NERC

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

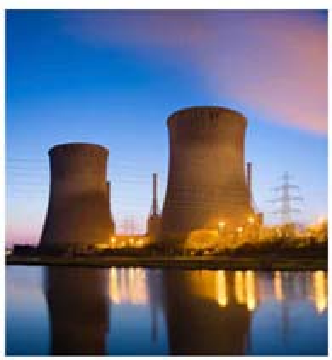
East Interconnection Frequency Response Assessment with Inverter Based Resources

Electricity Advisory Committee

Olushola Lutalo, Lead Engineer of System Analysis
Ganesh Velummylum, Senior Manager of System Analysis
Robert W. Cummings, Senior Director of Engineering & Reliability Initiatives

July 10, 2018

RELIABILITY | ACCOUNTABILITY

Background and Study Purpose

Study Purpose

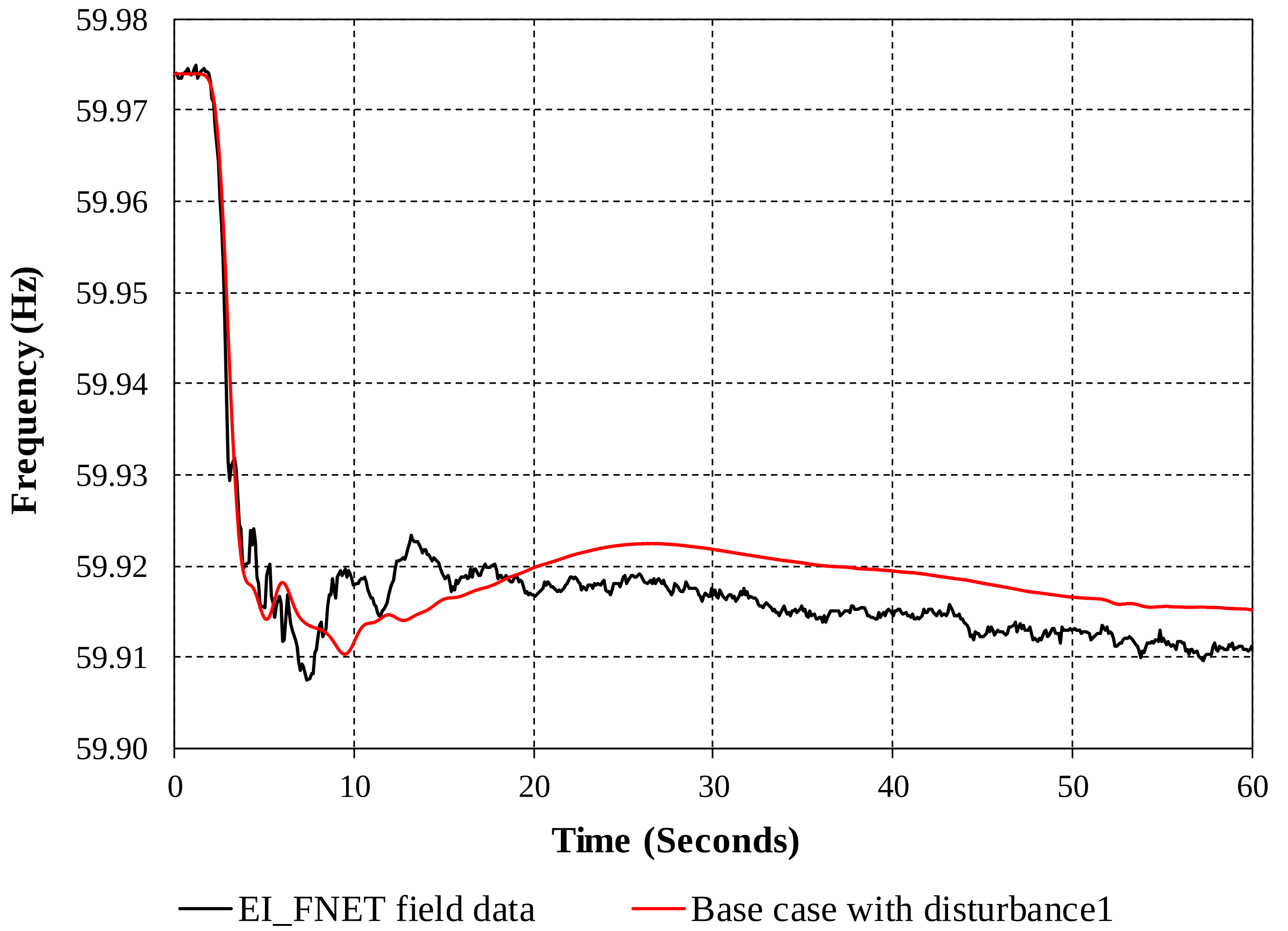
- To evaluate potential impacts on Eastern Interconnection resource shift from synchronous generation to Inverter Based Resources (IBR)

Study Process

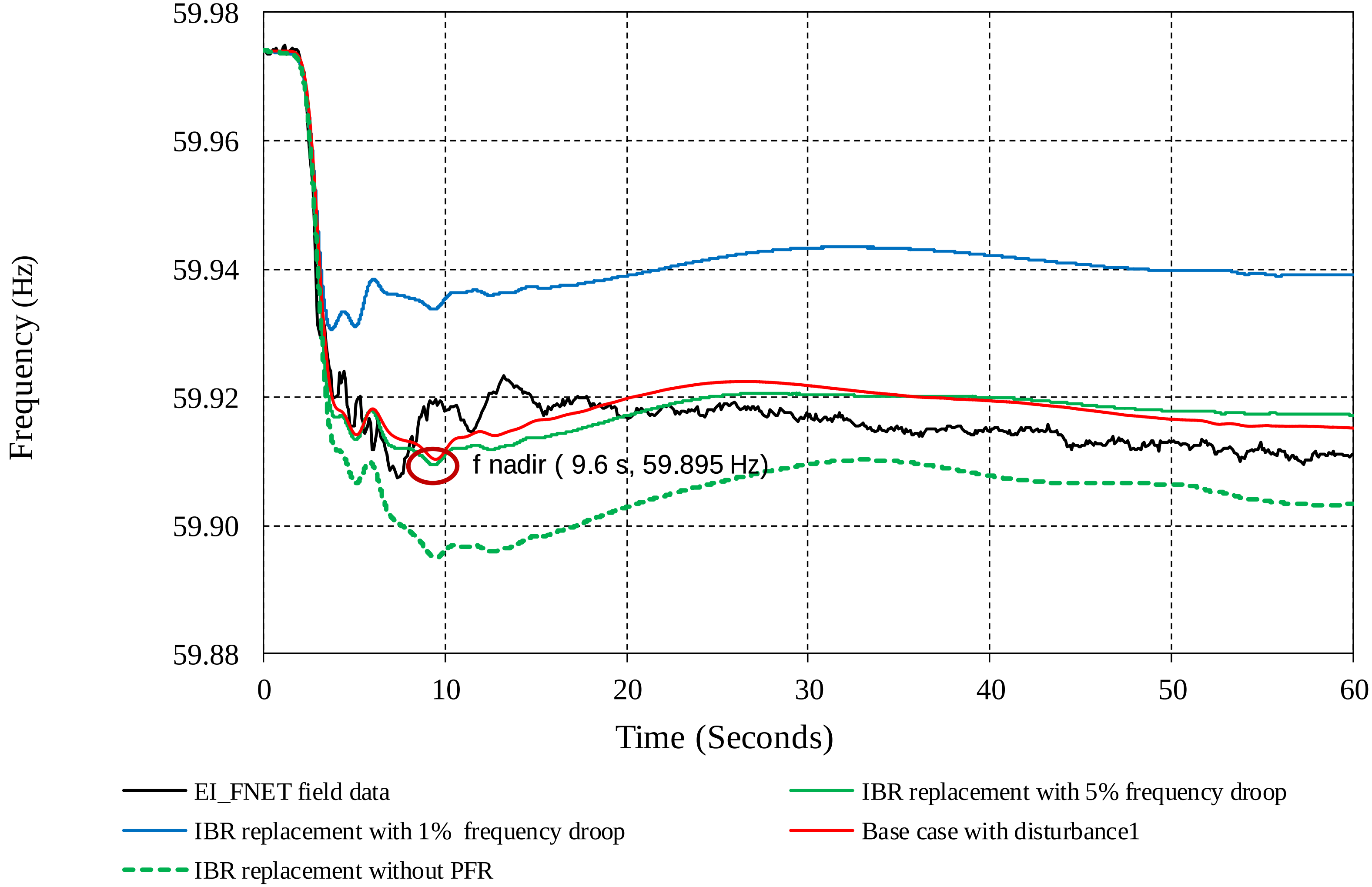
- Analysis was performed using the 2016 SERIES, ERAG/MMWG BASE CASE LIBRARY. CEII DATA 2021 Light Load Base Case
- Replace 20,000 MW of synchronous generation IEEEG1 governor type with wind IBR with and without Primary Frequency Response(PFR)
- Determined the frequency nadir and PFR impact of increasing levels of wind IBR penetration
- Compared the power response of wind IBR to synchronous generation under various contingency events

EI Model Benchmarked against Field Data

Model benchmarked against 2,100 MW resource loss

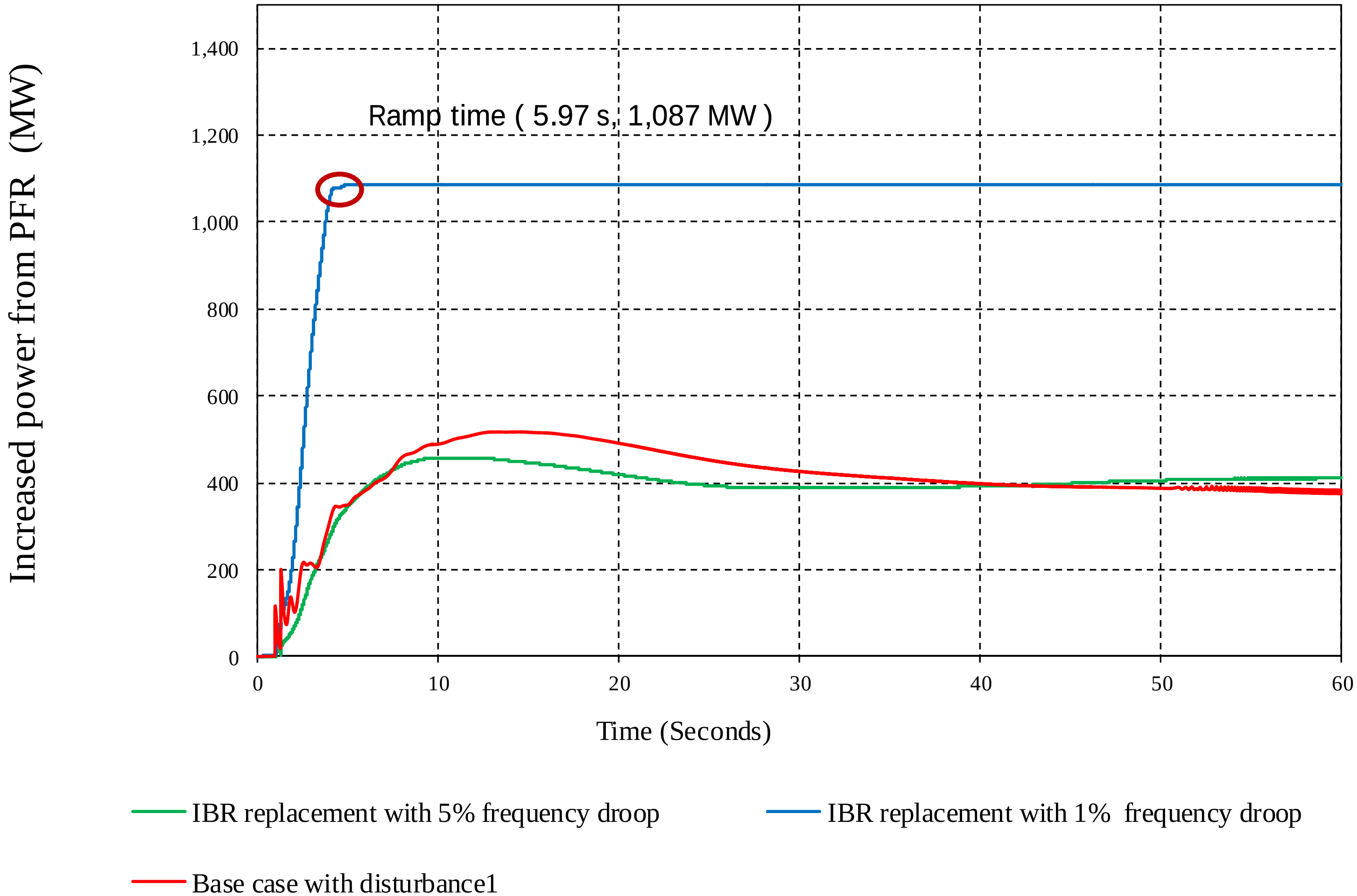


Frequency response for 2,100 MW resource loss



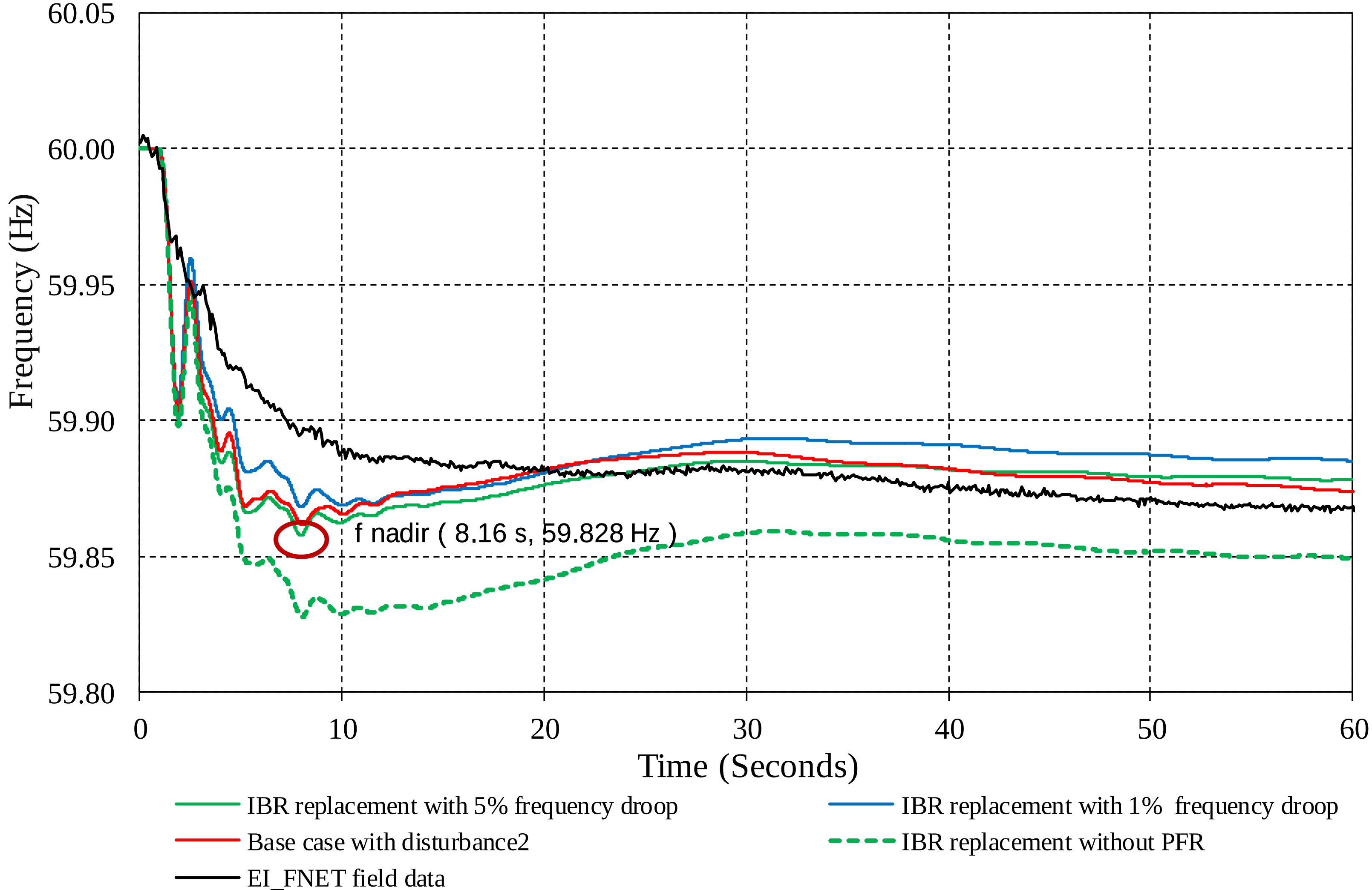
EI IBR Analysis of Disturbance 1

Power response for 2,100 MW resource loss



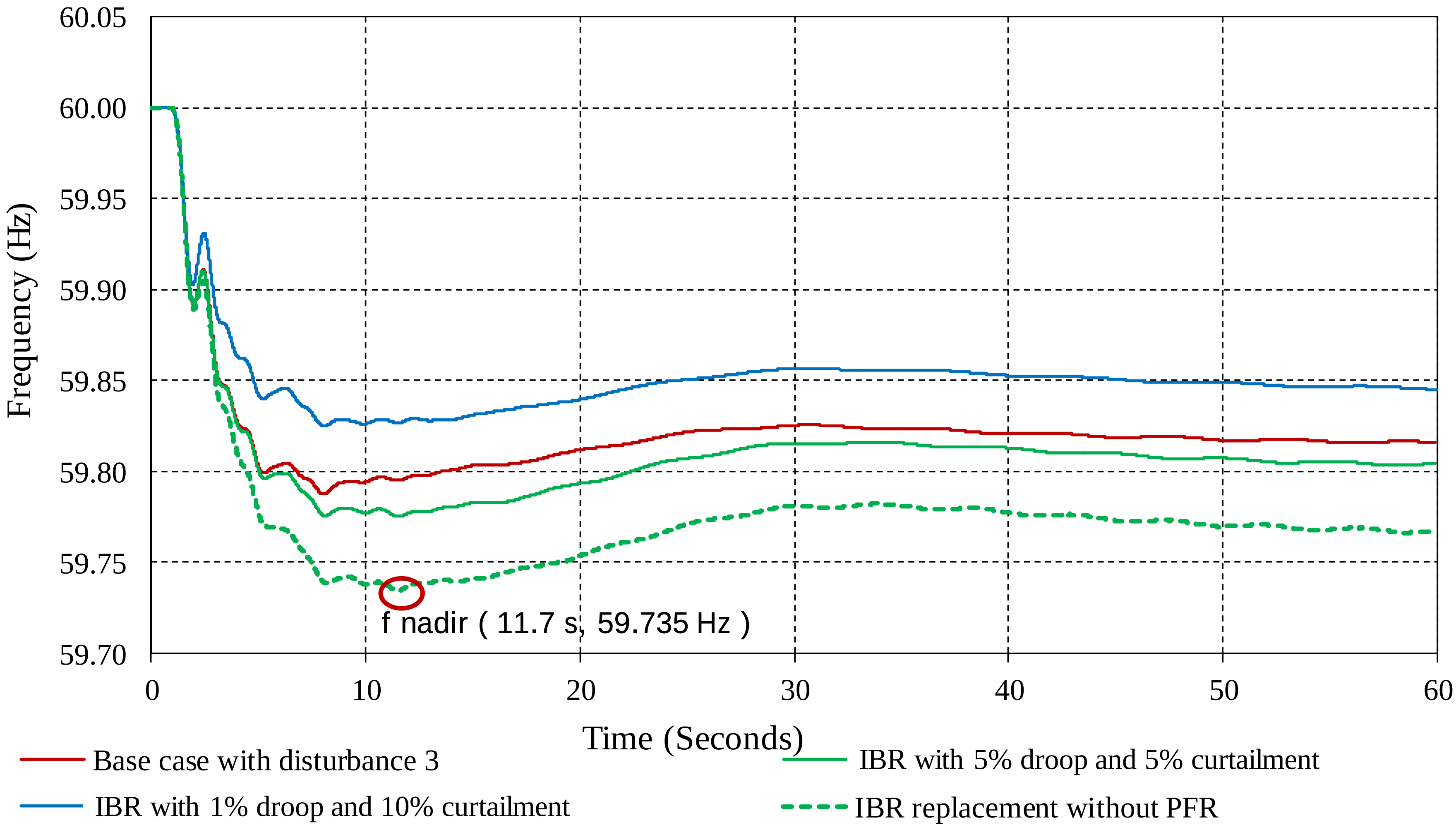
EI IBR Analysis of Disturbance 2

Frequency response for 4,500 MW resource loss



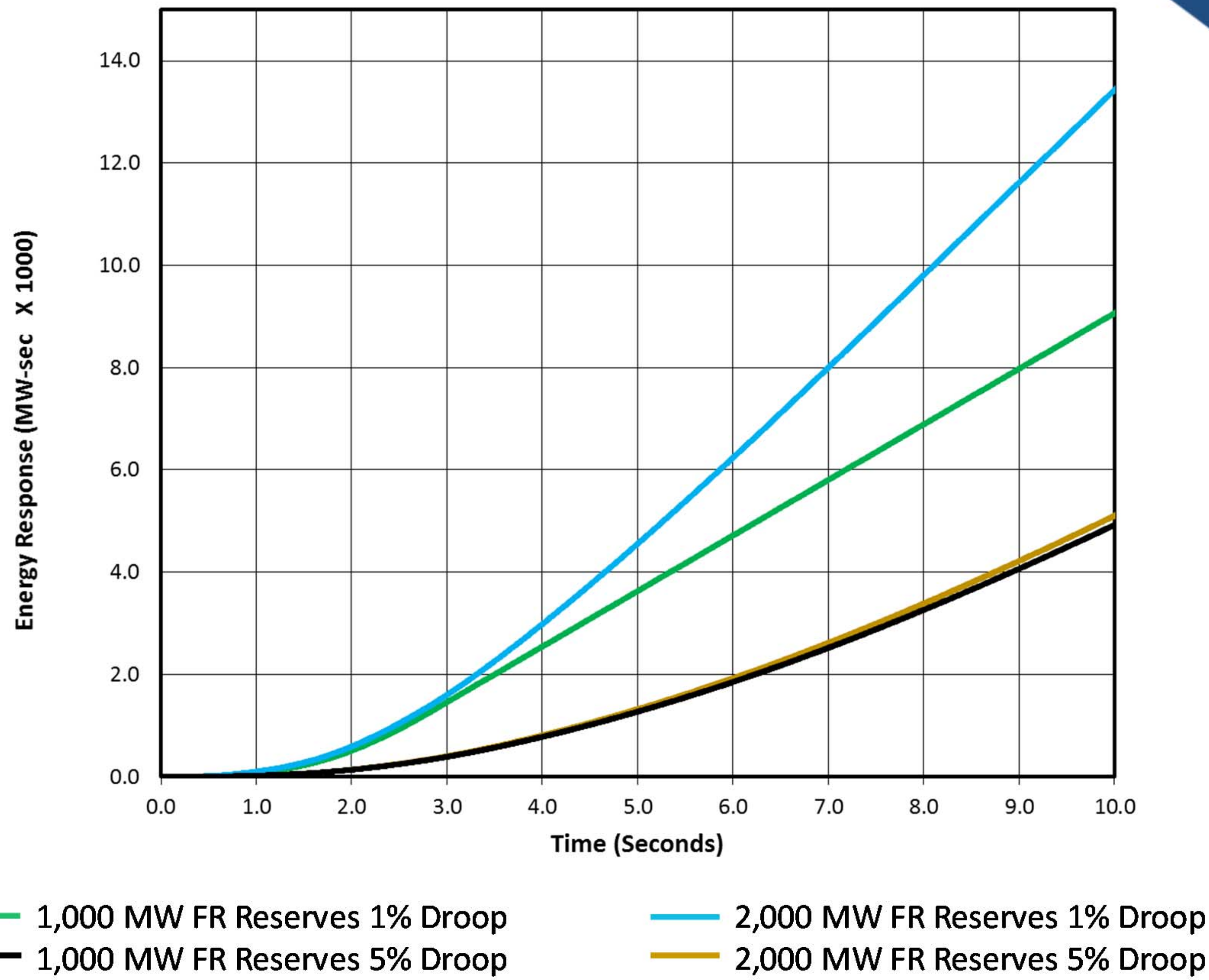
EI IBR Analysis of Disturbance 3

Frequency response for 6,800 MW resource loss

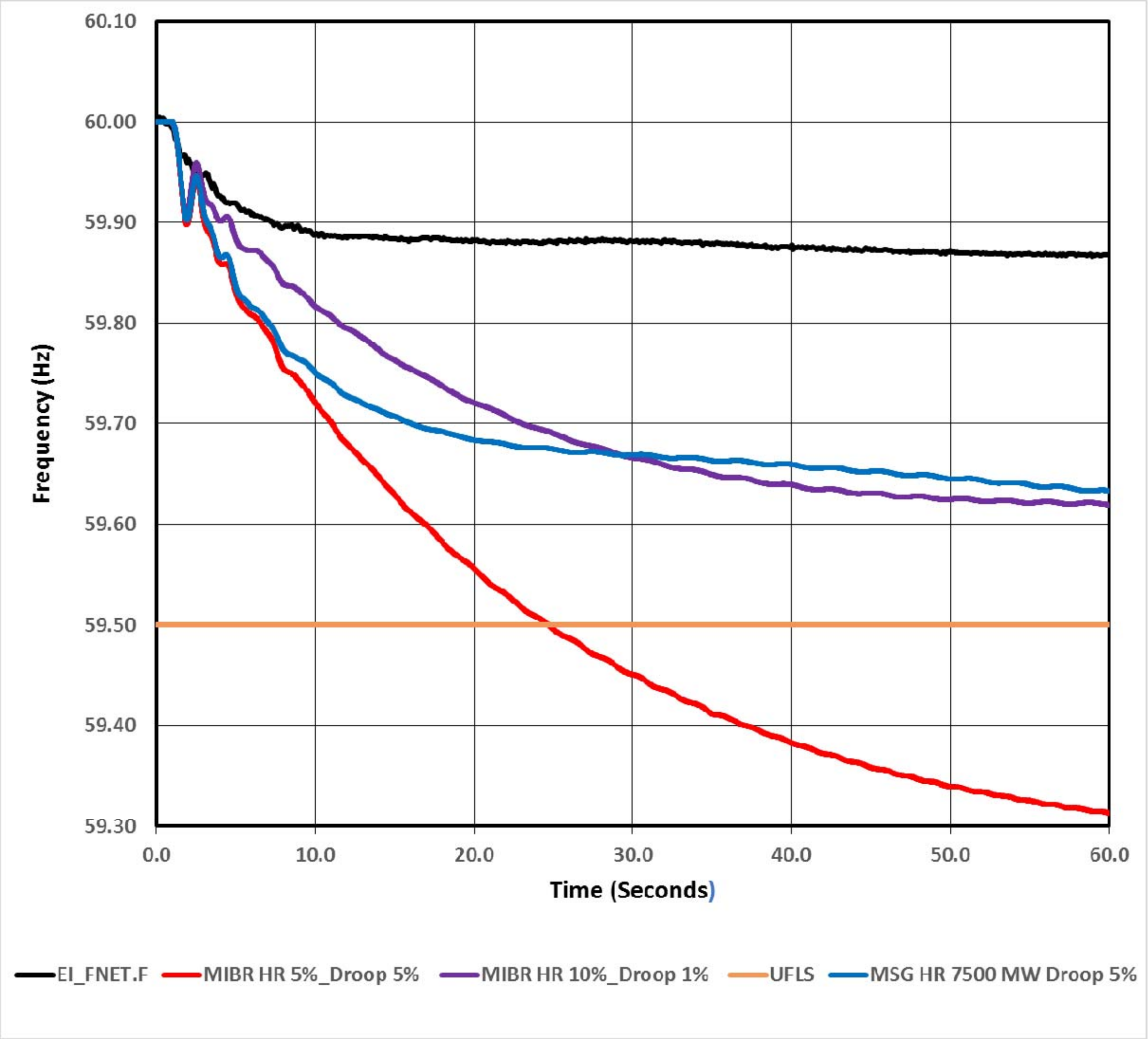


NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Droop versus Freq. Responsive Reserves

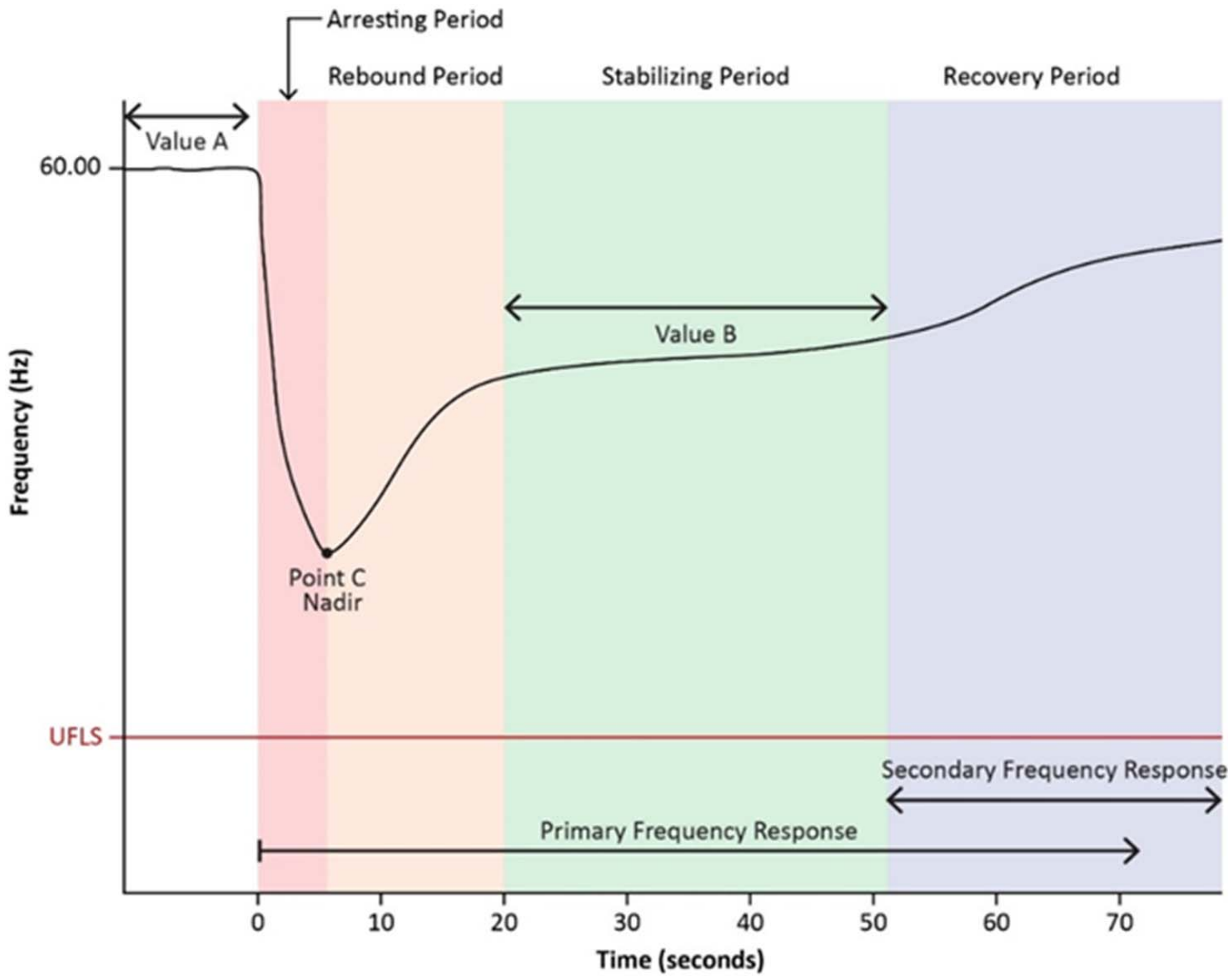


Minimum FR Resources Sensitivity 4500 MW Disturbance Event



NERC
NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

- Tradeoff between lower system inertia and high-speed energy injection
- Objective – Return the system to balance by injecting larger amounts of energy sooner during the arresting period of the frequency excursion



Conclusions

- IBR can outperform conventional generation governor action during the arresting phase of a frequency event – more energy can be delivered faster to rebalance the system
- IBR offers more controllable response - droop characteristics, deadbands, etc. can be tailored to the resource behind the inverter

Ongoing Work

- Frequency Response headroom will be further analyzed with high penetration of IBR for summer peak and light load conditions
- Assess various combinations of droop characteristics and frequency responsive reserves for effectiveness in arresting frequency decline for high rate of change of frequency (RoCoF) events
- Evaluate maximum IBR penetration with/without PFR under minimum inertia conditions

NERC
NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Questions and Answers