

Overnight on 28<sup>th</sup>/29<sup>th</sup> May 2001

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*Jenny Phillips*

*Graham Stein*

# Operational Forum

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- ◆ **4A trough, 28th May**
- ◆ **Response to High and Low Frequencies**
- ◆ **Low demands overnight**
- ◆ **1B trough, 29th May**

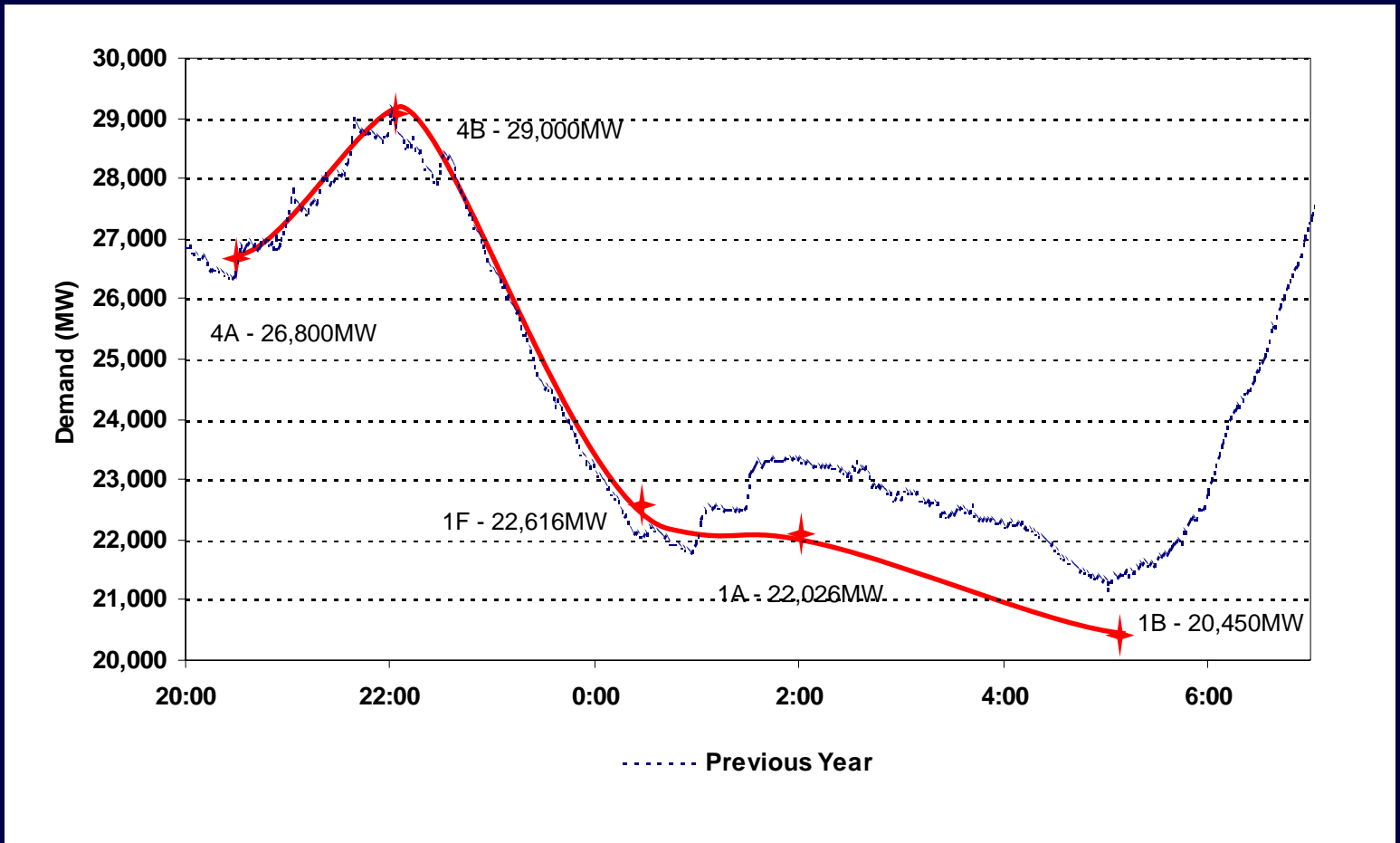
# 28 May 2001

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- ◆ **Bank Holiday Monday**
- ◆ **Demand profile selection difficult**
  - ◆ **“normal” Monday unsuitable**
- ◆ **Can only use last year’s bank holiday**
- ◆ **Different TV pickups**
- ◆ **Weather similar**

# Forecast Demand

28th/29th May



# Planning the 4A Trough

- ◆ **Physical Notifications - 28,664 MW**
- ◆ **Demand Forecast -26,800 MW**
- ◆ **Bids required - 1,884 MW**
- ◆ **First Bid of 70MW taken at 17:08**
- ◆ **1,375MW of Desynchronising bids taken from 3 hours ahead**

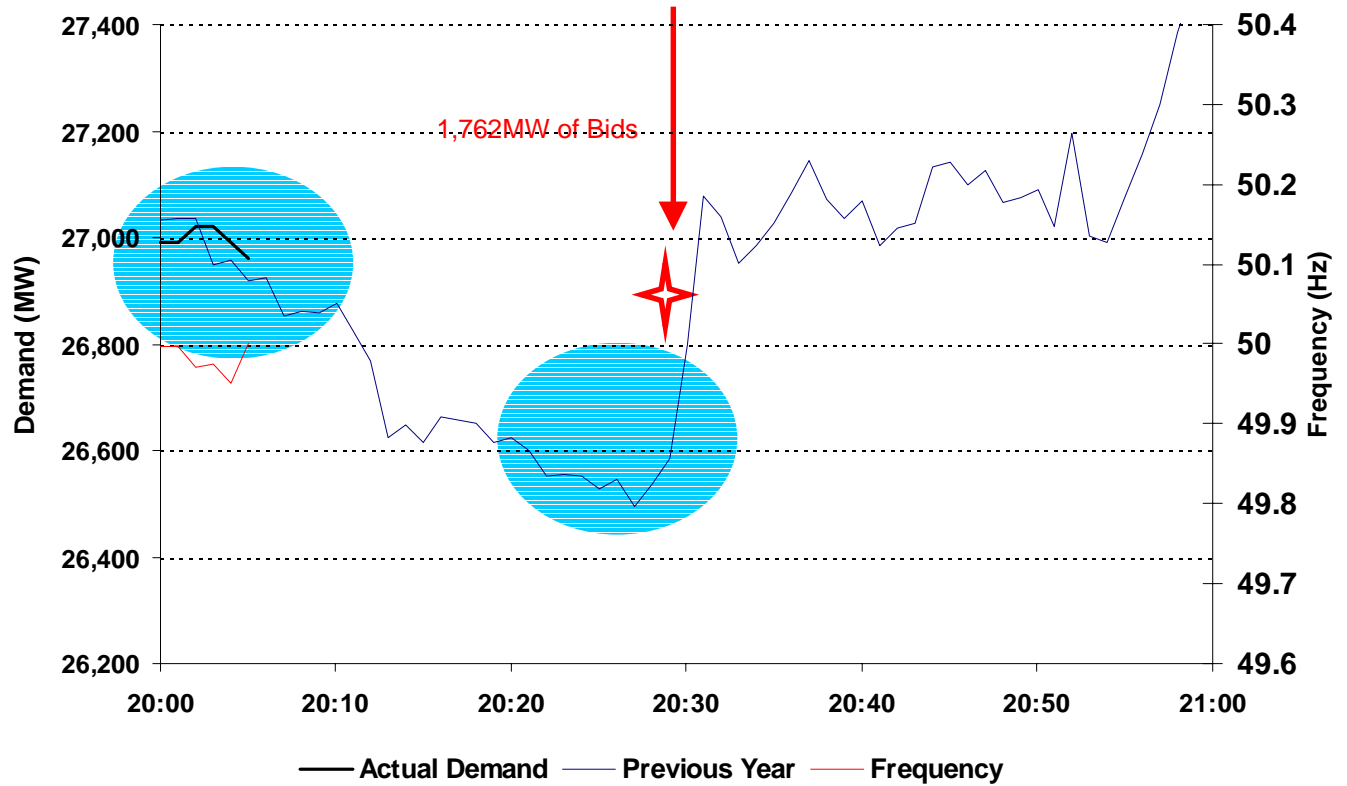
	<b>Accepted</b>	<b>From</b>	<b>To</b>	<b>MW</b>
ISG-SSTH1	17:08	20:04	20:36	70
EGGPS-3	17:11	18:15	21:00	250
EGGPS-1	17:37	18:29	21:30	405
COTPS-1	17:43	17:45	21:30	350
SEAB-2	18:36	18:38	22:30	370
<b>Total</b>				<b>1445</b>

# 4A Trough in Real Time

- ◆ **1,445MW of Bids already taken**
- ◆ **1,884MW of Bids required**

	<b>Accepted</b>	<b>From</b>	<b>To</b>	<b>MW</b>
ISG-SSTH1	17:08	20:04	20:36	70
EGGPS-3	17:11	18:15	21:00	250
EGGPS-1	17:37	18:29	21:30	405
COTPS-1	17:43	17:45	21:30	350
SEAB-2	18:36	18:38	22:30	370
COTPS-2	19:35	20:28	20:39	103
FIDL-4	19:40	19:42	20:36	129
KEAD-1	19:41	19:45	20:45	85
<b>Total</b>				<b>1762</b>

# At 20:05

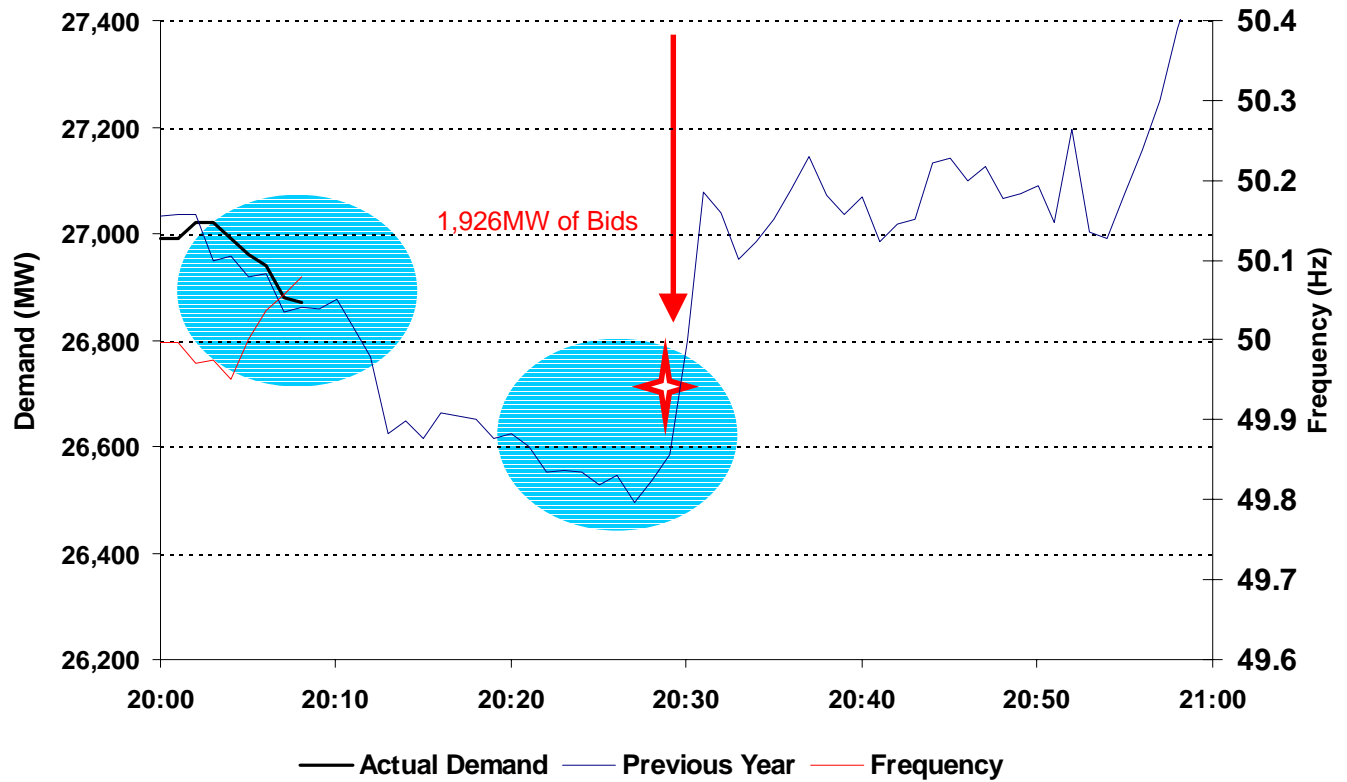


# 4A Trough in Real Time

- ◆ Demand Expected - 26,500 MW
- ◆ 1,762MW of Bids already taken
- ◆ 2,144MW of Bids required?

	Accepted	From	To	MW
ISG-SSTH1	17:08	20:04	20:36	70
EGGPS-3	17:11	18:15	21:00	250
EGGPS-1	17:37	18:29	21:30	405
COTPS-1	17:43	17:45	21:30	350
SEAB-2	18:36	18:38	22:30	370
COTPS-2	19:35	20:28	20:39	103
FIDL-4	19:40	19:42	20:36	129
KEAD-1	19:41	19:45	20:45	85
DIDC3	20:05	20:16	20:31	22
TILB-9	20:05	20:28	20:34	39
SEAB-1	20:08	20:27	20:32	48
AESB-1	20:09	20:29	20:38	55
<b>Total</b>				<b>1926</b>

# At 20:08

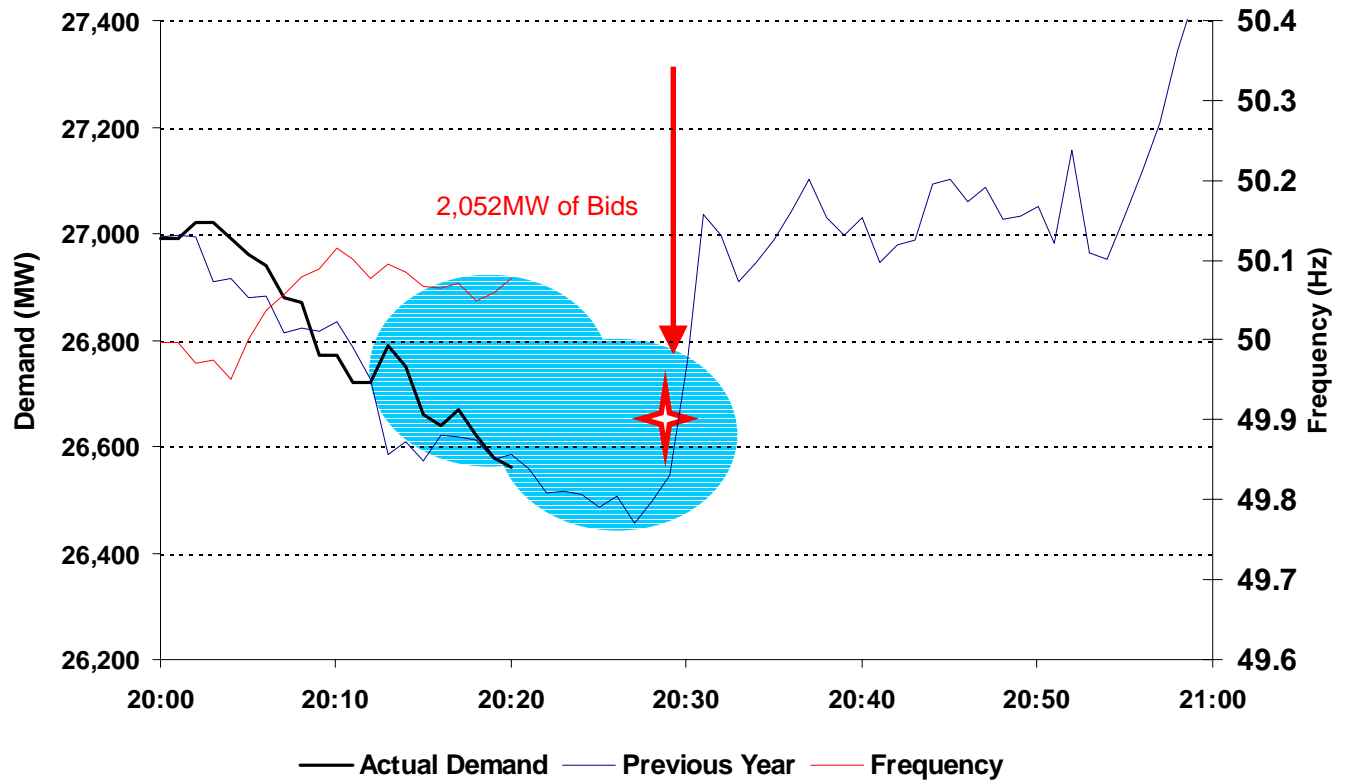


# 4A Trough in Real Time

- ◆ **Bids Taken by 20:20...**
- ◆ **...2,144MW Required**

	<b>Accepted</b>	<b>From</b>	<b>To</b>	<b>MW</b>
ISG-SSTH1	17:08	20:04	20:36	70
EGGPS-3	17:11	18:15	21:00	250
EGGPS-1	17:37	18:29	21:30	405
COTPS-1	17:43	17:45	21:30	350
SEAB-2	18:36	18:38	22:30	370
COTPS-2	19:35	20:28	20:39	103
FIDL-4	19:40	19:42	20:36	129
KEAD-1	19:41	19:45	20:45	85
DIDC3	20:05	20:16	20:31	22
TILB-9	20:05	20:28	20:34	39
SEAB-1	20:08	20:27	20:32	48
AESB-1	20:09	20:29	20:38	55
COTPS-2	20:10	20:22	20:39	160
DIDC3	20:10	20:27	20:49	40
TILB-9	20:10	20:27	20:39	60
KINO-1	20:11	20:25	20:32	20
KINO-3	20:11	20:26	20:33	10
<b>Total</b>				<b>2052</b>

# At 20:20

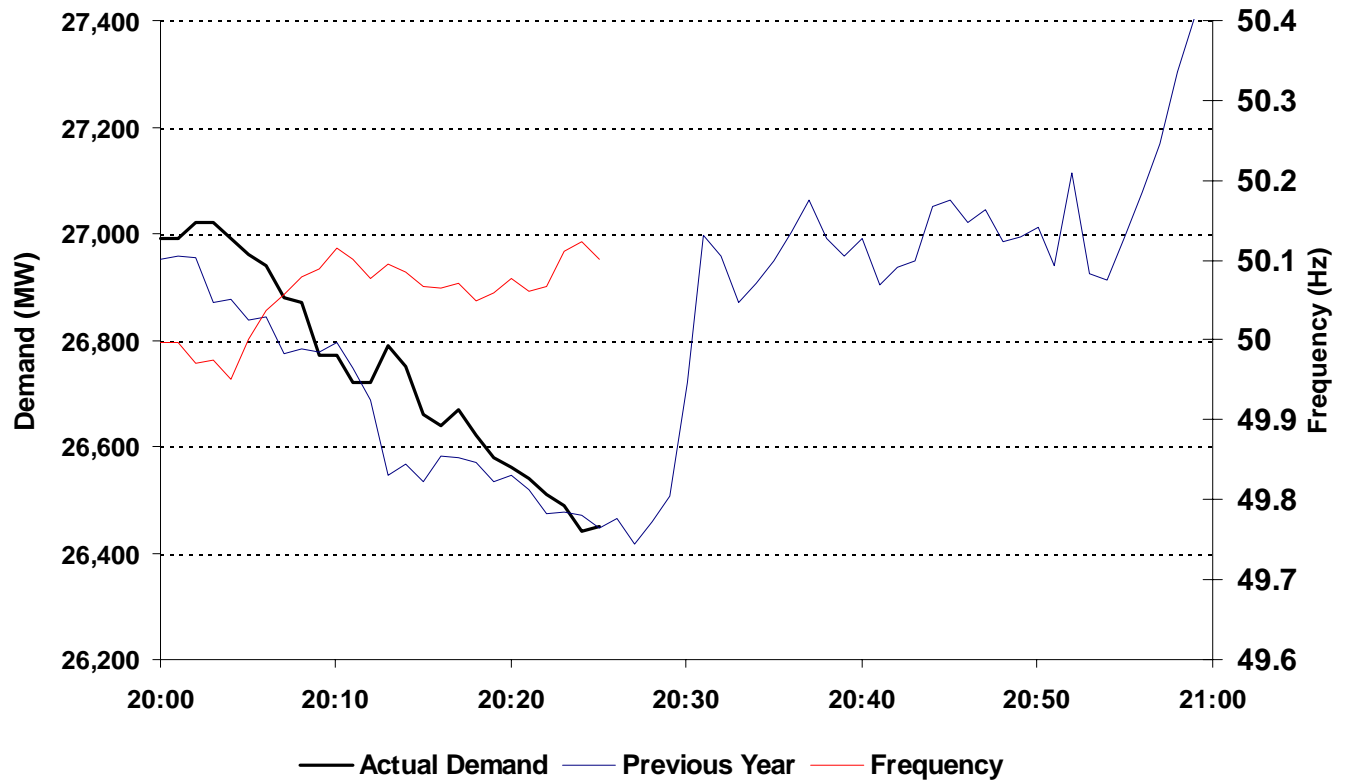


# 4A Trough in Real Time

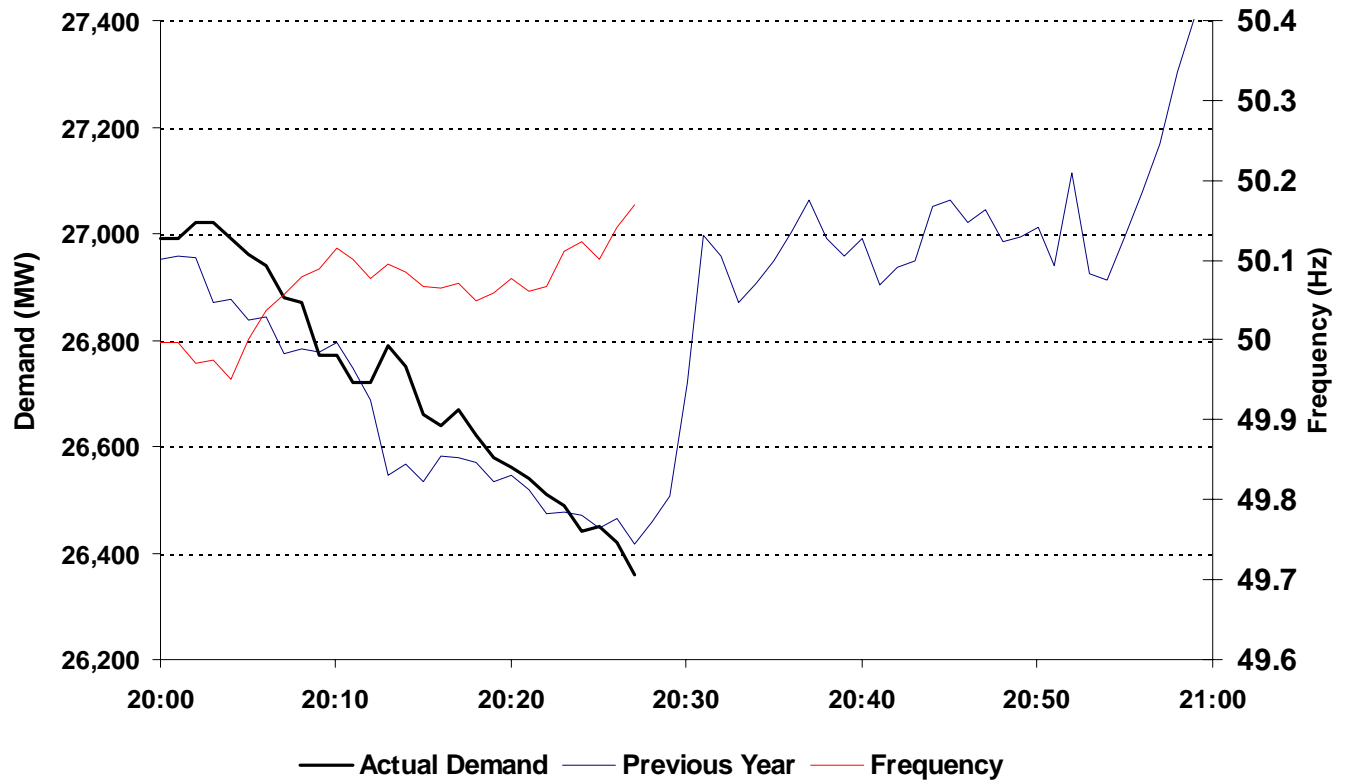
- ◆ Bids Taken by 20:25...
- ◆ ...2,144MW Required

	Accepted	From	To	MW
ISG-SSTH1	17:08	20:04	20:36	70
EGGPS-3	17:11	18:15	21:00	250
EGGPS-1	17:37	18:29	21:30	405
COTPS-1	17:43	17:45	21:30	350
SEAB-2	18:36	18:38	22:30	370
COTPS-2	19:35	20:28	20:39	103
FIDL-4	19:40	19:42	20:36	129
KEAD-1	19:41	19:45	20:45	85
DIDC3	20:05	20:16	20:31	22
TILB-9	20:05	20:28	20:34	39
SEAB-1	20:08	20:27	20:32	48
AESB-1	20:09	20:29	20:38	55
COTPS-2	20:10	20:22	20:39	160
DIDC3	20:10	20:27	20:49	40
TILB-9	20:10	20:27	20:39	60
KINO-1	20:11	20:25	20:32	20
KINO-3	20:11	20:26	20:33	10
DIDC3	20:22	20:24	20:34	52
<b>Total</b>				<b>2064</b>

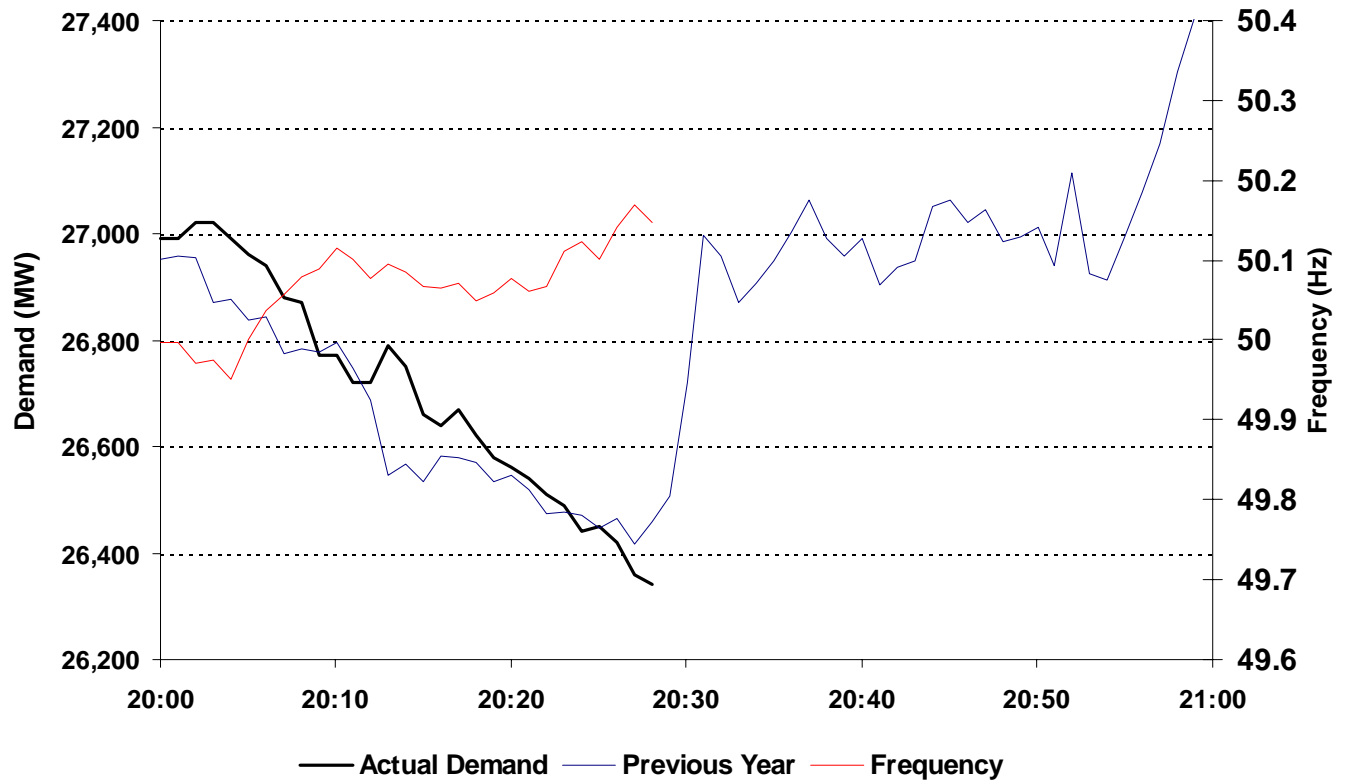
# At 20:25



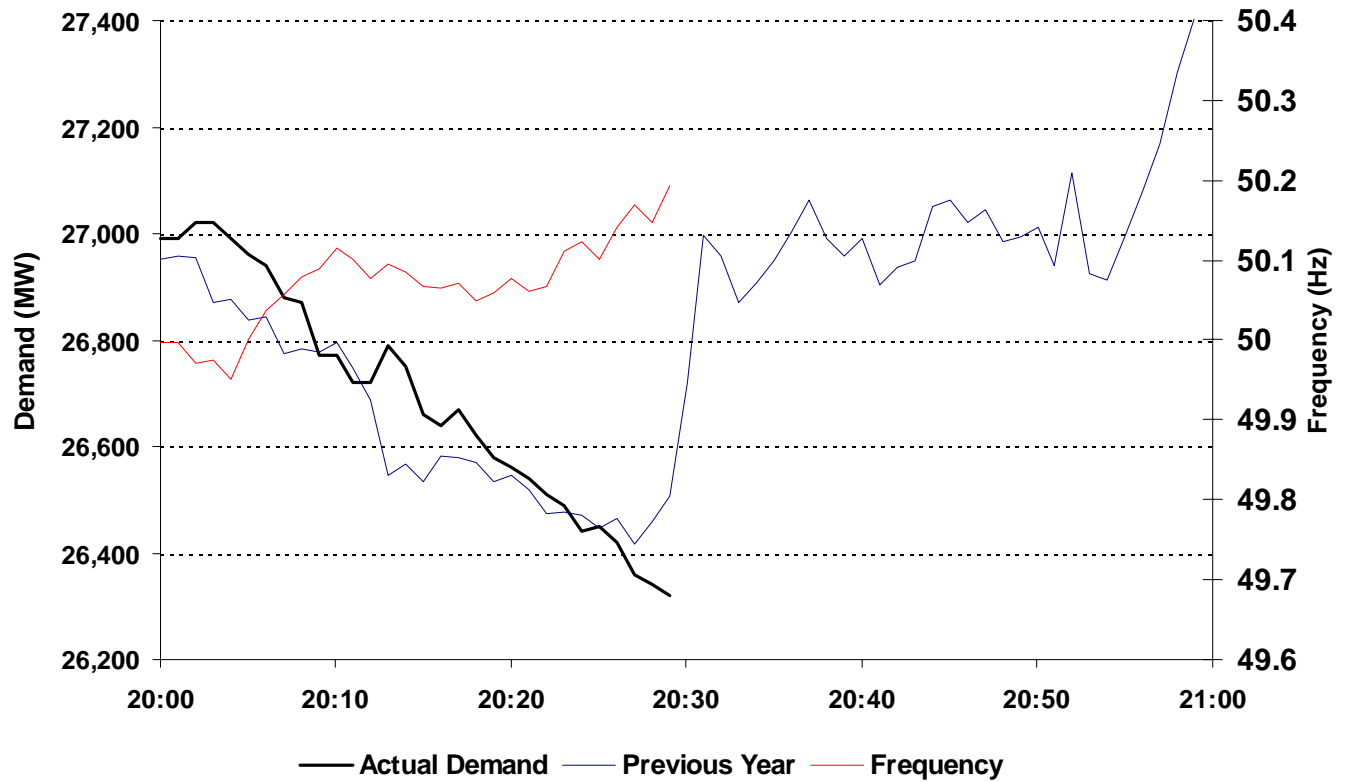
# At 20:27



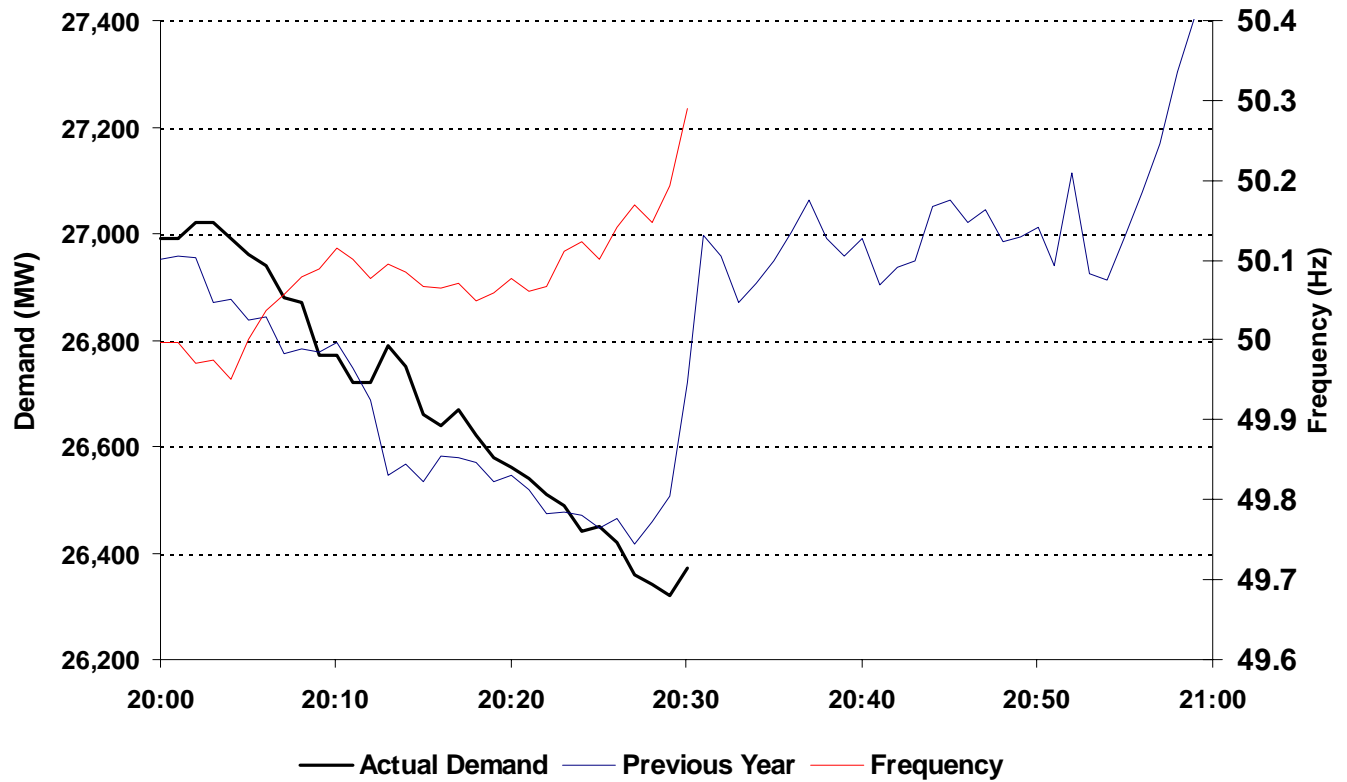
# At 20:28



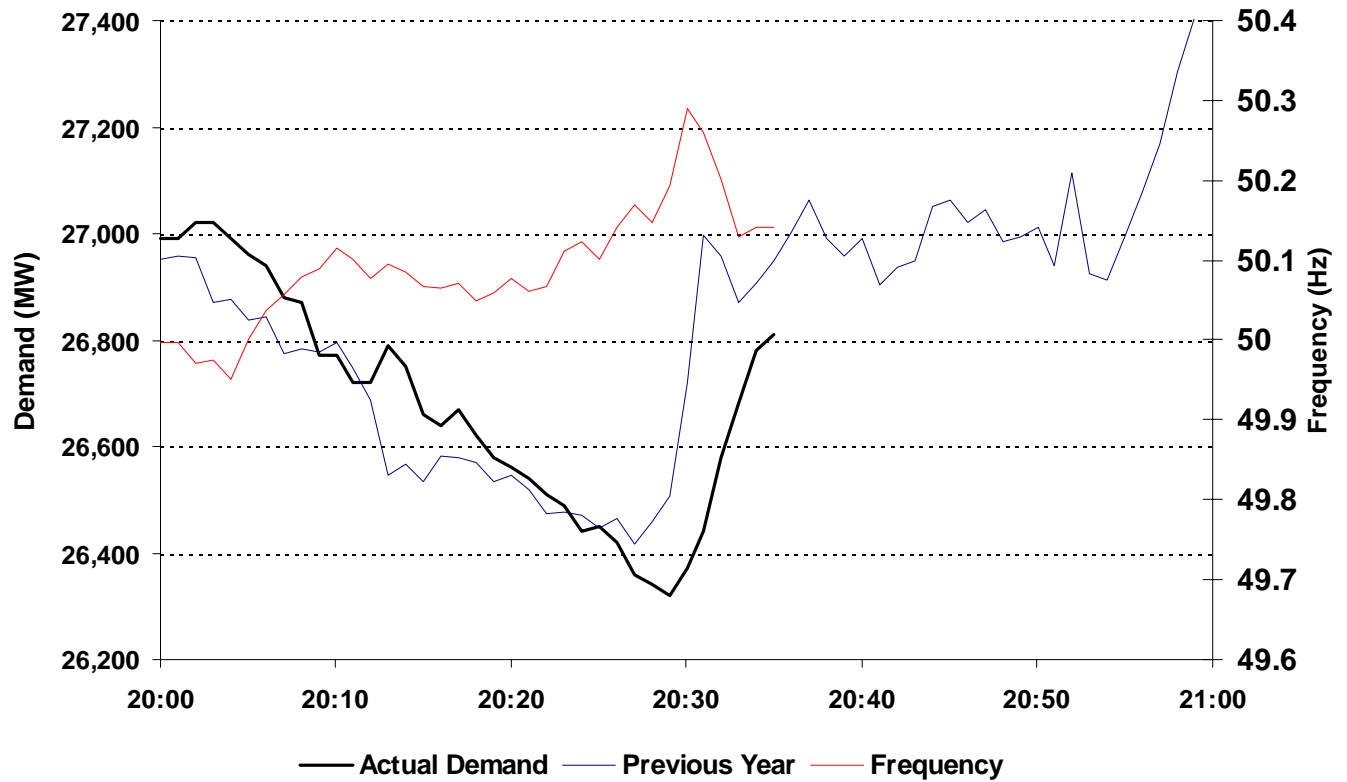
# At 20:29



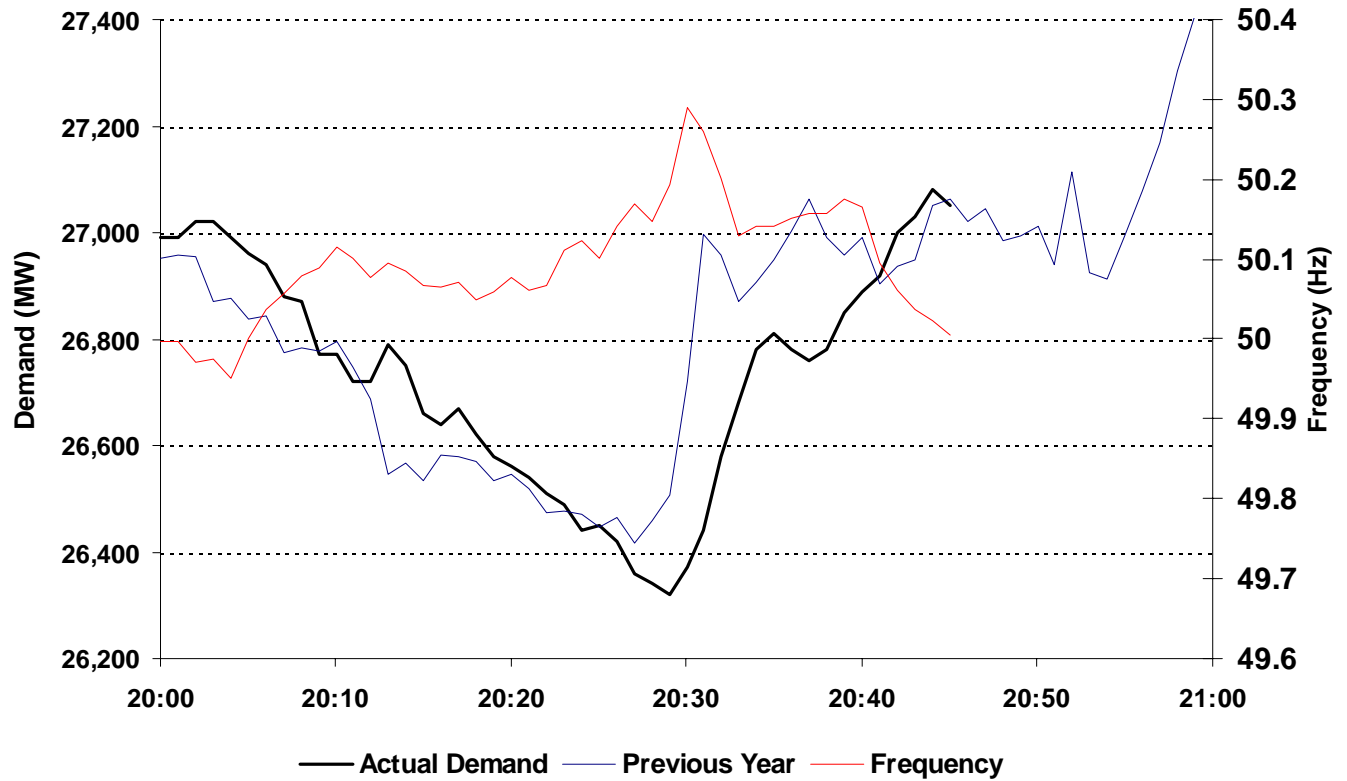
# At 20:30



# At 20:35



# At 20:45



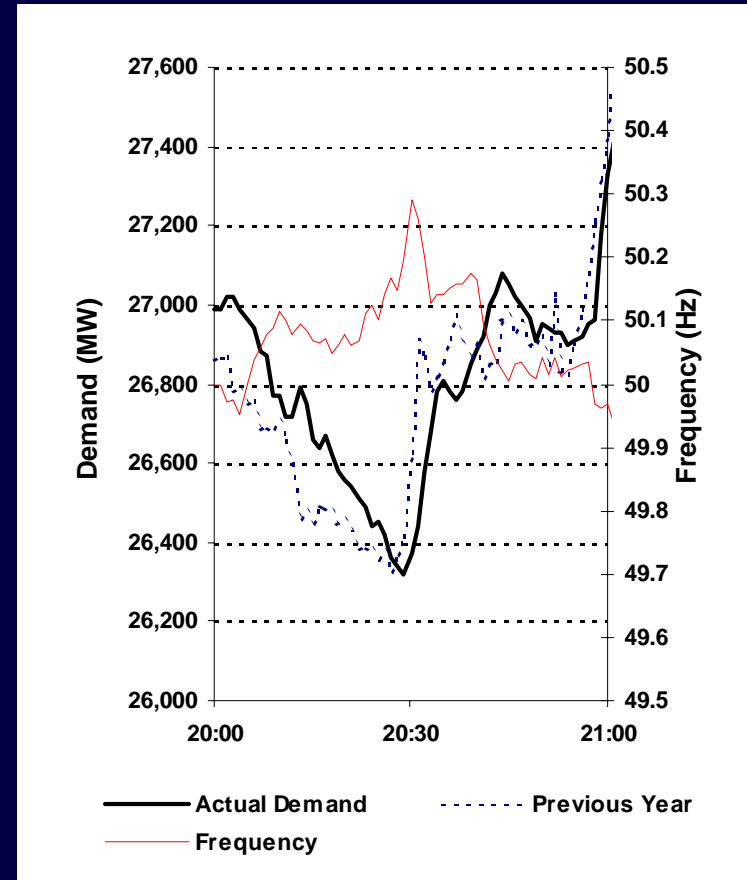
# 4A Trough in Real Time

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- ◆ **Achieved by -**
  - ◆ **Fine tuning Demand Forecast**
  - ◆ **Using Historic Profile**
  - ◆ **Working from current position to make finer adjustments closer to event**

# High Frequency at 20:30

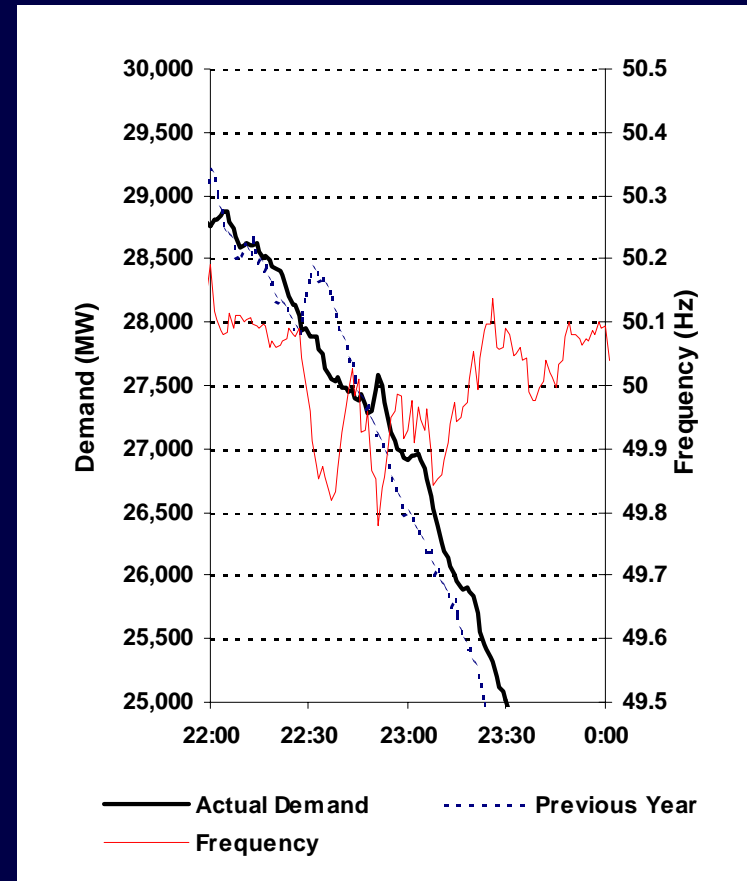
- ◆ 800MW drop off between 20:00 and 20:30
- ◆ Rapid turn around - TV Pick Up coincident with start of Lighting Up
- ◆ TV Pick Up not as rapid as expected
- ◆ Frequency started high to meet rapid turn around





# Low Frequency at 22:50

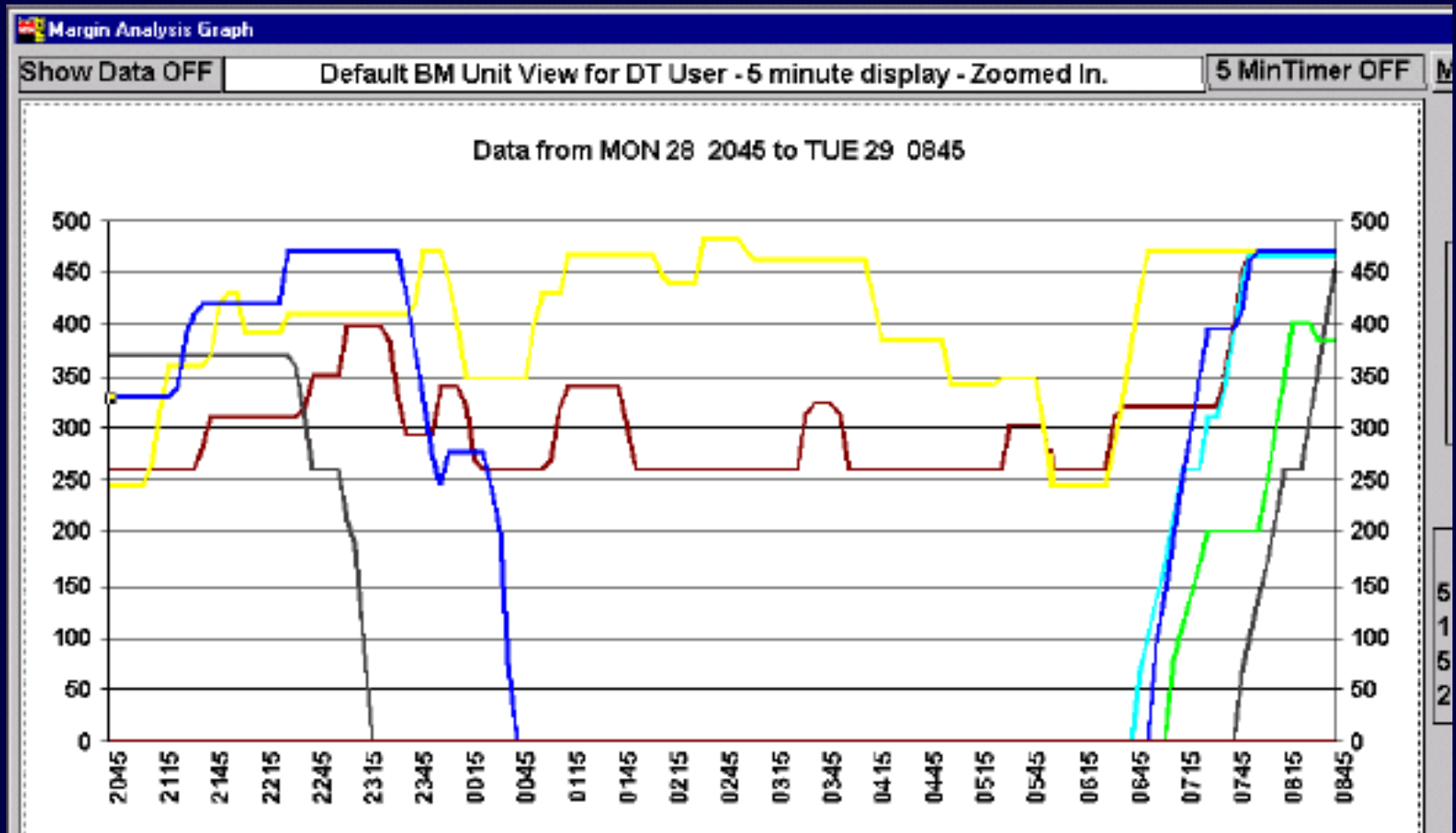
- ◆ Rapid fall off in demand...
- ◆ ...and generation
- ◆ Higher than expected TV pickup at end of 'Speed'



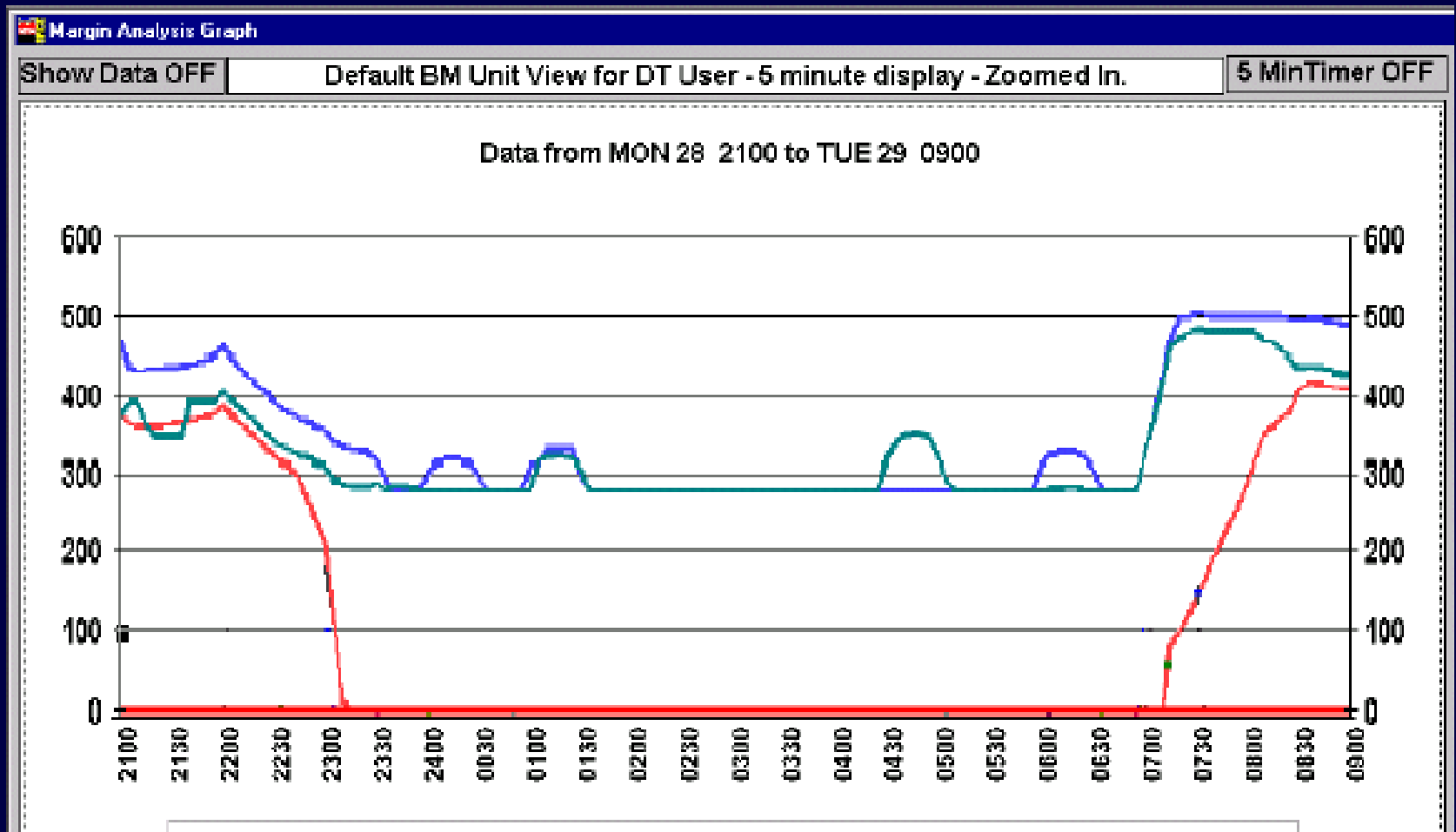
# Some Observations

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# PN Profiles



# PN Profiles



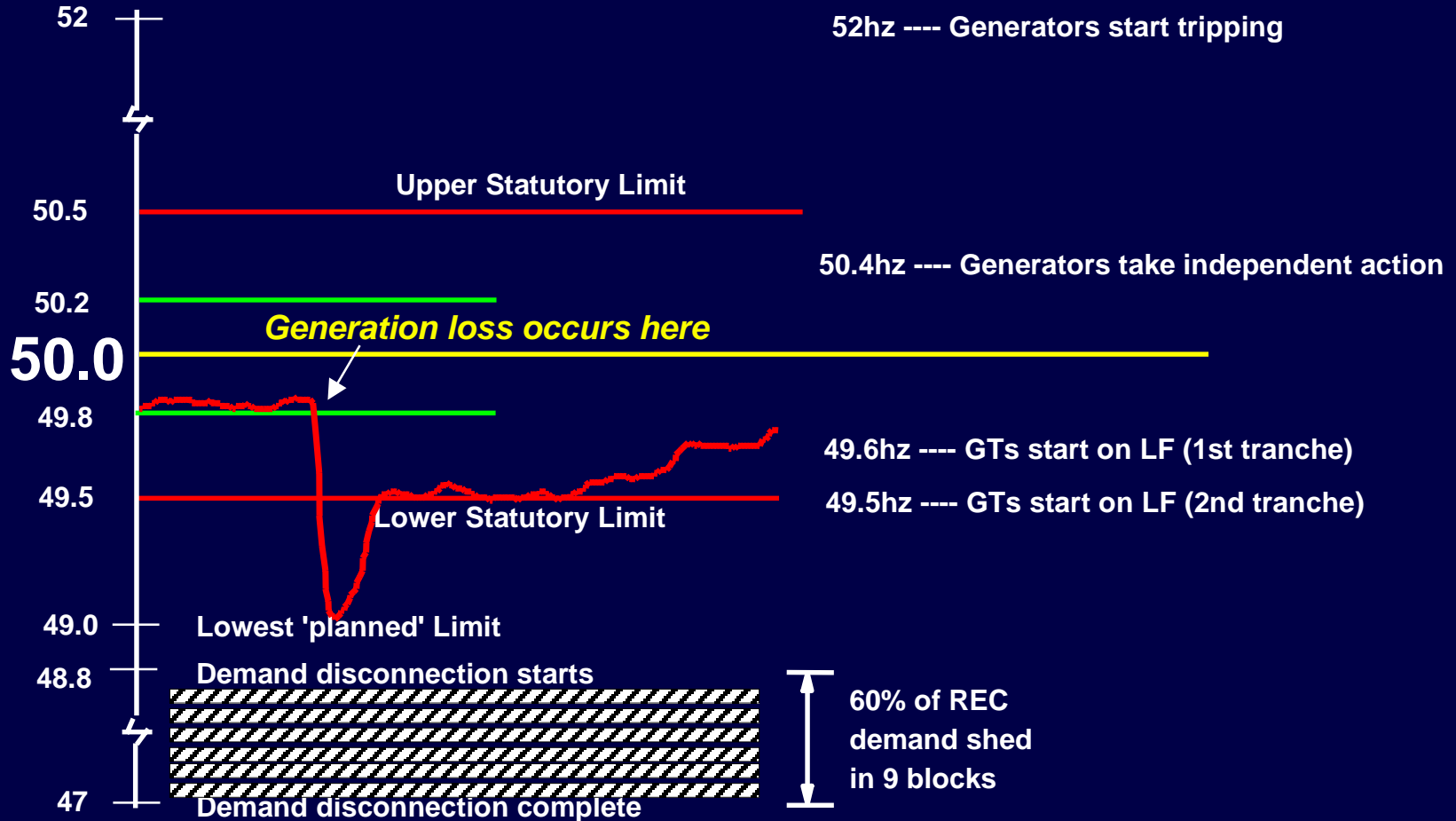
# Frequency Response

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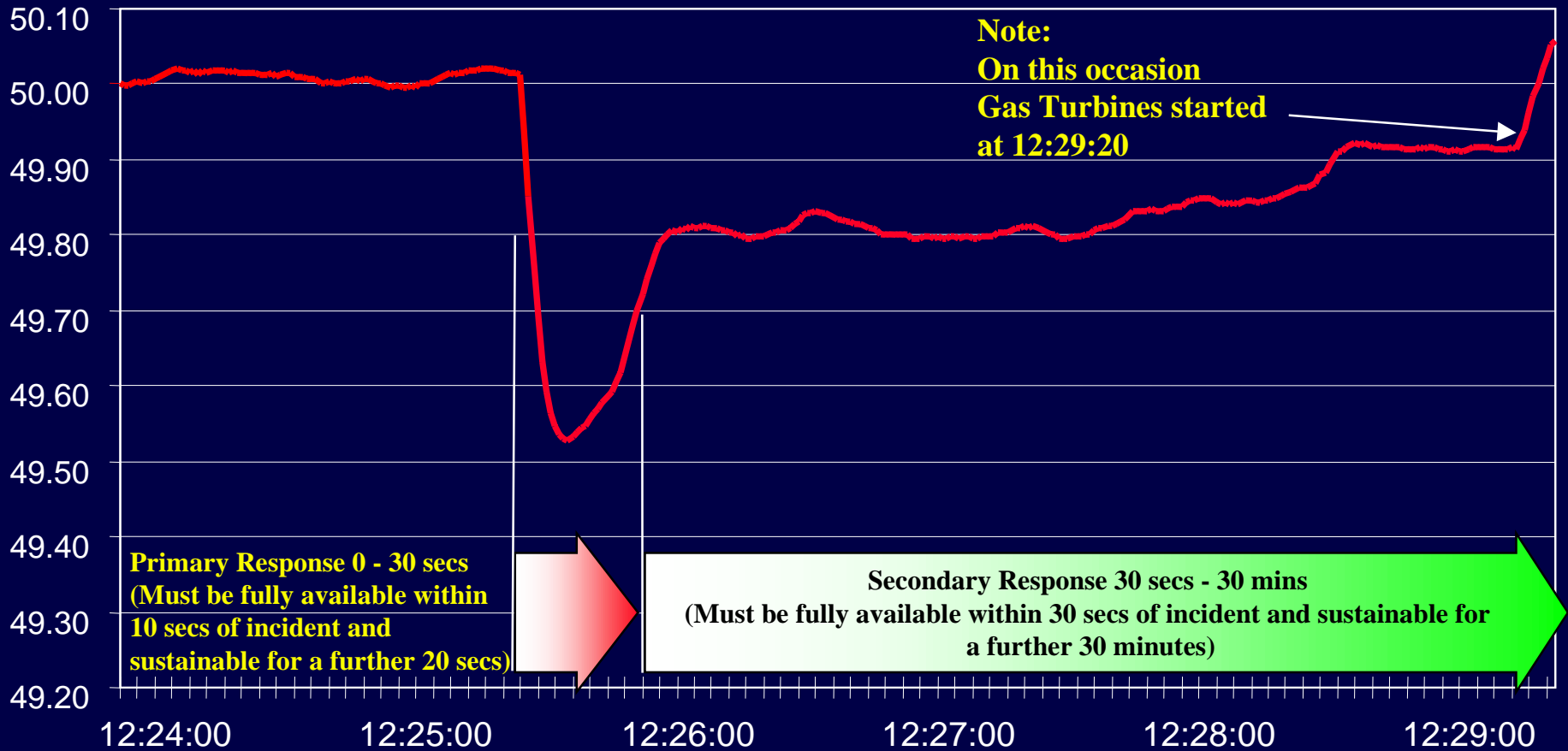
## *High and Low Frequency*

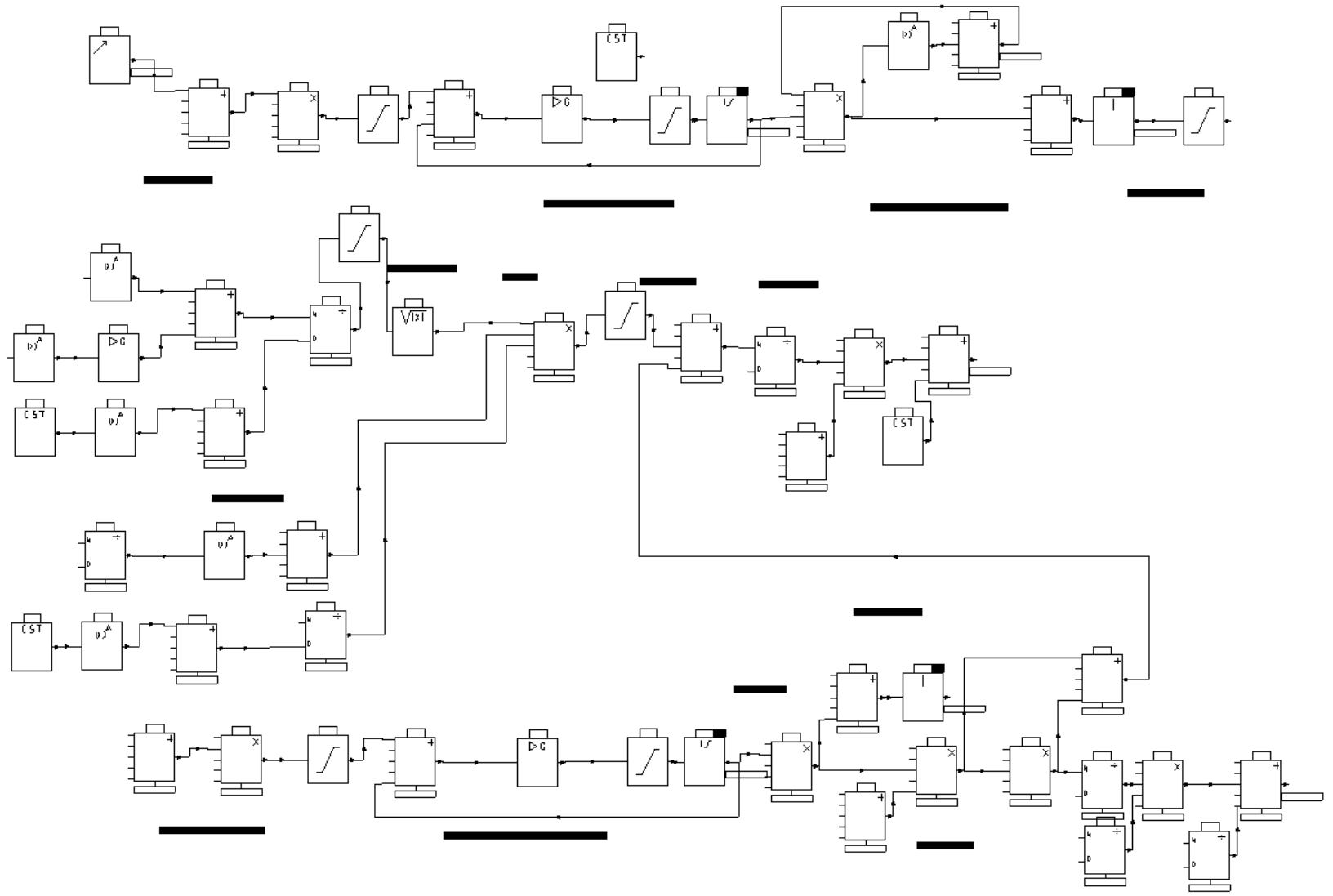
# Frequency Control

- major loss of generation at lower operational limit

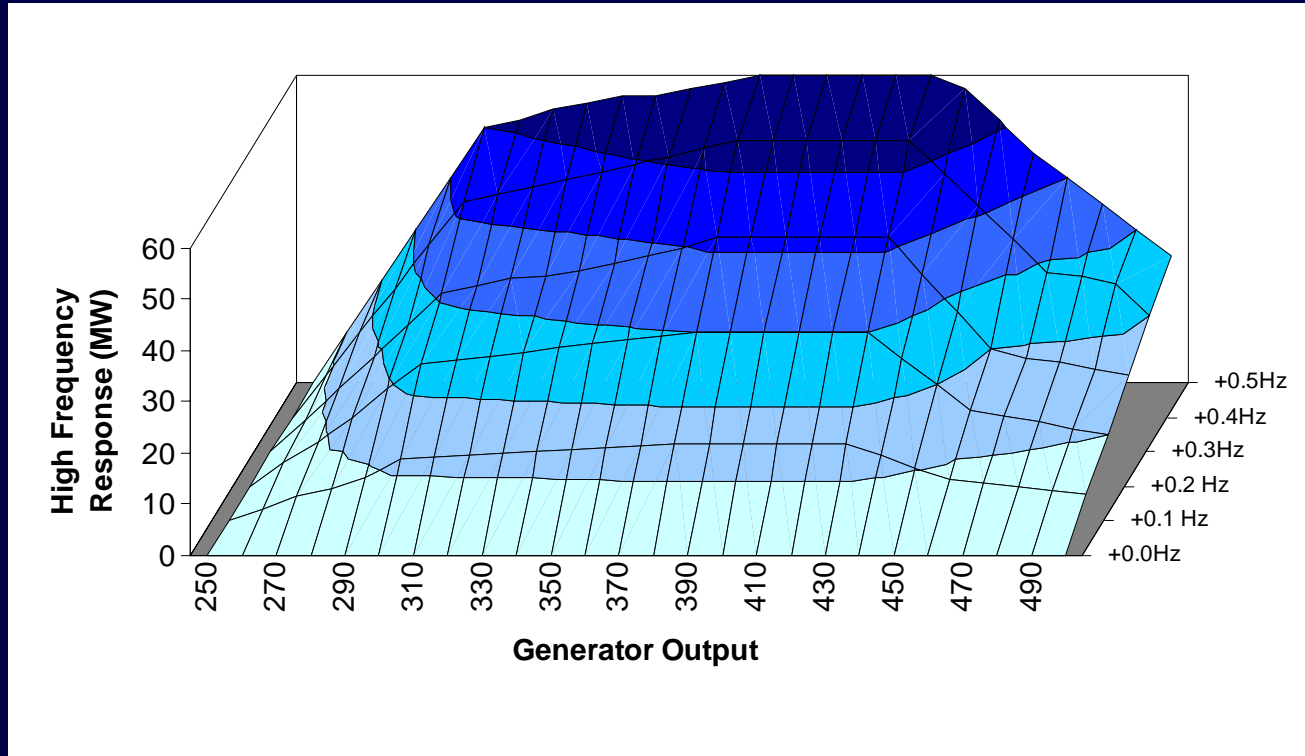


# Frequency Response

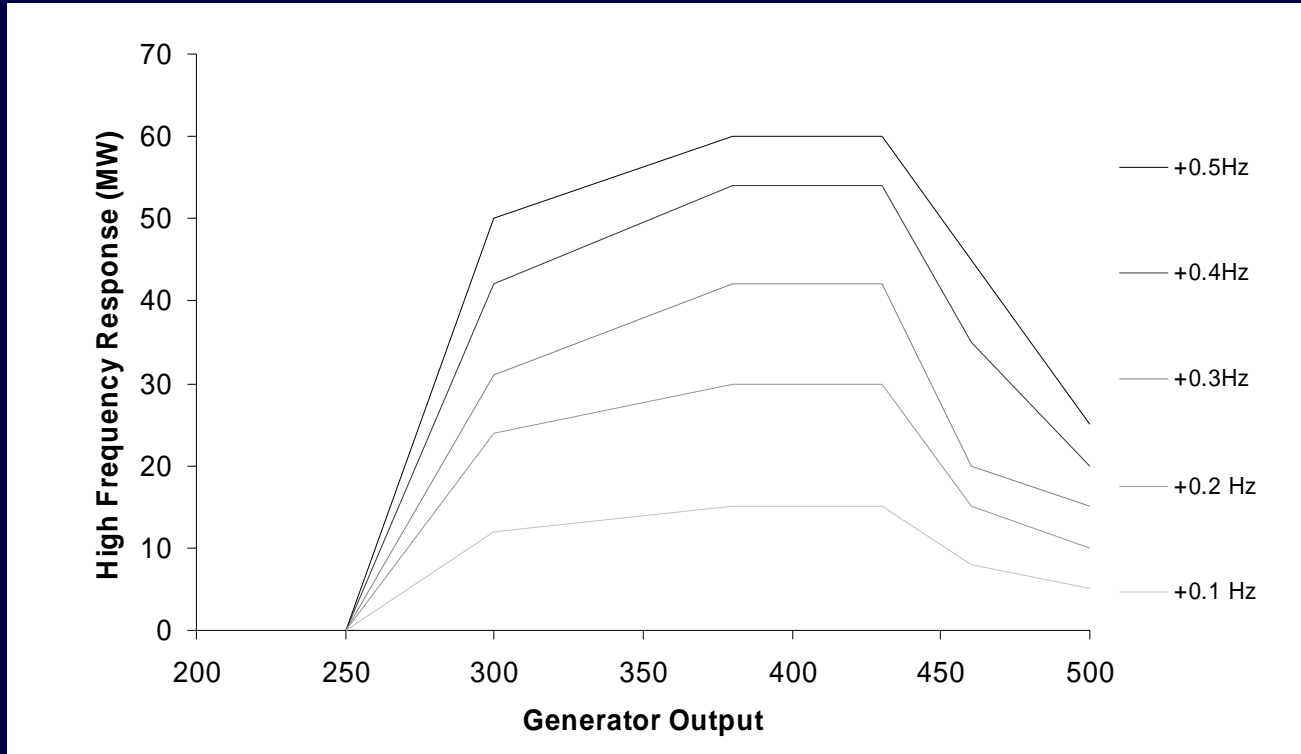




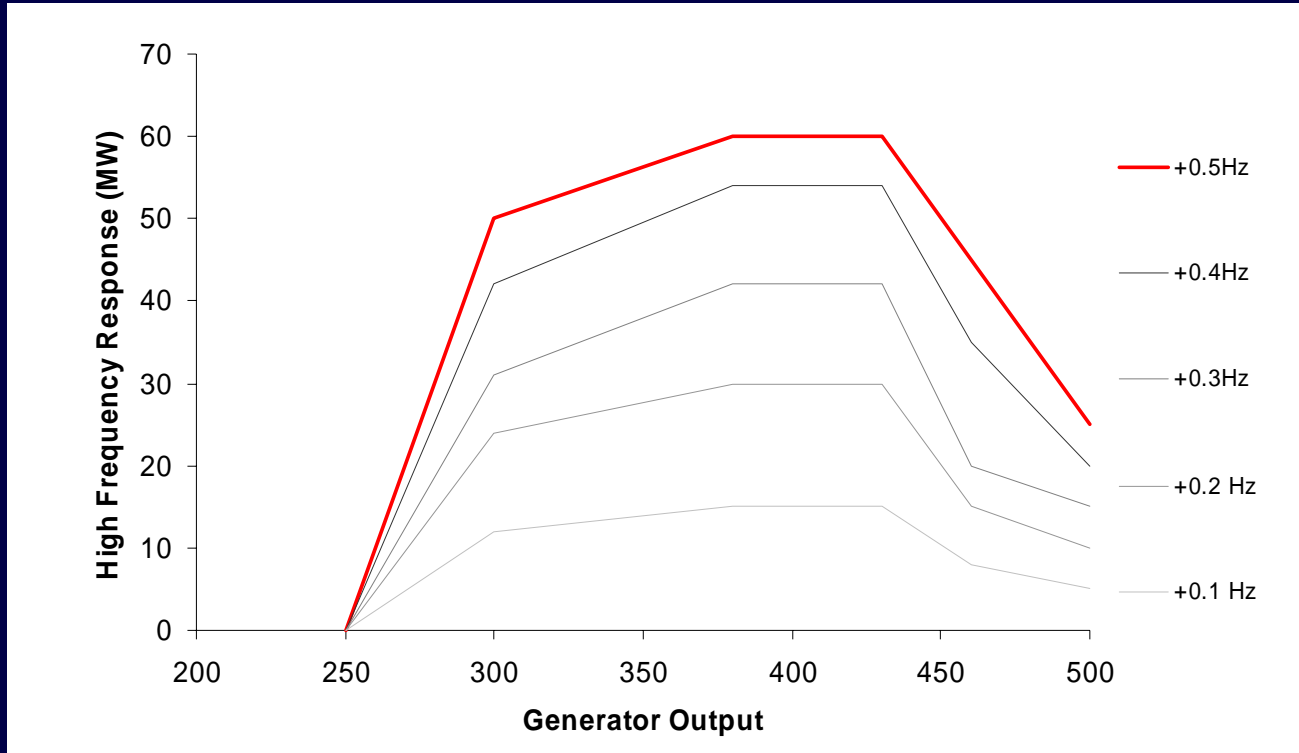
# High Frequency Response



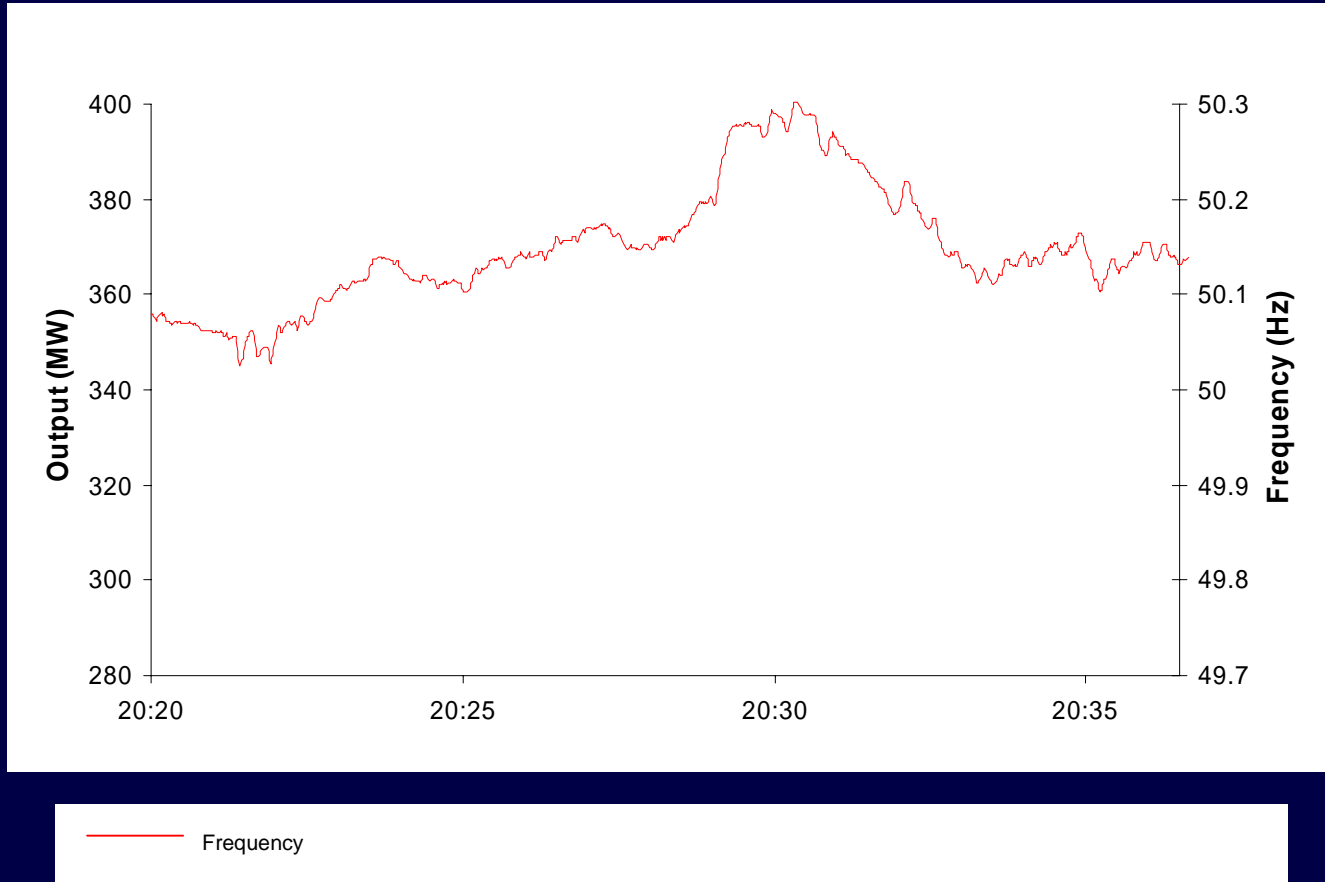
# High Frequency Response



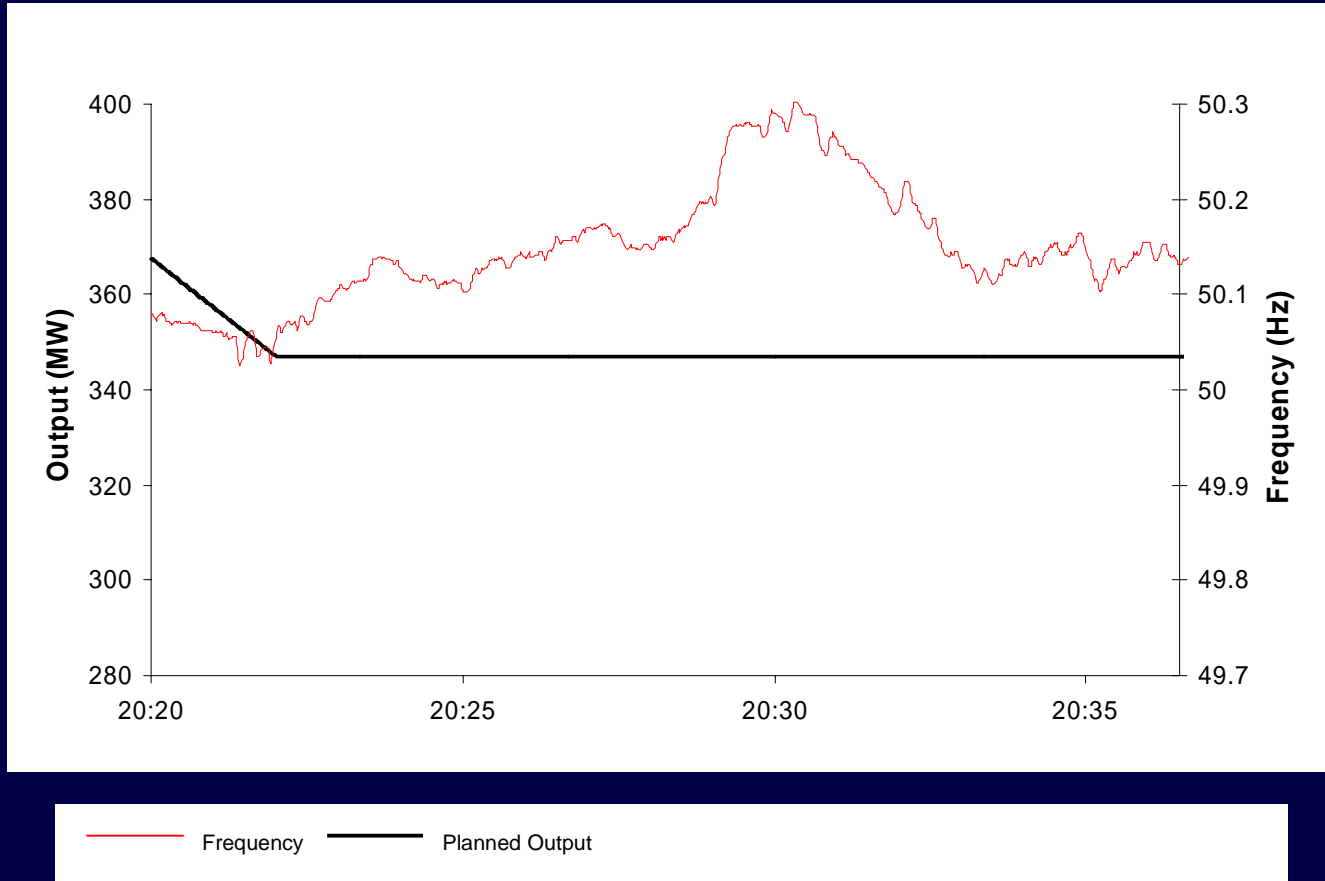
# High Frequency Response



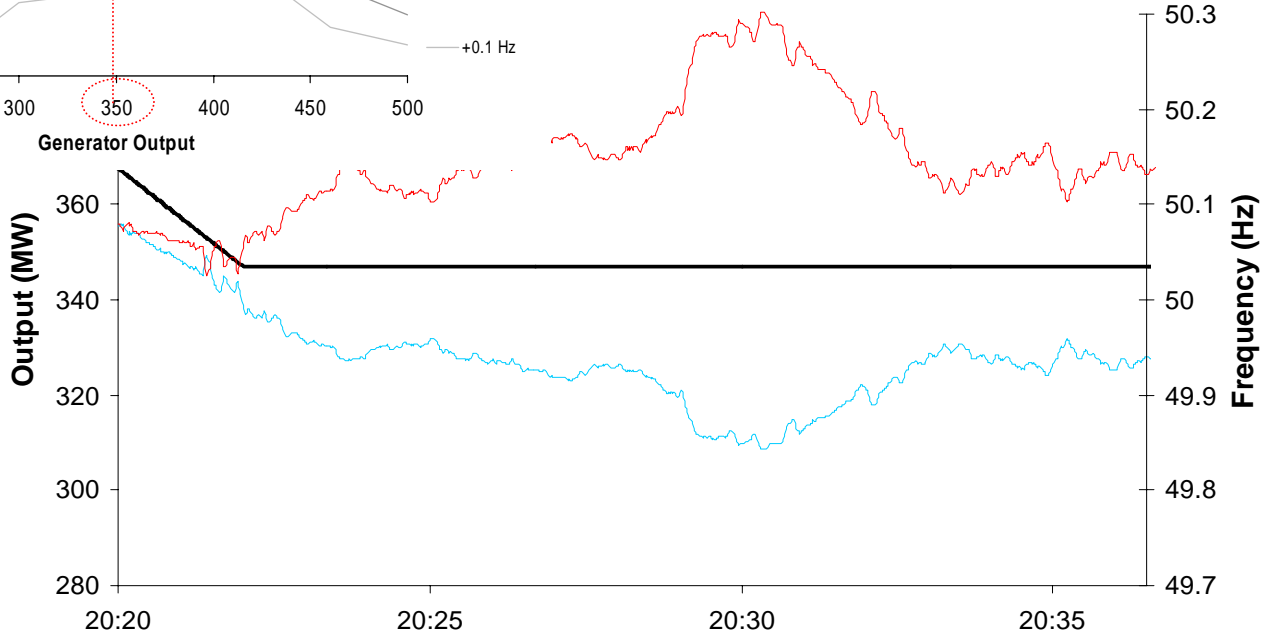
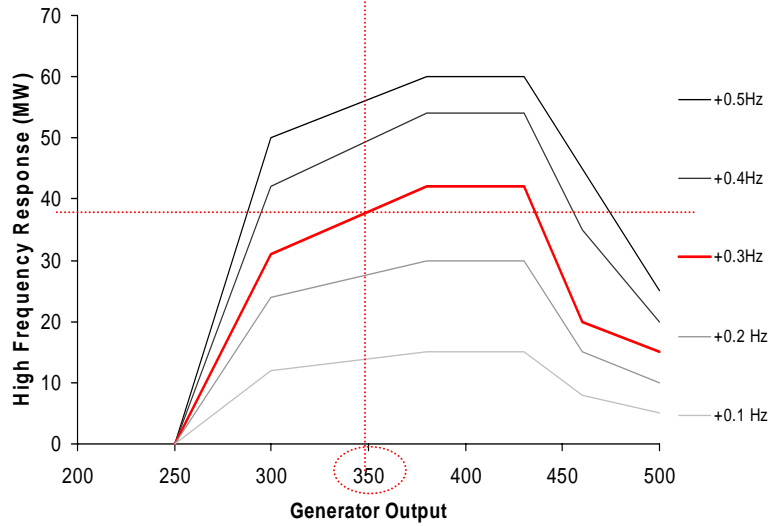
# A Real Example - 28th May



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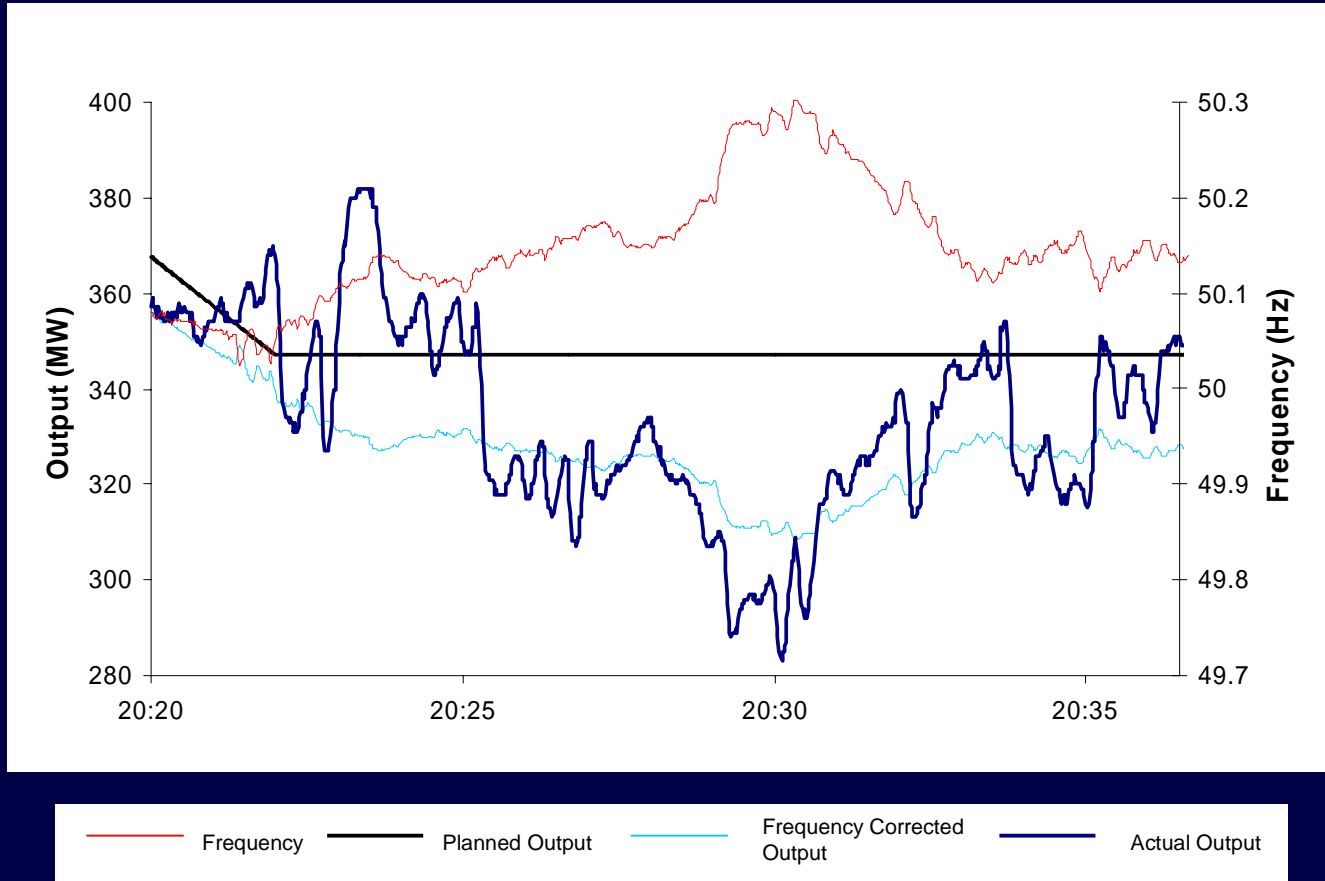


# Example - 28th May

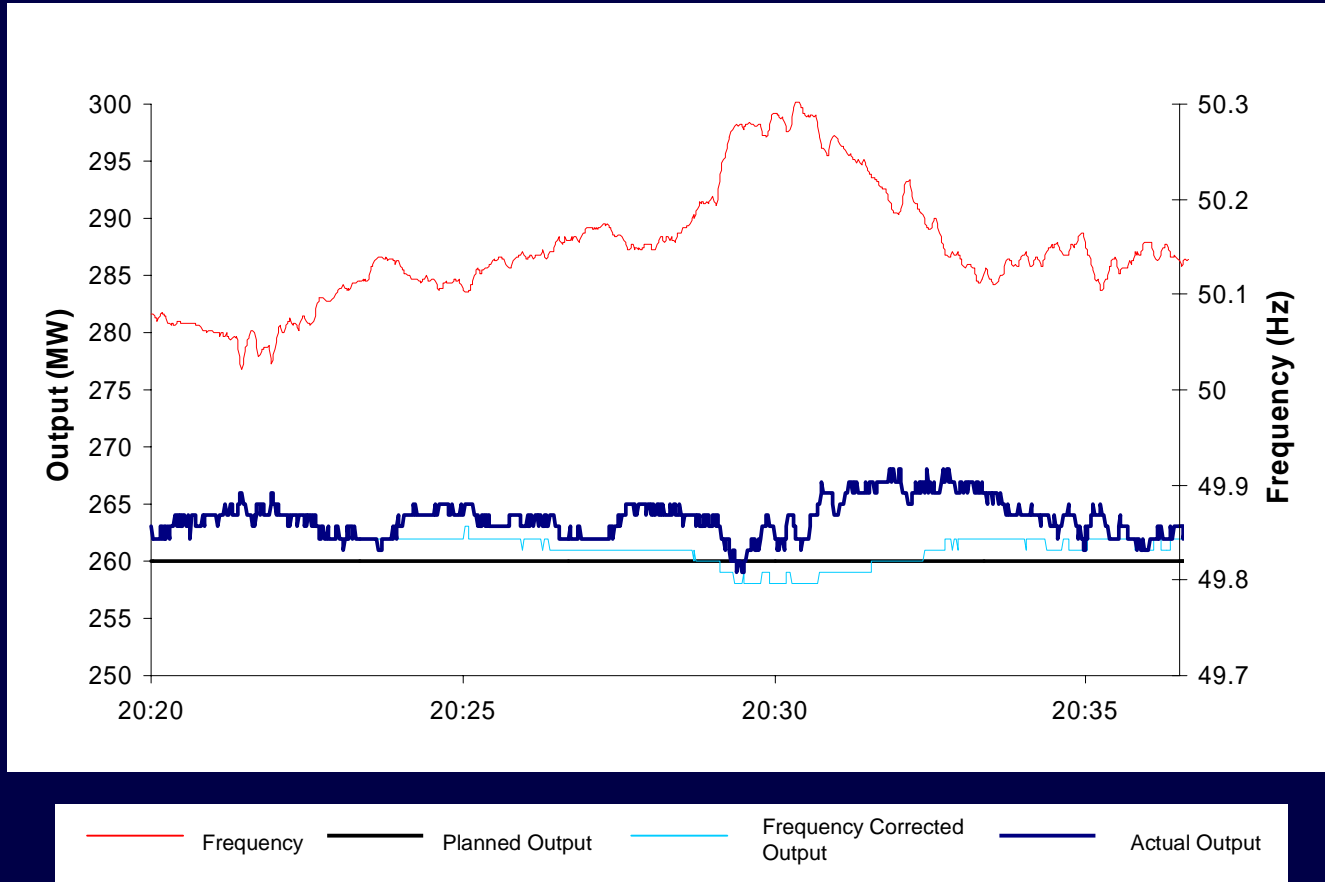


— Frequency — Planned Output — Frequency Corrected Output

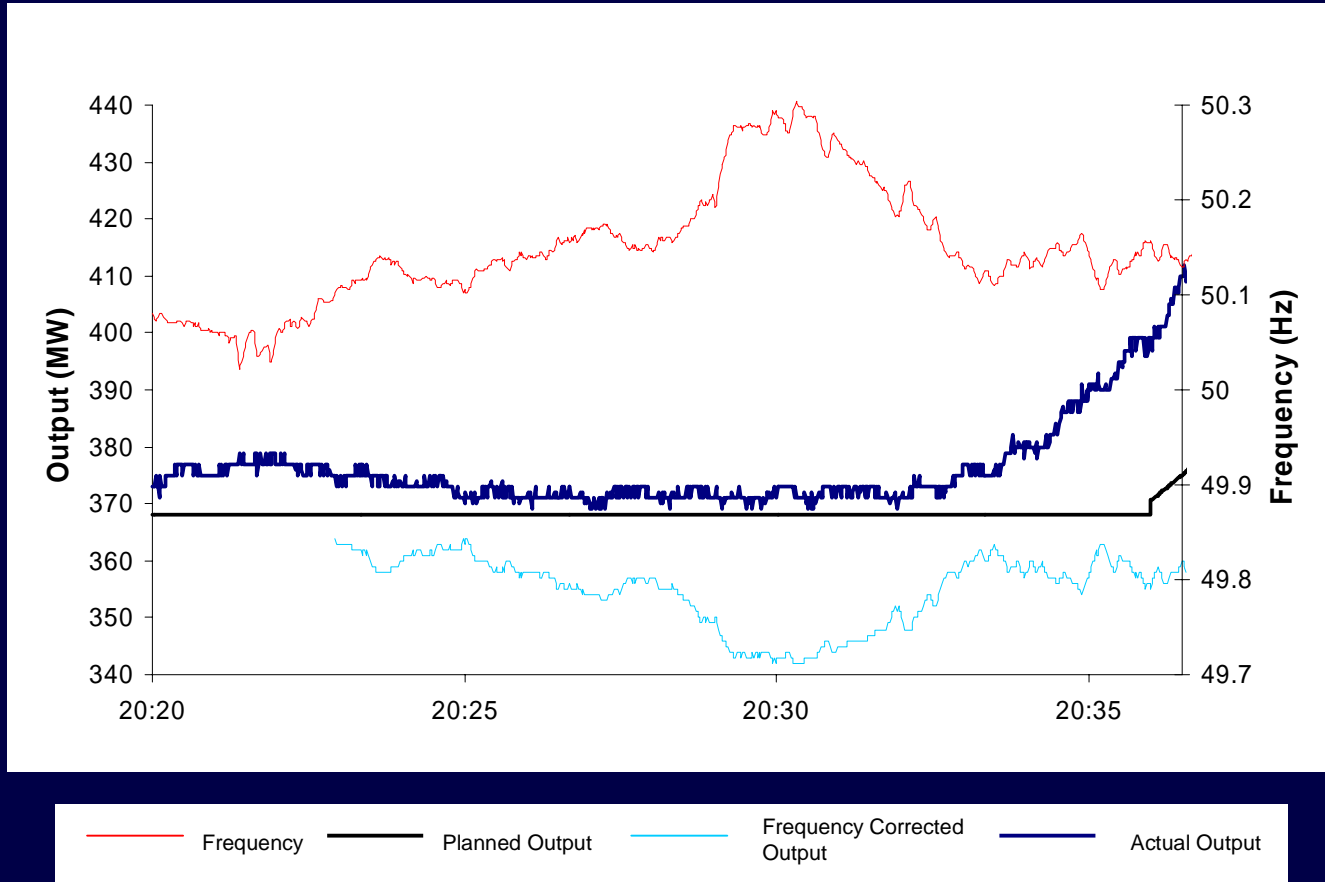
# A Real Example - 28th May



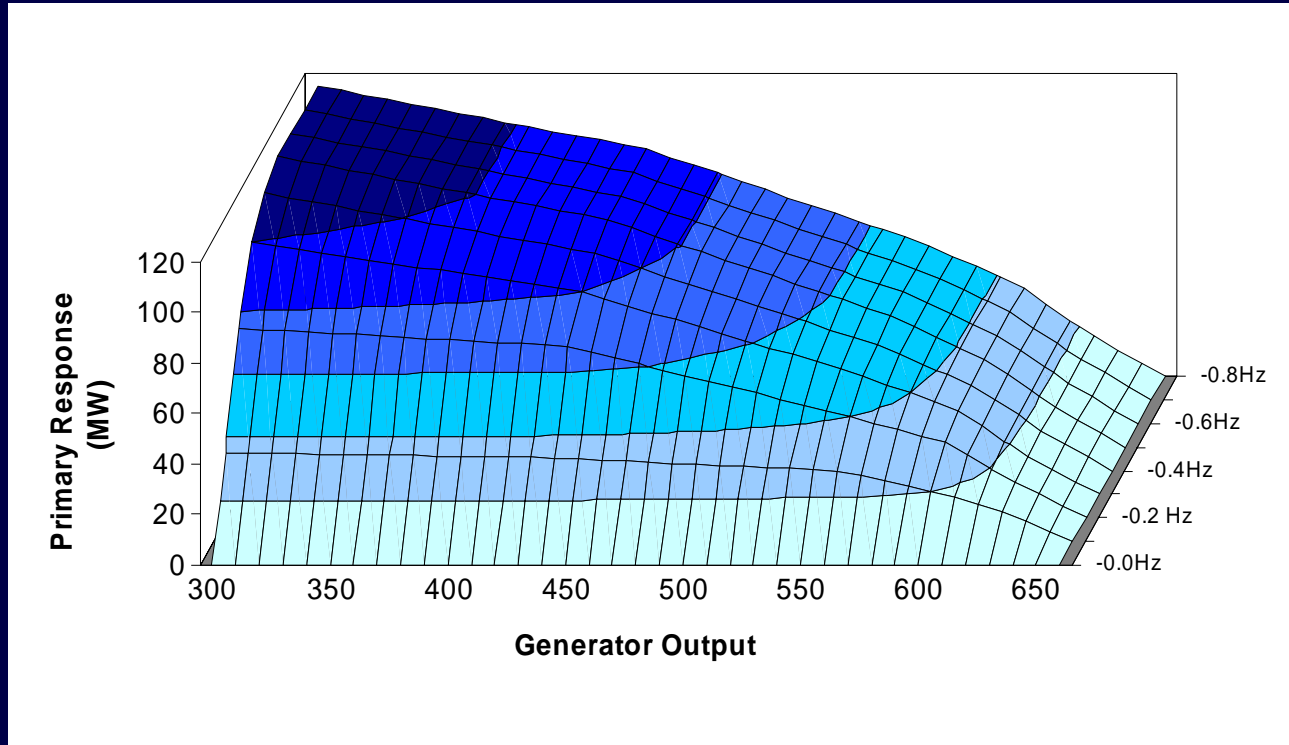
# High Frequency Response



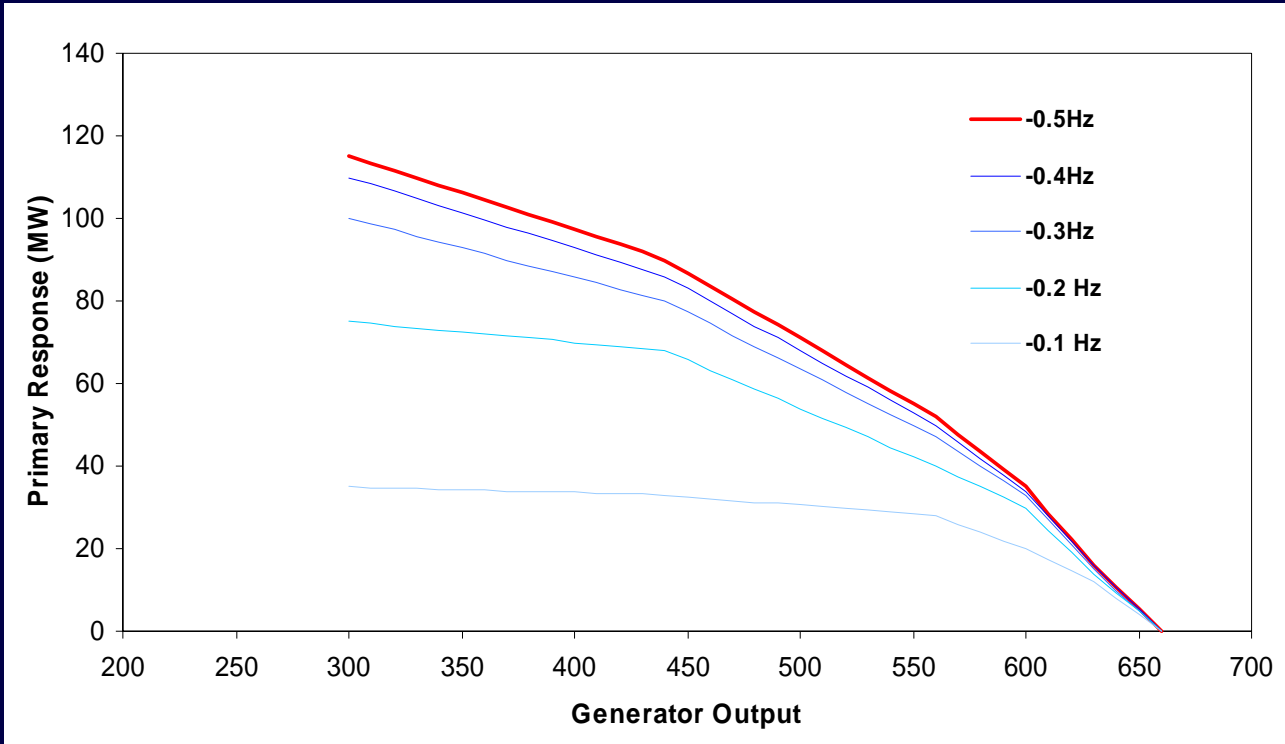
# High Frequency Response



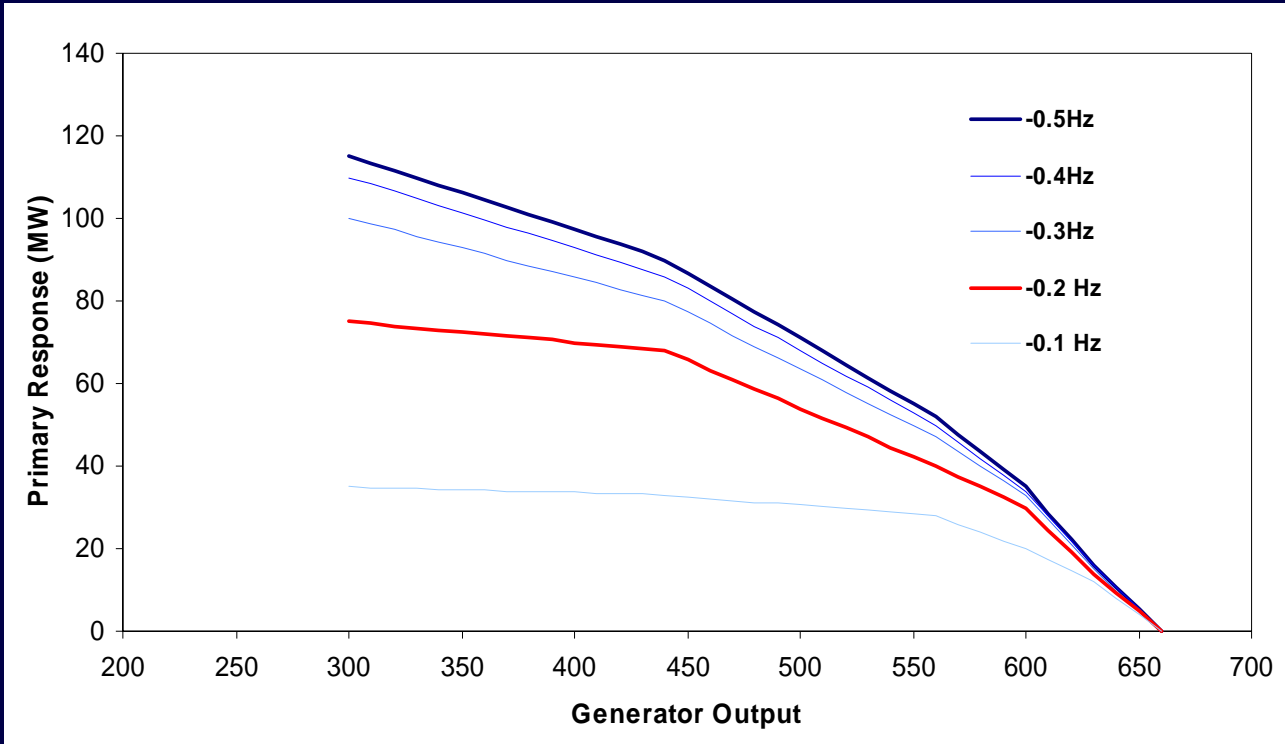
# Low Frequency Response



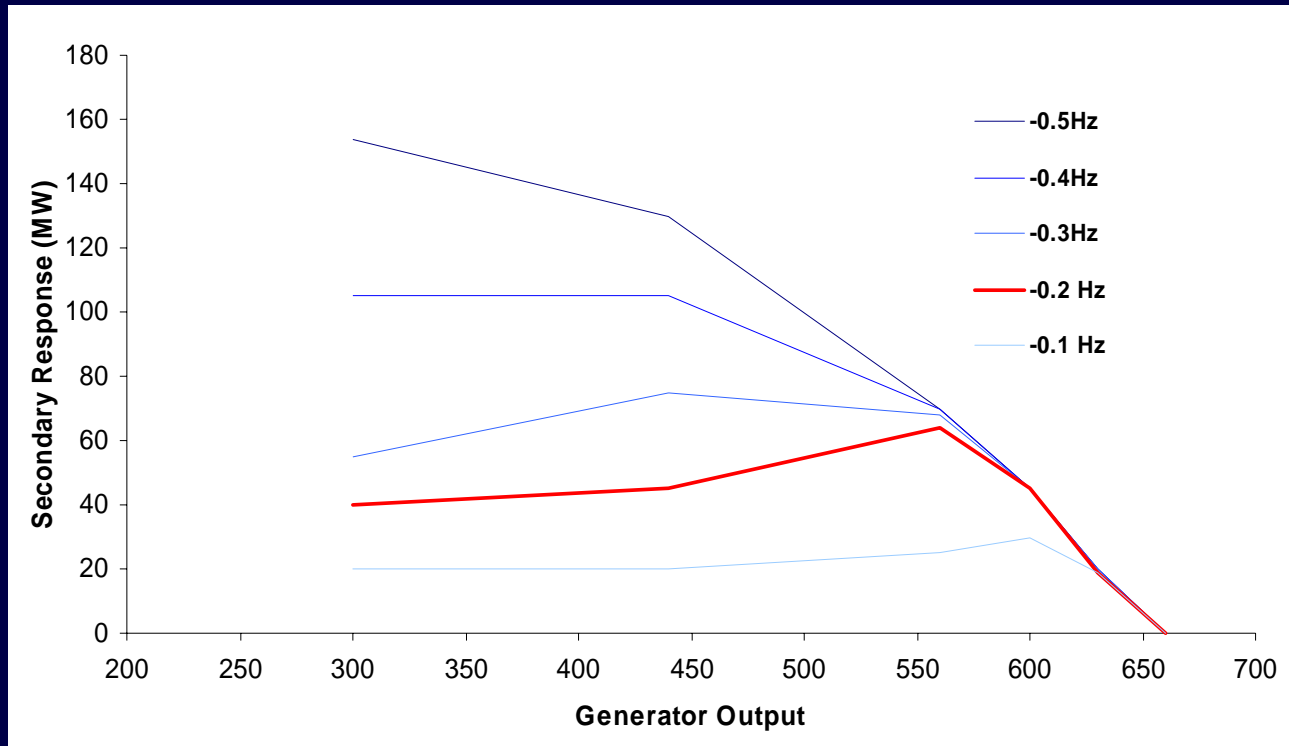
# Low Frequency Response



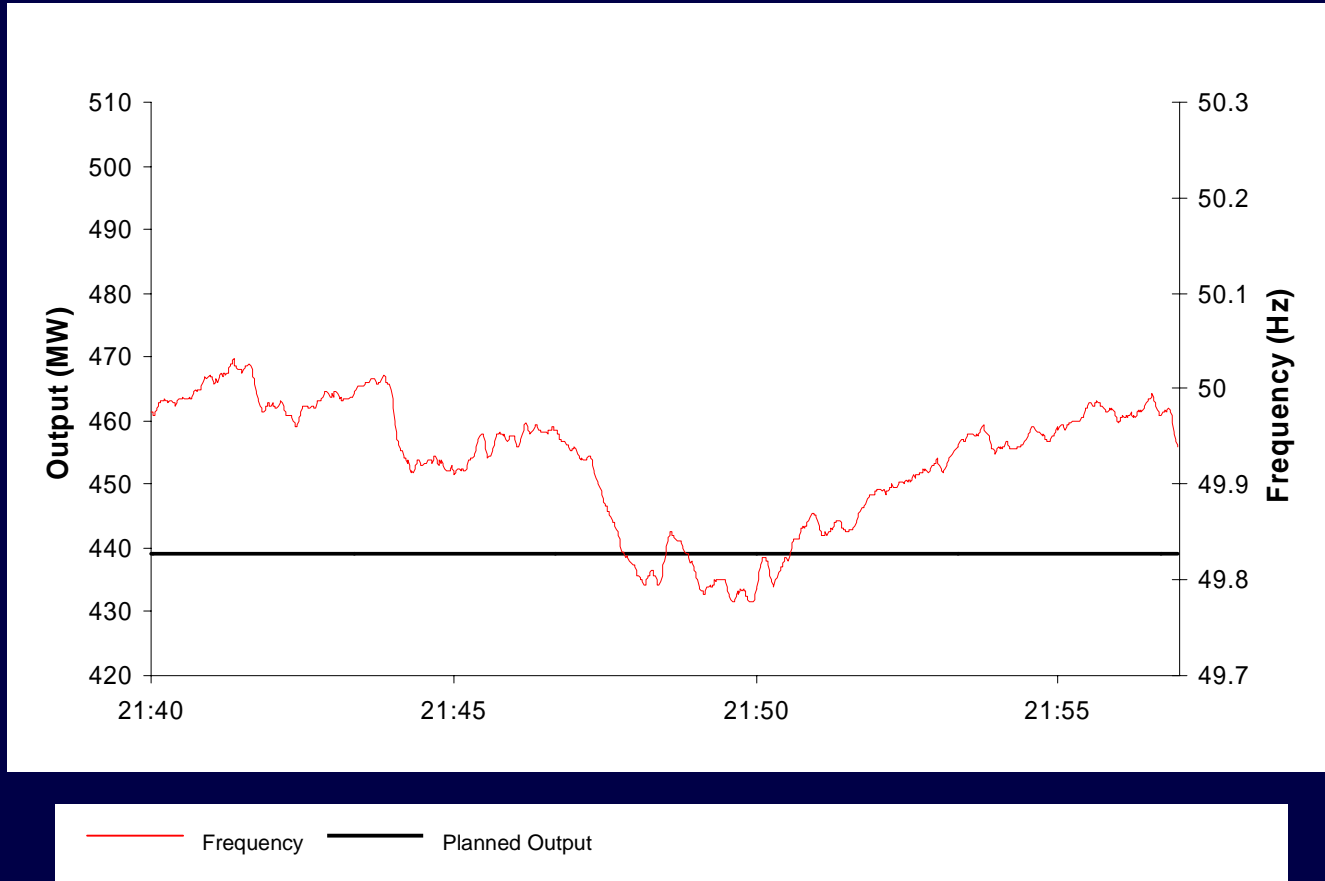
# Low Frequency Response



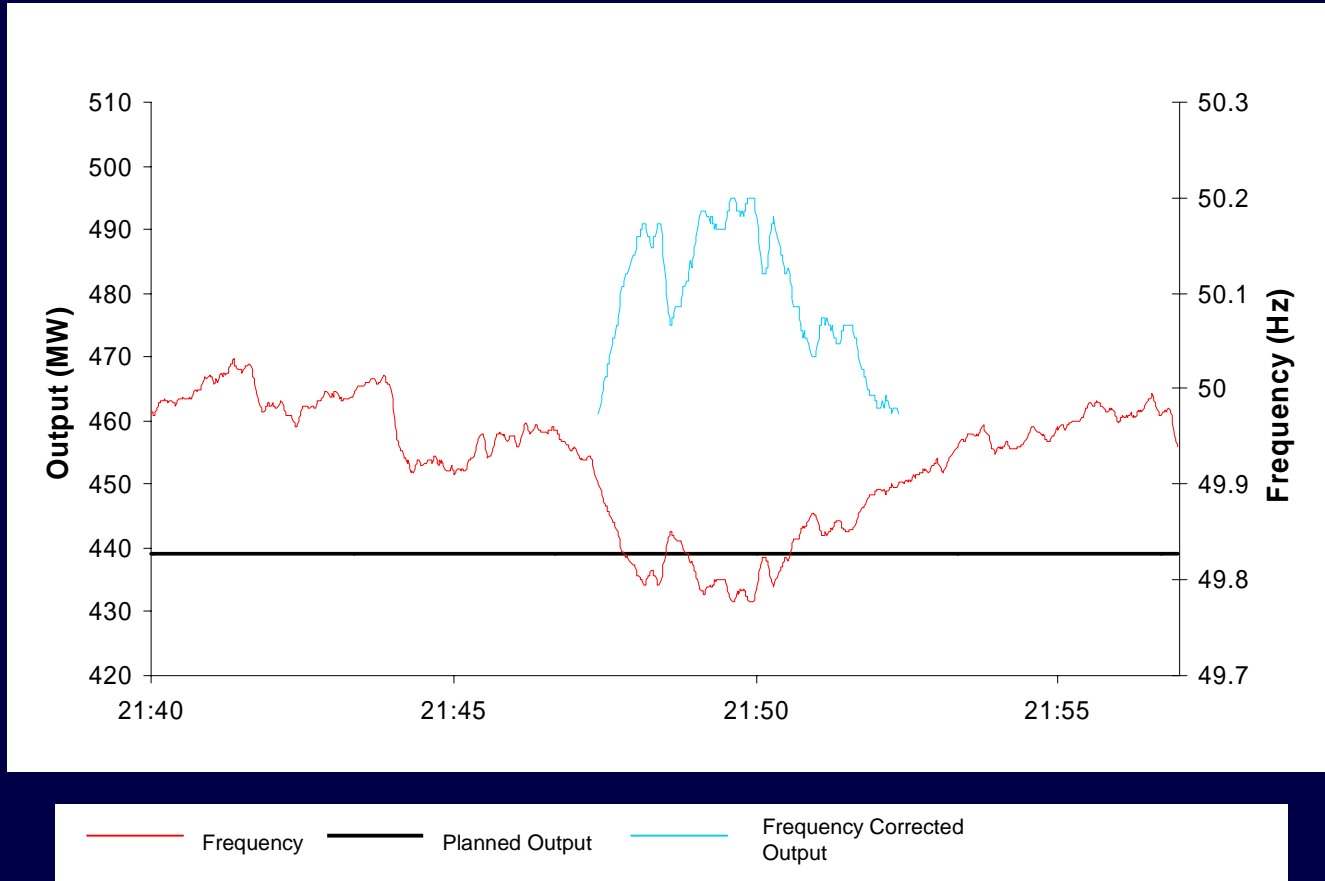
# Low Frequency Response



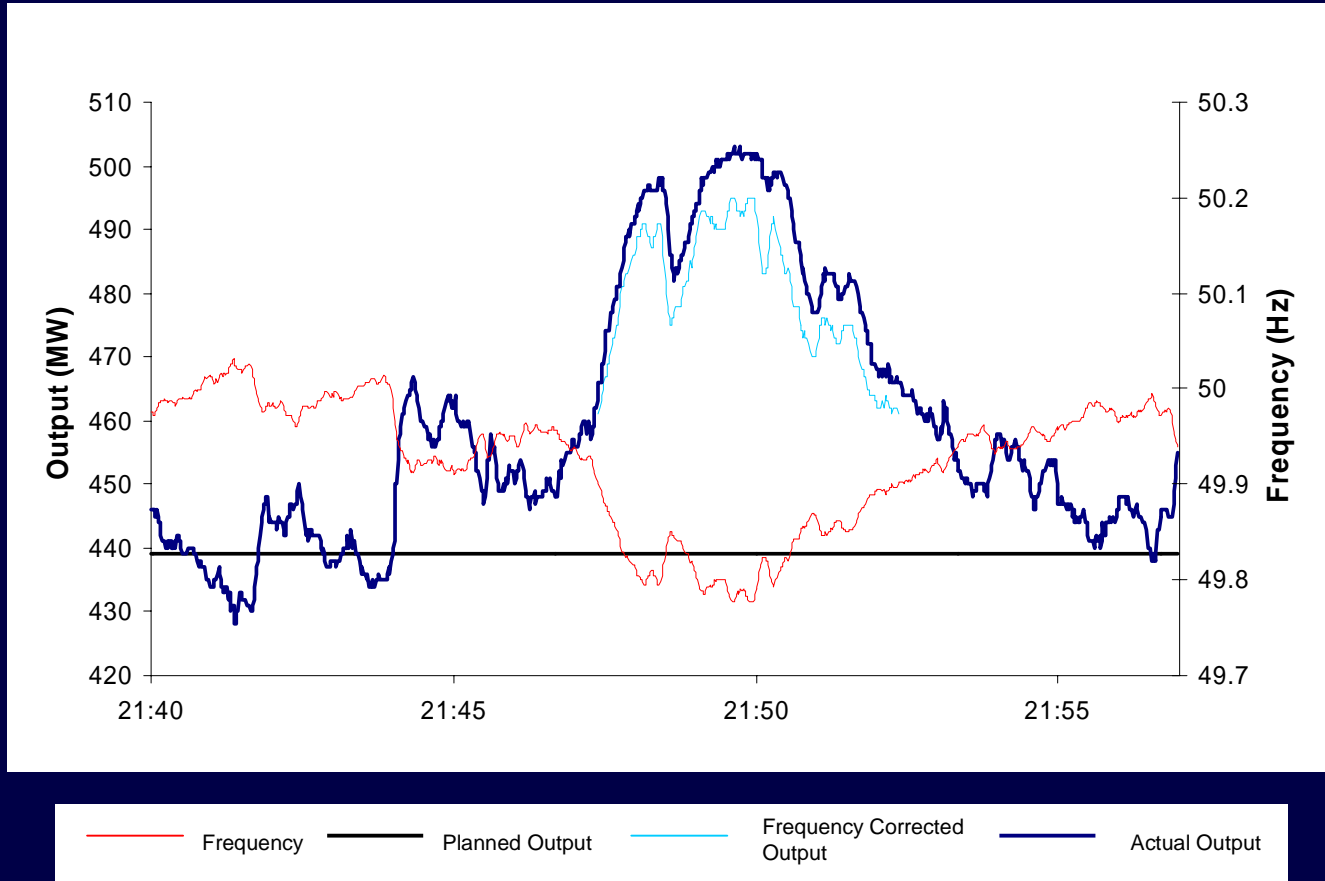
# A Real Example - 28th May



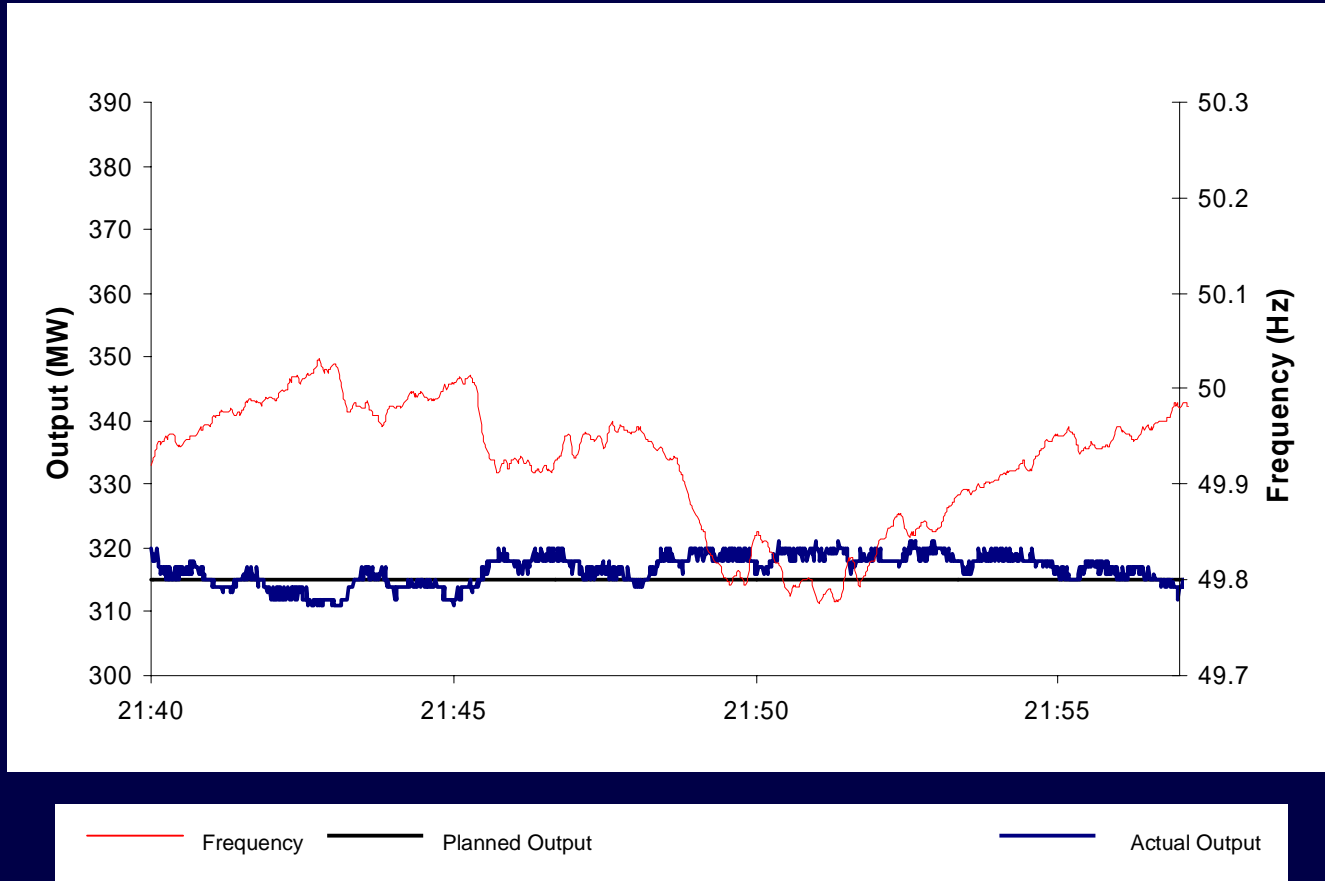
# A Real Example - 28th May



# A Real Example - 28th May



# Low Frequency Response

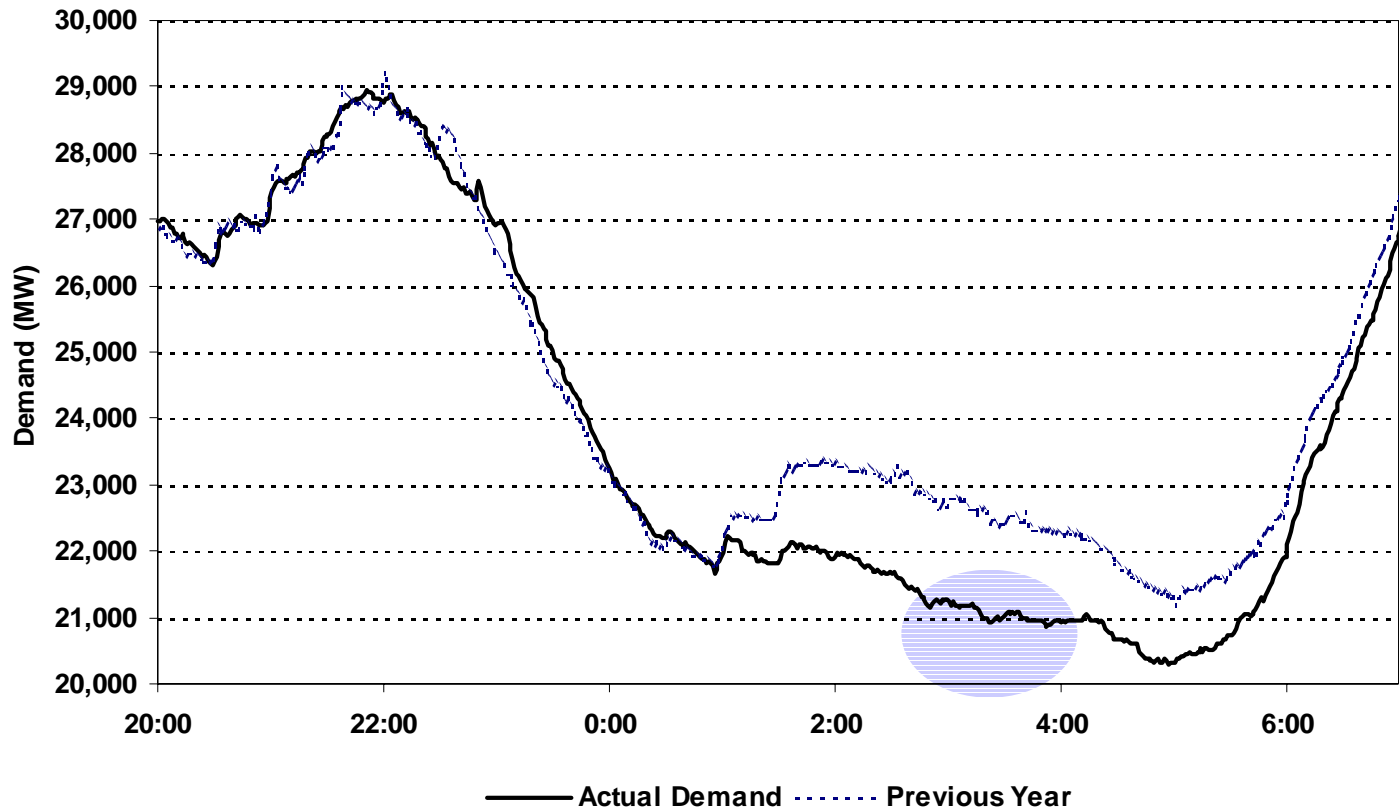


# Frequency Response

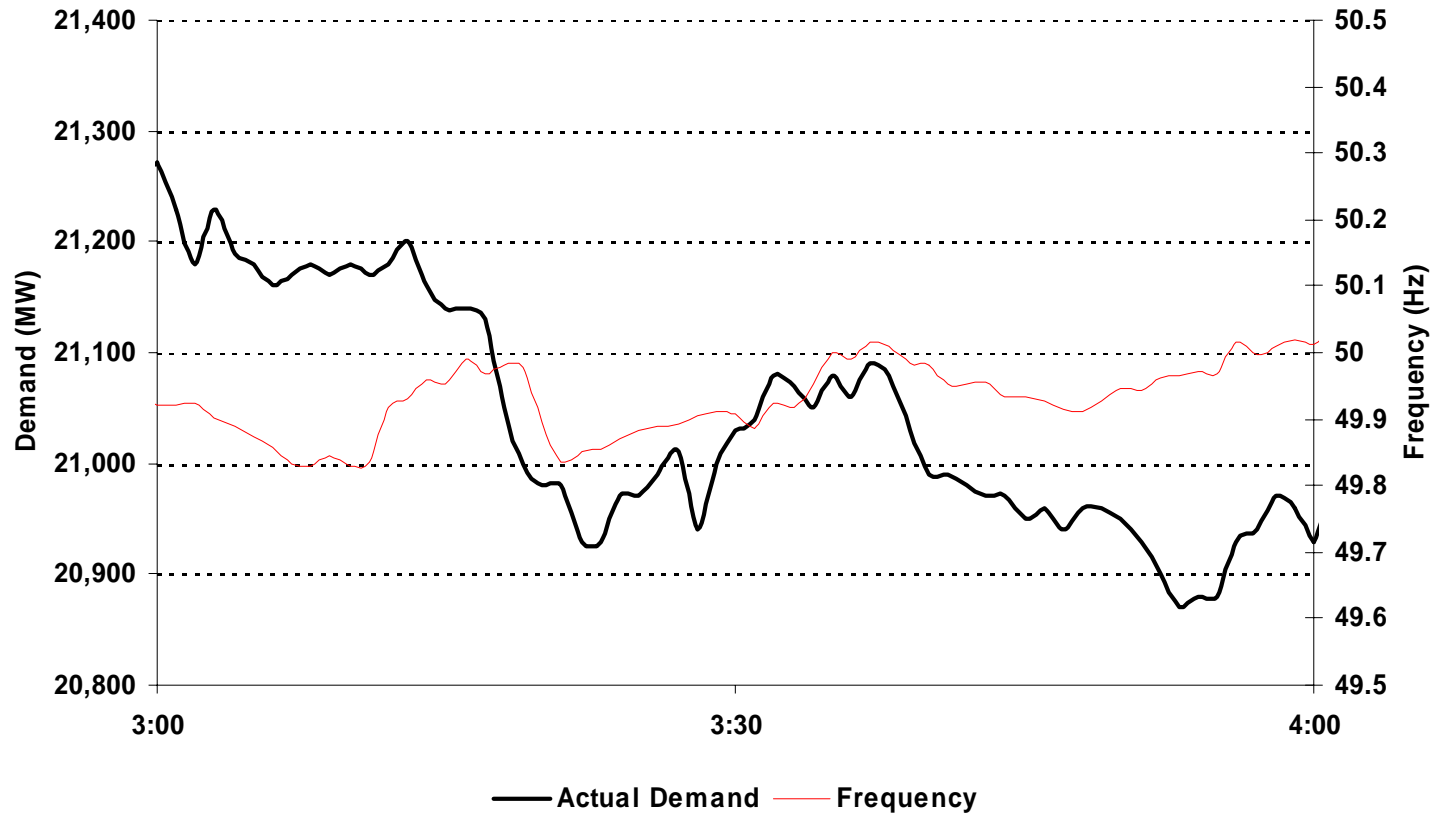
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- ◆ **Generators need to be loaded within a regulating range**
  - ◆ **Upward regulation in response to low frequencies**
  - ◆ **Downward regulation in response to high frequencies**
- ◆ **Covers instantaneous losses of generation and demand**
  - ◆ **Provided by Generation and Demand**

# Short Term Demand Variation



# Short Term Demand Variation



# Frequency Response

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- ◆ **Generators need to be loaded within a regulating range**
  - ◆ **Upward regulation in response to low frequencies**
  - ◆ **Downward regulation in response to high frequencies**
- ◆ **Covers continuous variation in demand as well as instantaneous losses**
- ◆ **This is particularly evident at times of low demand**

# Low Demand Periods

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*29th May - 05:00 1B Trough*

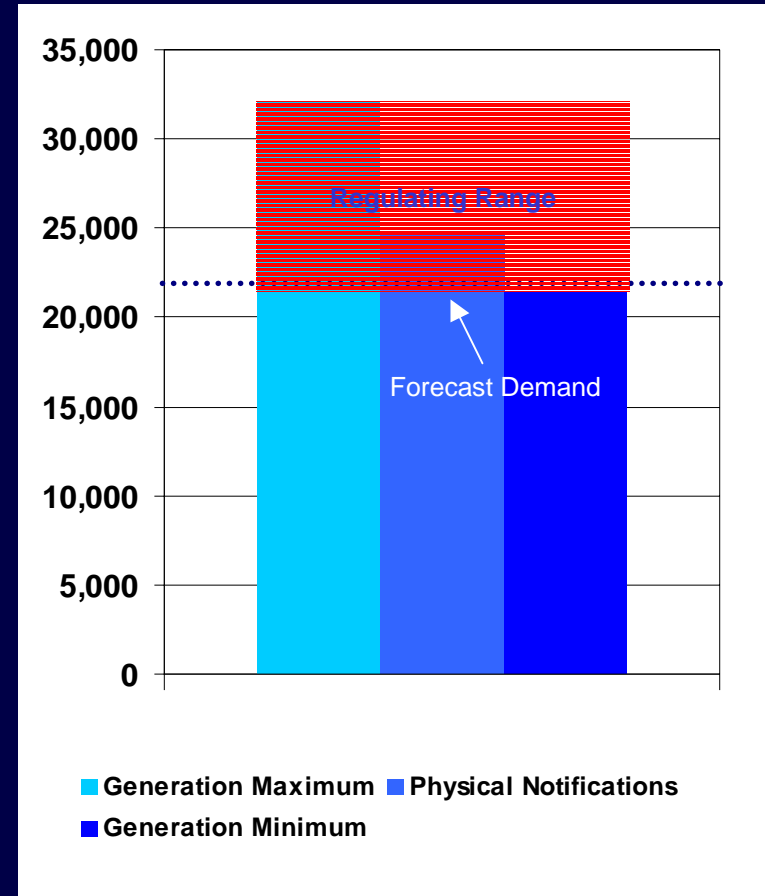
# Low Demand Periods

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- ◆ **Substantial amount of demand met by generation with low incremental cost**
- ◆ **Some of the generation is technically inflexible, some has adopted an inflexible commercial position**
- ◆ **Some generators may need to de-synchronise to provide regulating room**

# 29th May - 05:00 Minimum

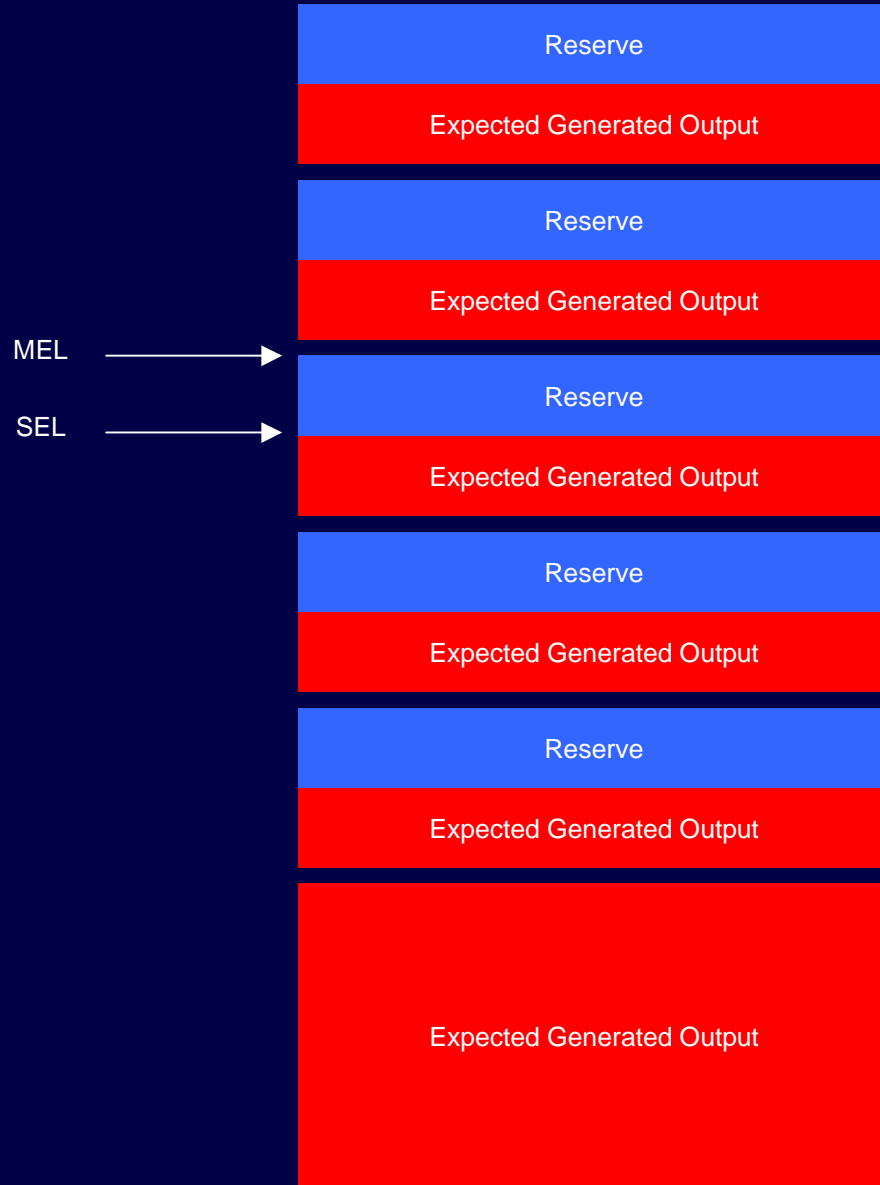
- ◆ **Physical Notifications**  
- 24,546MW
- ◆ **Generation Maximum**  
- 32,157MW
- ◆ **Generation Minimum** -  
21,340MW
- ◆ **Demand Forecast** -  
21,558MW



# Illustrative Example

- ◆ **Stack of Inflexible generation**
- ◆ **Stack of flexible generation at minimum**







Expected Generated Output

Expected Generated Output

Expected Generated Output

Expected Generated Output

Expected Generated Output

Expected Generated Output

Reserve

Reserve

Reserve

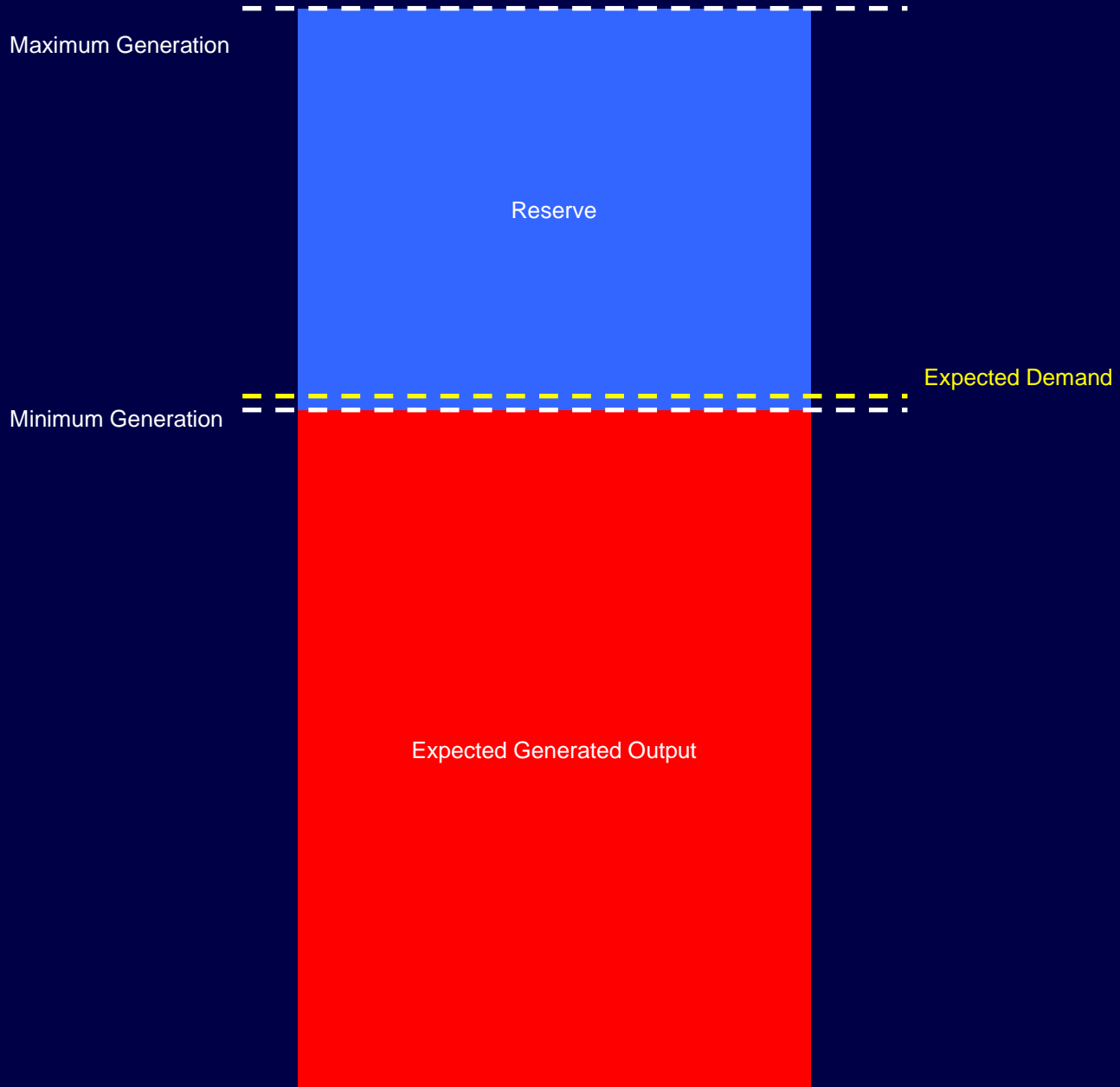
Reserve

Reserve



Expected Generated Output

Reserve



Reserve

Expected Generated Output

Reserve

Expected Generated Output

Reserve

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Expected Generated Output

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Expected Generated Output

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Expected Generated Output

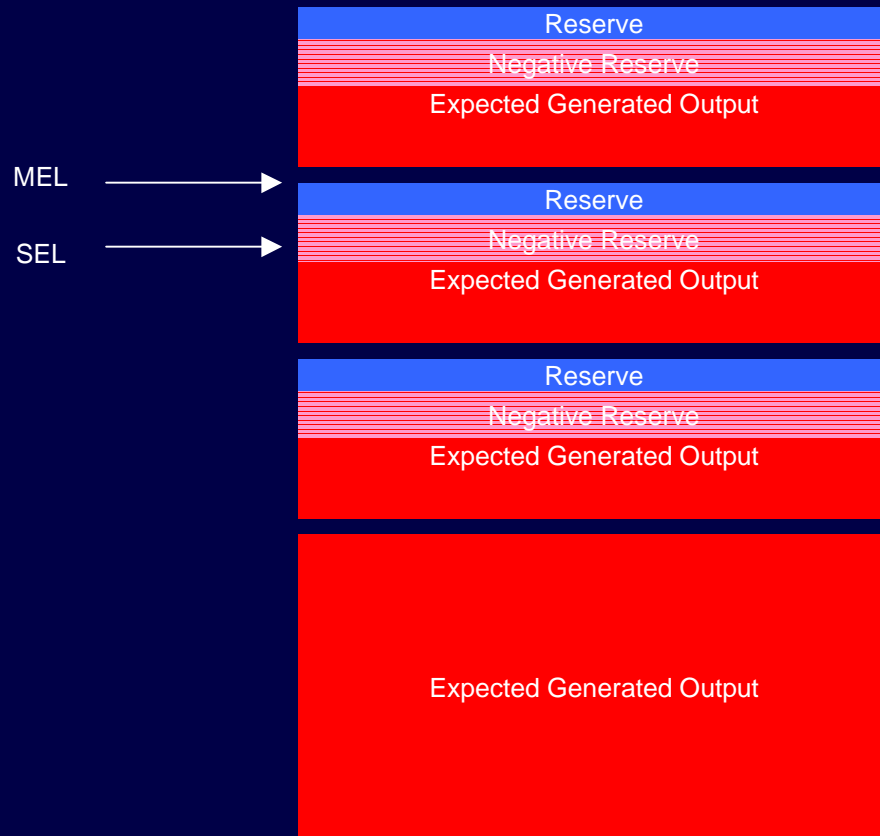
Reserve

Expected Generated Output

Reserve

Expected Generated Output

Expected Generated Output



Expected Generated Output

Reserve  
Negative Reserve

Expected Generated Output

Reserve  
Negative Reserve

Expected Generated Output

Reserve  
Negative Reserve

Expected Generated Output

Expected Generated Output

Reserve

Negative Reserve

Expected Generated Output

Reserve

Negative Reserve

Expected Generated Output

Reserve

Negative Reserve

Expected Generated Output

Expected Generated Output

Expected Generated Output

Expected Generated Output

Expected Generated Output

Reserve

Reserve

Reserve

Negative Reserve

Negative Reserve

Negative Reserve

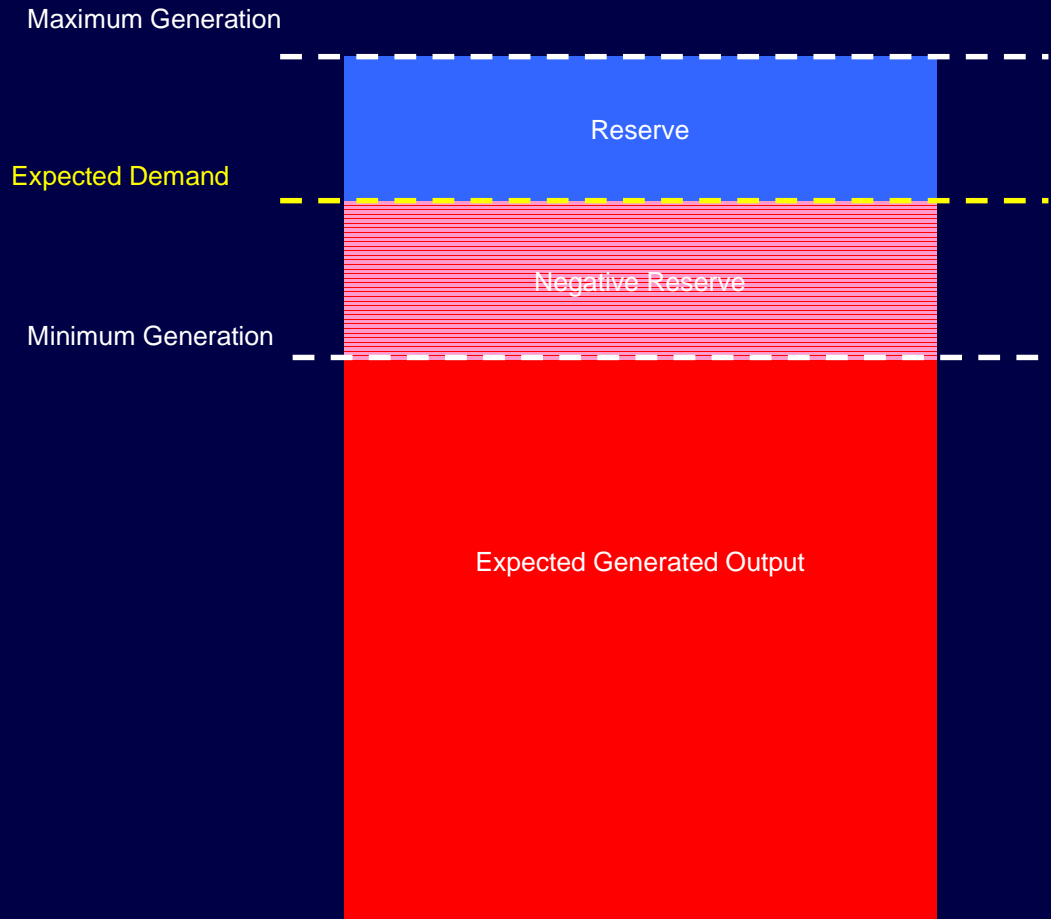


Expected Generated Output

Reserve

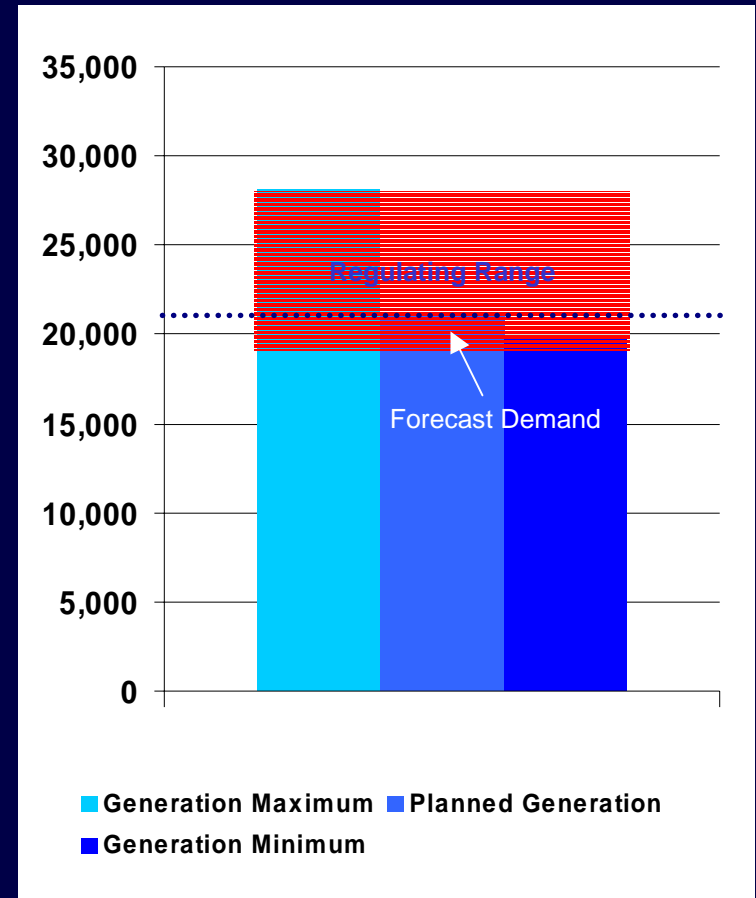
Negative Reserve

# Regulating Requirements Met



# 29th May - Operating Plan

- ◆ **Final Plan Issued at 00:00**
- ◆ **Demand Forecast 21,558MW**
- ◆ **Maximum Generation - 28,165 MW**
- ◆ **Minimum Generation - 19,952MW**



# 29th May - Operating Plan

- ◆ **Planned 'De-syncs' - 3,456MW**
- ◆ **Selected on the basis of highest Bid first**
- ◆ **Frequency Response Capability taken into account**

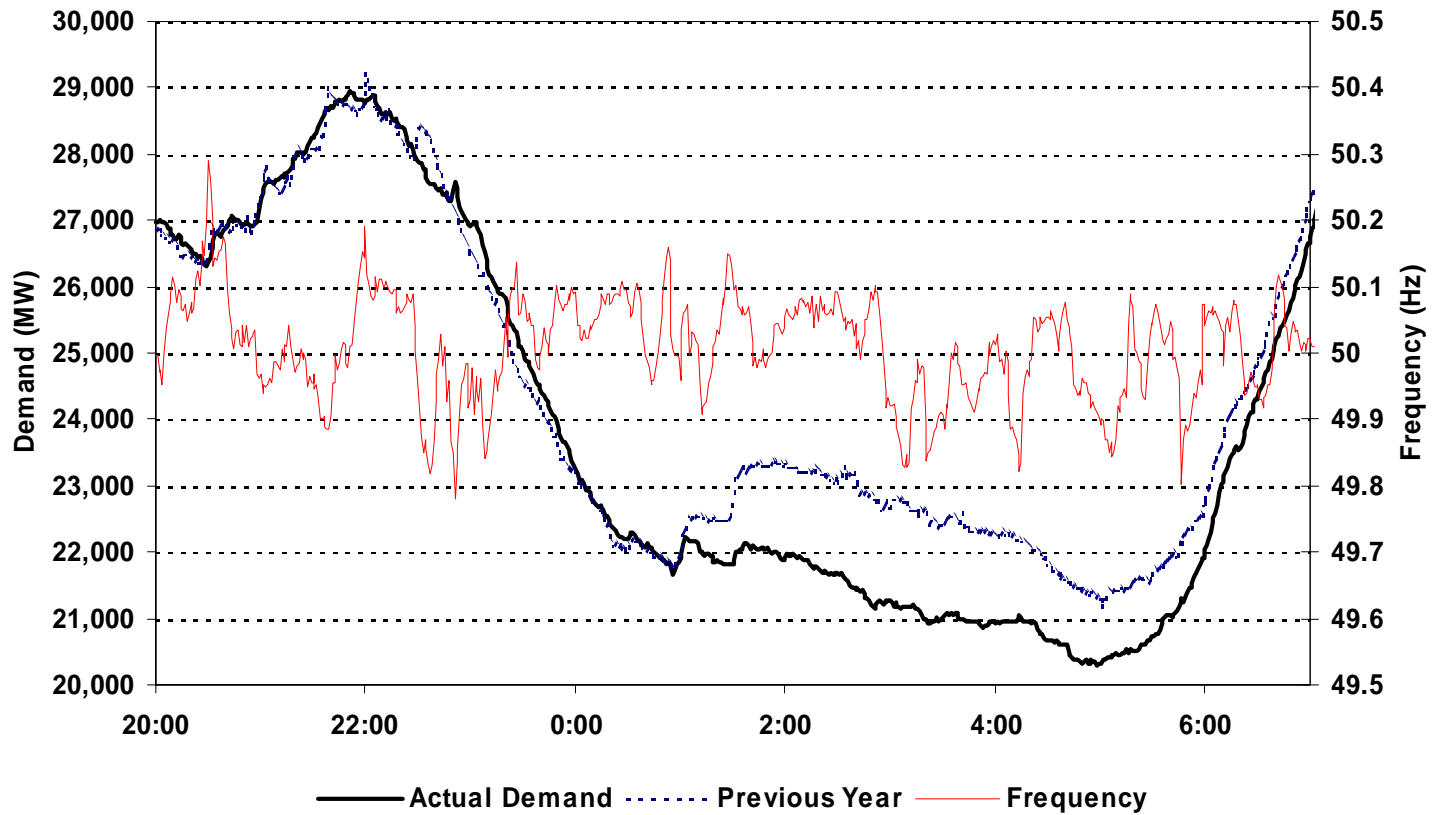
<b>BMU</b>	<b>PN</b>
SEAB-1	736
SEAB-2	250
KEAD-1	650
COTPS-2	377
KINO-3	300
EGGPS-3	433
DRAXX-5	300
EGGPS-1	410
<b>Total</b>	<b>3,456</b>



# Bid Offer Acceptances

BMU	Accepted	From	To	From_MW	To_MW
COTPS-2	29/05/01 00:00:00	29/05/01 00:59:00	29/05/01 03:30:00	0	0
COTPS-2	29/05/01 01:33:00	29/05/01 01:36:00	29/05/01 04:00:00	0	0
DRAXX-5	29/05/01 00:42:00	29/05/01 00:44:00	29/05/01 04:30:00	0	0
DRAXX-5	29/05/01 02:06:00	29/05/01 02:08:00	29/05/01 04:35:00	0	0
EGGPS-1	29/05/01 00:26:00	29/05/01 00:44:00	29/05/01 04:00:00	0	0
EGGPS-1	29/05/01 01:56:00	29/05/01 01:58:00	29/05/01 04:45:00	0	0
EGGPS-3	28/05/01 23:33:00	28/05/01 23:35:00	29/05/01 03:30:00	0	0
EGGPS-3	29/05/01 01:16:00	29/05/01 01:18:00	29/05/01 04:25:00	0	0
KEAD-1	29/05/01 00:06:00	29/05/01 00:08:00	29/05/01 04:00:00	0	0
KEAD-1	29/05/01 01:56:00	29/05/01 01:58:00	29/05/01 04:20:00	0	0
KINO-3	29/05/01 01:00:00	29/05/01 01:30:00	29/05/01 05:00:00	0	0
SEAB-1	29/05/01 01:08:00	29/05/01 01:10:00	29/05/01 02:10:00	0	0
SEAB-1	29/05/01 02:35:00	29/05/01 02:37:00	29/05/01 03:50:00	0	0
SEAB-2	29/05/01 01:08:00	29/05/01 01:10:00	29/05/01 03:10:00	0	0
SEAB-2	29/05/01 02:37:00	29/05/01 02:39:00	29/05/01 04:39:00	0	0

# Frequency



# What We Need...

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- ◆ **...to manage minimum demand periods-**
  - ◆ **Generation with good continuous regulating capability**
  - ◆ **More demand!**
  - ◆ **Bid volume**

# What happens if...

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- ◆ **...we run out of bid volume**
  - ◆ **NRAPM Warning Issued**
  - ◆ **Emergency Instructions issued to de-synchronise generation (deemed bids)**
  - ◆ **However, responsive generation with bid volume could be left on**

# Conclusions

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- ◆ **Frequency Response introduces a large amount of complexity to despatch**
- ◆ **Low demand periods will require de-synchronisation of generation**
- ◆ **Please consider the bid volumes you make available in these periods**

# Bid Taken to Wall

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- ◆ **Contact the BMU concerned to advise of the total time the unit is expected to be kept off**
- ◆ **Give *likely* return time**
- ◆ **Continue to issue BOAs for this duration whilst system conditions and BMU bid prices remain in line with expectations.**

# Bid Taken to Wall

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- ◆ **If system conditions change (e.g. unexpected loss of inflexible generation), or BMU prices are revised following the discussion, no further BOAs should be taken**
- ◆ **BMU concerned would be expected to profile PN / MEL return at the end of the wall.**

# Operational Forum

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*Overnight on 28th/29th May 2001*