

Frequency Response Payments

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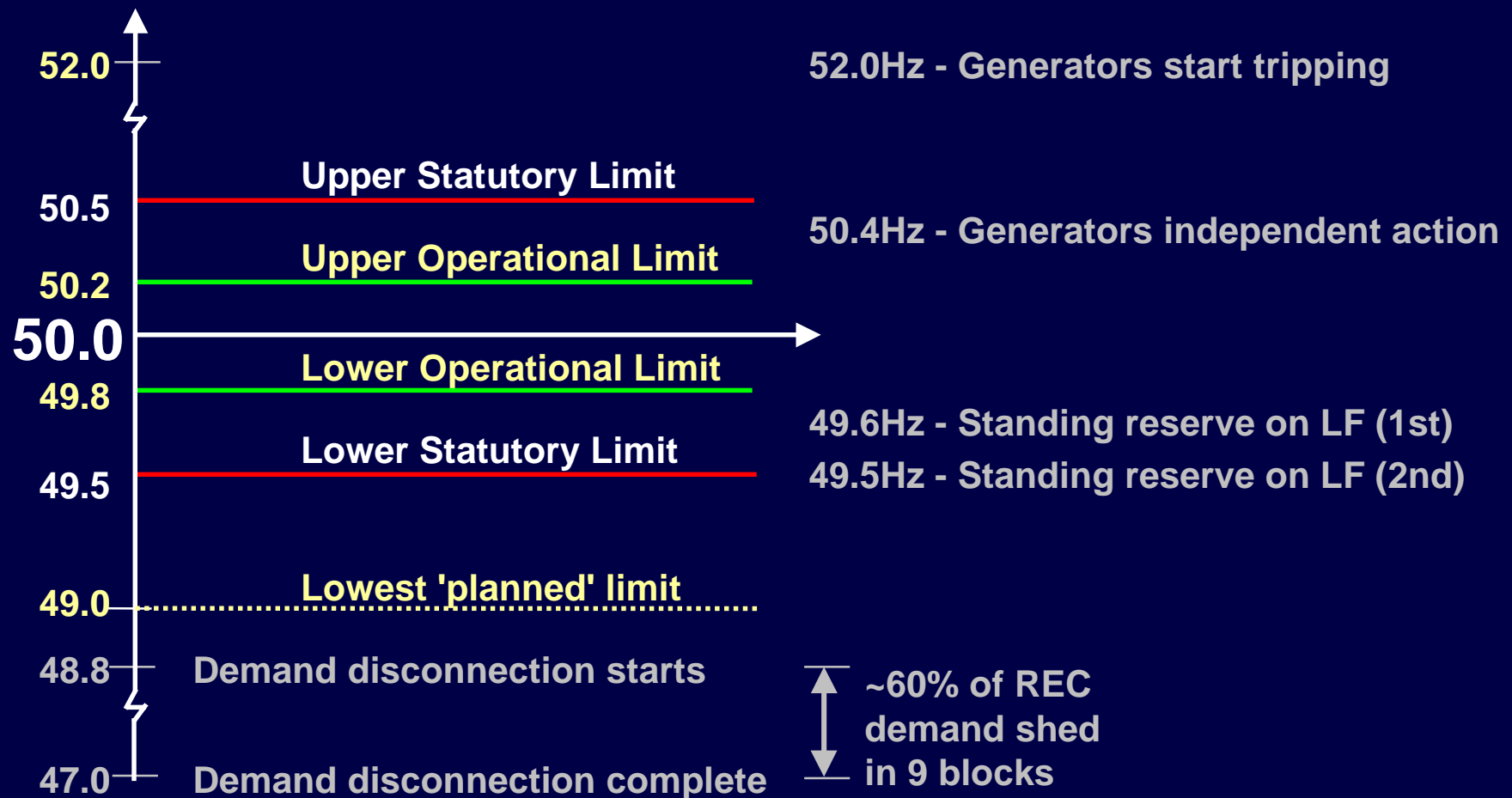
Content

- ◆ **What is Frequency Response**
- ◆ **Definitions**
- ◆ **Payment for mandatory service**
- ◆ **Demand side participation**

Frequency Response

- ◆ **What is it?**
 - ◆ **an automatic change in active power output or demand in response to a frequency change**
- ◆ **Why we need it?**
 - ◆ **to maintain system frequency within statutory and operational limits**

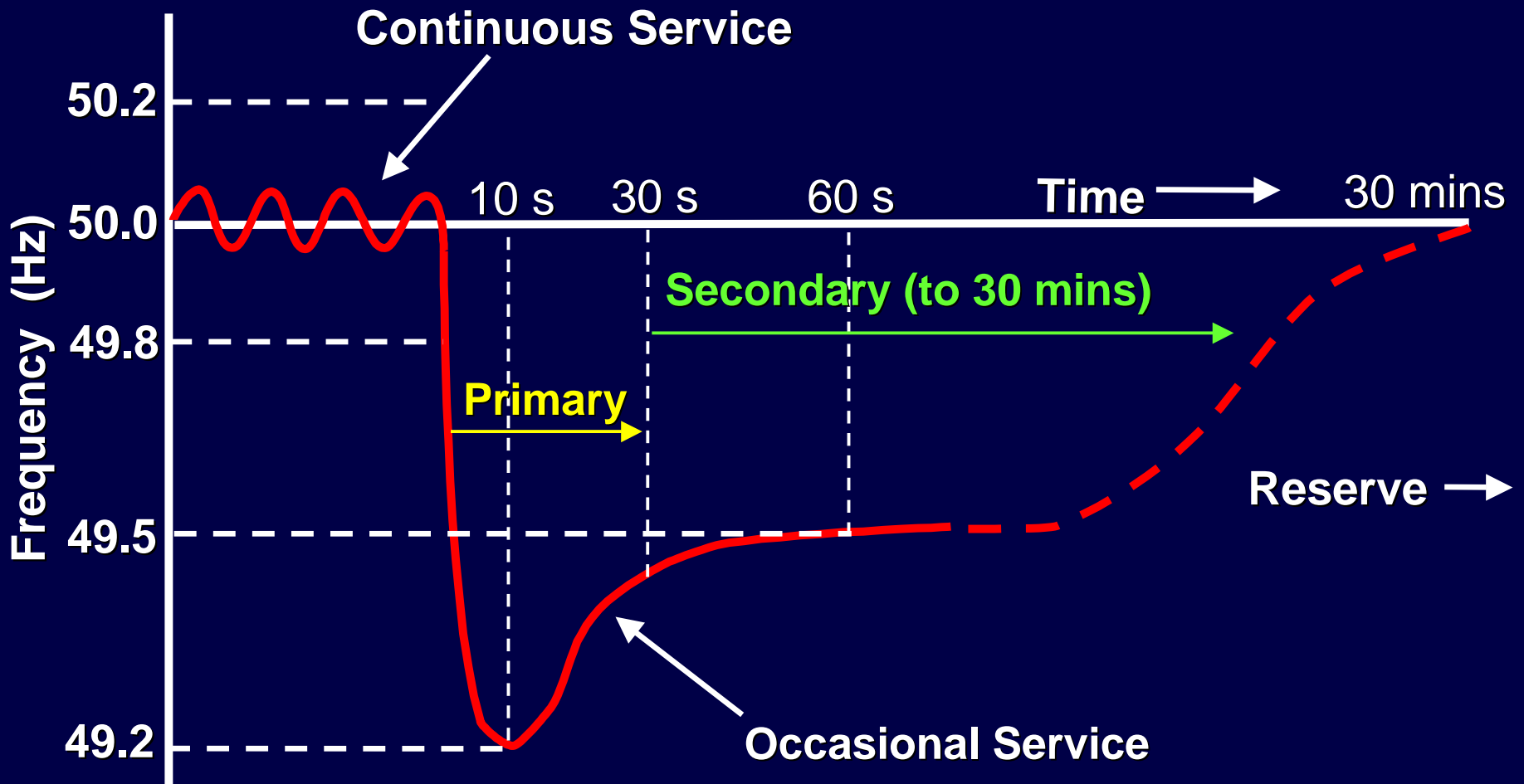
Standards



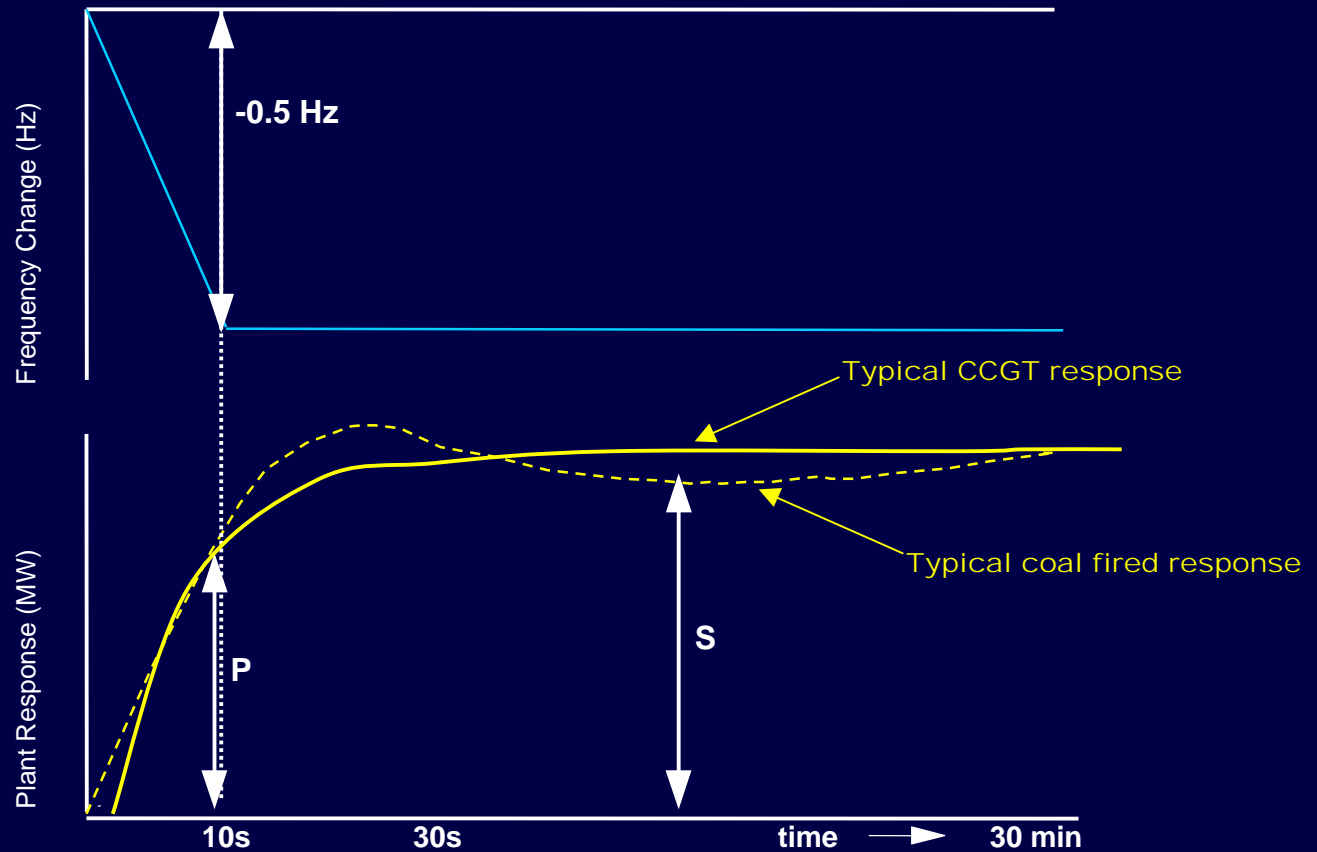
Frequency Response

- ◆ **Who can provide it?**
 - ◆ **all licensed generators in accordance with Grid Code mandatory requirements**
 - ◆ **generators offering enhanced commercial services**
 - ◆ **demand tripping by low frequency relay**
 - ◆ **unlicensed generators with a commercial agreement**

Frequency Control Phases

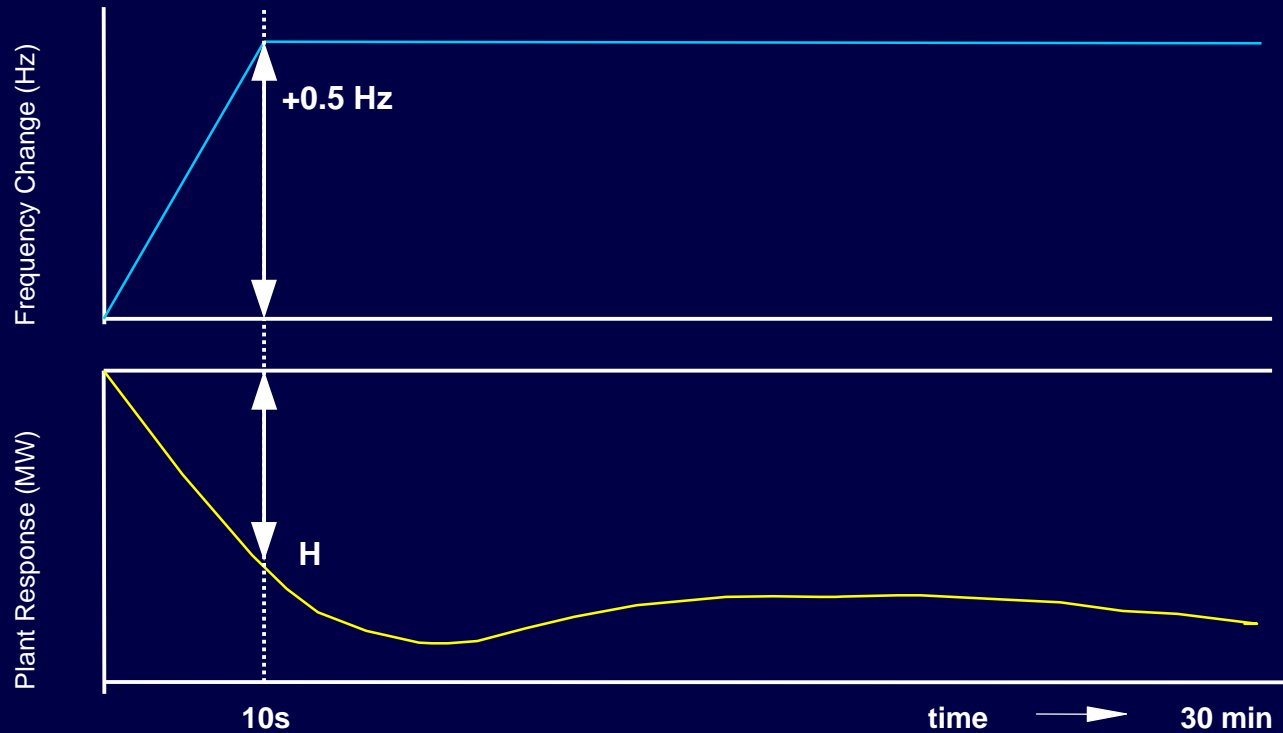


Typical Primary & Secondary Delivery



Typical High Delivery

High Frequency



Frequency Response Procurement

- ◆ **How is it procured?**
 - ◆ **bilaterally between National Grid and service providers**
 - **cost reflective basis for mandatory service - terms in CUSC**
 - **commercial basis for any “alternative” response products**

Frequency Response Payment

- ◆ **Three types of payment for mandatory service:**
 - ◆ load level changes via bids and offers
 - ◆ capability fee when selected to provide primary, secondary or high
 - ◆ imbalance compensation

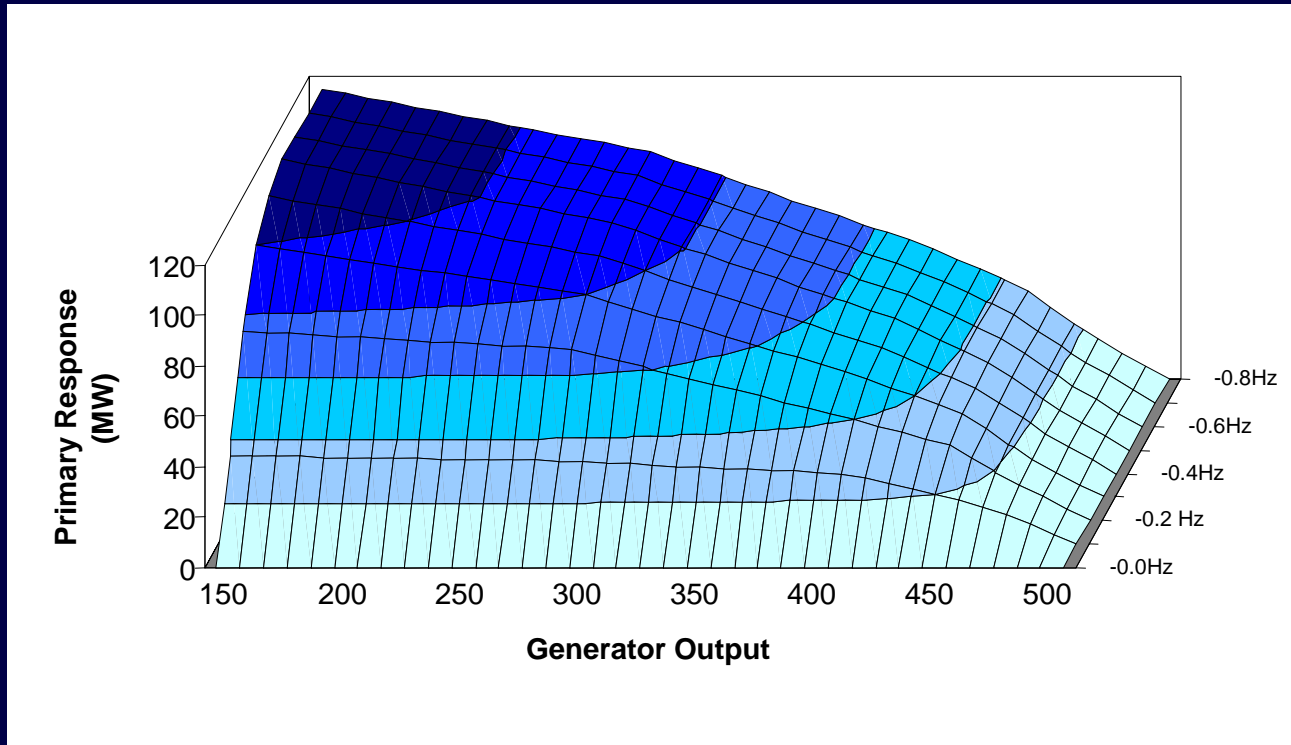
Frequency Response Payment

- ◆ **Payment options for commercial service:**
 - ◆ payment for load level changes
 - ◆ capability fee when selected
 - ◆ imbalance compensation
 - ◆ option fee for providing specific service

Mandatory Payment arrangements 1

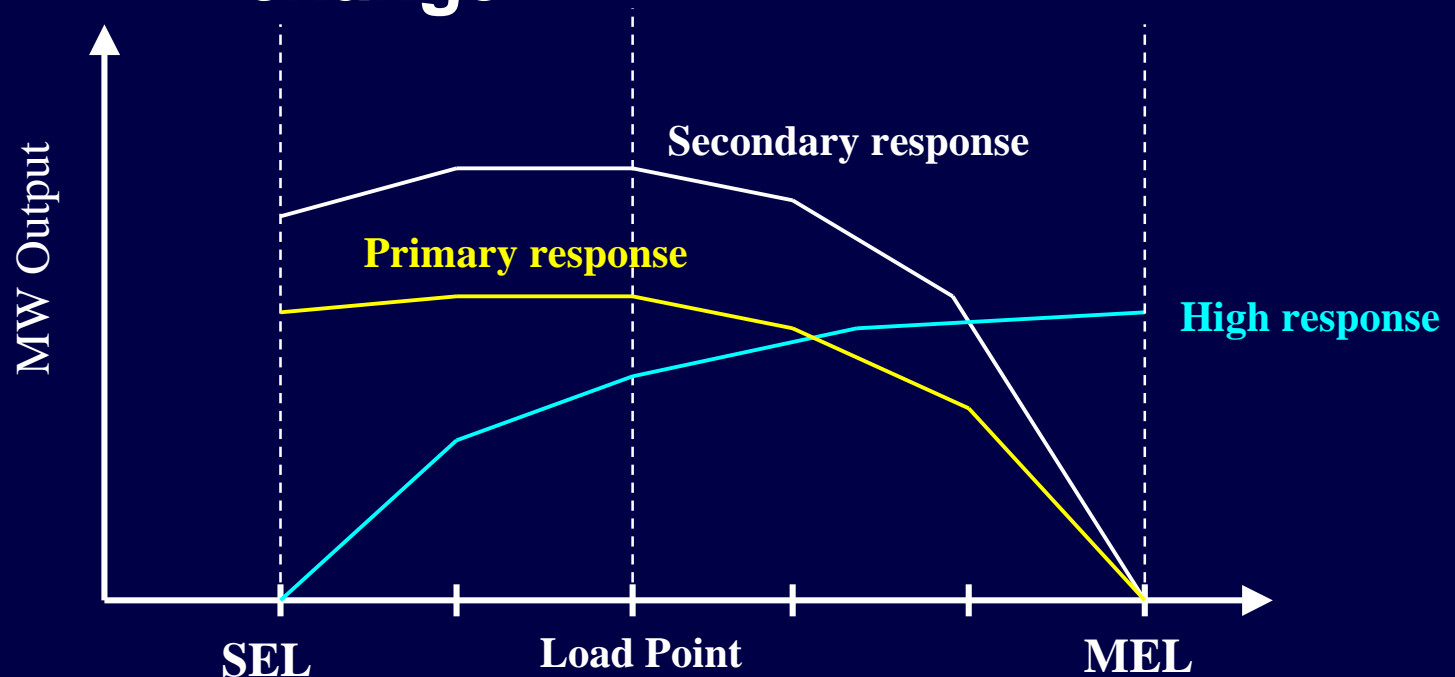
- ◆ load level change costs
 - ◆ need to optimise BMU loading to enable low or high response to be provided
 - ◆ usually bids and offers taken through the BM

Low Frequency Response



Frequency Response

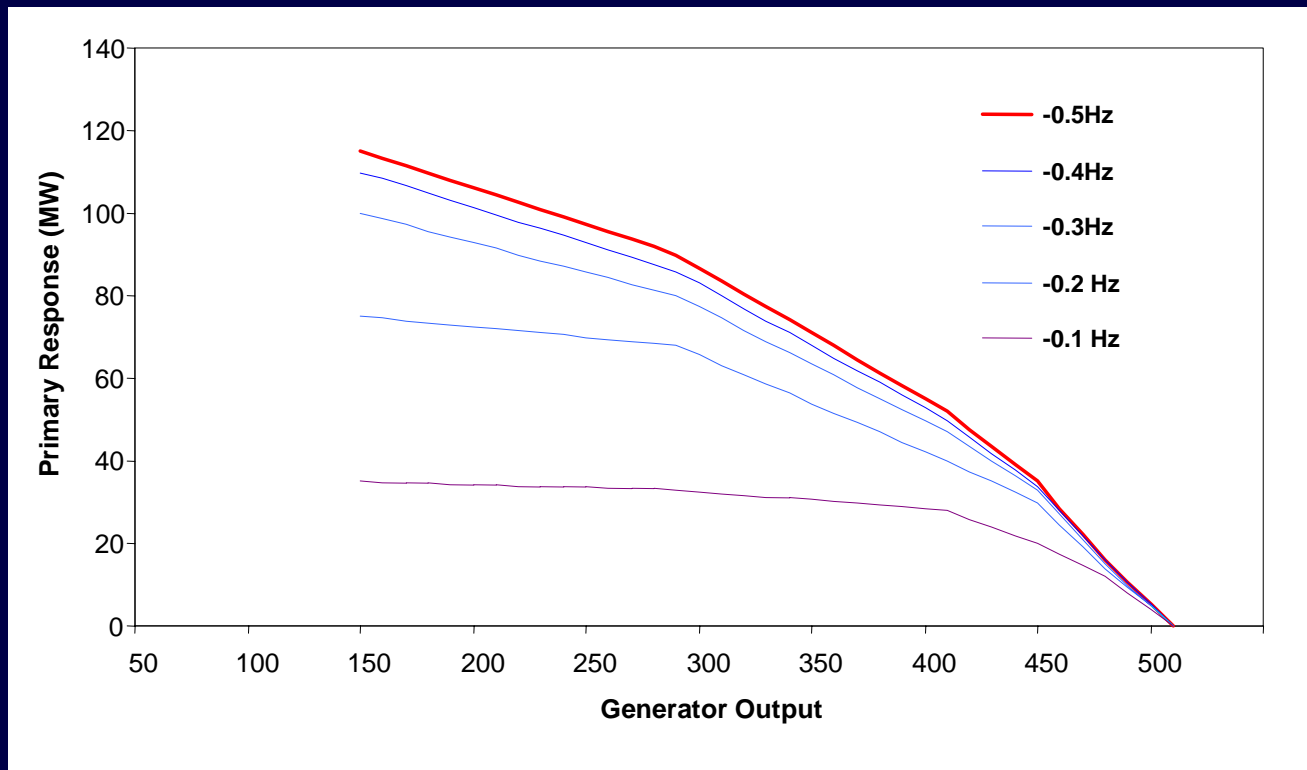
- ◆ **Provision by a Generator**
 - ◆ a function of de-load and frequency change



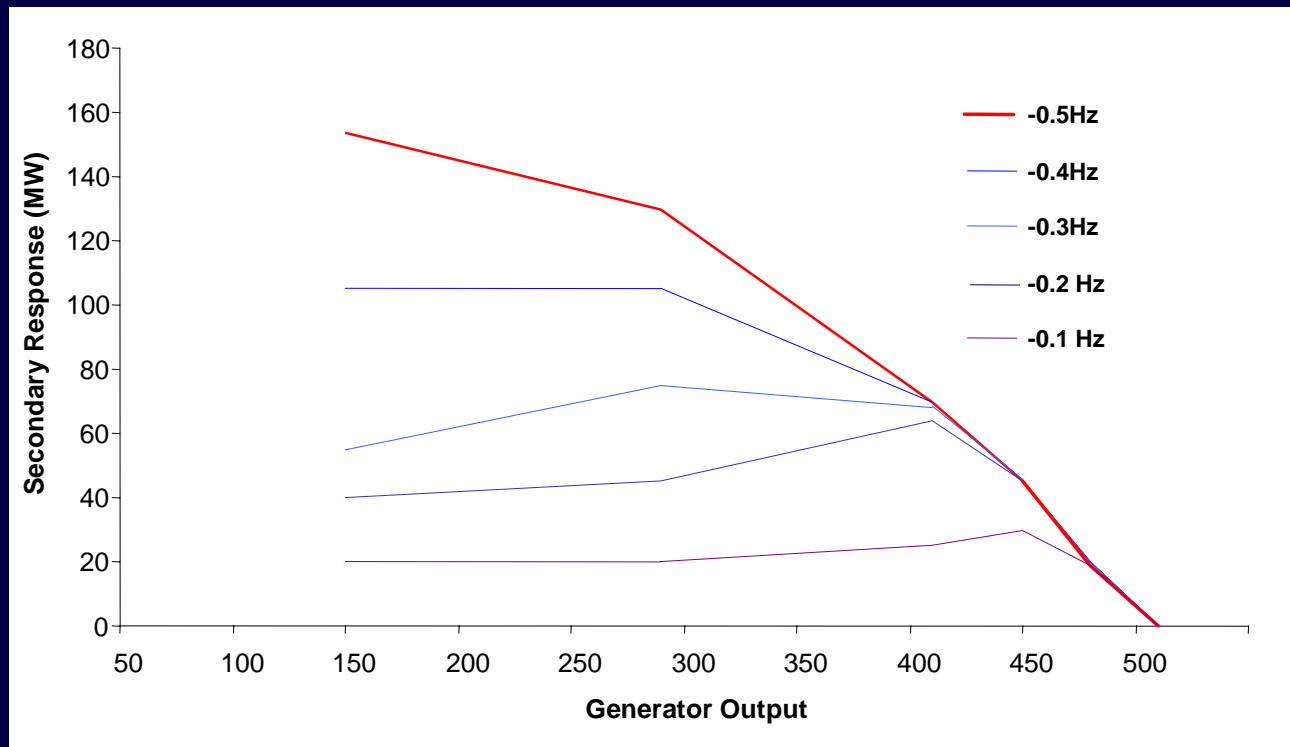
Mandatory Payment arrangements 2

- ◆ Fee for holding primary, secondary and high response
- ◆ loss of efficiency while operating in frequency response mode
- ◆ based on cost reflective charging principles in CUSC
- ◆ providers get £/MW/hr based on capability at 0.5Hz deviation

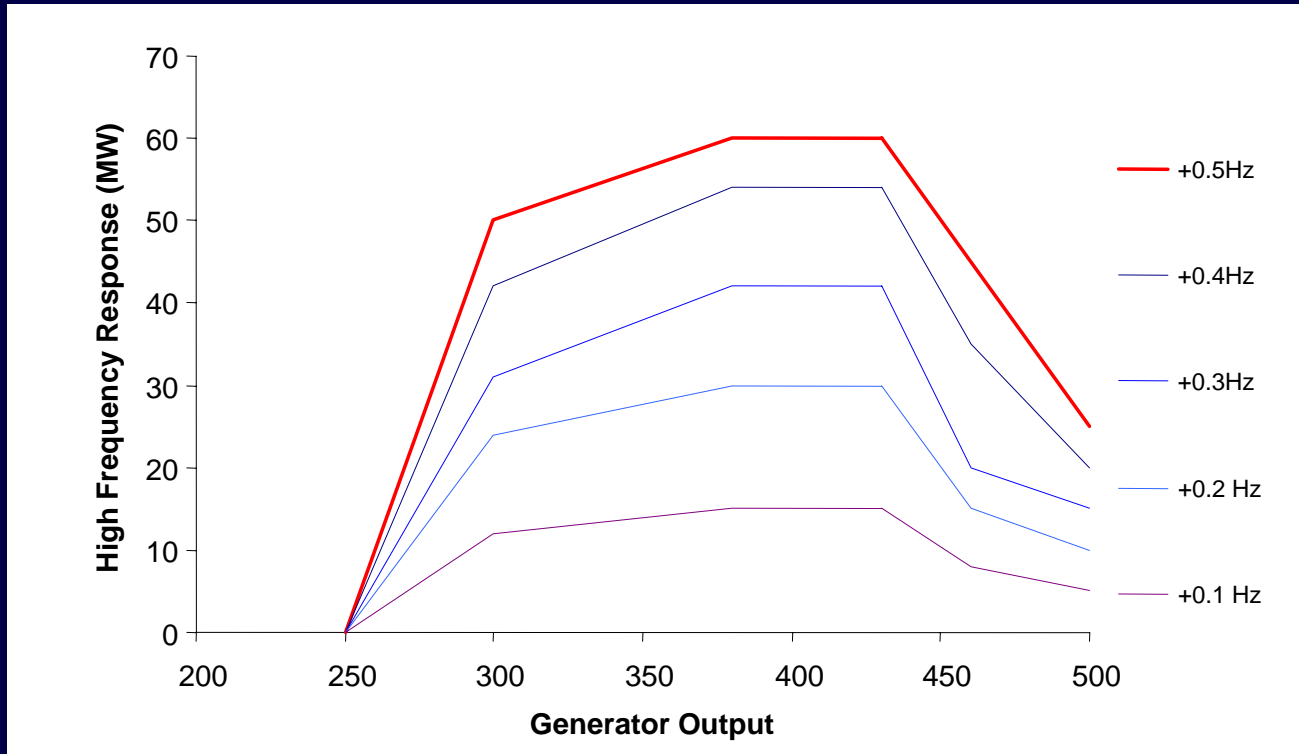
Primary Frequency Response



Secondary Frequency Response



High Frequency Response



Mandatory Payment arrangements 3

- ◆ **Imbalance compensation payment**
- ◆ When supplying frequency response, providers can be subject to imbalance
- ◆ Providers should not be subject to imbalance when supplying frequency response
- ◆ Volume of response delivered is calculated and compensation paid

Volume Calculation

- ◆ Expected change in active power derived from the relevant capability matrix set out in the MSA
- ◆ Linear interpolation of Primary, Secondary and High response matrix between de-load points and frequency deviation
- ◆ Per minute calculation using:
 - ◆ Minute average frequency deviation
 - ◆ Minute interpolation of de-load

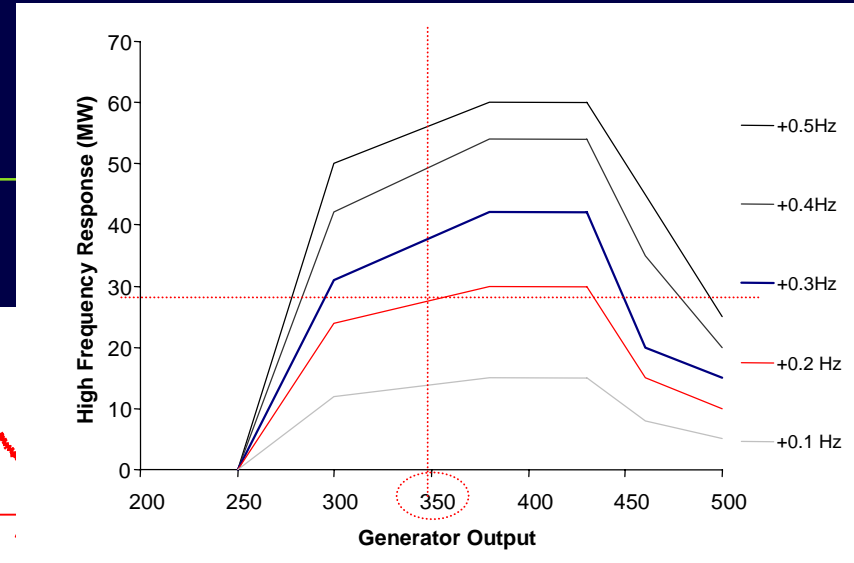
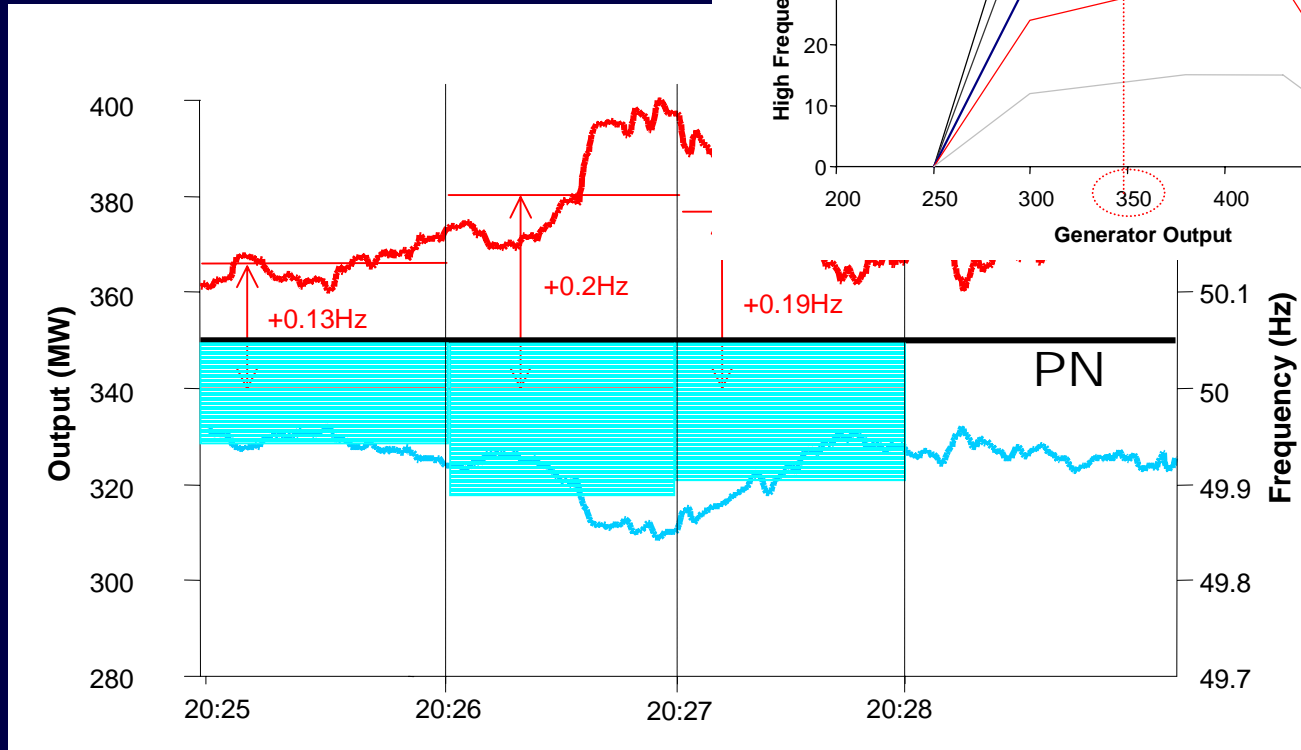
Frequency Response Matrix

- ◆ **Response Matrix**
 - ◆ **BMU specific**
 - ◆ **6 load points (MEL to maximum de-load point)**
 - ◆ **6 x 3 Primary Provision**
 - 0.2Hz, -0.5Hz, -0.8Hz for each de-load point
 - ◆ **ditto Secondary & High**

Response Capability Matrix

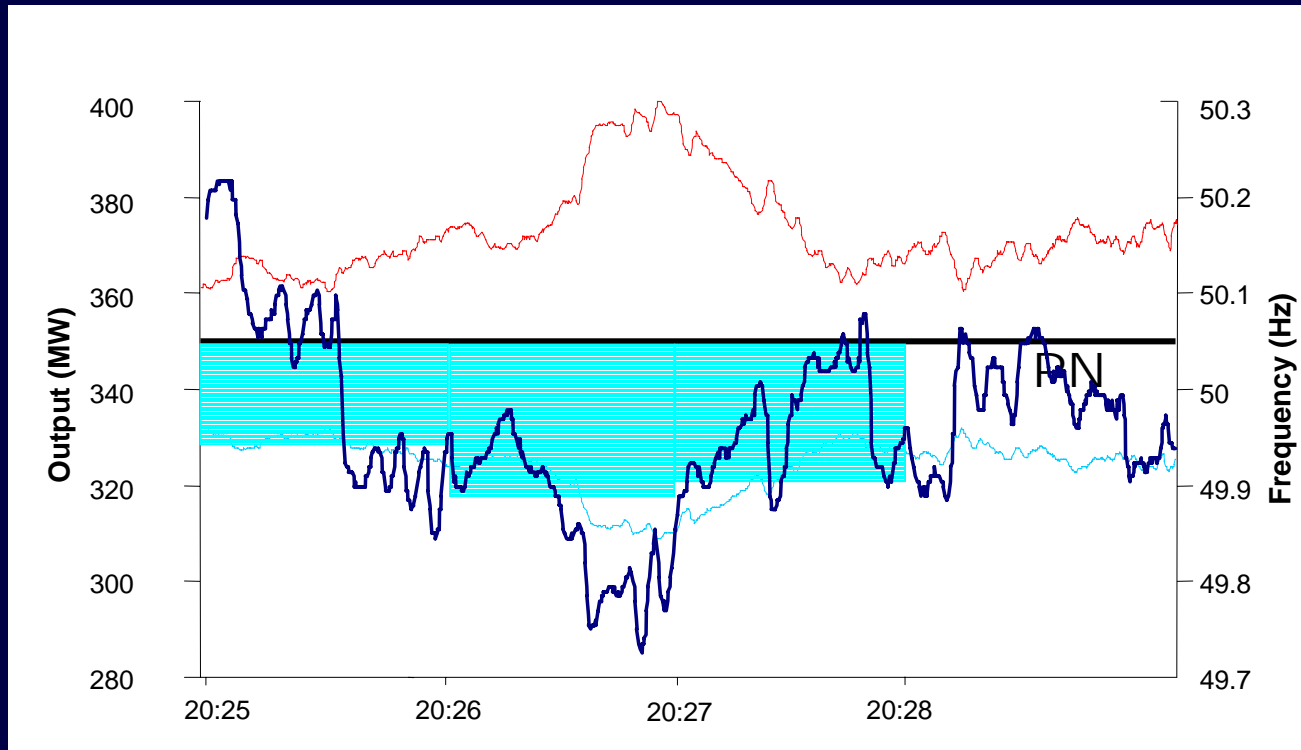
Genset deload (MW)	Low Frequency Response		Secondary Response (MW)				
	Δf_p (Hz)	Primary Response (MW)					
			$\Delta f_s = -0.1\text{Hz}$	$\Delta f_s = -0.2\text{Hz}$	$\Delta f_s = -0.3\text{Hz}$	$\Delta f_s = -0.4\text{Hz}$	$\Delta f_s = -0.5\text{Hz}$
De-load point	-0.1	P1	S11				
	-0.2	P2	S12	S22			
	-0.3	P3	S13	S23	S33		
	-0.4	P4	S14	S24	S34	S44	
	-0.5	P5	S15	S25	S35	S45	S55
	-0.6	P6	S16	S26	S36	S46	S56
	-0.7	P7	S17	S27	S37	S47	S57
	-0.8	P8	S18	S28	S38	S48	S58

Example



— Frequency — Planned Output — Per Second Imbalance

Example

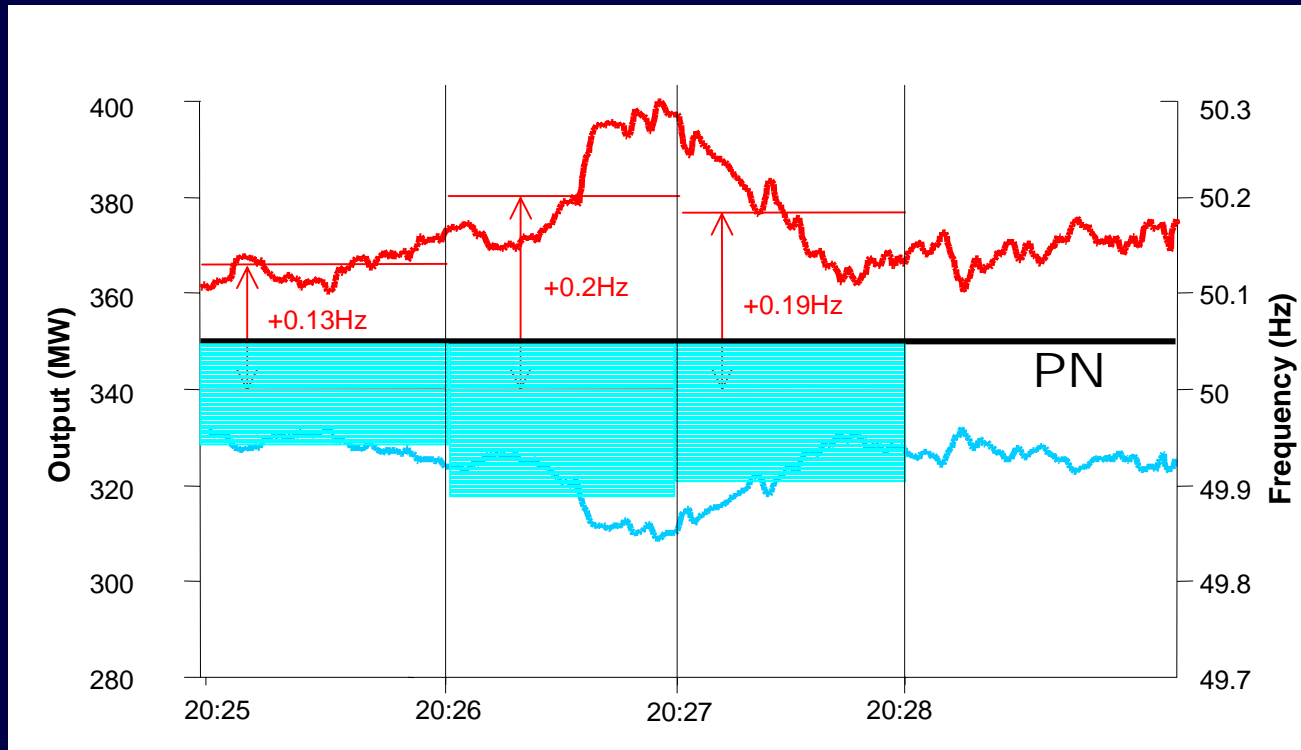


— Frequency — Planned Output — Per Second Imbalance

Agreed Changes

- ◆ **P71 - removal of imbalance when supplying applicable balancing services - will be implemented on 25/02/03**
- ◆ **Applicable Balancing Services Volume Data - indicates the volume of imbalance to be removed**
- ◆ **Licence change introducing ABSVD**
- ◆ **CAP011 - Changes to CUSC for P71 implementation**

Example



— Frequency — Planned Output — Per Second Imbalance

Demand Side

- ◆ **Procured bilaterally or through an agent**
- ◆ **Over 370MWs from 15 sites currently contracted**
- ◆ **FCDM - Frequency Control by Demand Management has two types of service**
 - **firm**
 - **probabilistic**

Prospective Changes

- ◆ **CAP009 - Volume changes to frequency imbalance calculation**
 - ◆ **Introduces an additional matrix called “Power Delivery Data”**
- ◆ **Leads to a more accurate volume calculation**

Demand Side

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- ◆ **FCDM - Frequency Control by Demand Management has two types of service**
 - **firm**
 - **probabilistic**

Firm Service

- ◆ **Designated volume of MWs tripped at 49.7Hz**
- ◆ **Contracted through an agent**
- ◆ **Supply week ahead, then day ahead availability**
- ◆ **At day ahead, NGC select providers with suitable availability**
- ◆ **Availability payment £/MW/hr**
- ◆ **No utilisation payment**

Probabilistic Service

- ◆ **Accumulated load from a number of sites**
- ◆ **Probability of accumulated load being above requirement 90% of the time**
- ◆ **Requires a minimum number of sites to ensure probabilistic requirements can be met**
- ◆ **Currently below this minimum**
- ◆ **Looking for additional providers who can supply this service**

Questions?

- ◆ **If you'd like to know more, please come and speak to me**