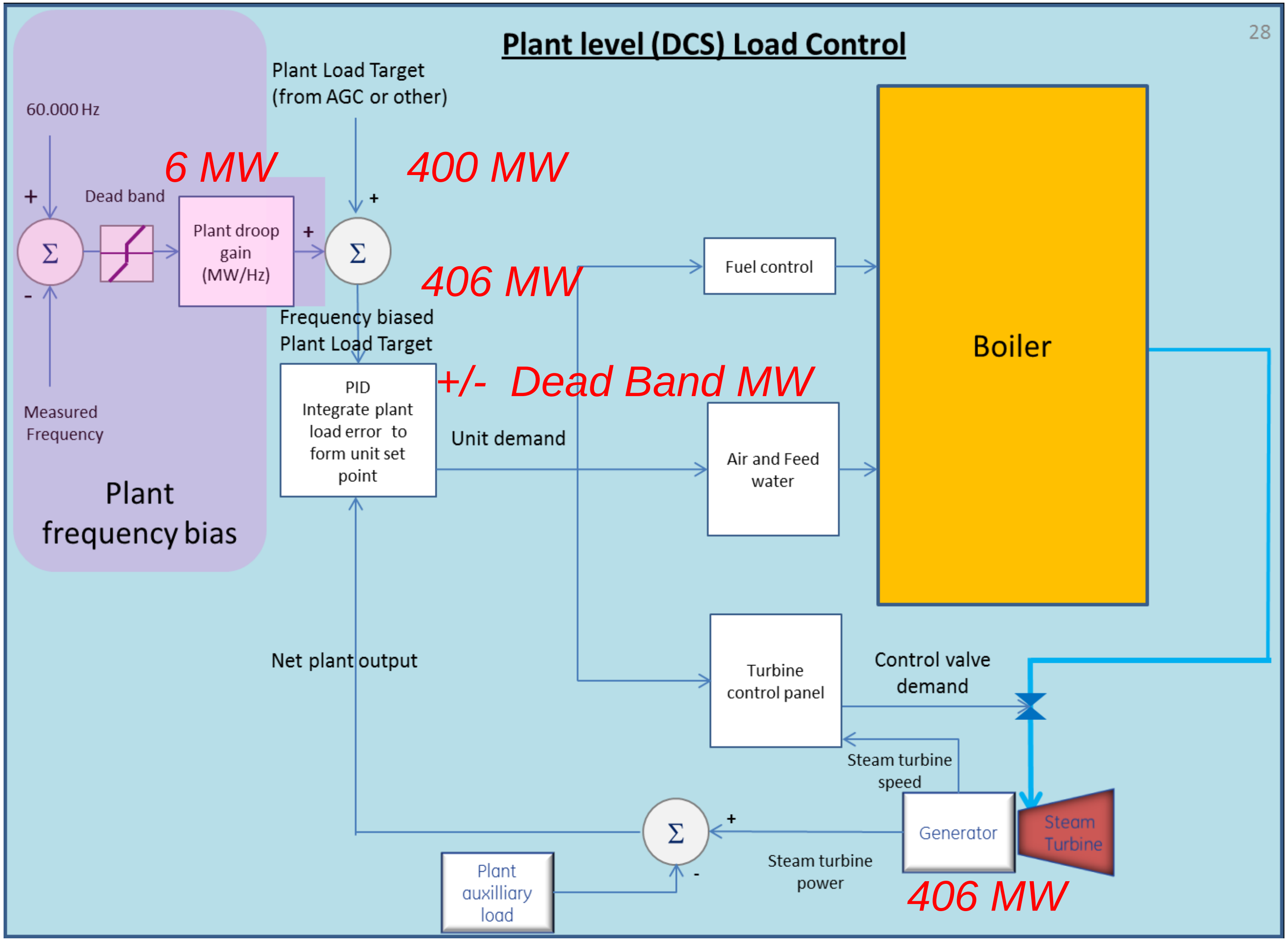
Frequency 60.000 Hz



Graphic from GE info bulletin PSIB20150212

Conventional Steam Plant

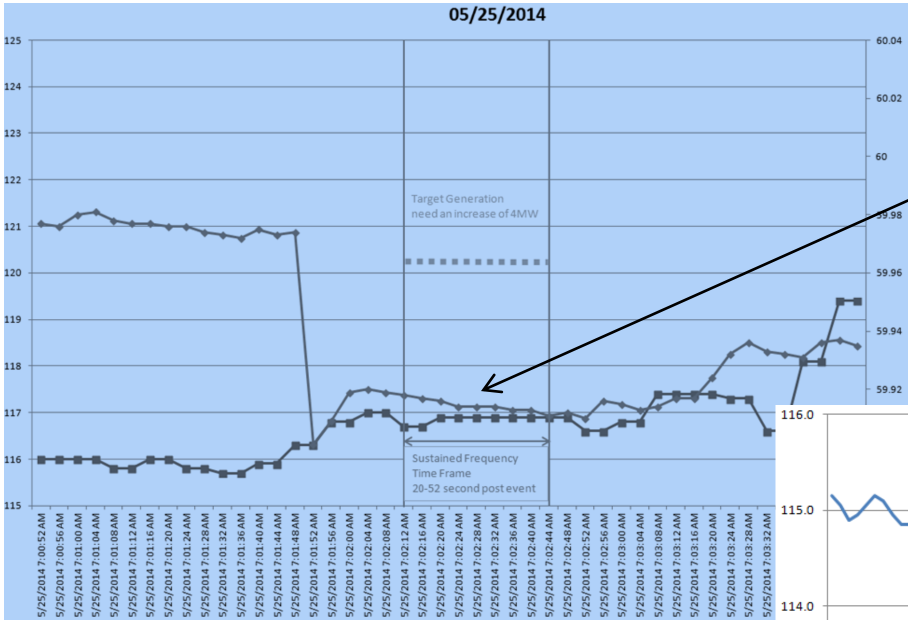
Frequency 59.940 Hz



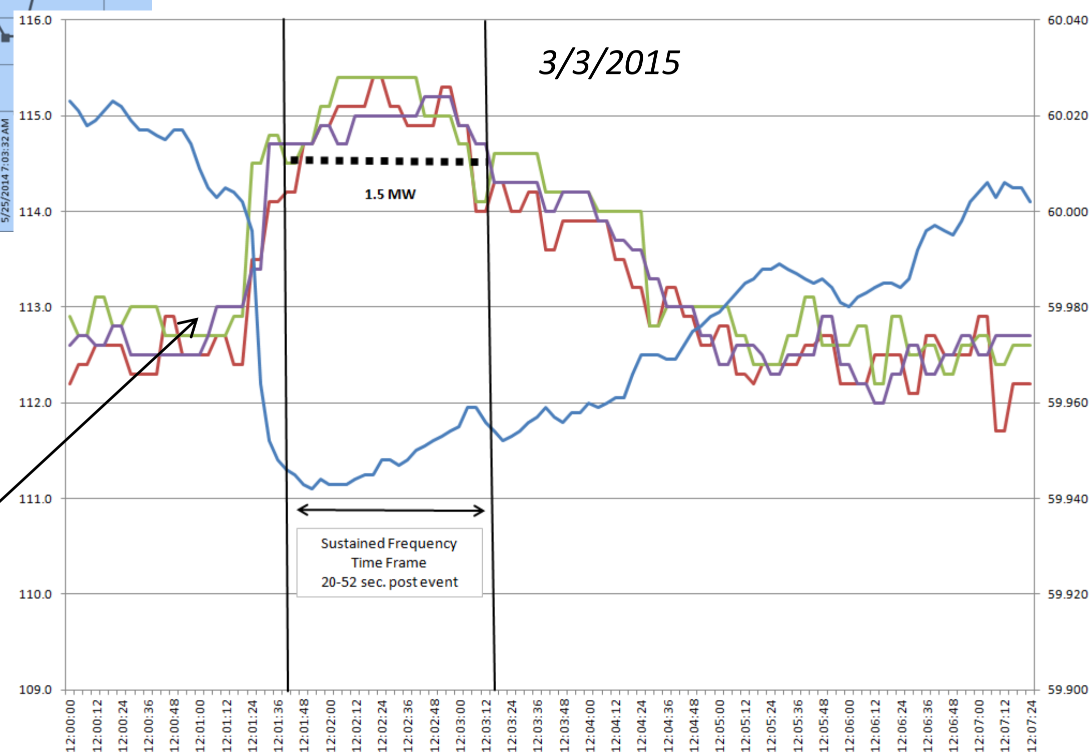
Graphic from GE info bulletin PSIB20150212

Tale of Two Tales

No Frequency Algorithm in DCS



3 -175 MW GE7FA Gas Mark VIe Turbine



Frequency Algorithm in Plant DCS

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What Has Been Learned: 3) BA EMS Pulse Control Squelching Response

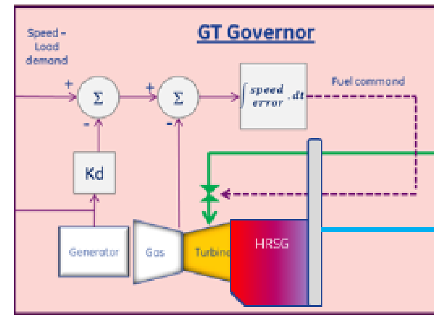
Balancing Authority EMS Pulse Control Squelching Frequency Response to the Generator

200 MW

Pulses Signals

200 MW

Generator



200 MW

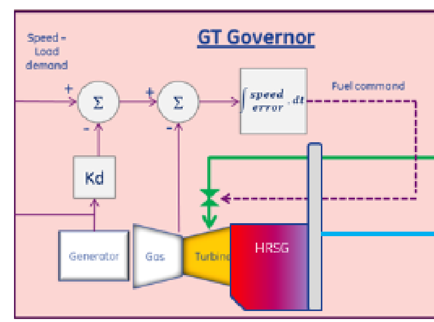
Frequency Decline to 59.92 HZ

200 MW

203 MW

Pulses Signals

200 MW



203 MW

Missing Algorithm to calculate 203 MW

Next Steps

1. OEMs, including GE, Siemens, and ABB, have and continue to communicate to its customer base through advisories and customer meetings.
2. Architect and Engineering Firms have been asked to communicate to their customer base.
3. Regions have been asked to formally communicate to GO's and BA's about the identified issues and request a timeline to address the issues.
4. NERC RS developing a Generator Governor Guideline for recommended settings for all Interconnections
5. Suggesting changes to FERC for governor requirements in the Large Generation Interconnection Agreement and Small Generation Interconnection Agreement

Resources

- NERC Resource Subcommittee
- North American Generator Forum *www.generatorforum.org*
- Original Equipment Manufacturers
- Industry Trade Associations
- Architect /Engineering Firms
- Balancing Authority

Participating Entities

GE imagination at work

Schneider Electric

BURNS McDONNELL

SIEMENS

EMERSON. Process Management

TOSHIBA Leading Innovation >>>

ABB Power and productivity for a better world™

EthosEnergy

CB&I

ALSTOM

FLUOR

BLACK & VEATCH Building a world of difference.

Questions

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Update on the Cause of the April 7, 2015 Outage, Washington DC.

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Summer Committee Meetings

David Souder, Director of Operations Planning, Operations Support Department, PJM