

# Available Transfer Capability Risk Mitigation Measures Overview Information Session

July 28, 2020

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**Welcome**

- Purpose
  - Provide an update regarding the reasons for the BC/MT interties trip, system performance during the event, and the mitigations implemented in order to reduce the risk of impacting customers in Alberta from such system events in the future
  - Provide a forum to address stakeholder questions

# Registration (as of July 24, 2020)

- ADC
- Alberta Newsprint Company (ANC)
- Alberta Utilities Commission (AUC)
- AltaLink Management Ltd.
- Annapolis Power Systems Corp
- ASU
- ATCO Electric Ltd.
- Balancing Pool
- BC Hydro
- Best Consulting Solutions Inc.
- BETM
- BHE Canada / MATL
- Boost Energy Ventures
- Capital Power
- City of Lethbridge
- City of Medicine Hat
- City of Medicine Hat Power Plant
- City of Red Deer
- CNOOC Petroleum NA
- CNRL
- Customized Energy Solutions
- DePal Consulting Limited
- Direct Energy
- Dow Chemical Canada ULC
- EAI
- EDC Associates
- Edison Energy
- Enel X
- ENMAX Power Corporation
- EPCOR Distribution and Transmission
- EQUUS
- FortisAlberta Inc.
- FortisBC
- GBE Fund
- Hatch Upside
- Heartland Generation Ltd.
- Hut 8 Mining
- Imperial Oil
- IPCAA
- Lionstooth Energy Inc.
- MATL LLP
- Maxim Power
- Mercer Peace River Pulp Ltd.
- Members of the public
- Millar Western Forest Products Ltd
- Morgan Stanley
- MPR Ltd.
- MSA
- NaturEner USA, LLC
- NorthPoint Energy
- NWR
- Pathfinder Consulting Services 2001 Ltd
- Powerex Corp.
- PSI Power System Innovation
- Reactive Technologies Limited
- Renoir Consulting Inc.
- SaskPower
- Smart Wires
- Suncor Energy Inc.
- TC Energy
- TD Securities
- TERIC Power
- Tidal Energy Marketing
- TransAlta Corporation
- Velocity American Energy LP
- Way Consulting Ltd
- Wolf Midstream
- Woods PLC

The background of the slide is a blue-tinted photograph of two hands shaking in a firm grip. The hands are positioned in the center-left of the frame. The background also features a faint, white, geometric network pattern of lines and dots, and a blurred cityscape at the bottom.

*OUR ENGAGEMENT PRINCIPLES*

**Inclusive and Accessible**

**Strategic and Coordinated**

**Transparent and Timely**

**Customized and Meaningful**

The participation of everyone here is critical to the engagement process. To ensure everyone has the opportunity to participate, we ask you to:

- Listen to understand others' perspectives
- Disagree respectfully
- Balance airtime fairly
- Keep an open mind

- All attendees will join the webinar in listen-only mode and the host will have attendee cameras disabled and microphones muted
- When asking or typing in a question, **please state the organization you work for and your first and last name**
- Two ways to ask questions during the Q&A portion if you are accessing the webinar using your computer or smartphone
  - If you would like to ask a question during the Q&A portion, click the icon to raise your hand and the host will see that you have raised your hand. The host will unmute your microphone, you in turn will need to unmute your microphone and then you can ask your question. Your name will appear on the screen but your camera will remain turned off.
  - You can also ask questions by typing them into the Q&A window. Click the “Q&A” button next to “Raise Hand.” You’re able to up-vote questions that have been already asked.



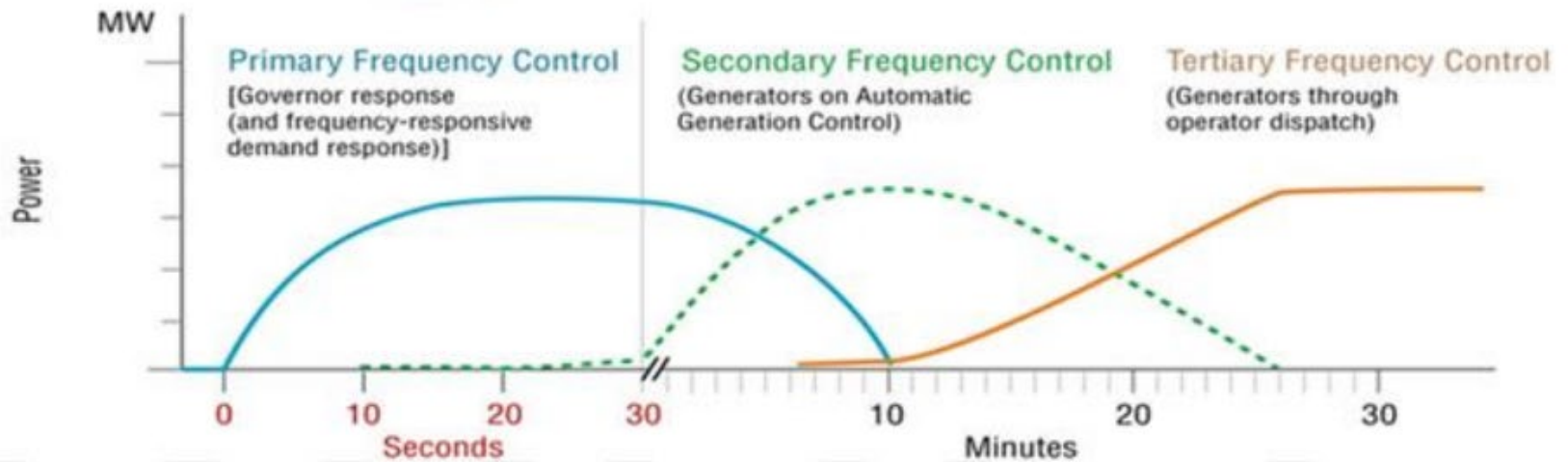
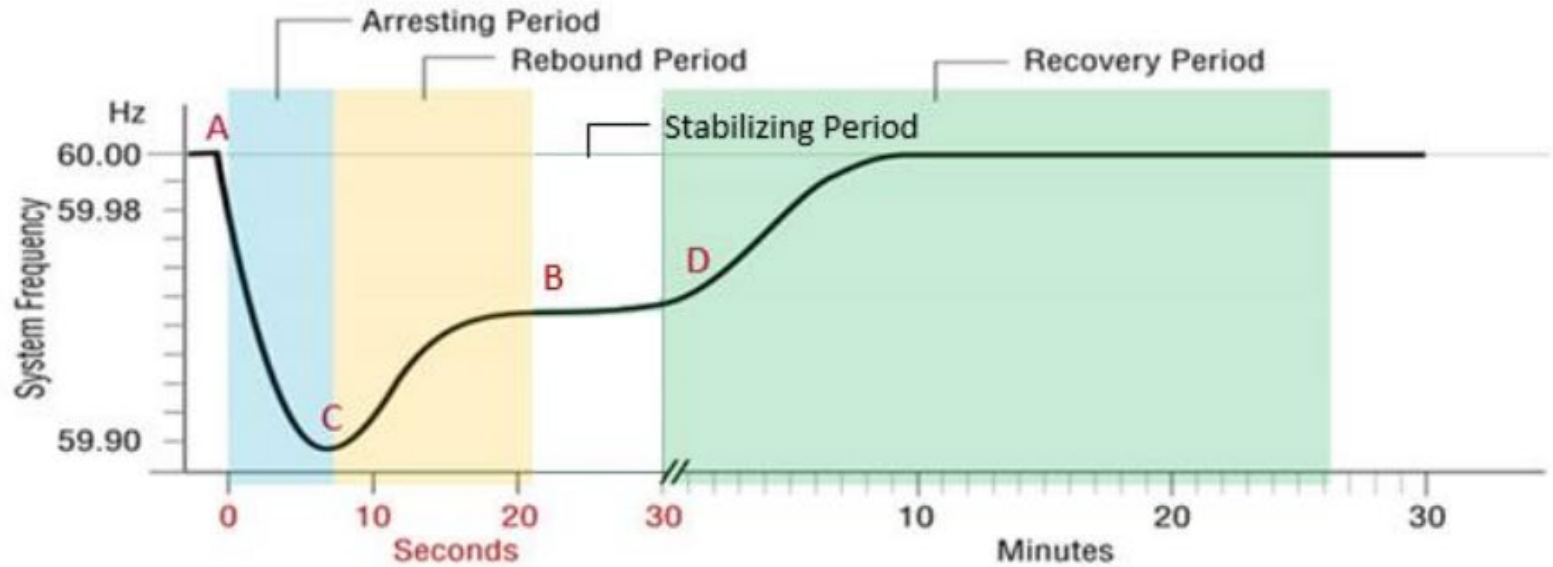
- Using a 2-in-1/PC/MAC Computer
  - Hover your cursor over the bottom area of the Zoom app and the Controls will appear.
  - Click “Raise Hand” and the host will be notified that you would like to ask a question.
  - Click “Lower Hand” to lower it if needed.
  - You can also ask questions by tapping the “Q&A” button and typing them in. You’re able to up-vote questions that have been already asked.
- Using Smartphone
  - Tap “Raise Hand.” The host will be notified that you’ve raised your hand.
  - Tap “Lower Hand” to lower it if needed.
  - You can also ask questions by tapping the “Q&A” button and typing them in. You’re able to up-vote questions that have been already asked.

- If you are accessing the webinar via conference call
  - If you would like to ask a question during the Q&A portion, on your phone's dial pad, hit \*9 and the host will see that you have raised your hand. The host will unmute your microphone, you in turn will need to unmute your microphone by hitting \*6 and then you can ask your question. Your number will appear on the screen.
- Phone controls for attendees
  - To raise your hand, on your phone's dial pad, hit \*9. The host will be notified that you've raised your hand.
  - To toggle between mute and unmute, on your phone's dial pad, hit \*6.

# Introductions

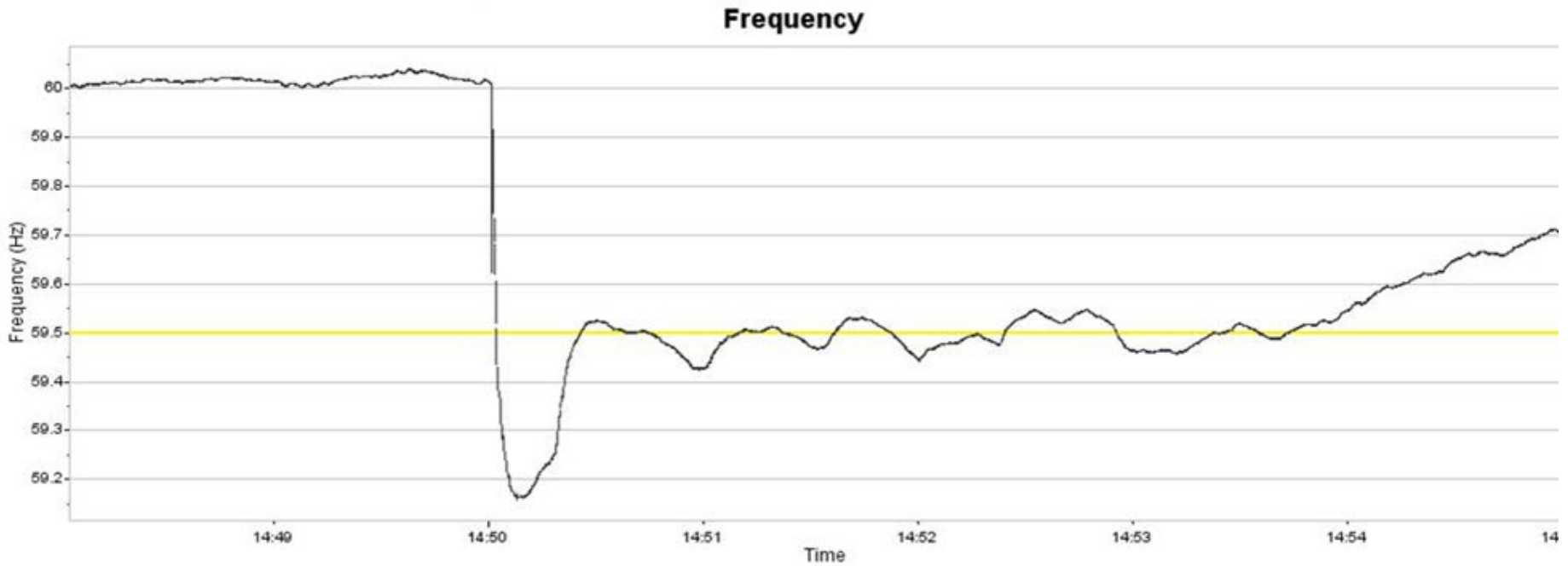
- Frequency response characteristics
- June 7, 2020 event overview
- Reasons for system under-performance on June 7<sup>th</sup>
- Historical system performance and trends
- June 7<sup>th</sup> system performance
  - Under Frequency Load Shed (UFLS)
  - Load Shed Service for imports (LSSi)
  - Generator frequency response
- Mitigation measures and next steps

# Frequency response characteristics



- Prior to the event – lightning strike on BC side of 1201L @ 2:50pm)
  - Scheduled import: 909MW
  - Alberta Internal Load (AIL): 8764MW
  - Actual flow on the intertie: 923 MW
  - Wind generation output: 930 MW
  - LSSi Armed: 181 MW
- Post event
  - Frequency dropped to 59.15 Hz (nadir “C” point)
  - UFLS: ~ 400 MW
    - **D1** (59.3 Hz, 15 seconds), **D2** (59.5 Hz, 30 seconds) and **D3** (59.5 Hz, 60 seconds) UFLS blocks tripped
    - Includes LSSi ~ 188 MW

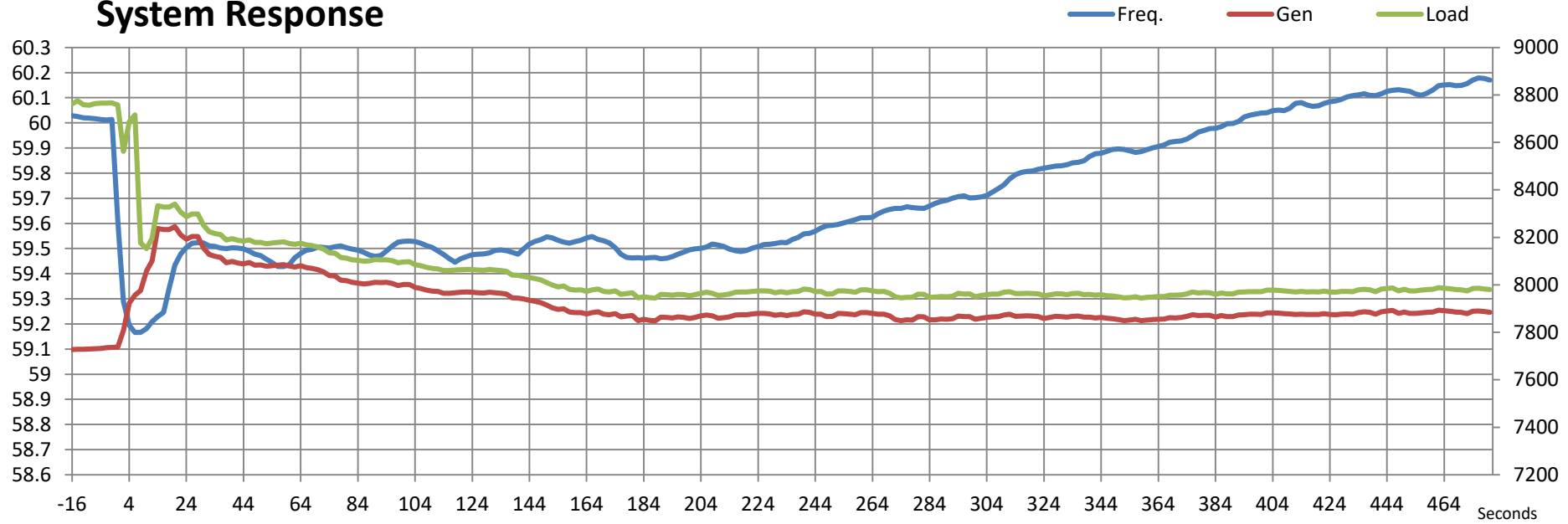
# Frequency dip – 59.15 Hz



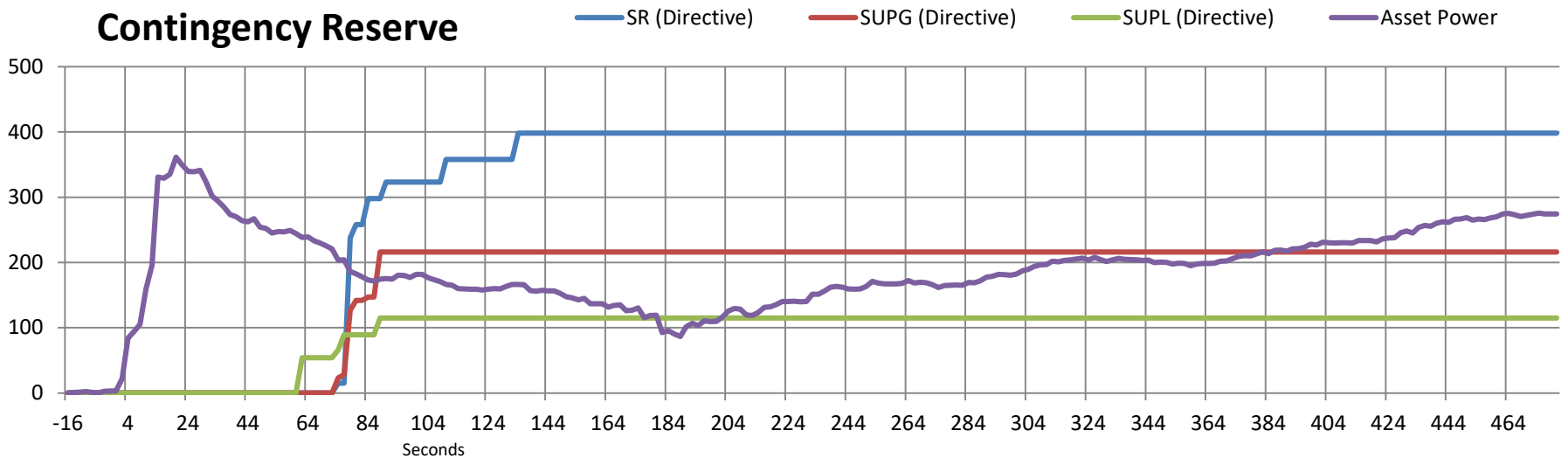
# System response



## System Response

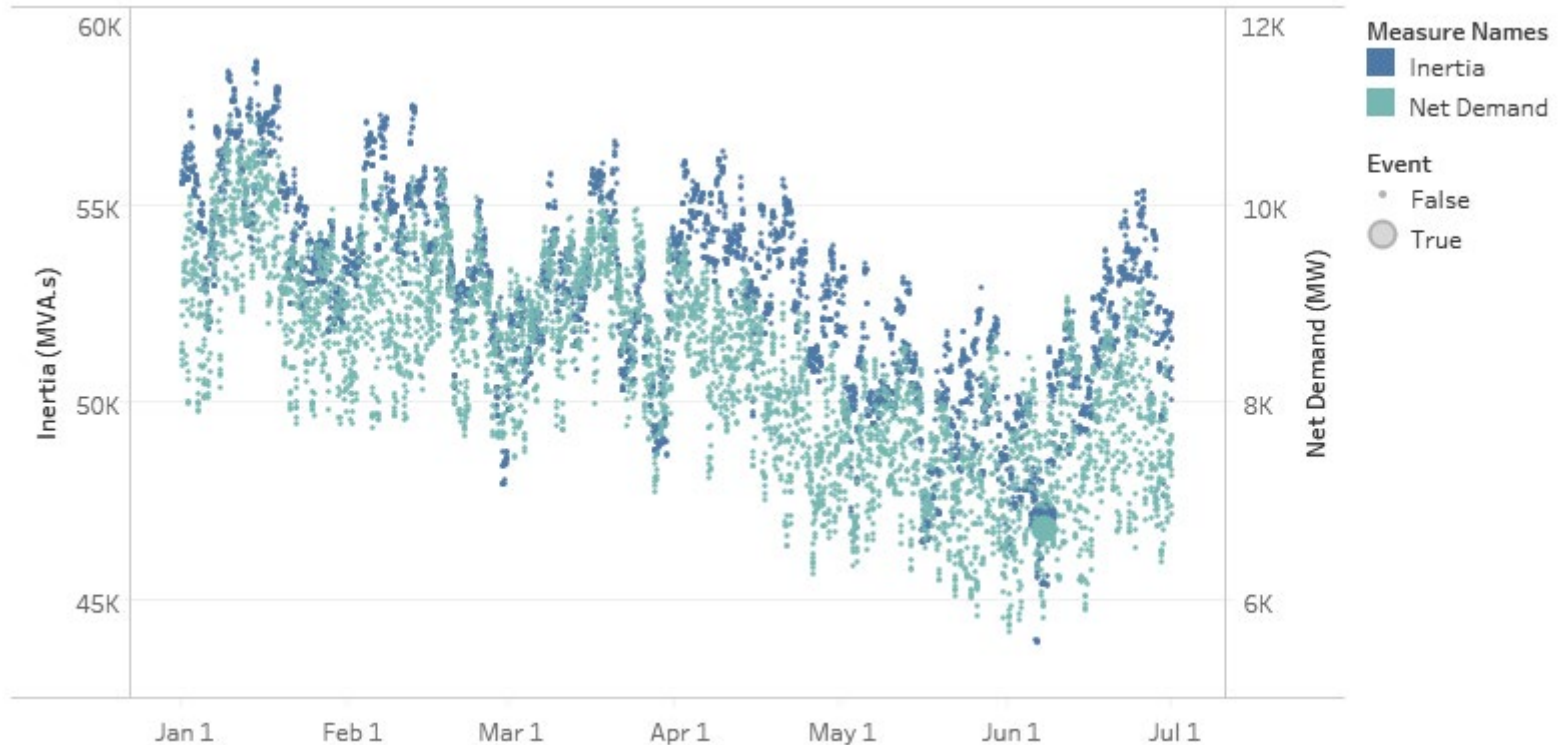


## Contingency Reserve





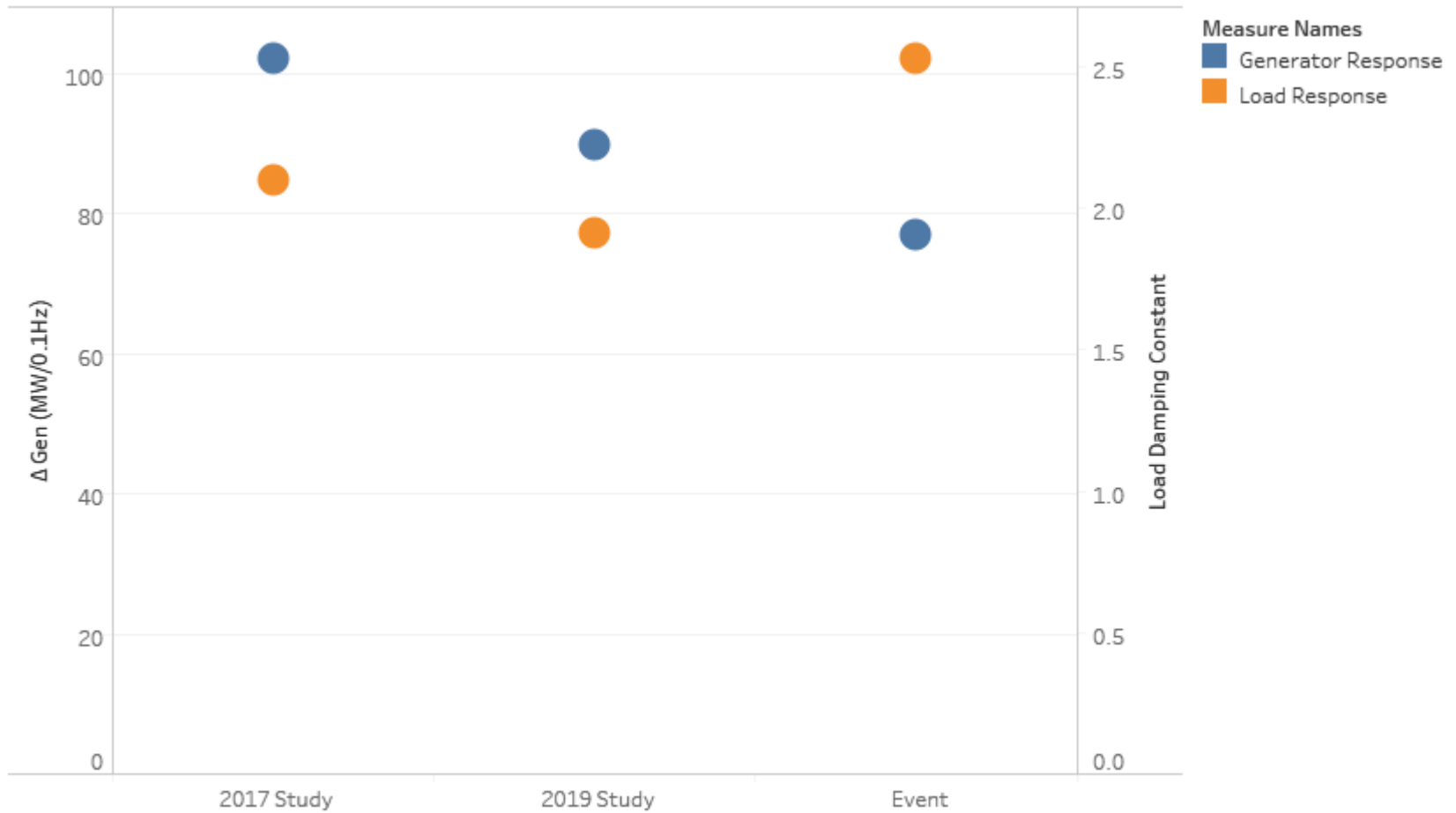
# System inertia



- The inertia at the time of the event was 47.1 GVA.s
- The inertia impacts Rate of Change of Frequency (RoCoF) and frequency nadir

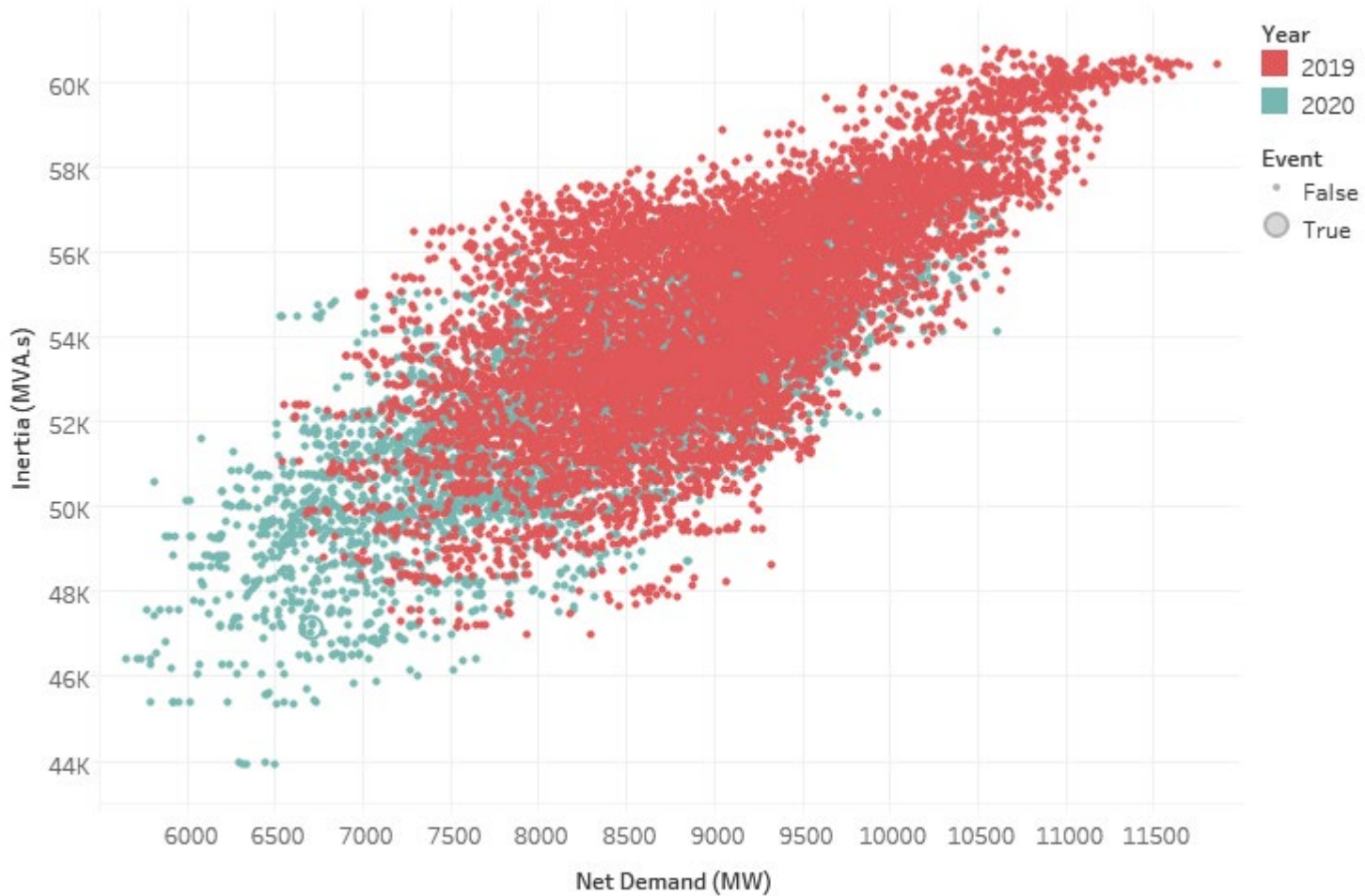
- Low inertia
  - Caused by high renewables and high intertie flow
  - Studied range was between 50 and 60 GVA.s
  - Actual pre-contingency inertia was 47.1 GVA.s
- Generator governor response
  - Change in generator response per 0.1 Hz change in frequency
  - Studied was between 88 MW/0.1 Hz to 102 MW/0.1Hz
  - Observed was around 77 MW/0.1Hz which dropped to 40 MW/0.1Hz

# Studied response comparison with event

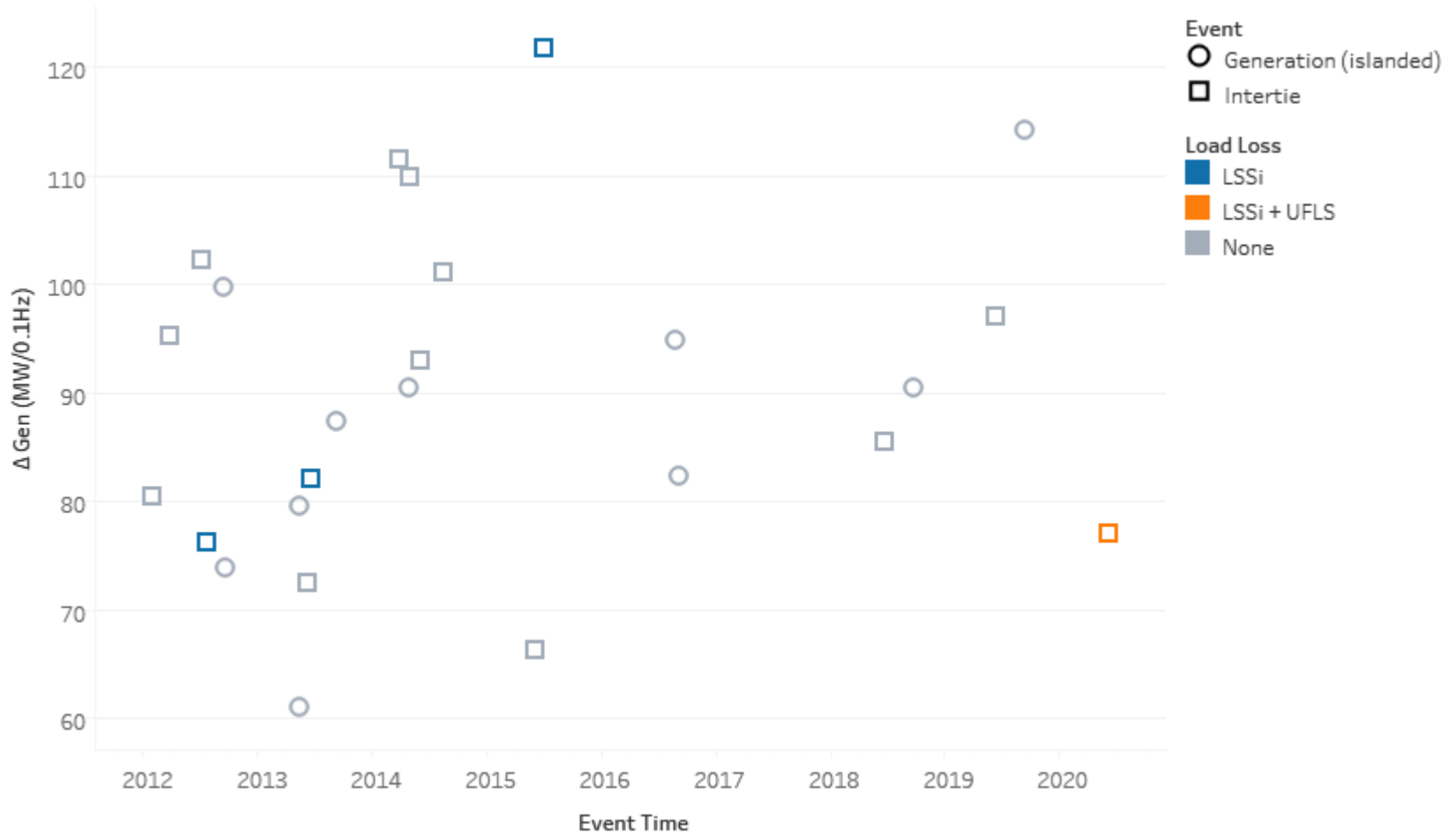


# Historical Trends and Performance

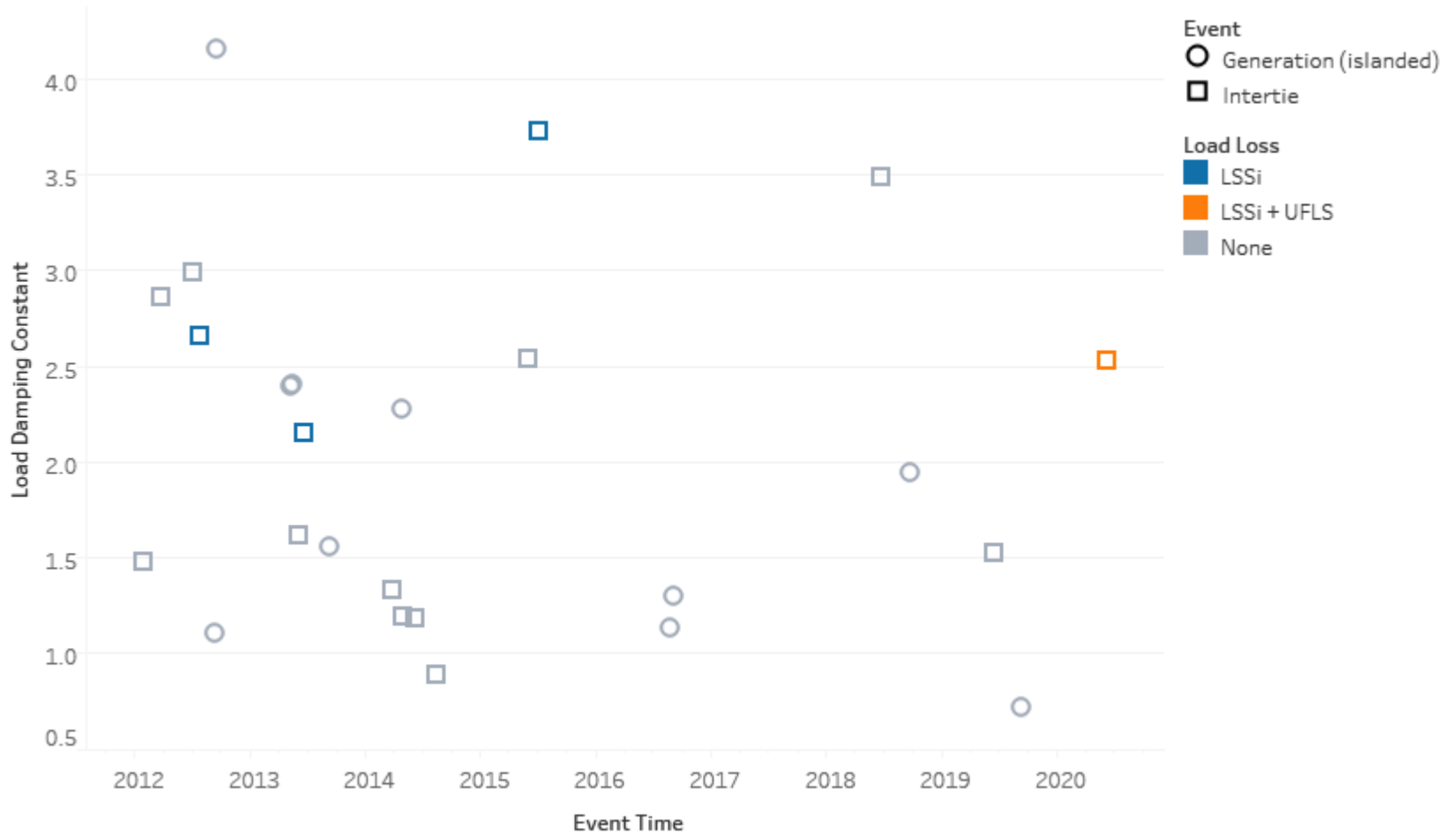
# System inertia trend



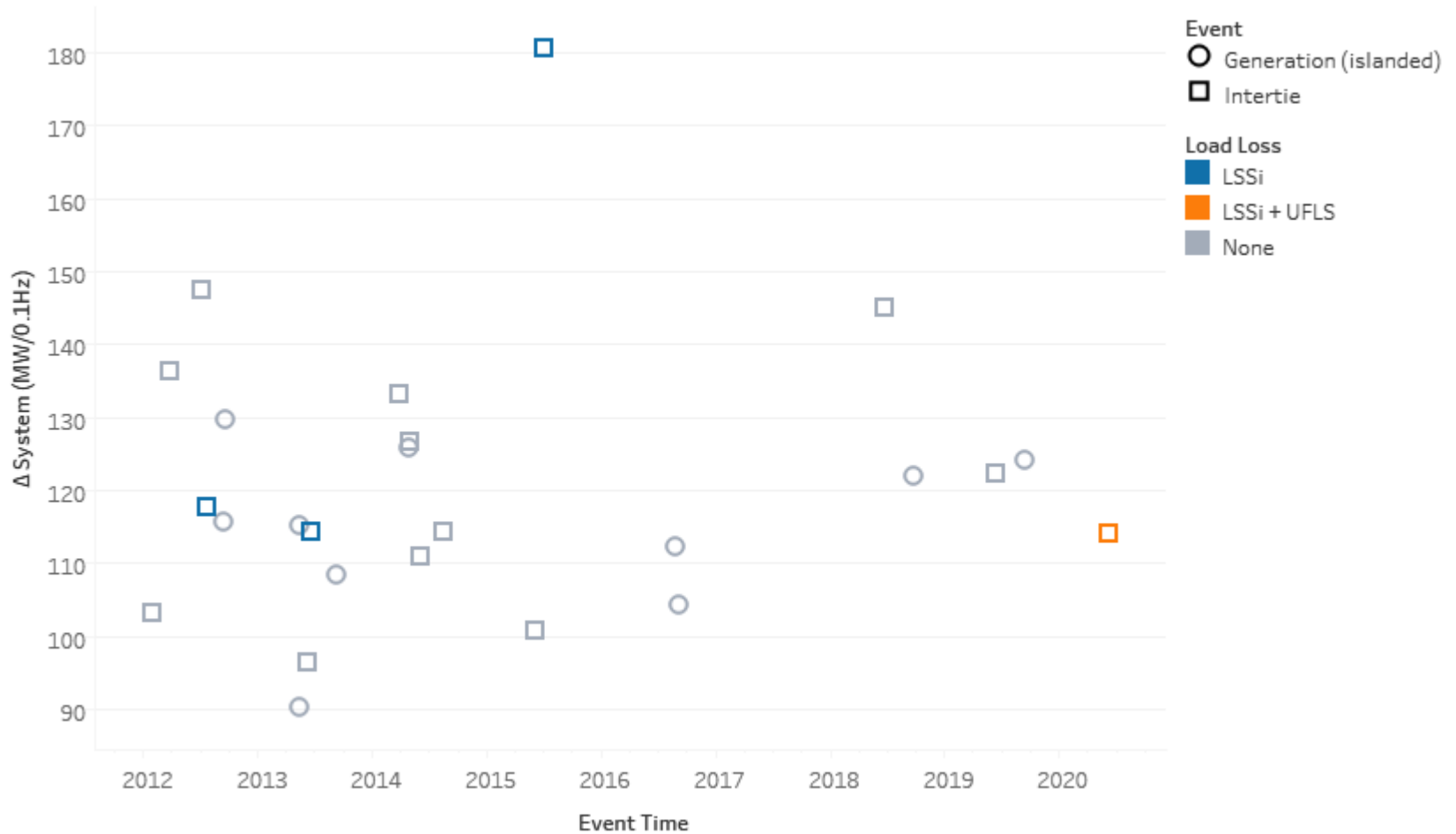
# Generation response



# Load response

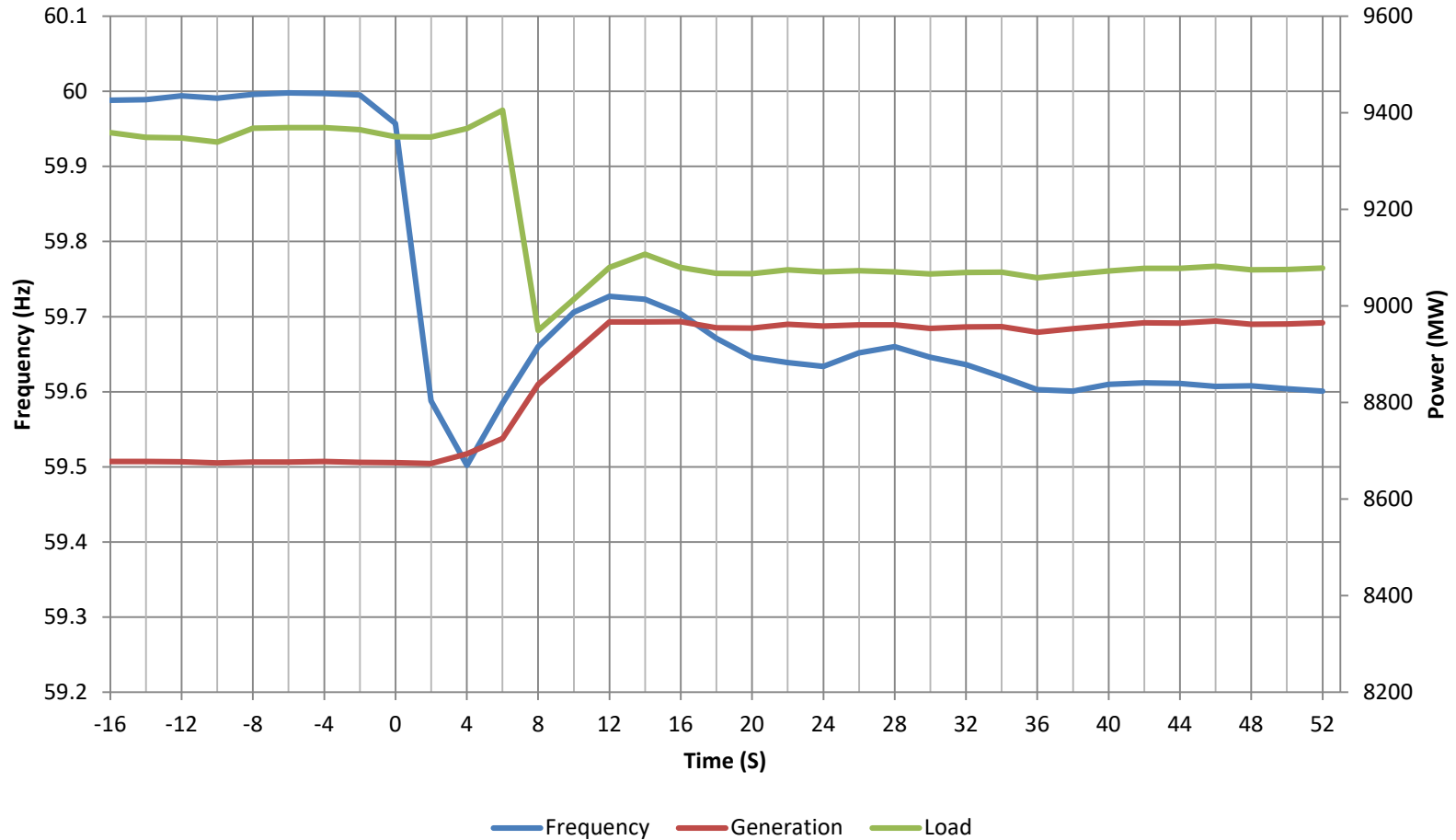


# Generation + Load response

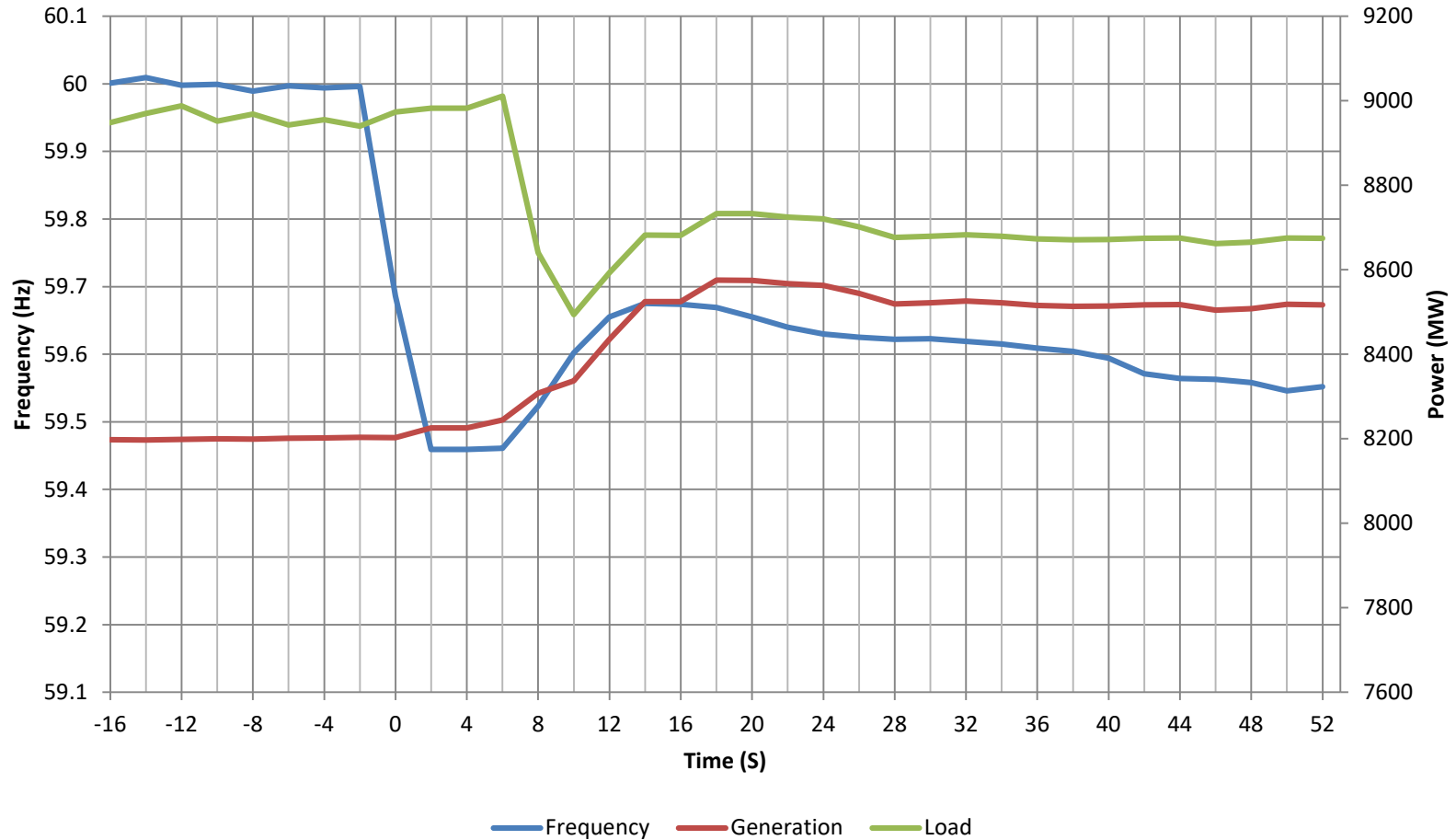




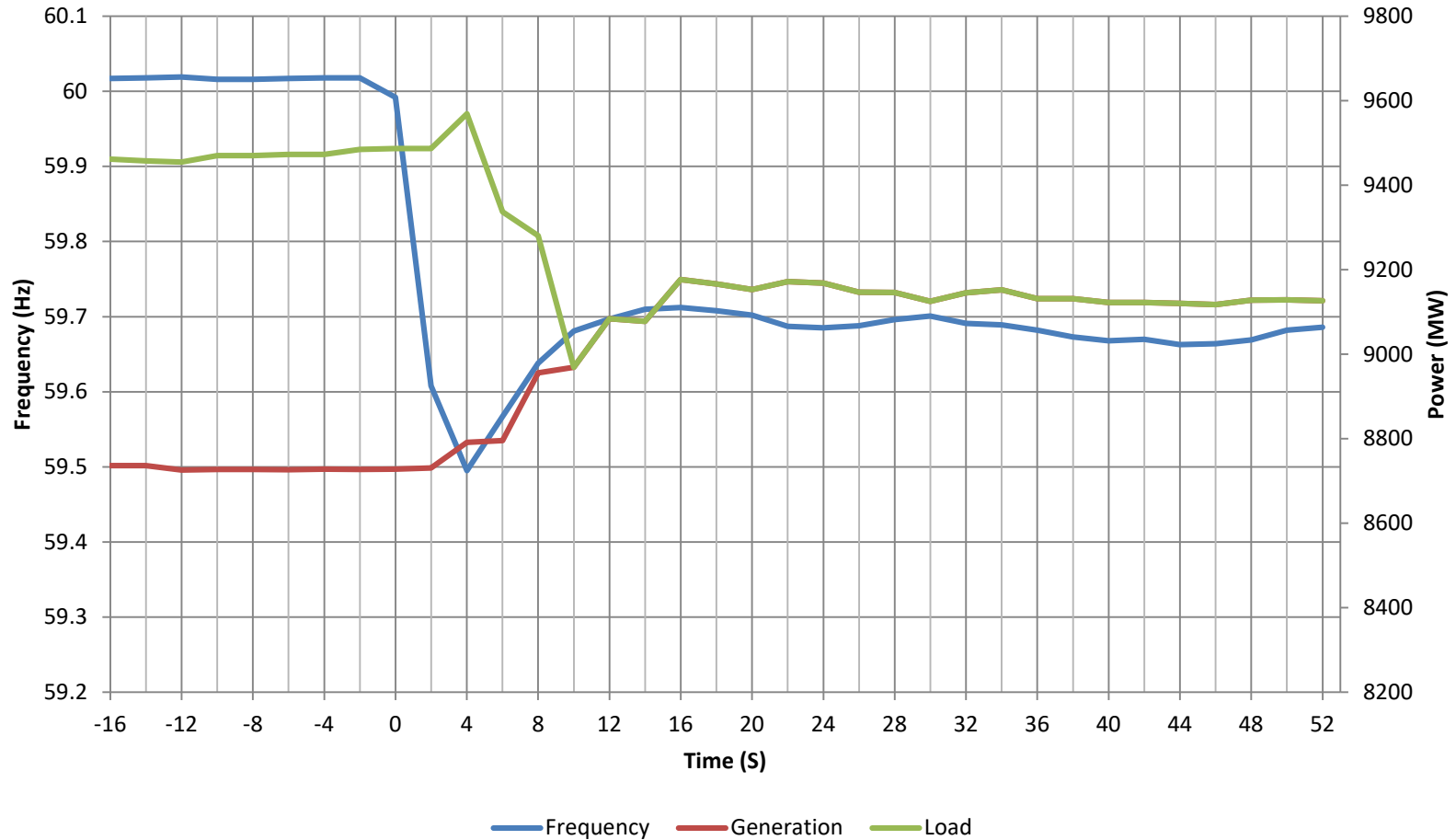
# 2012-07-20: Loss of 569 MW (import) with ~133 MW of LSSi



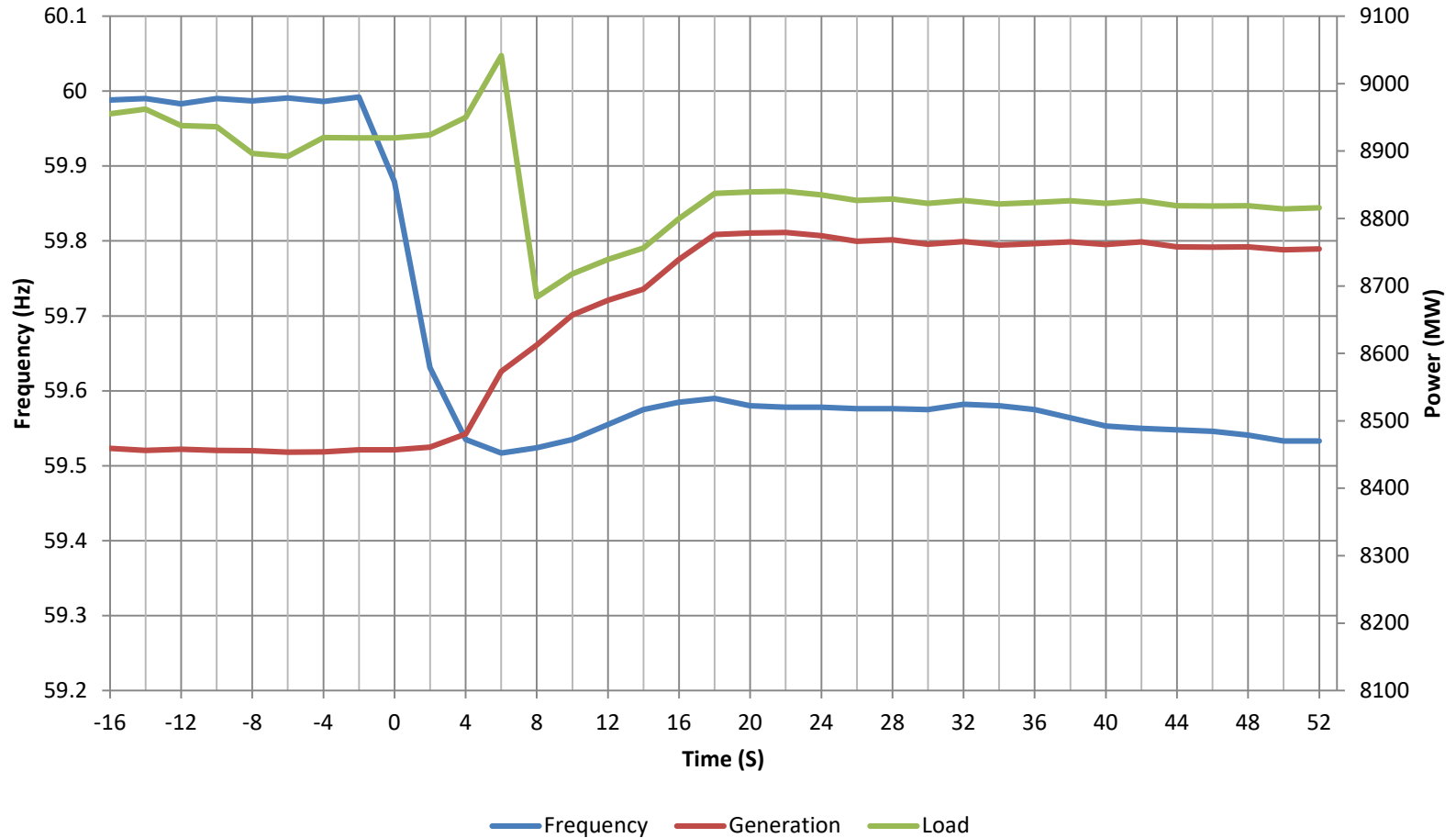
# 2013-06-18: Loss of 601 MW (import) with ~145 MW of LSSi



# 2015-06-29: Loss of 739 MW (import) with ~133 MW of LSSi



# 2013-06-03: Loss of 410 MW (import)



# Performance – Under Frequency Load Shed (UFLS)

# UFLS Operation summary

AIES Islanding & UFLS June 7, 2020 event -UFLS Feeders Performance Analysis Summary

TFO/DFO	D1 Block (59.3 Hz, Td=15 sec)				D2 Block (59.5 Hz, Td=30 sec)				D3 Block (59.5 Hz, Td=60 sec)				Total UFLS Summary (D1+D2)			
	UFLS Operative Feeders	UFLS Operative MW	UFLS NON-Operative Feeders	UFLS NON-Operative MW	UFLS Operative Feeders	UFLS Operative MW	UFLS NON-Operative Feeders	UFLS NON-Operative MW	UFLS Operative Feeders	UFLS Operative MW	UFLS NON-Operative Feeders	UFLS NON-Operative MW	UFLS Total Operative Feeders	UFLS Total Operative MW	UFLS total NON-Operative Feeders	UFLS total NON-Operative MW
TFO/DFO-A	15	42.46	4	8.728	3	12.396	11	27.98	2	7.676	15	75.238	18	54.856	15	36.71
TFO/DFO-B	9	28.22	0	0	7	22.64	3	7.48	0	0	0	0	16	50.86	3	7.48
TFO/DFO-C	8	21.1	0	0	6	22.4	0	0	4	7.7	0	0	14	43.5	0	0.00
TFO/DFO-D	6	20.42	0	0	6	9.3	0	0	2	13.66	1	3	12	29.72	0	0.00
TFO/DFO-E	2	8.5	0	0	1	4.3	0	0	0	0	0	0	3	12.8	0	0.00
TFO/DFO-F	1	1.8	0	0	0	0	1	3.7	0	0	0	0	1	1.8	1	3.70
TFO/DFO-G	3	8.762	0	0	3	3.81	0	0	0	0	0	0	6	12.572	0	0.00
<b>Grand Total</b>	<b>44</b>	<b>131.262</b>	<b>4</b>	<b>8.728</b>	<b>26</b>	<b>74.846</b>	<b>15</b>	<b>39.16</b>	<b>8</b>	<b>29.036</b>	<b>16</b>	<b>78.238</b>	<b>70</b>	<b>206.108</b>	<b>19</b>	<b>47.888</b>

## Performance – Load Shed Service for imports (LSSi)

LSSi Providers	Armed LSSi MW	Actual Operated LSSi MW (within 200ms from sensing 59.5+/-0.02Hz)
Service Provider A	56.7	54.87
Service Provider B	54.0	54.42
Service Provider C	33.5	12.80*
Service Provider D	30.0	32.30
Service Provider E	6.9	7.45
<b>TOTAL</b>	<b>181.1</b>	<b>161.84</b>

Note : \* Service Provider C's actual load drop could not be recorded due to issue with recording device.



# Performance – Generator Frequency Response

- Per the below excerpt from section 502.5 of the ISO rules, *Generating Unit Technical Requirements*, all transmission connected generators (MARP > 10MW) are required to have a continuously acting governor in service and which is responsive to the system frequency excursions:

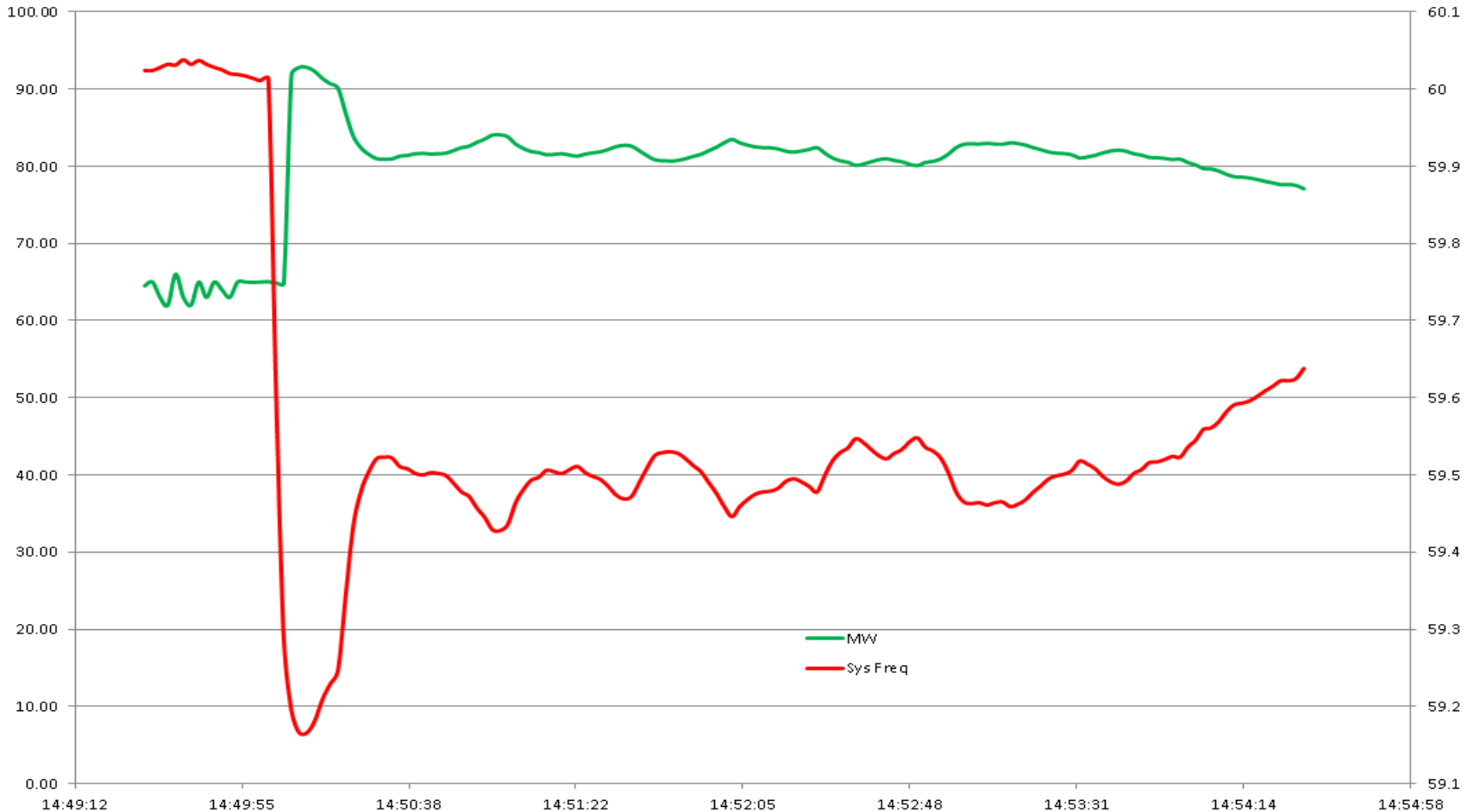
## Frequency and Speed Governing Requirements

- 9(1) A **generating unit** with a **maximum authorized real power** equal to or greater than 10 MW must have a continuously acting **governor system**, which must be designed:
  - (a) to be continuously in service, free to respond to frequency changes and controlling the response to frequency changes while the **generating unit** is electrically connected to the **transmission system** and is producing any **real power** as measured at the generator stator winding terminals;
  - (b) with a droop setting equal to or greater than 3% but less than or equal to 5%;
  - (c) with a deadband, intentional plus unintentional, not exceeding plus or minus 0.036 Hz; and
  - (d) with the capability of manual setpoint adjustments within a range of 59.4 Hz and 60.6 Hz.
- The generator droop setting must be between 3% and 5%

# Generator frequency response – Ideal

Ideal Unit : GT (MARP= 100 MW)

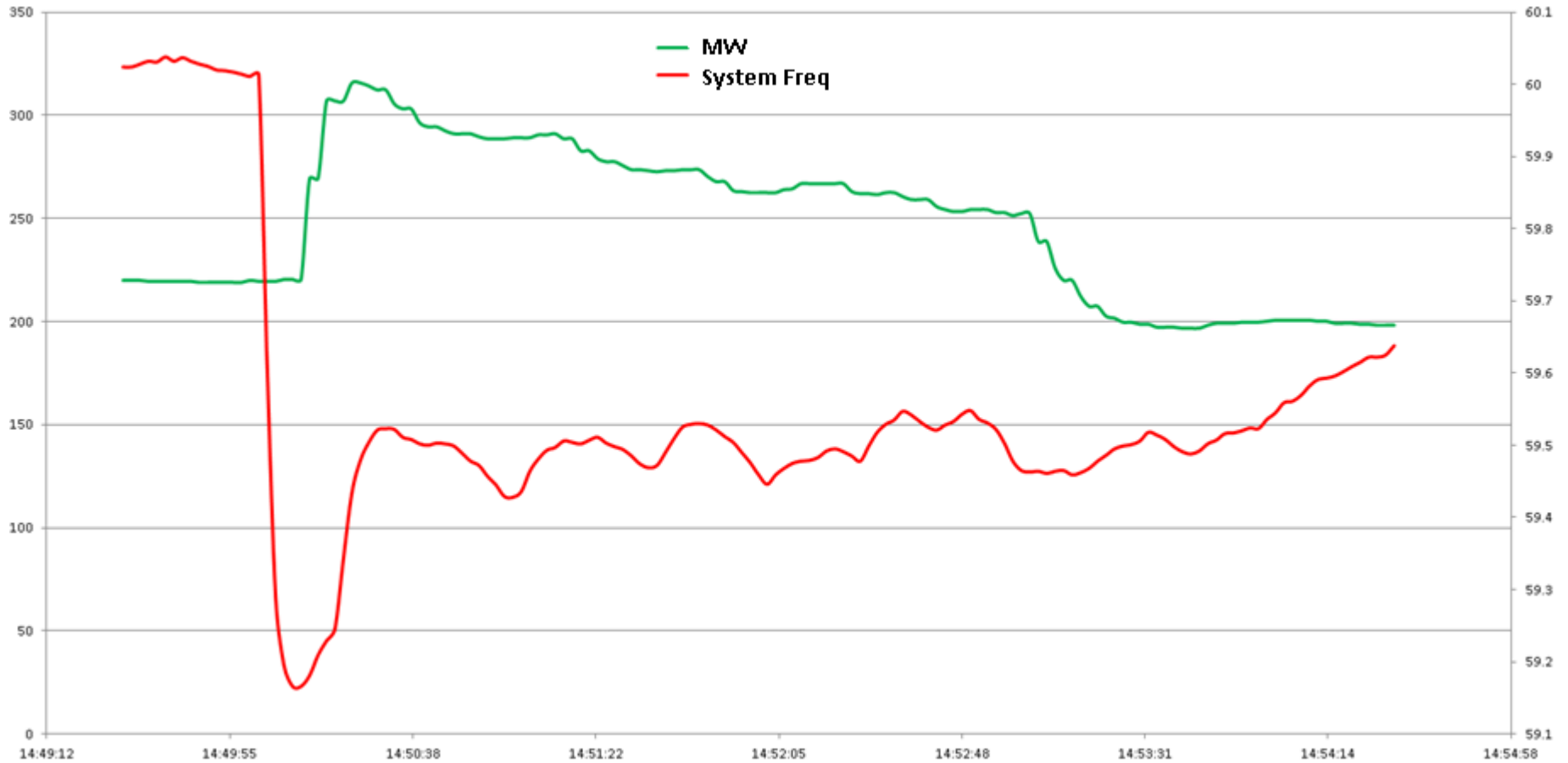
Expected ~ PFR MW/0.1HZ = 3.33 MW



- Most generators did not provide primary frequency response as required under ISO rules
  - Around 25 assets under performed
- Only a handful of generators provided an appropriate response
  - Less than 10 assets
- Renewable resources did not provide any primary frequency response
  - No headroom available

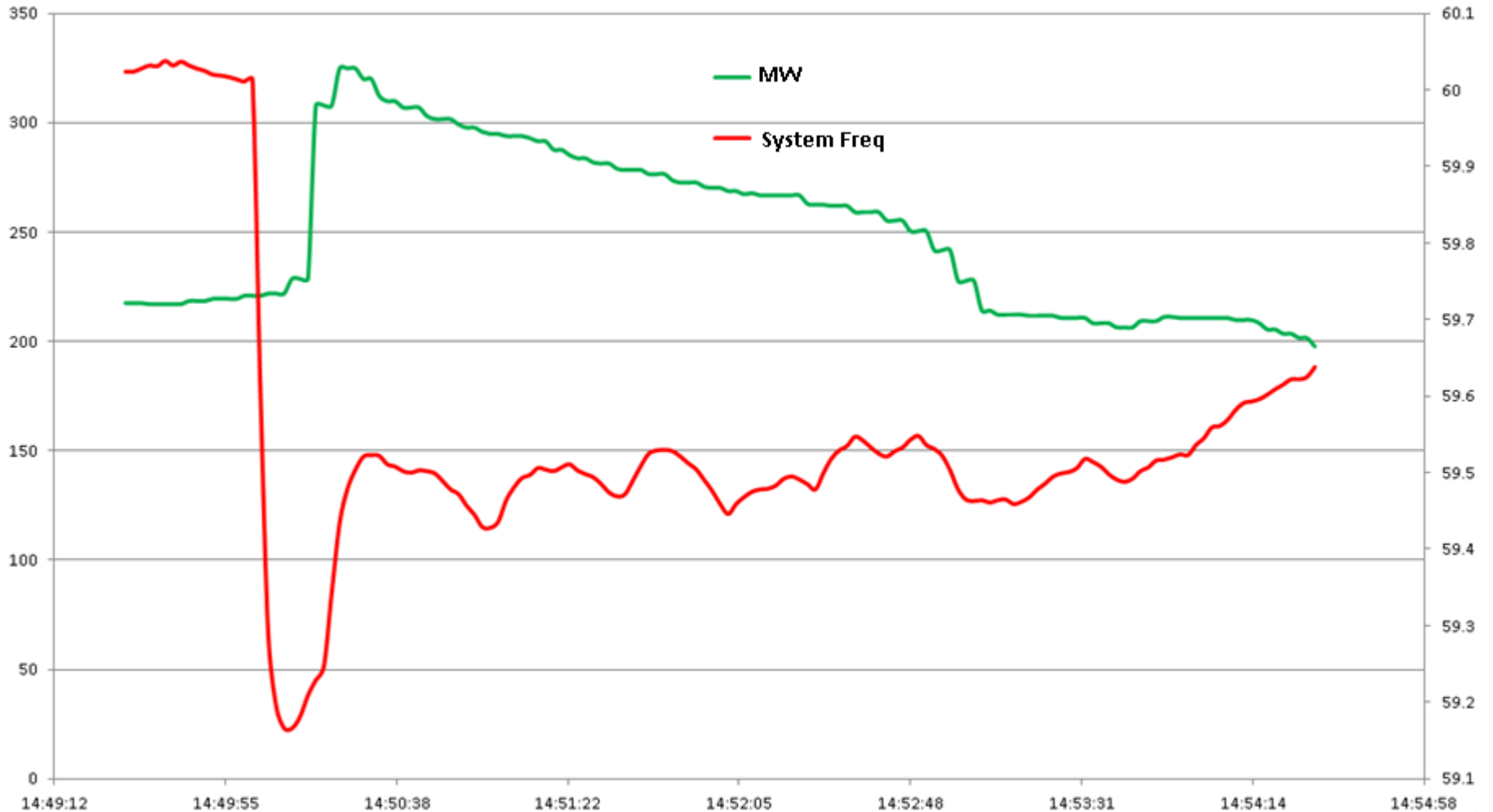
# Generator frequency response – Good

Generator A



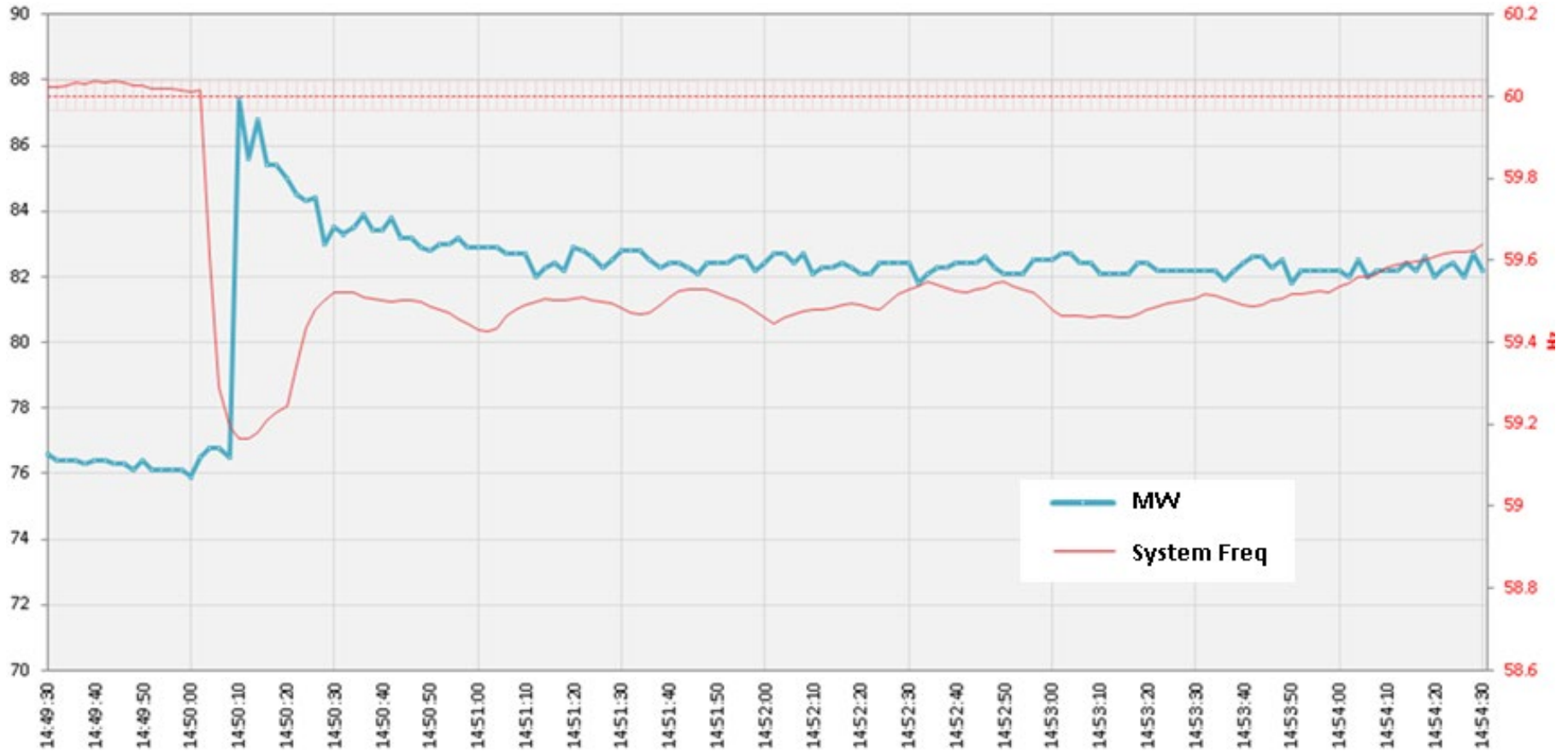
# Generator frequency response – Good

Generator B



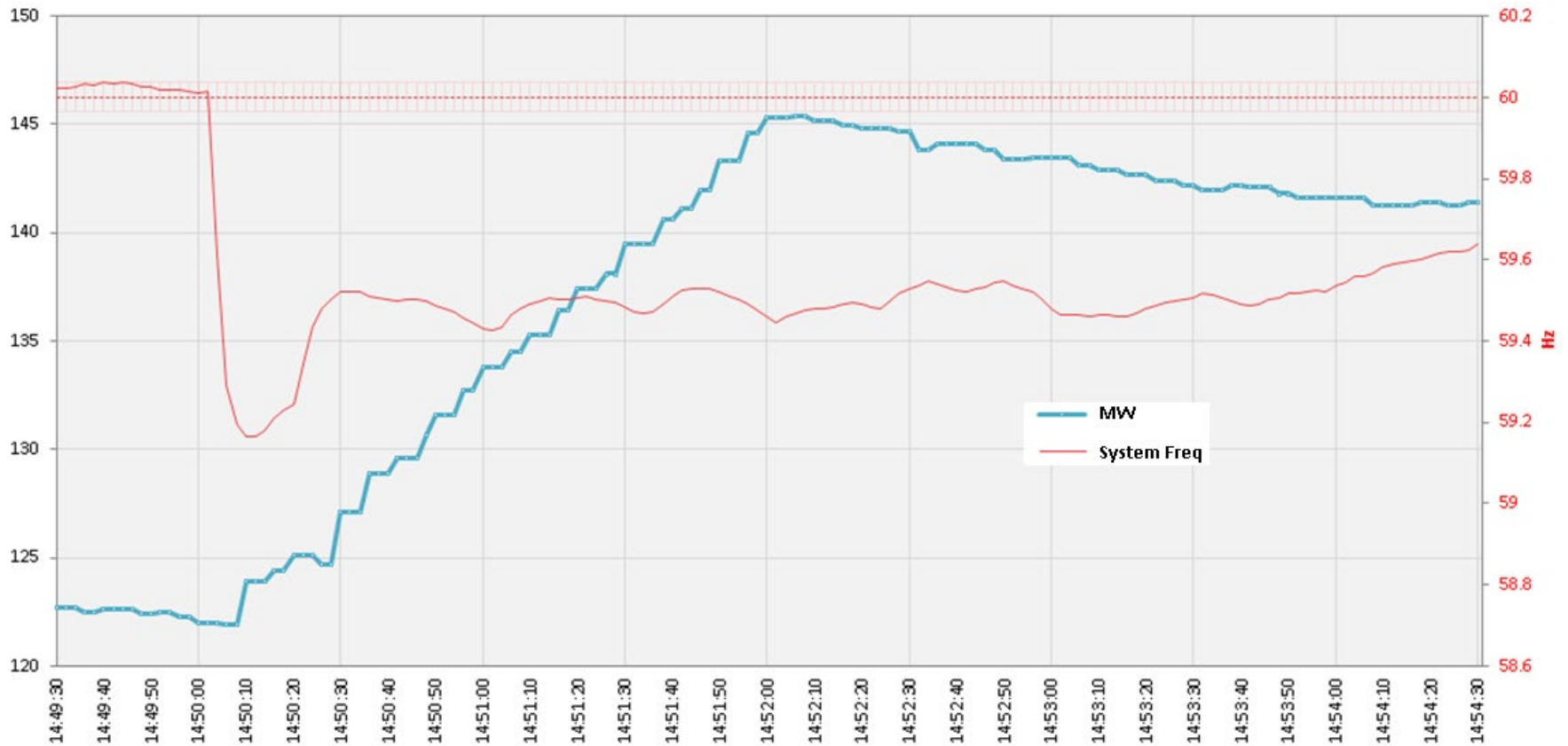
# Generator frequency response - Good

Generator C



# Generator frequency response – Concerning

## Generator D

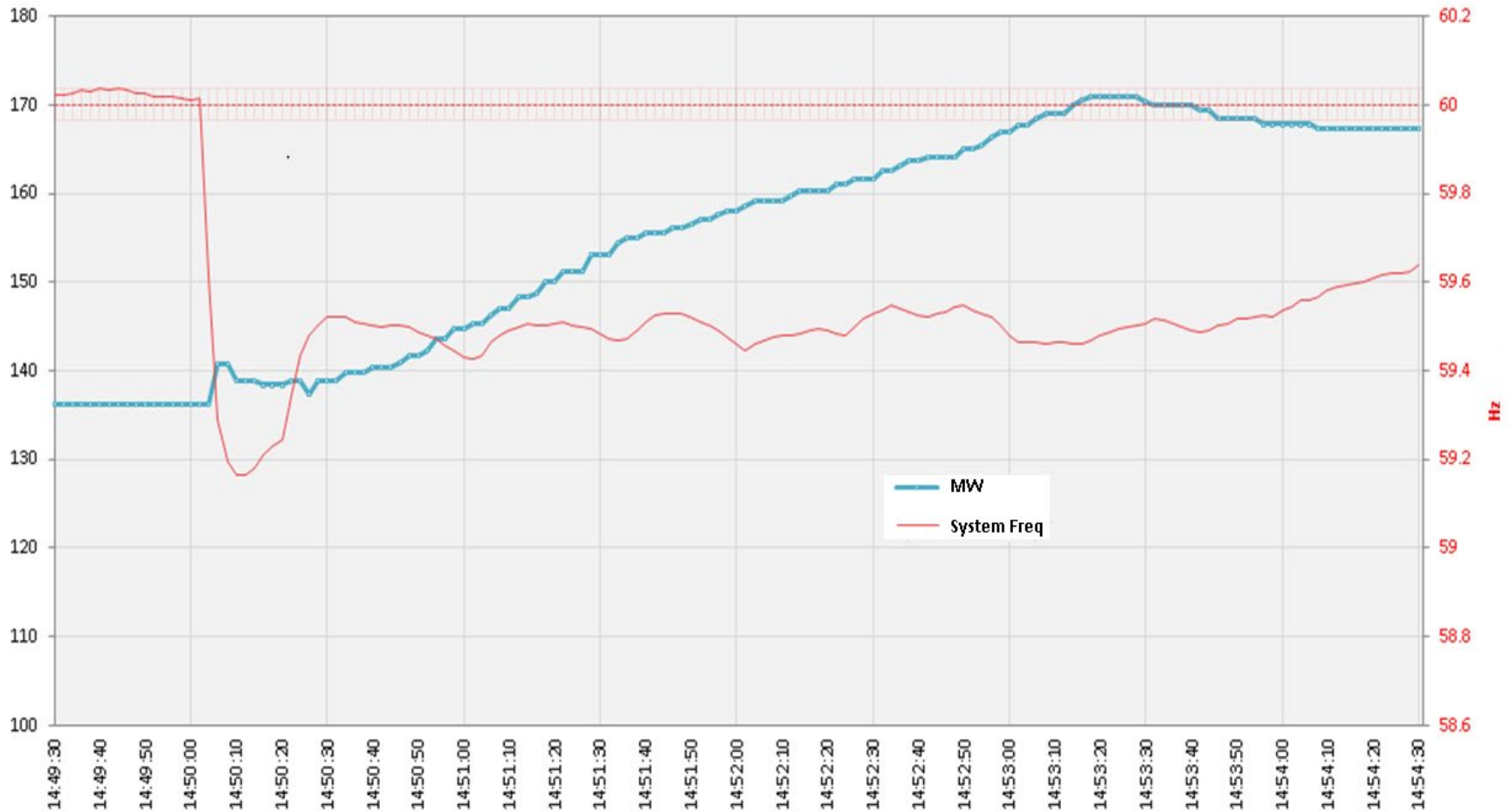




# Generator frequency response – Concerning

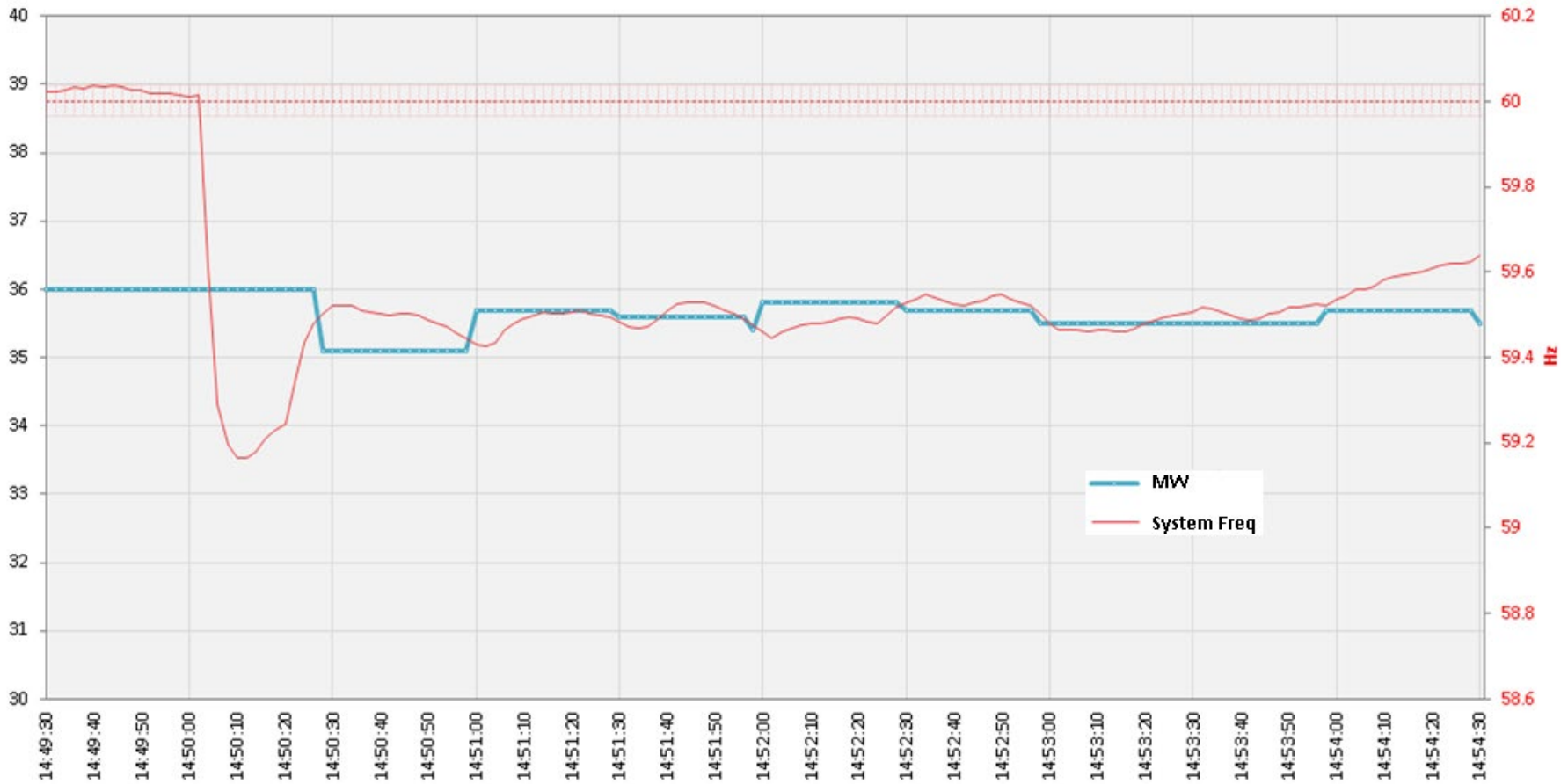


## Generator E



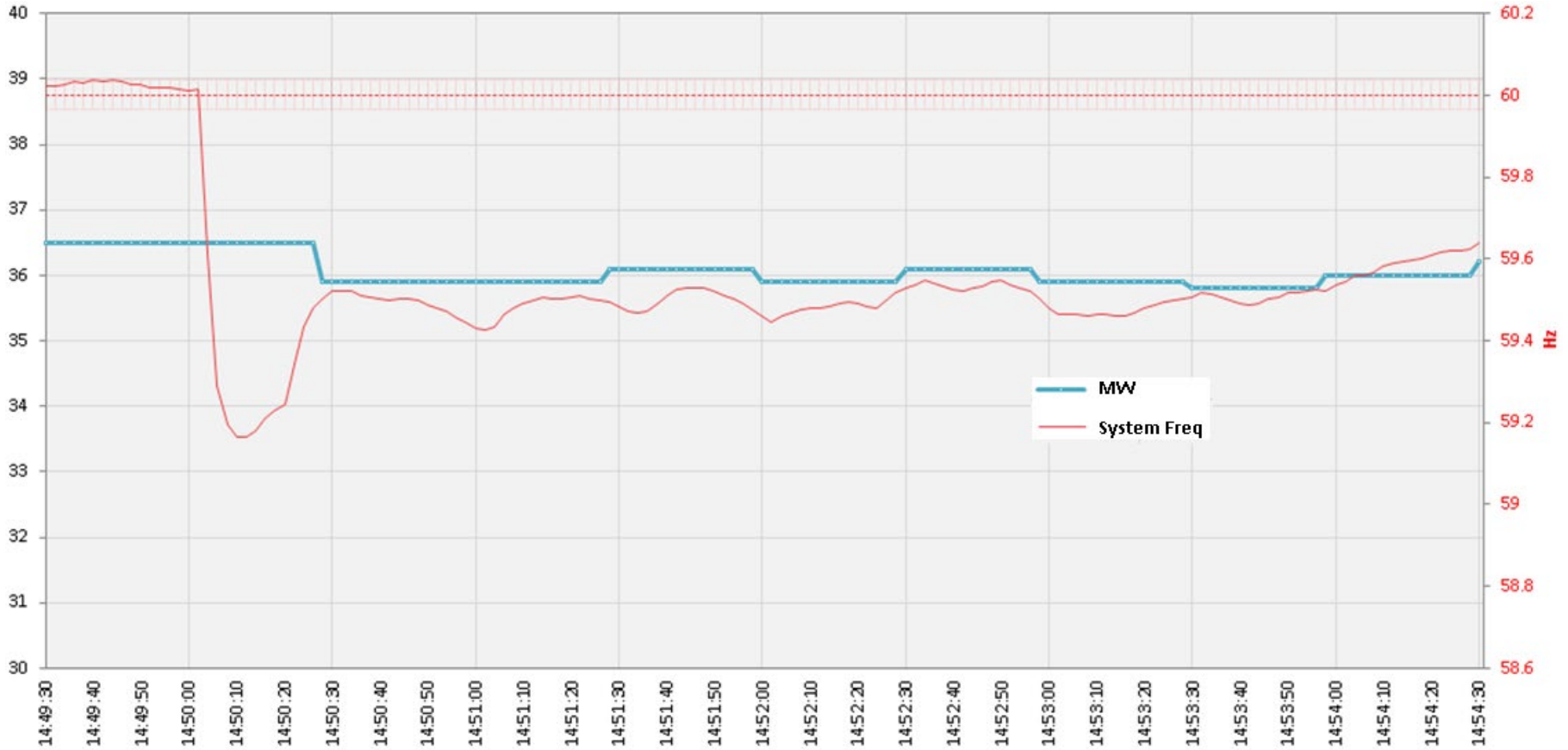
# Generator frequency response – Poor

## Generator F



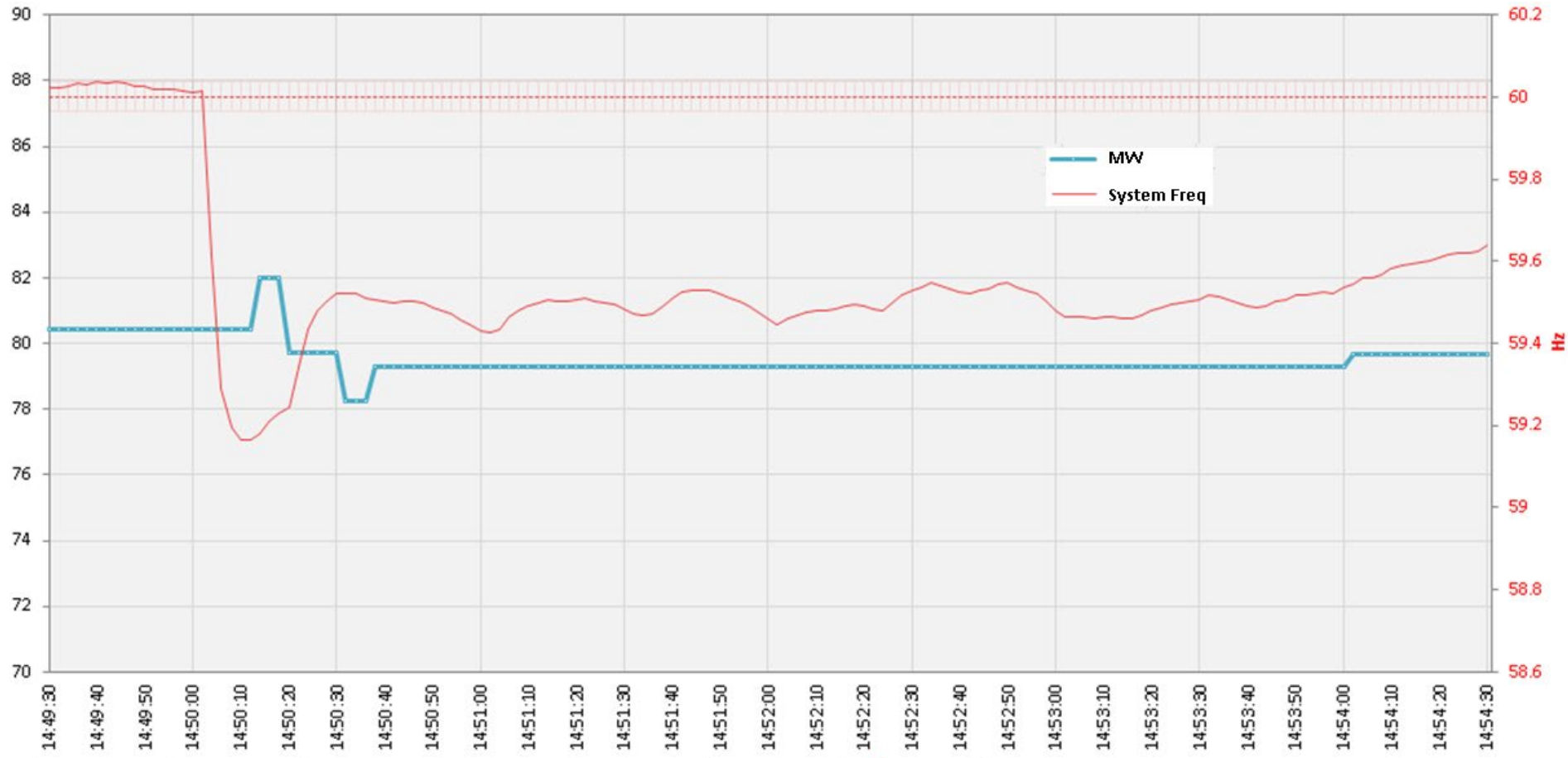
# Generator frequency response – Poor

## Generator G



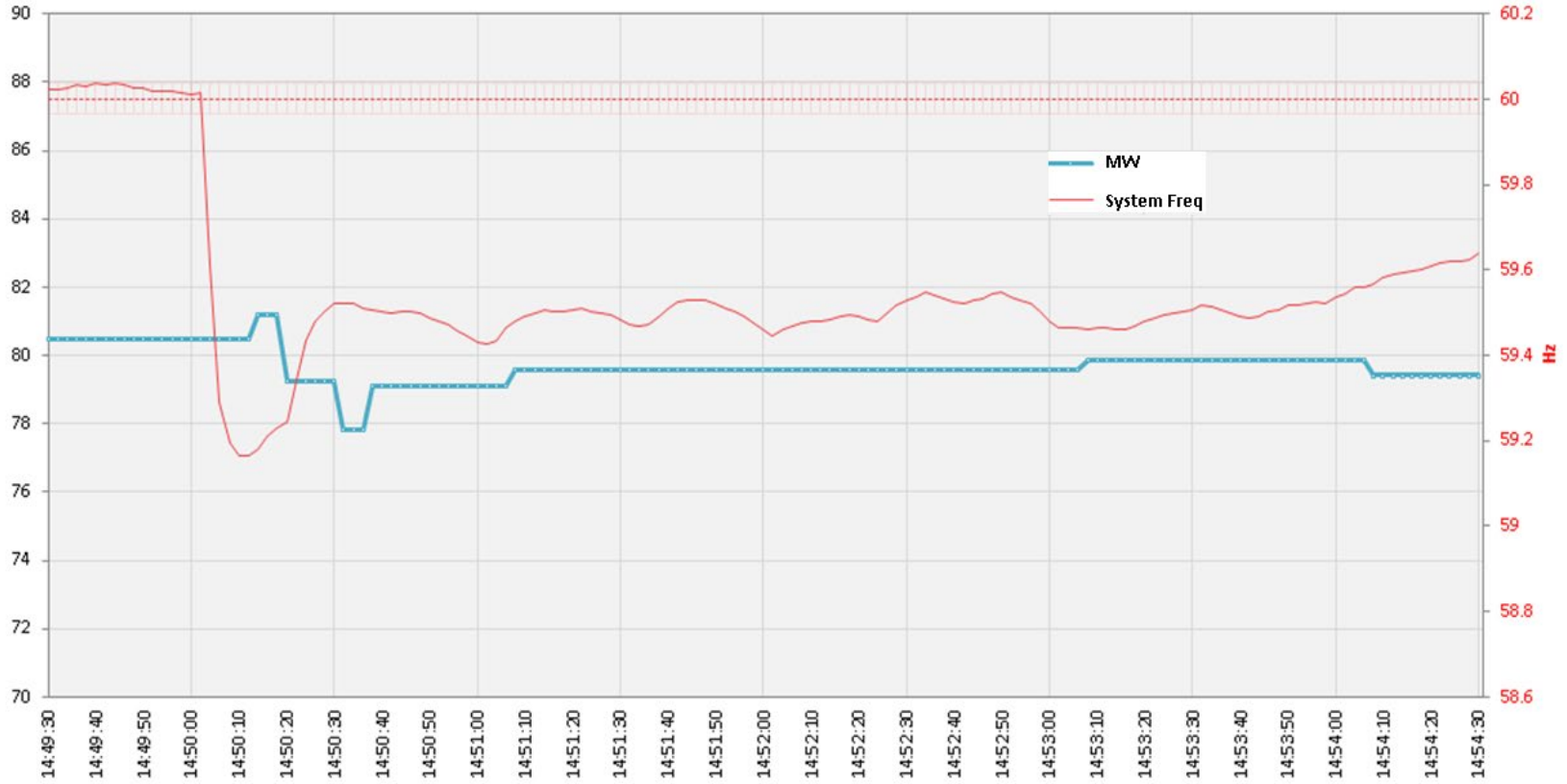
# Generator frequency response – Poor

## Generator H



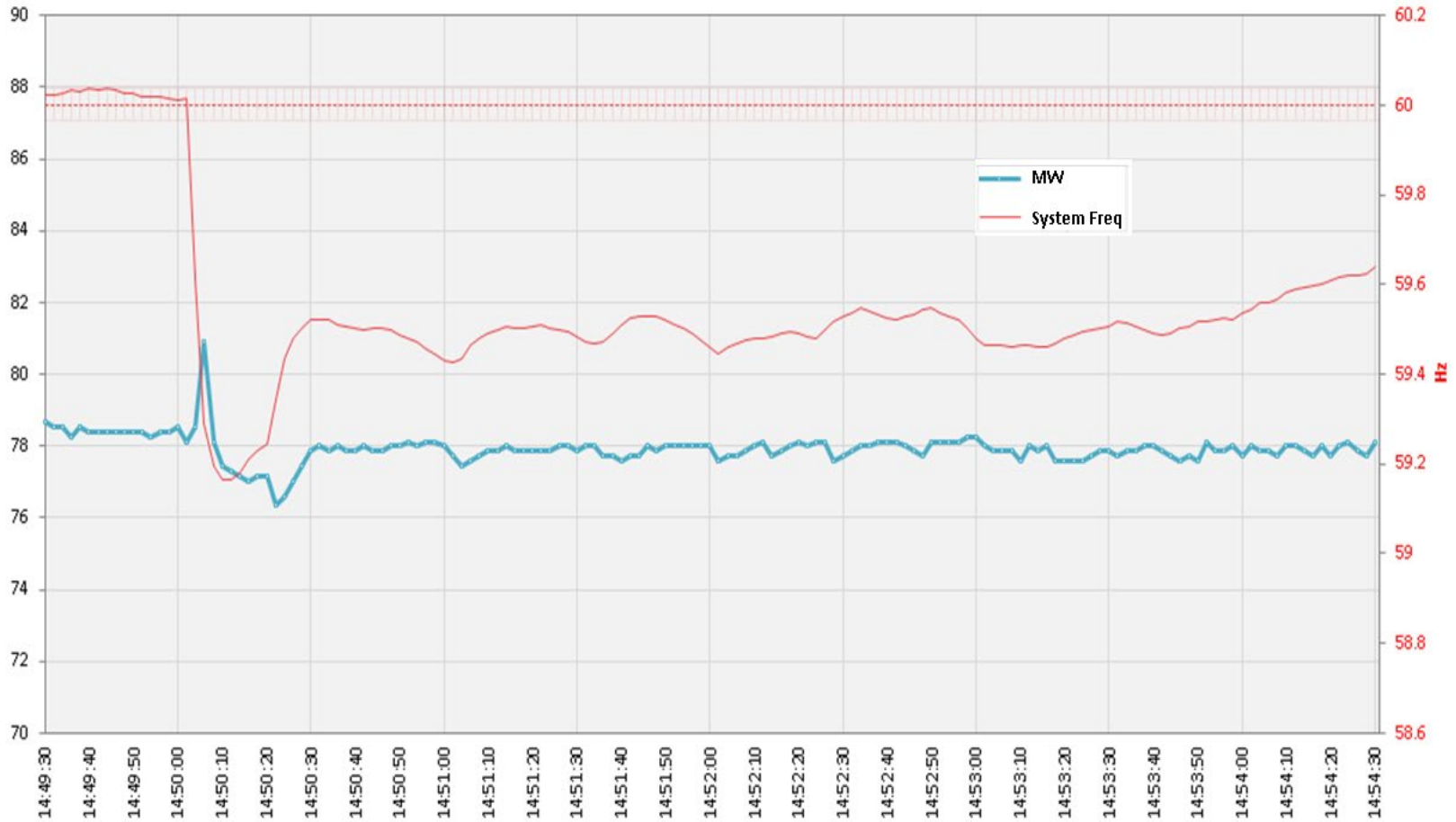
# Generator frequency response - Poor

## Generator I



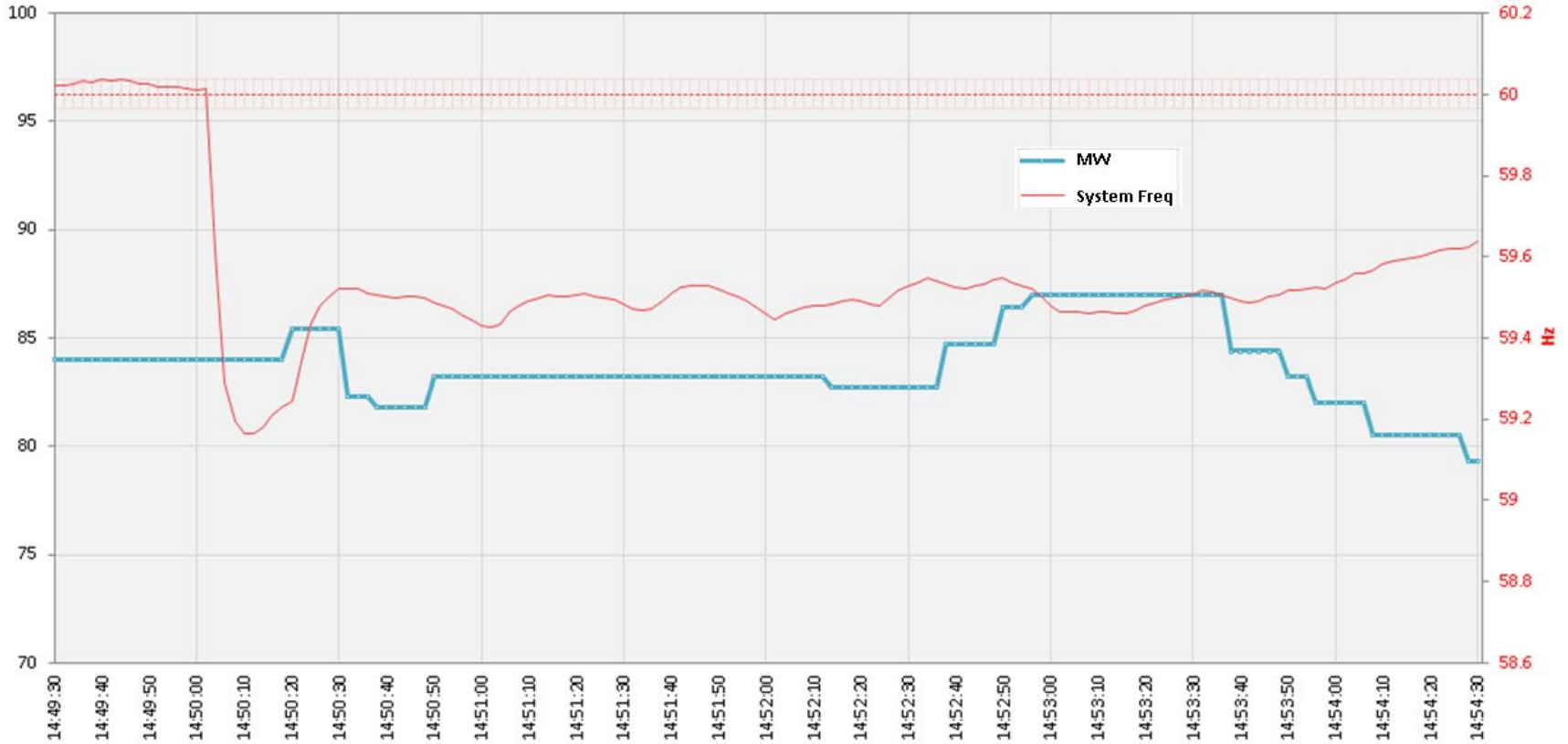
# Generator frequency response – Poor

## Generator J



# Generator frequency response – Poor

## Generator K



# Mitigation Measures and Next Steps



- Available Transfer Capability (ATC) was held at 550 MW until additional mitigation measures were implemented
- Mitigation measures effective June 22, 2020
  - **Step 1: Load Shed Service for imports (LSSi) arming**
    - Updated study results
      - *Lower response from generators and loads*
      - *Generator response @ 90 MW/0.1Hz*
      - *Load damping constant @ 1.9%*
    - Additional volumes to ensure 90% confidence level
  - **Step 2: System inertia calculations incorporated**
    - Calculates ratio of contingency to system inertia
      - *Ratio needs to be lower than 0.0135*
    - Reduces ATC if ratio above threshold

# LSSi – Revised arming table – Effective June 22, 2020

BC/MT ATC Import	AIL (MW)											
	7000 to 7499	7500 to 7999	8000 to 8499	8500 to 8999	9000 to 9499	9500 to 9999	10000 to 10499	10500 to 10999	11000 to 11499	11500 to 11999	12000 to 12499	12500 and above
Below 500	0	0	0	0	0	0	0	0	0	0	0	0
501 to 550	23	23	10	0	0	0	0	0	0	0	0	0
551 to 600	72	72	55	24	24	10	0	0	0	0	0	0
601 to 650	120	120	105	72	72	50	47	43	26	10	0	0
651 to 700	172	170	156	124	116	100	93	89	74	51	43	41
701 to 750	219	219	207	175	167	147	140	134	116	103	89	86
751 to 800	270	268	257	225	218	193	187	182	165	150	135	128
801 to 850	321	317	307	275	262	243	235	229	214	196	181	175
851 to 900	373	365	358	325	310	292	282	276	263	243	227	222
901 to 950	418	413	408	376	360	339	328	323	312	289	273	268
951 to 1000	477	467	457	427	411	387	375	370	362	336	321	315
1001 to 1050	535	520	506	478	451	437	421	416	409	382	371	362
1051 to 1100	595	580	566	533	501	488	470	461	457	429	419	408
1101 to 1150	650	635	621	584	551	538	516	508	507	478	468	453
1151 to 1200	714	691	670	649	591	585	563	558	554	526	514	499
1201 to 1250	778	752	727	704	641	635	608	605	600	575	559	544

- “Safe operating procedure” established for operation of the AB-BC intertie in the event of inclement weather (mainly lightning) along the intertie corridor
  - 20% of the outages are sustained outages based on last 10 year data
  - Nearly half of the sustained outages are caused by adverse weather (mainly lightning)
- A revised LSSi arming table will be used under the safe operating procedure
  - Based on generator response observed on June 7<sup>th</sup>
  - Generator response of 40 MW/0.1 Hz and average load damping constant

# Safe operating procedure – LSSi arming levels

Alberta Internal Load (AIL)

	7000	7500	8000	8500	9000	9500	10000	10500	11000	11500	12000	12500	
<b>-500</b>	120	126	106	70	81	56	57	55	36	12	7	11	
<b>-550</b>	171	175	156	121	128	104	104	101	83	60	54	56	
<b>-600</b>	221	224	207	172	176	153	151	148	131	108	101	102	
<b>-650</b>	272	272	257	223	224	201	198	194	178	155	147	147	
<b>-700</b>	324	322	308	276	268	252	245	241	226	203	194	193	
<b>Imports</b>	<b>-750</b>	371	371	359	327	319	299	292	286	268	255	241	238
	<b>-800</b>	422	420	409	377	370	345	339	334	317	302	287	280
	<b>-850</b>	473	469	459	427	414	395	387	381	366	348	333	327
	<b>-900</b>	525	517	510	477	462	444	434	428	415	395	379	374
	<b>-950</b>	570	565	560	528	512	491	480	475	464	441	425	420
	<b>-1000</b>	631	621	611	579	563	539	527	522	514	488	473	467
	<b>-1050</b>	693	678	663	630	603	589	573	568	561	534	523	514
	<b>-1100</b>	755	740	726	685	653	640	622	613	609	581	571	560
	<b>-1150</b>	808	793	779	736	703	690	668	660	659	630	620	605
	<b>-1200</b>	867	837	832	796	743	737	715	710	706	678	666	651
	<b>-1250</b>	935	894	884	856	793	787	760	757	752	727	711	696

- UFLS feeder level performances
  - On-going discussions with DFOs
  - Feeder performance
- Generator performance
  - Review of generator performance on-going
  - Engagement with generating resources
    - Information requests (IRs) to all under-performing generators
    - Follow-up conversations to occur
- Frequency response of system
  - Plan being developed to mitigate poor system frequency response (integrated ancillary services roadmap)
  - Draw upon NERC and WECC recommendations
  - Engage the broader technical community and appropriate stakeholders



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Thank you