

# Summer Operation Low Demand System Warnings

Mat Hofton

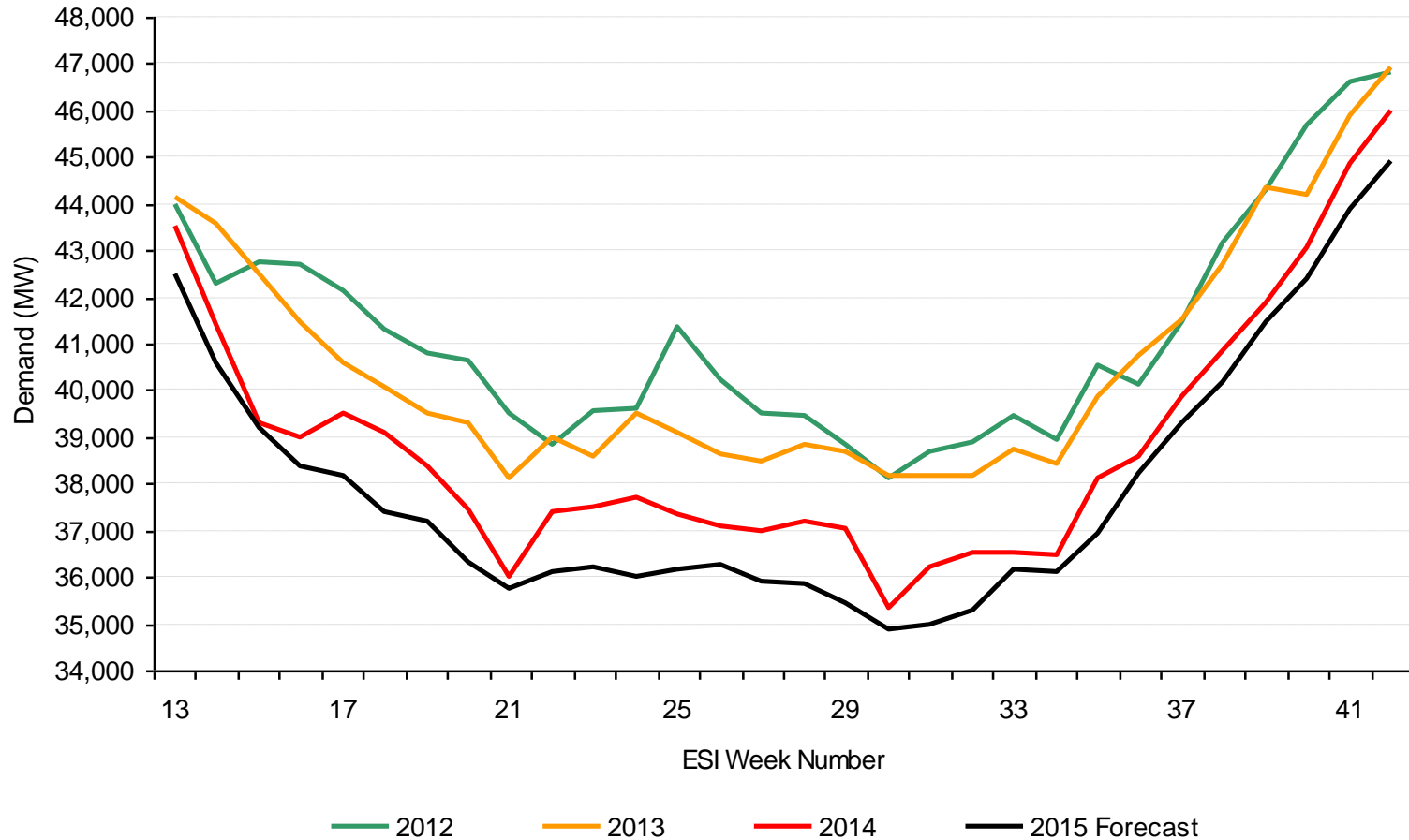
## Summary

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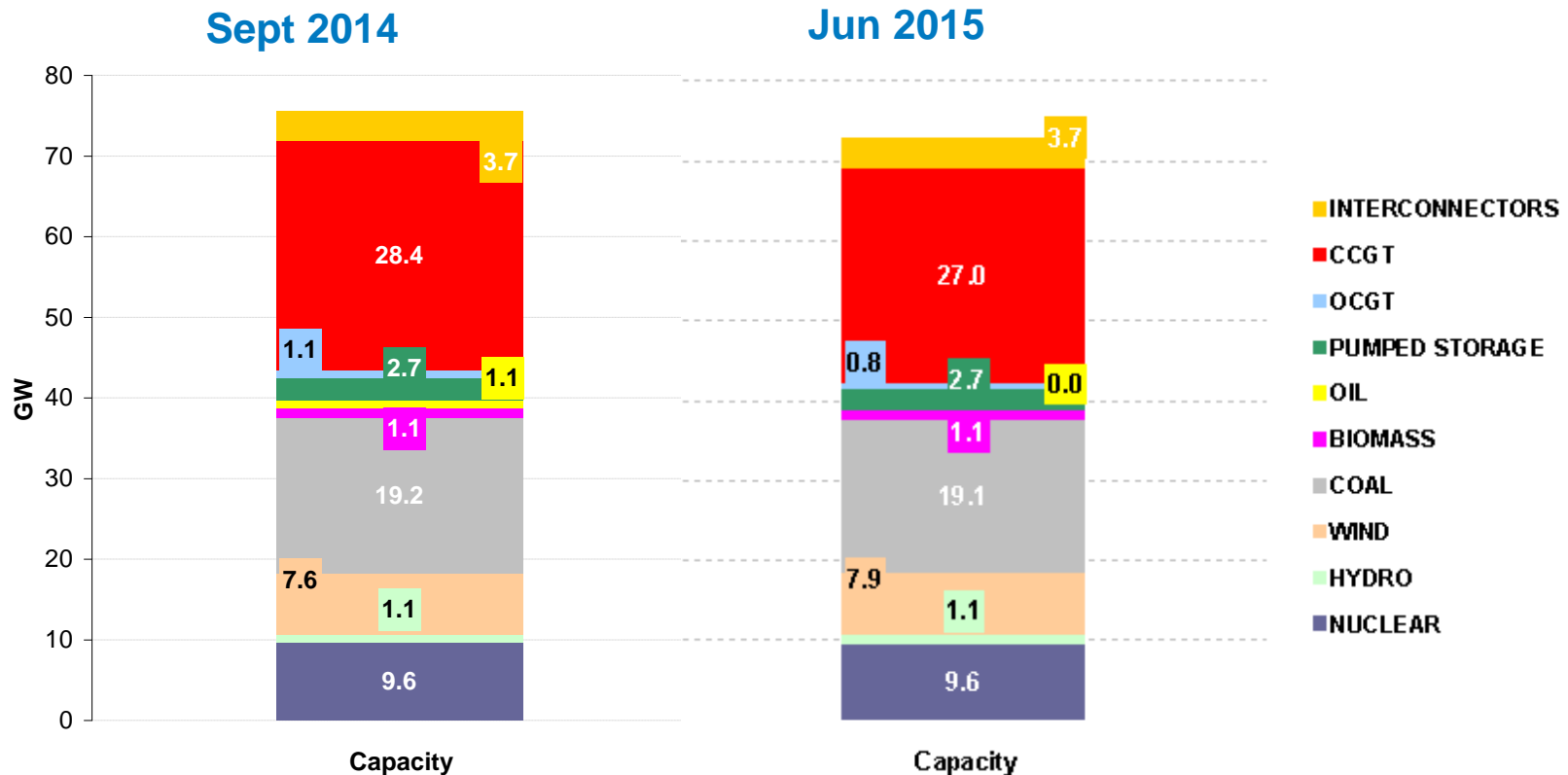
- Summer Demand
- Generation Changes
- High Demand and Generation
- Low Demand and Generation
- Low Demand System Warnings
- Emergency Instructions
- New NRAPM risk report
- Voltage Update

# Summer Demand (Jun to Aug)

Weather Corrected Weekly Peak Demands

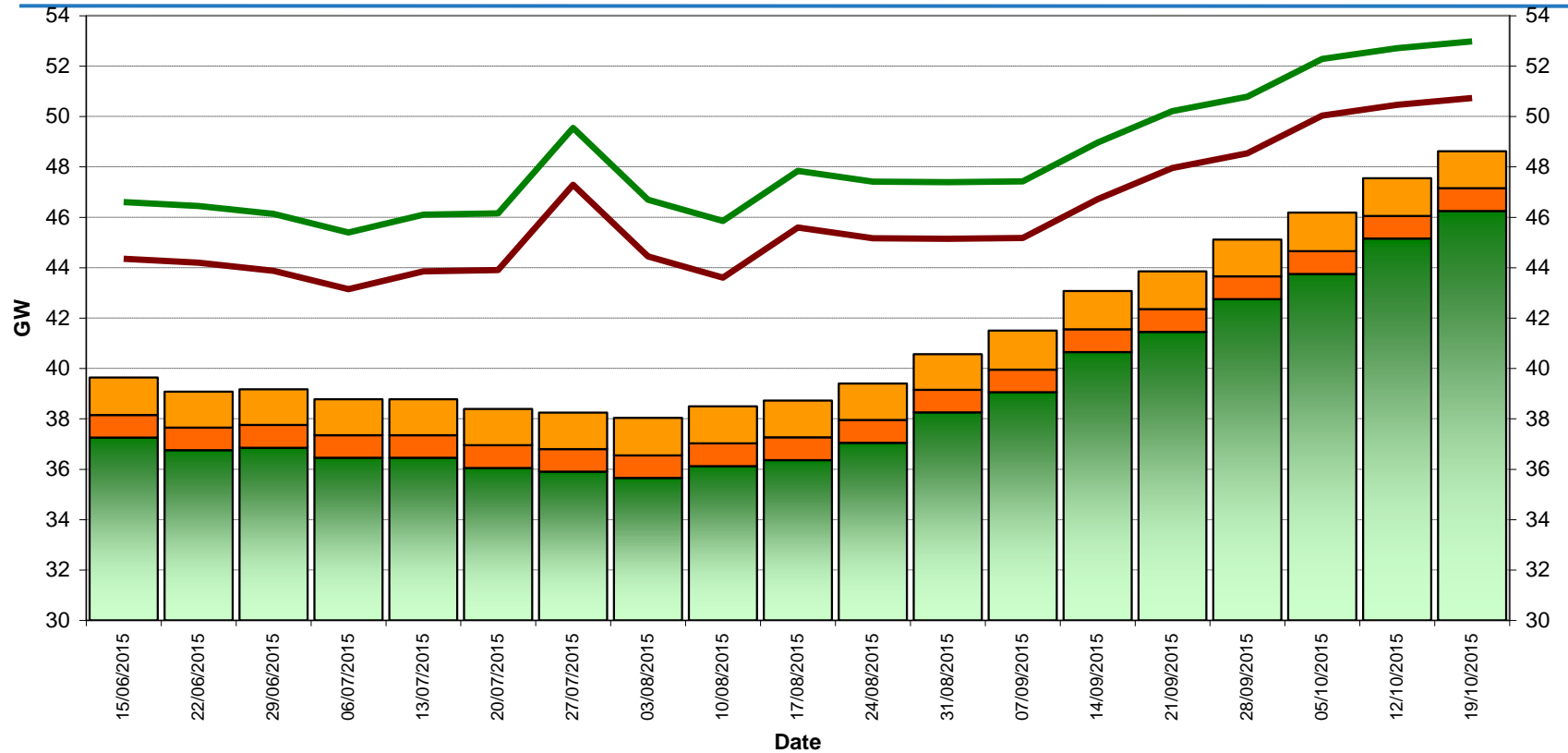


# Changes in Generation



- Overall generator capacity dropped from 75.3GW last September to 72.8GW now, a drop of 2.5GW.
- This is due to the closure of the Fawley GT's, the closure of Barking B2, Littlebrook and Killingholme PG 1 & 2 and Killingholme North.
- We expect to lose Ironbridge unit 2 and Wylfa 1 & 2 by the end of December 2015 and Ferrybridge 3 & 4 and Longannet by the end of March 2016.

# Positive Margin



- Basic Reserve Requirement
- FR Reserve Requirement
- Max Normal Demand (including Full Ireland Export)
- Assumed Generation (Wind at EFC) with Max IC Imports
- Assumed Generation (Wind at EFC) including 750MW imports from Europe

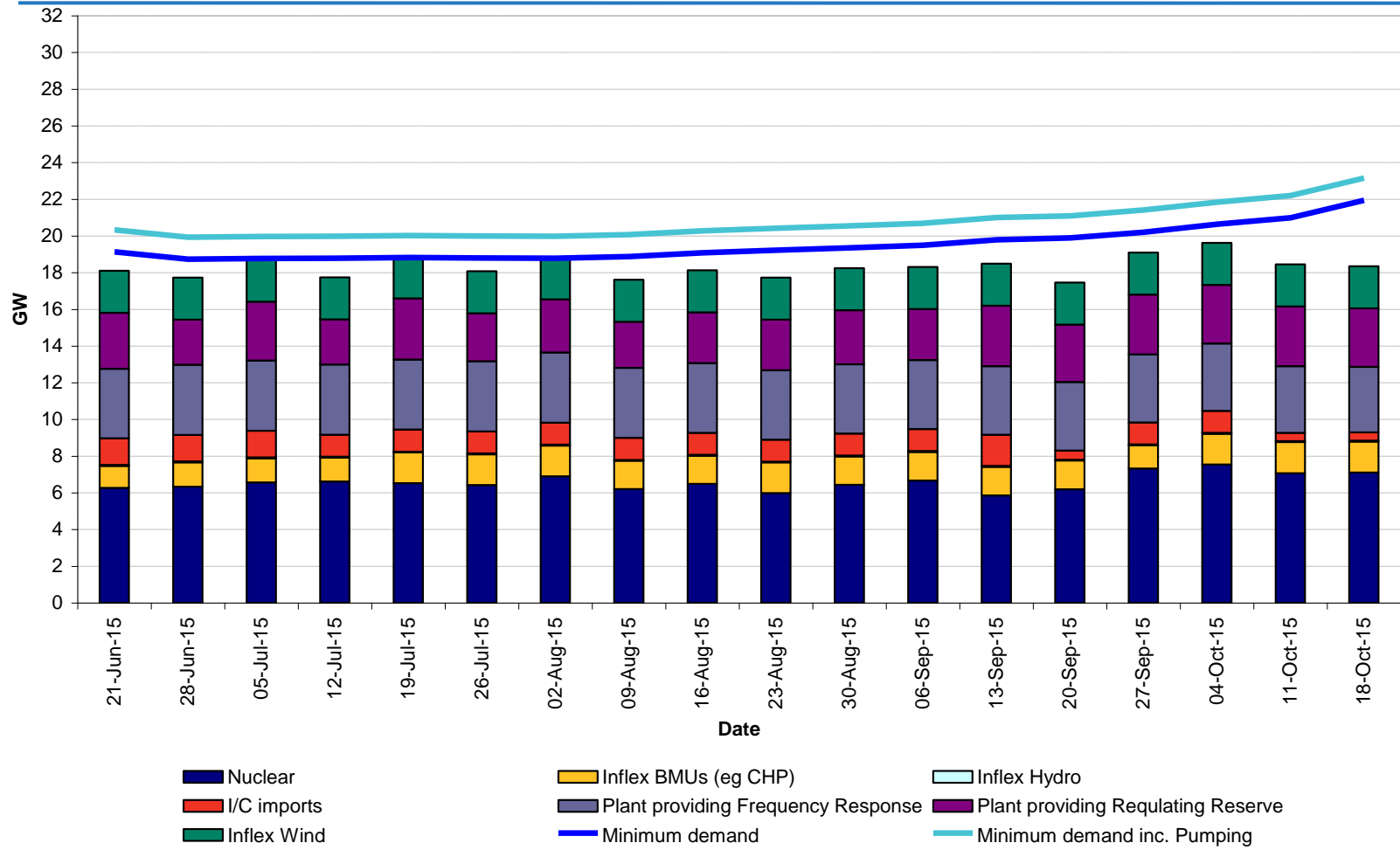
■ **Minimum margin forecast with ICs at virtual float of 3.8GW, week commencing 19<sup>th</sup> October.**

## Low Demand Periods

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- Flexible generation required to maintain frequency response and withstand largest loss
- Maintain positive and negative reserve levels – demand forecast error, generation and demand losses
- Maintaining system voltage profile
- Maintain sufficient system inertia
- Less flexible generation includes: Nuclear, Interconnectors, some wind, CHP, some Hydro

# Minimum Demand and Generation



	2011	2012	2013	2014	2015
Average Minimum Demand	21090	21008	20532	19546	19158
Minimum Demand	19903	19678	19407	18027	18131

# Low Demand System Warnings

## Negative Reserve Active Power Margin

### System NRAPM (Energy)

- National Demand & Generation

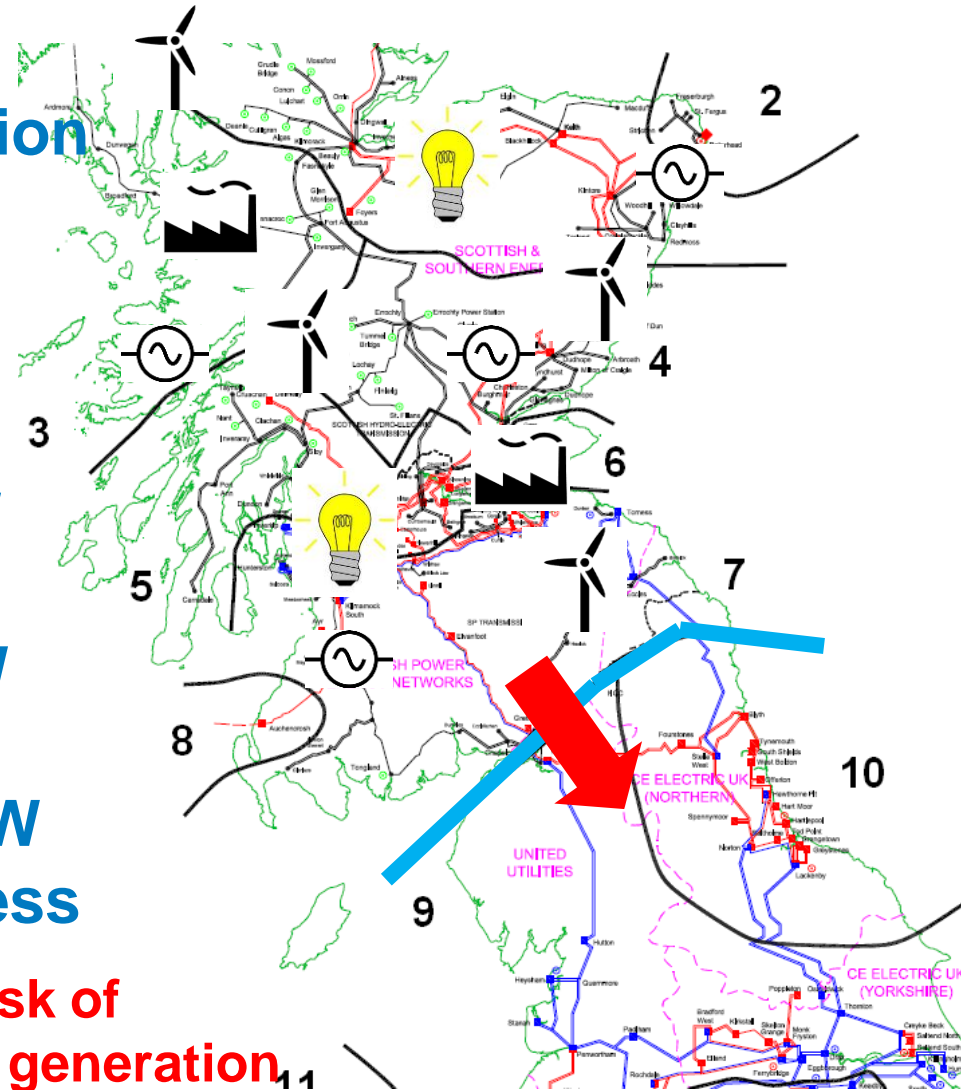
### Local NRAPM

- Caused by constraints

### Example:

- Overnight demand = 1.8GW
- Total Generation = 6GW
- SCOTEX constraint = 1.7GW
- 2.4GW of BM actions
- Inflexible generation = 3.6GW
- $3.6 - 1.8 - 1.7 = 100\text{MW}$  excess

**NRAPM warning issued indicating risk of emergency instructions to inflexible generation**





# Emergency Instructions

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- Risk of NRAPM and EI increasing with lower levels of demand and embedded generation
- When can EIs be used (Grid Code):
  - When no BOA will resolve the problem
  - When a generator has a BELLA, BEGA or BCA contractual relationship with NG
  - In order to maintain system or localised NRAPM
  - Can only be rejected on safety grounds
- Order of actions for insufficient NRAPM:
  - All available Balancing Mechanism actions and Commercial Actions
  - EI to BMUs and BELLAs
  - EI to desynchronise any Existing Gas Cooled Reactor Plant that has offered flexibility

# Emergency Instructions - Settlement

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- BM Unit
  - Post event BOA to end of BM window
- No BOA available (BMU) or no EDL
  - Zero price BOA
- Non-BM (BELLA)
  - Not compensated
- Energy related (System NRAPM) – part of imbalance price
- Constraint related (Local NRAPM) – tagged as System, removed from imbalance price
- Costs recovered through BSUoS charges for all Parties



## Summary

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- Risk of insufficient NRAPM increasing with lower demands and embedded contribution
- Increased risk of Emergency Instructions to inflexible BM plant and BELLA connections
- NG encourage BM participation – get paid to balance the system – reduce risk of EI
- NRAPM risk forecasting report from July
- Enquiries about BM participation please contact your account manager

# Voltage and Inertia Update

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# Voltage Update

- **Sanction phase 1:**
  - **8 reactors commissioned, further 3 by end of 2015, 1 in 2016**
- **Sanction phase 2:**
  - **Further 8 new reactors across 2015/16**
- **Draft European Code proposals to limit reactive power transfer from DNO's at low demand periods**
- **If justified through joint analysis, new connection points must have the capability to not export reactive power at an active power flow of less than 25% of the maximum import capability.**

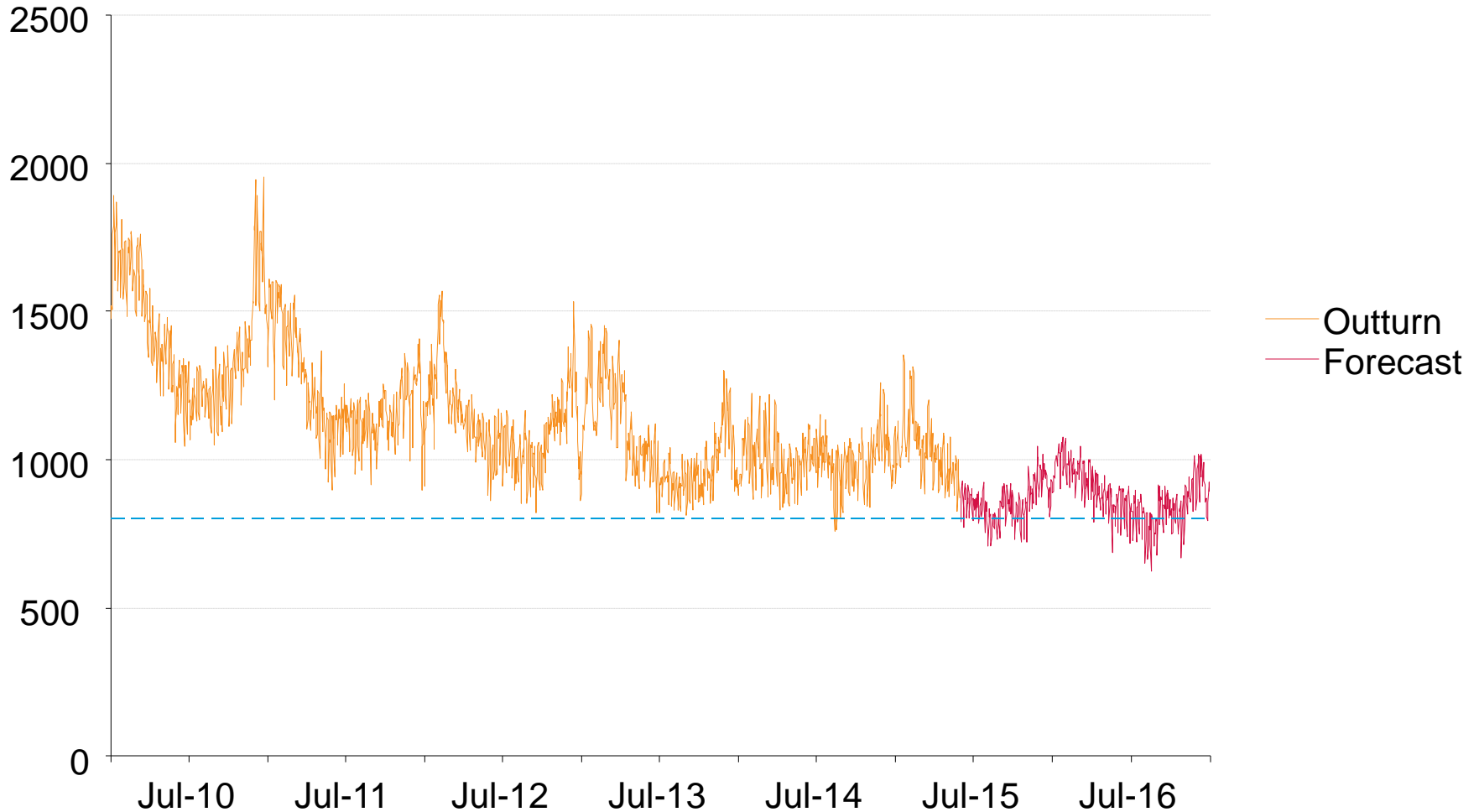
Reactor Location	MVA <sub>r</sub>	Progress
<b>Reactors sanctioned in 2011</b>		
SJOW SR1	200	Commissioned
LOVE SR7	200	Commissioned
LALE SR2	100	Commissioned
GRAI SR1 (replacement)	200	Commissioned
SJOW SR4 (replacement)	200	mid-July 15
LOVE SR1 (replacement)	200	Mar-16
WYMO SR1	200	Sept-15
WHAM SR1	200	mid-July 15
WALH SR3	60	Commissioned
HURS SR7	100	Commissioned
COWL SR2	200	Commissioned
PENT SR2	200	Commissioned
<b>Tier 1 Reactors (Due in 2015) sanctioned in 2014</b>		
KINO SR3	200	1 <sup>st</sup> week of Aug 15
STEW SR1	100	30 <sup>th</sup> Sept 15
DRAK SR1	200	Dec-15
<b>Tier 1 Reactors (Due in 2016) sanctioned in 2014</b>		
WWEY 275kV	100	2016
Greystones A 275 kV	100	2016
Greystones B 275 kV	100	2016
Bramford 400 kV	200	2016
Walham 400 kV	200	2016
<b>Commissioned to date</b>	<b>1260</b>	
<b>Further Planned</b>	<b>2000</b>	

# System Inertia and Frequency Response

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- System Inertia continues to reduce as synchronous generation is progressively displaced
- Frequency response requirements are increasing as inertia reduces at times of low demand
- Significant balancing actions required on most night-time periods and many weekends
- Requirements are not rising as quick as they might have because
  - Larger infeed loss risks are not connecting as soon as they could have
  - We are working to a Rate of Change of Frequency (RoCoF) constraint of  $0.125\text{Hzs}^{-1}$  associated with Loss of Mains protection on distributed generation
  - Other system issues are tending to be resolved with synchronous generation

# RoCoF Constraint Infeed Loss Limit Forecast





## Loss of Mains Protection Changes

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- Changes to protection settings on distributed generators at stations of 5MW and larger are underway
  - 2.5GW of capacity addressed, approximately 8GW to go
  - Thanks go to distributed generator owners who've done the work already
  - Completion required by August 2016

# Loss of Mains Protection Changes

- Possible changes to protection on smaller generators are currently being assessed by a joint Distribution Code and Grid Code Workgroup
  - Approximately 5GW of generation capacity under consideration
- Similar issues are under consideration in Ireland

The screenshot shows the National Grid website header. On the left is the 'nationalgrid' logo. On the right are links for 'Corporate', 'UK', 'US', 'Media', and 'Blog'. Below these is a search bar with a magnifying glass icon. A horizontal navigation menu contains the following items: 'Home', 'Our services', 'Our company', 'In your area', 'Industry information', 'Careers', and 'Contact us', each with a right-pointing arrow. Below the navigation menu is a large banner image with the 'nationalgrid' logo overlaid. Below the banner, on the left, are links for 'Back' and 'Current modifications'. The main content area displays the title 'GC0035 / GC0079 Frequency Changes during Large Disturbances and their effect on the total system - Phase 1 & 2'.

A joint Distribution Code and Grid Code Workgroup was established to examine:

- whether there is still a need for RoCoF based Loss of Mains protection;
- the costs, benefits and risks of change to recommend RoCoF settings; and
- the need for a requirement for equipment to withstand a specified Rate of Change of Frequency

**Summary:**

GC0035 represents Phase 1 work which looked at generators with a capacity greater than 5MW. Meetings 1-20 were to discuss Phase 1 work which was approved on 24 July 2014 and the Authority Decision can be found at

## What does the future hold?

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The RoCoF constraint will be in place until 2017 at the earliest

Completion of the current programme of protection setting changes **may** allow us to progressively raise the limit

Forecast costs are up to £20m per year

The requirement for faster acting frequency response will emerge and grow as inertia reduces

Timing is dependent on generation and demand trends

## What does the future hold?

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- We plan to articulate and discuss future requirements using the System Operability Framework

<http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/System-Operability-Framework/>

- We're also looking at enhanced frequency control capabilities with a number of partners

<http://www2.nationalgrid.com/UK/Our-company/Innovation/NIC/>

