Frequency Response
for
Load Loss in the Western Interconnection

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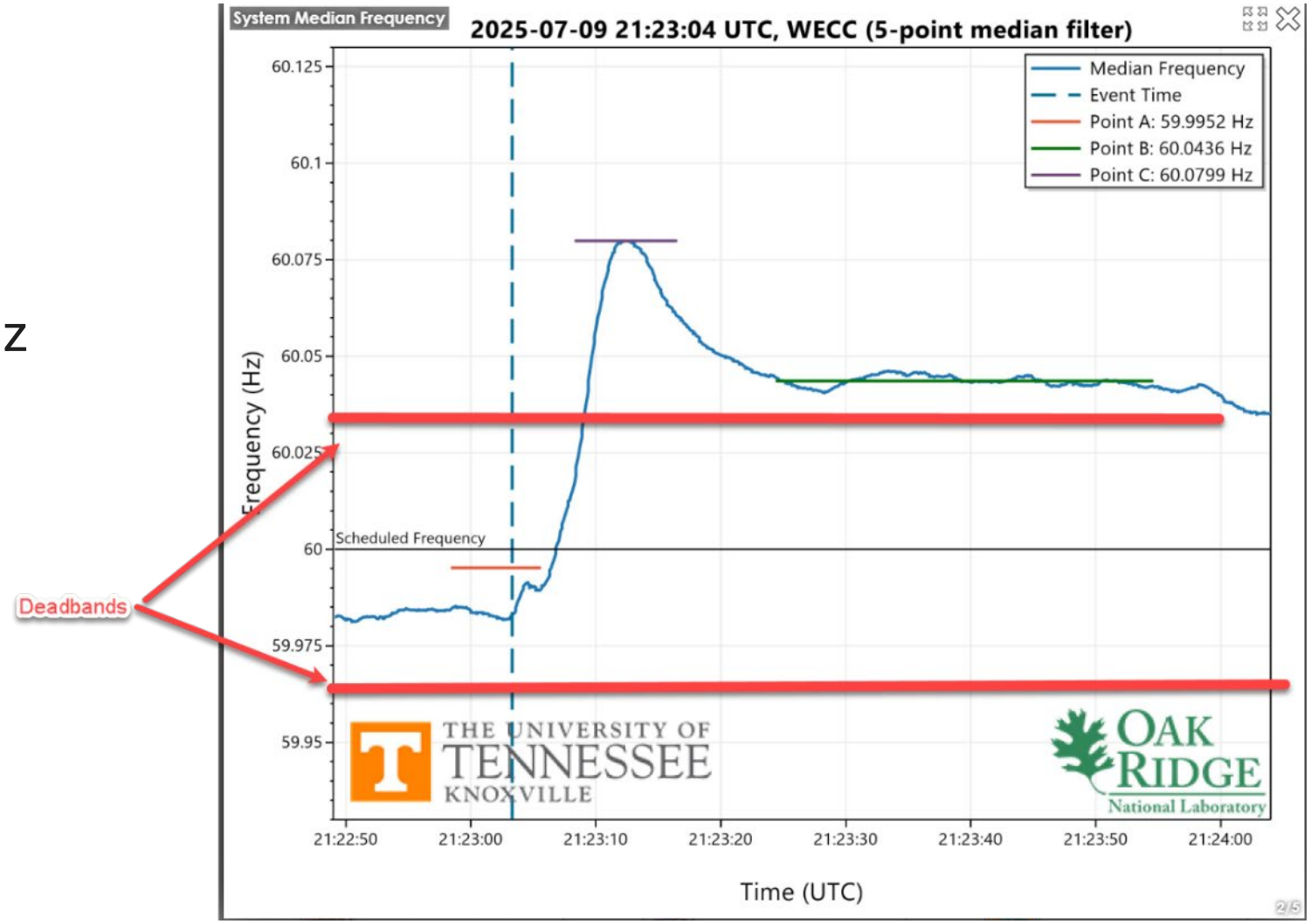
Agenda

- Recent Load Loss Events and Simulations
- Newer Large Loads
- Preliminary Simulations
- Recommendations

Recent Load Loss Events

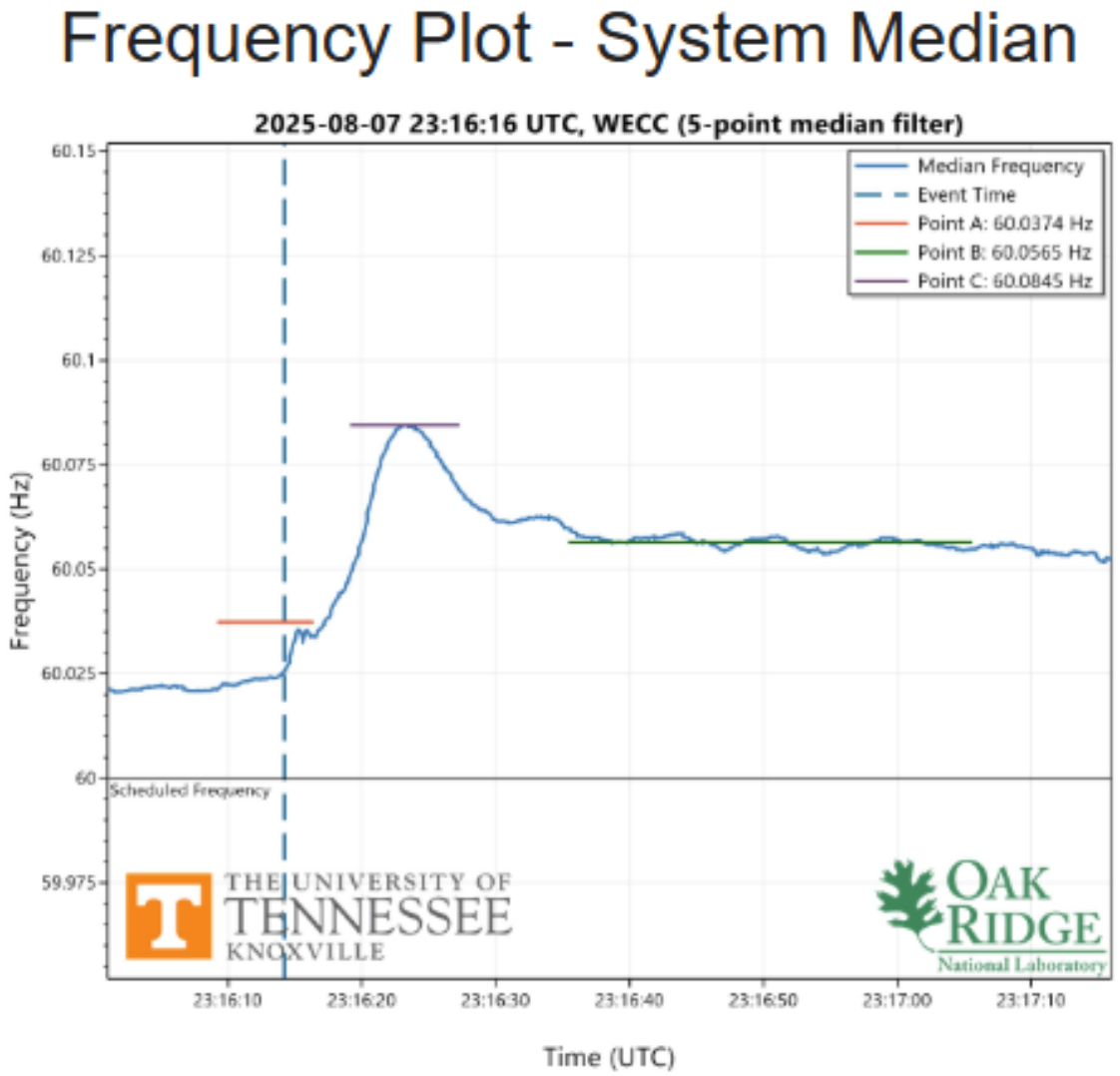
FNETs - 1

- Event:
  - 7-9-2025 @1423PPT
  - Load loss of 1,414 MW
  - Frequency of 60.0799 Hz
  - FNET Event Report



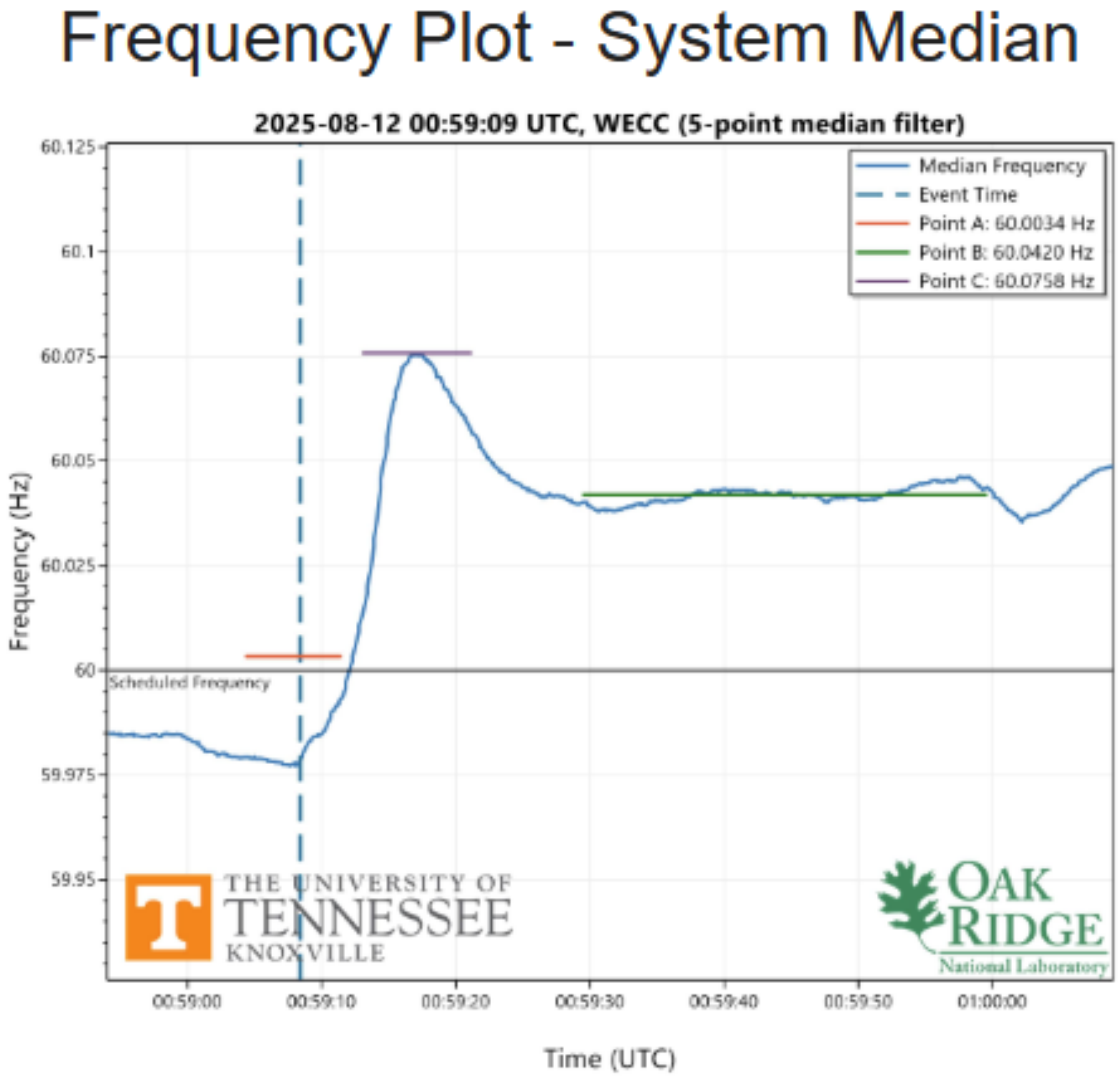
FNETs - 2

- Event:
  - 8-7-2025 @1616PPT
  - Load loss of 1,467 MW
  - Frequency of 60.0845 Hz
  - FNET Event Report



FNETs - 3

- Event:
  - 8-11-2025 @1759PPT
  - Load loss of 1,347 MW
  - Frequency of 60.076 Hz
  - FNET Event Report



Events Assessment

- System Conditions:
  - BA load ranged 3,273 MW – 3,579 MW before the event
  - The initiating event was a 230 kV fault, with load tripping by UV, OC & FIDVR
  - Load loss ranged from 1,347 MW – 1,467 MW
- For a ~1,400 MW load loss in the WI, the frequency increased by ~0.08 Hz

Simulation of Load Loss Events

Simulation Results

- 2025 Heavy Summer Base case and associated dynamics file
- Simulated 230 kV fault and consequential load loss of ~1,467 MW of load
- For a ~1,450 MW load loss simulation, it demonstrates a similar frequency increase of ~0.075 Hz
- *Note: In general, for the WI, a 1,000 MW generation loss results in a 0.1 Hz frequency deviation*

Newer Large Loads

Newer Large Loads

- Existing loads:
  - Residential, Commercial, Industrial, Agricultural, etc.
  - Large Pumps, Pump-Generator-Plants
  - Arc Furnaces
  - Mining Loads
  - Data Centers
  - Minimal aggregated loads (TOU)
  - Rate-based loads
- Newer large loads
  - Large Loads – AI Data Centers, etc.
  - Large aggregated loads (TOU/EV)
  - Other

Newer Large Load Categories

Category	Large Loads	TOU / EVs
Voltages	Significant impact	Minimal / No impact
Frequency	Significant impact	Potential significant impact
Operational Knowledge	LL Owners/Operators & BES Operators	Owners/Operators (BES & non-BES)
Operating Times	Unknown / random	On the hour, typical times (0000; 1600; 1700; 2100)
Occurrence	Varies	Specific days/times
Magnitude	~600MWs; Up to 1,000s of MWs?	~800 MWs; Up to 1,000s of MWs?
Response Times	Seconds	Seconds
Oscillations	Likely	Unlikely

Preliminary Frequency Simulations of Large Load Losses

Simulations

- 2025 Base case and associated dynamics file
- Loss of Large Loads
- Observed frequency responses
- *(Preliminary analysis did not focus on voltages, oscillations, etc.)*

Large Load Loss Summary for 2025 Light Spring

~Large Load Loss (MW)	~Max. Frequency (Hz) (500 kV Bus)	Voltage/Frequency Violation (lhvrt/lhfrt) Generation Trip (~MW)
1,000	60.065	72
2,000	60.127	147
3,000	60.188	160
4,000	60.234	309
5,000	60.286	413

WECC Off-nominal Frequency Load Shedding Plan regarding generators:

Underfrequency Limit	Overfrequency Limit	* Minimum Time
>59.4 Hz	< 60.6 Hz	N/A (continuous operation)
≤59.4 Hz	≥60.6 Hz	3 minutes
≤58.4 Hz	≥61.6 Hz	30 seconds
≤57.8 Hz		7.5 seconds
≤57.3 Hz		45 cycles
≤57.0 Hz	≥61.7 Hz	Instantaneous trip

* Minimum Time is the time the generator should stay interconnected and producing power.

Recommendations

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- Further assessments for newer large loads
- Determine likely operating characteristics, magnitudes, etc., of newer large loads
- Evaluate future TOU / EV programs as part of potential risk screening

Thank you

I would be happy to answer any questions or have further discussion.

WECC

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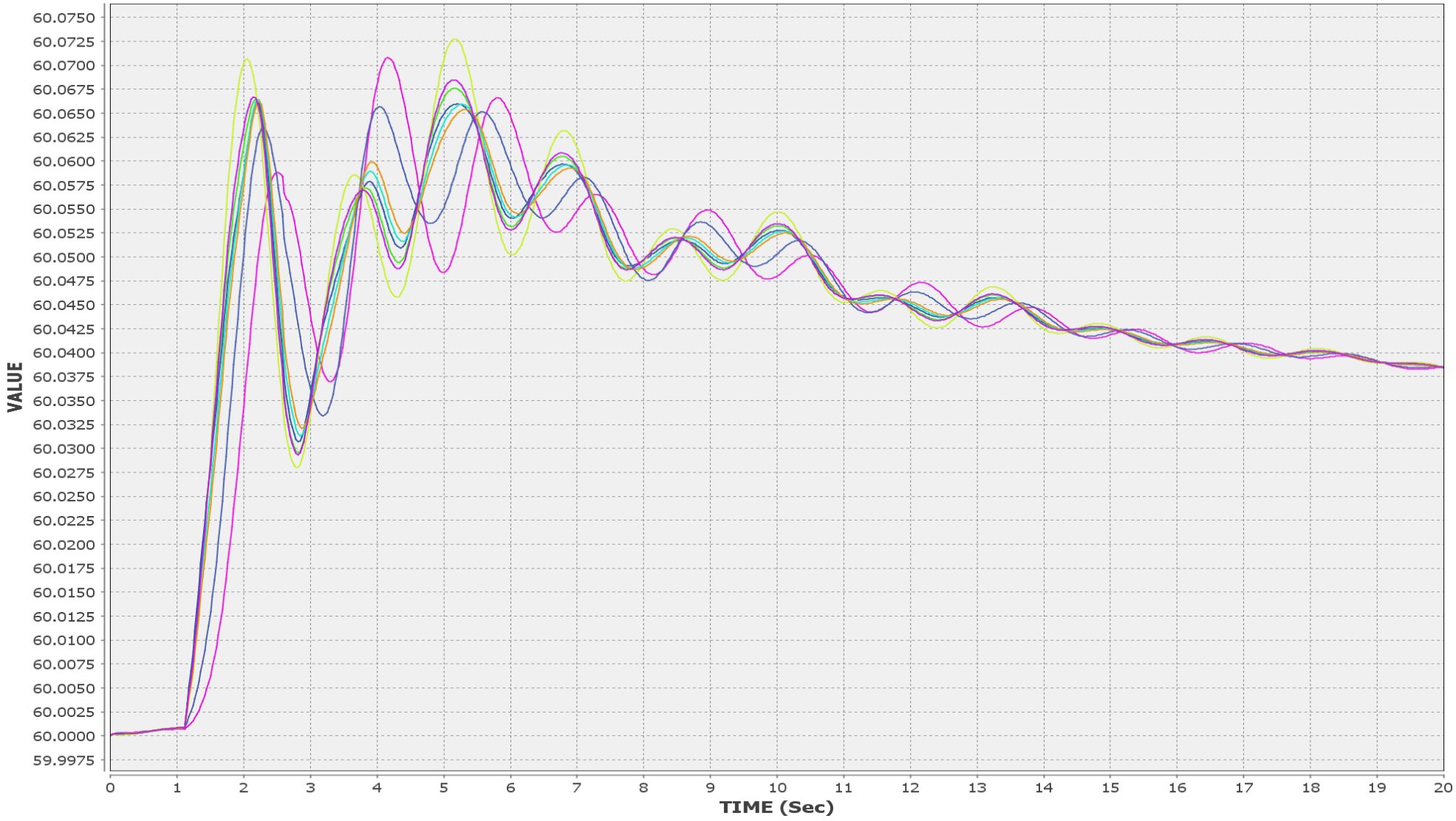
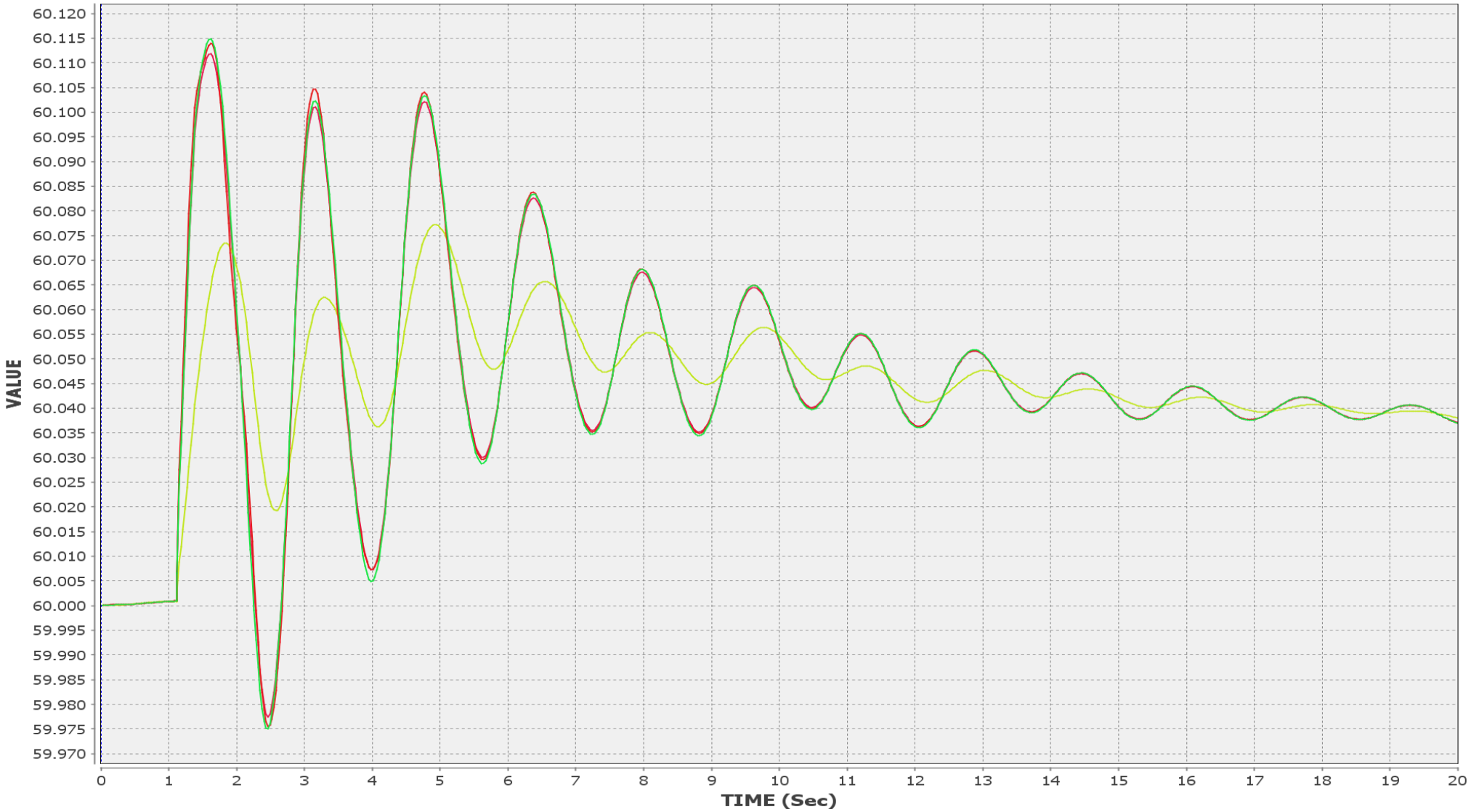
Additional Information

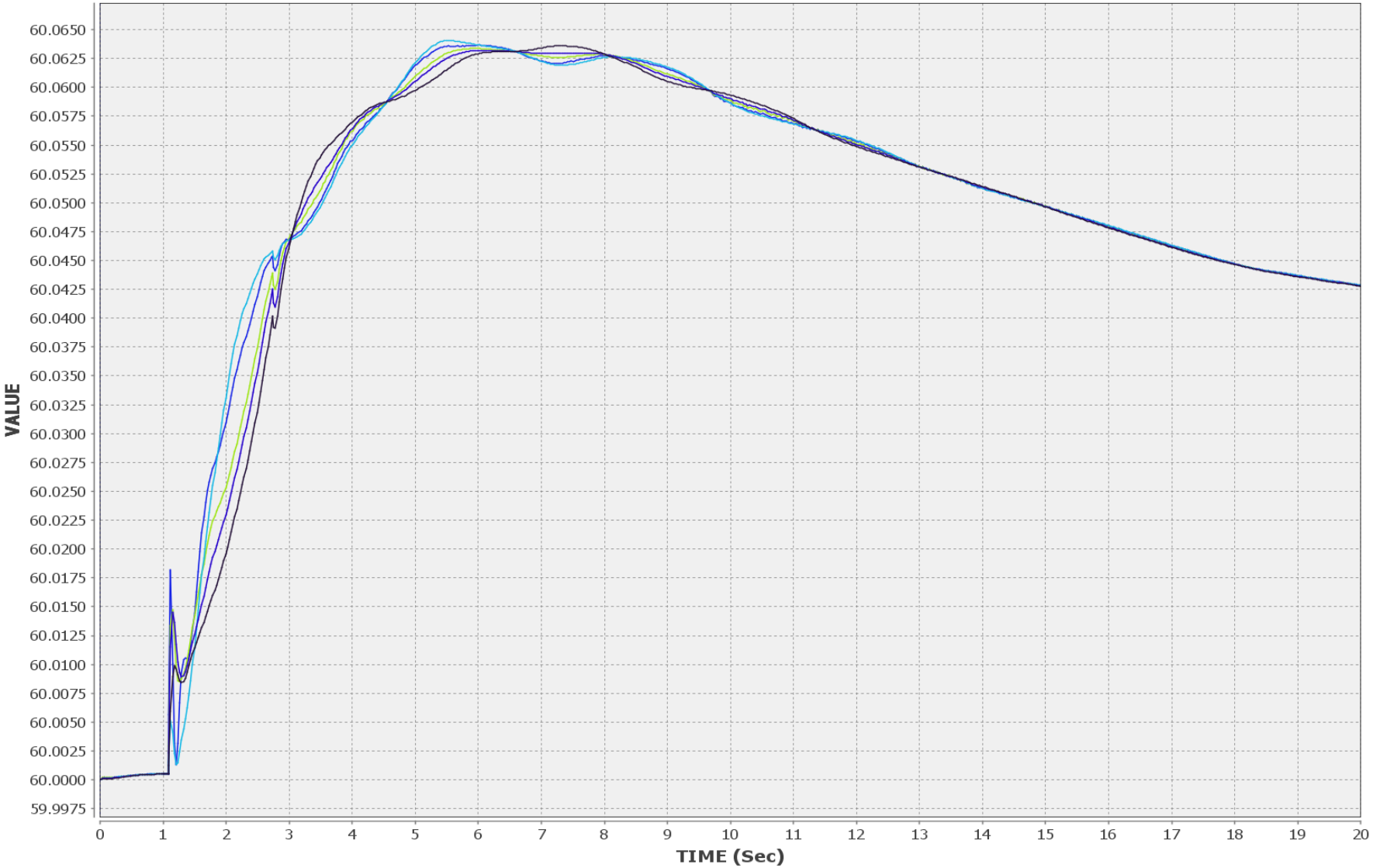
Simulation Results – Frequency (APS, SCE, PG&E, BPA 500 kV Buses)



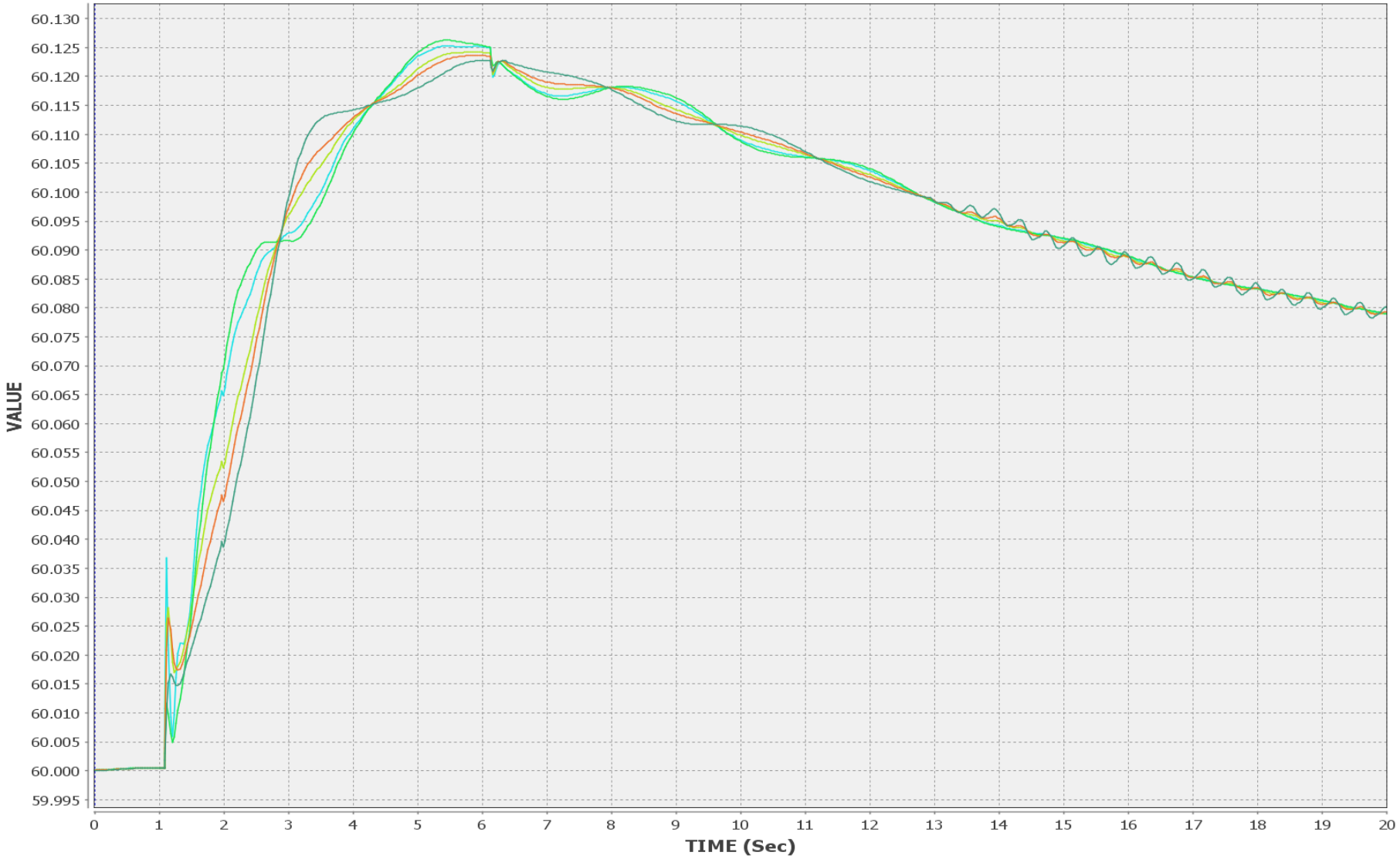
Simulation Results – Frequency (SDG&E 500 kV Buses)



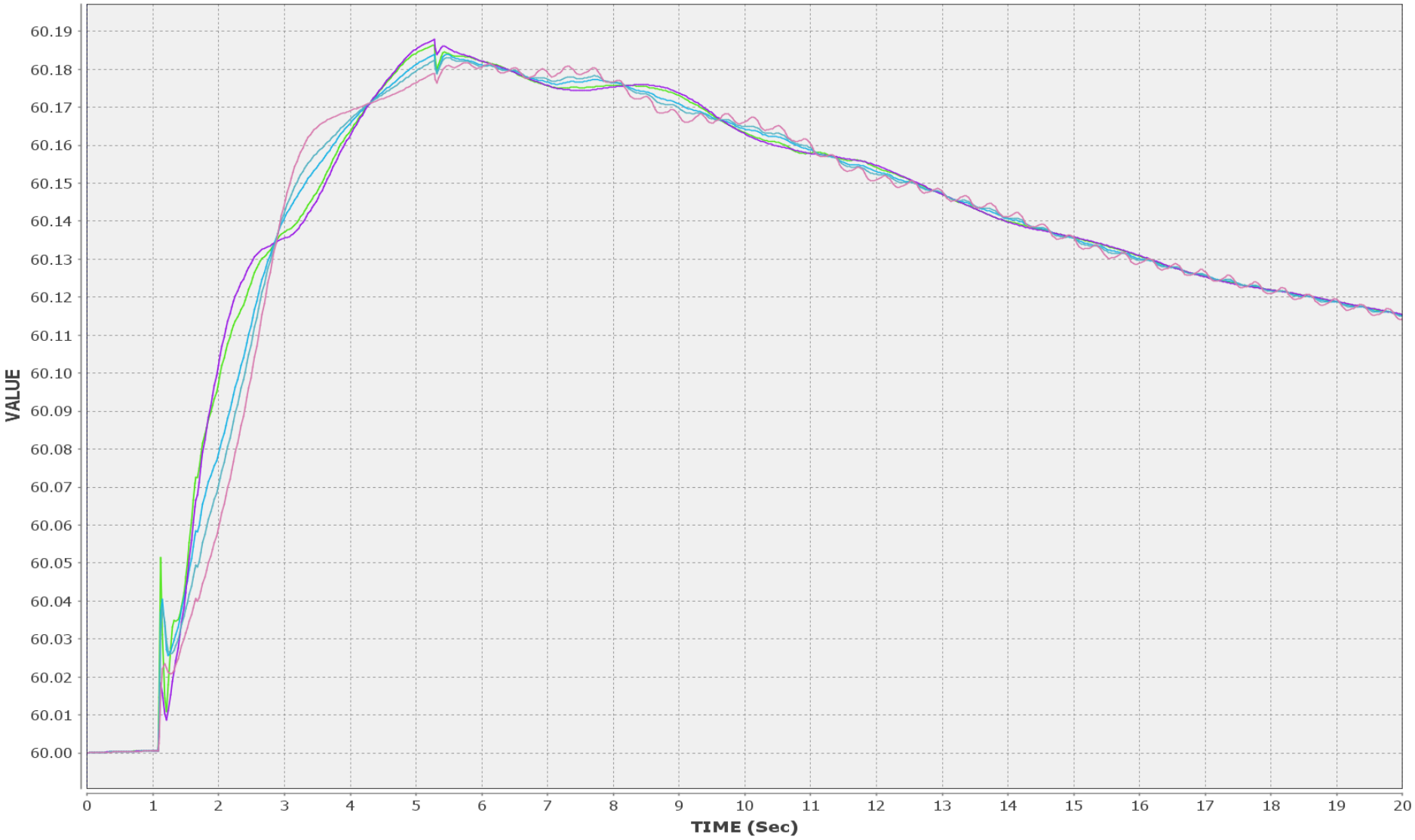
1,000 MW LL Loss (~72 MW tripped by lhfrt)



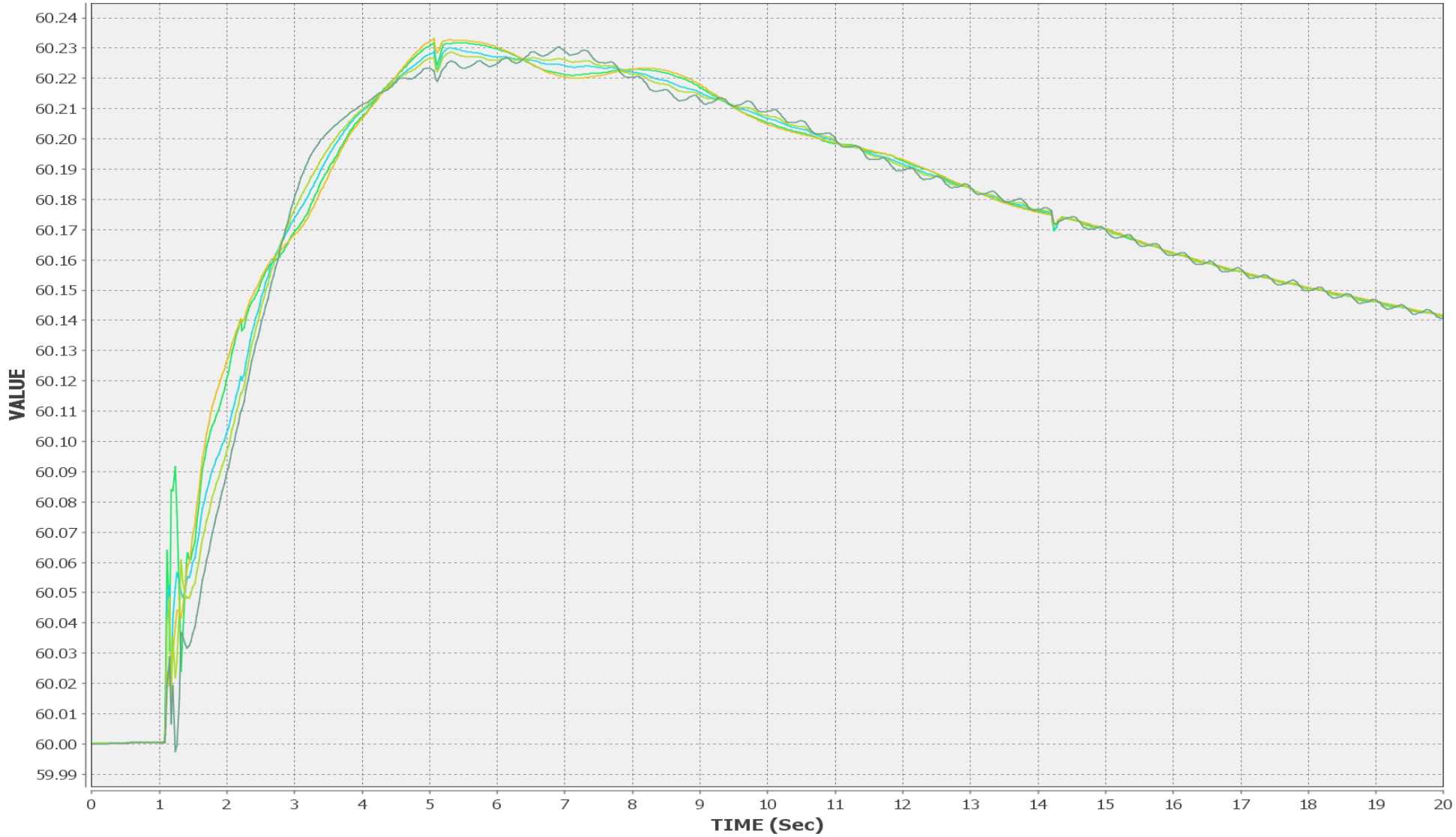
2,000 MW LL Loss (~147 MW tripped by lhfrt/lhvrt)



3,000 MW LL Loss (~160 MW tripped by lhfrt/lhvrt)



4,000 MW LL Loss (~309 MW tripped by lhfrt/lhvrt)



5,000 MW LL Loss (~413 MW tripped by lhfrt/lhvrt)