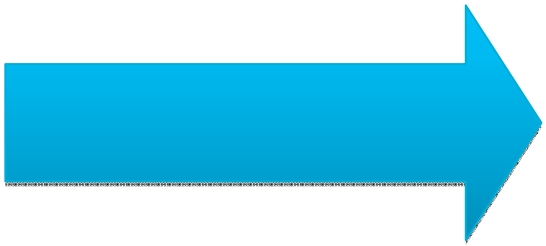
System Operability Framework (SOF)

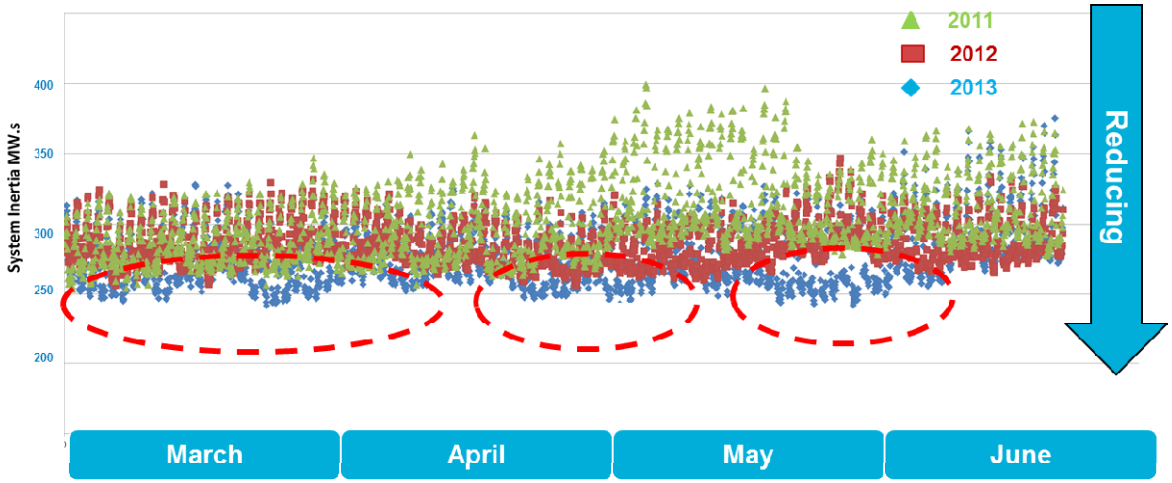
Vandad Hamidi -SMARTer System Performance Manager
Transmission Network Services

Changes so far…

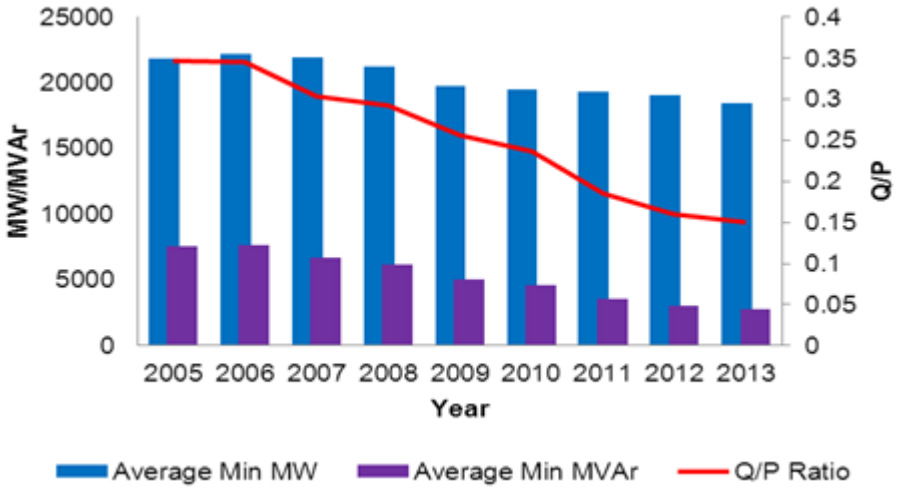


And the effect…

System Inertia



Reactive Power Demand



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Future Energy Scenarios

System Operability Framework

Future Energy Scenarios

Change in Energy Landscape

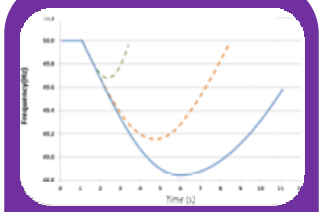
- Generation mix
- Interconnection
- Demand side services

Performance Requirements

Economic, Efficient and Operable System

- Large infeeds (>1800MW)
- System stability
  - Frequency
  - Voltage
  - Rotor angles
- Constraint minimisation
- Market facilitation

Operational Challenges



Reduction in System Strength

- System inertia
  - RoCoF
  - Primary response
  - System stability
- Short circuit level
  - Power quality
  - Protection
  - HVDC commutation
  - System stability

Operation Solutions & Opportunities

SMART Grid Development

- Rapid response
- Demand side response
- Low load operation of thermal plants
- Dynamic thermal ratings
- System wide controller
- Parallel HVDC links

Electricity Ten Year Statement

System Operation Chapter of ETYS

- Variations in each topic
- Opportunities for stakeholders to provide new services
- Stakeholder feedback

International Experience

- Learnings used in SOF – Examples

DS3 Programme **Frequency and Voltage**	**Operating under Low Fault Level**	**Operating with high level of Wind and Solar**
Generator withstand capability with high RoCoF	**System Stability and Study Capability**	**Interaction between generator shaft and system resonance**

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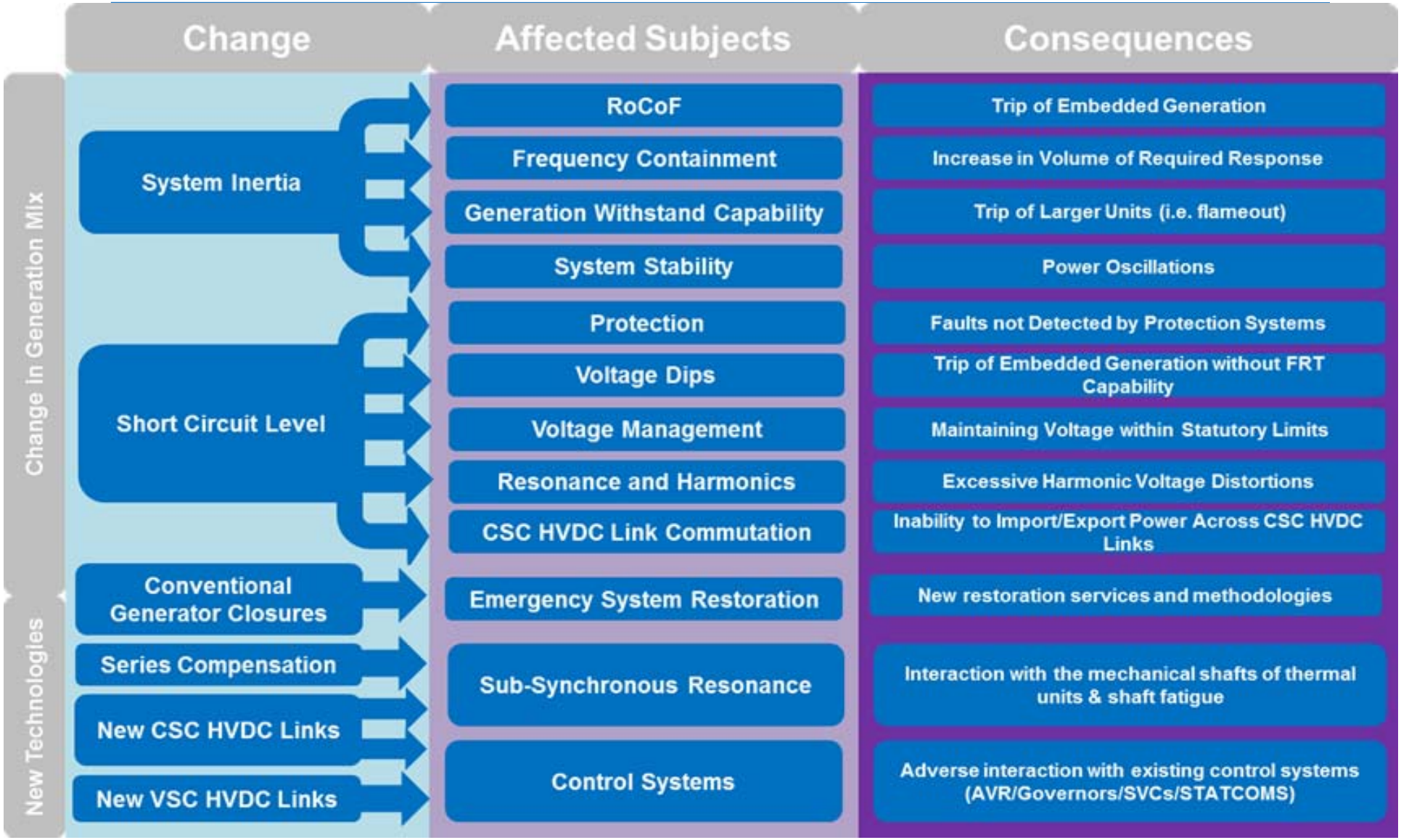
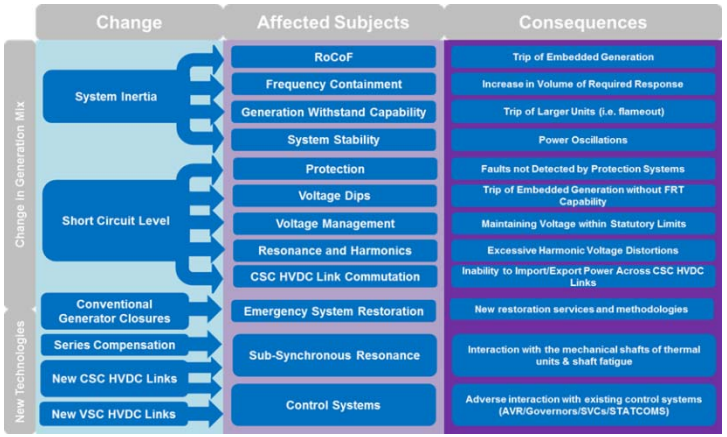
SOF 2014 Topics



SOF Stakeholders

Interaction with Service Providers



New Services

Balancing Services

- Fast Frequency Response
- Enhanced Reactive Power
- Black Start

Network Services

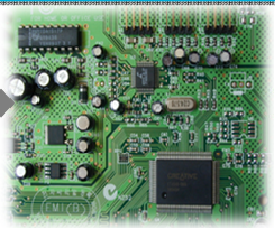
- Demand Side Response
- Voltage Control & Enhanced Voltage Control

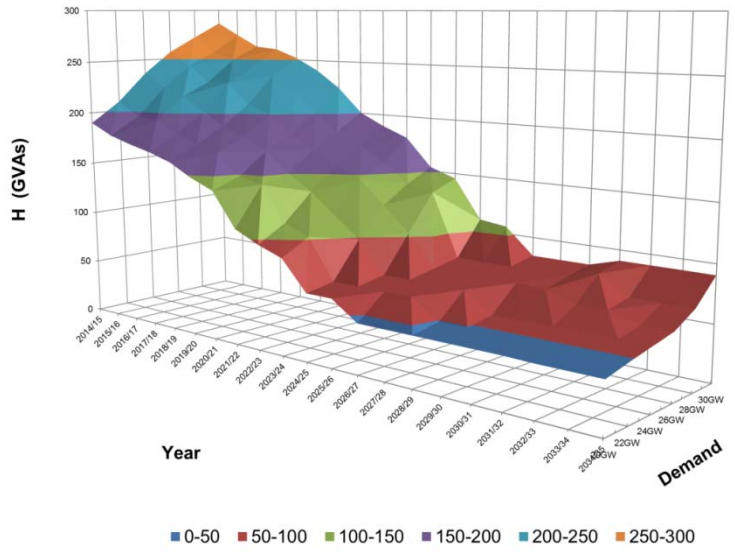
Example – Frequency Control (1)

Synchronous Power Plant (i.e. Thermal, Hydro)

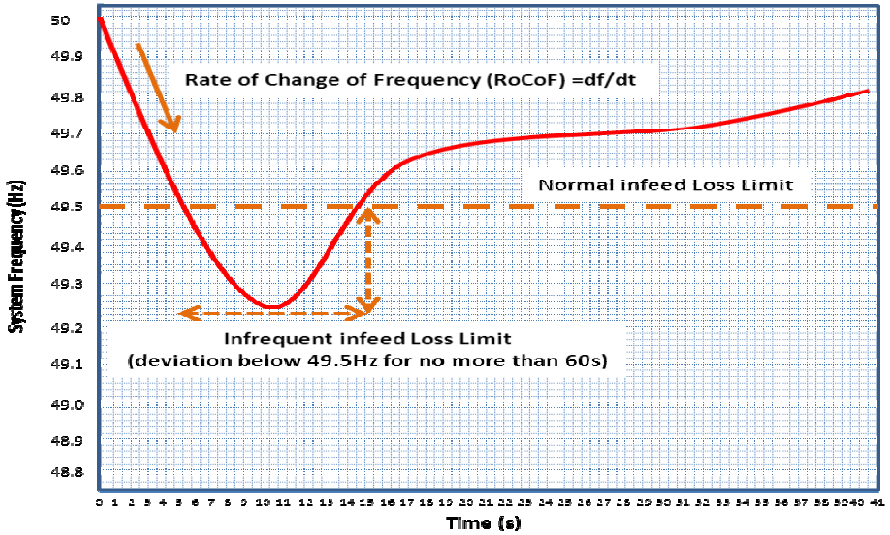
Change in Generation Mix and Technologies

Non-Synchronous Power Plant (i.e. Wind, Solar)





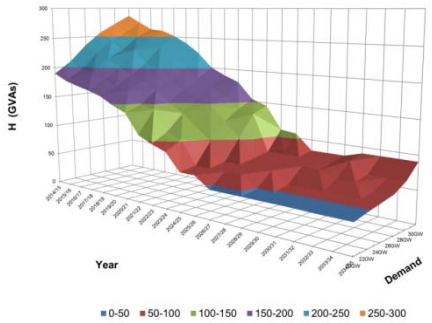
Example – Frequency Control (2)

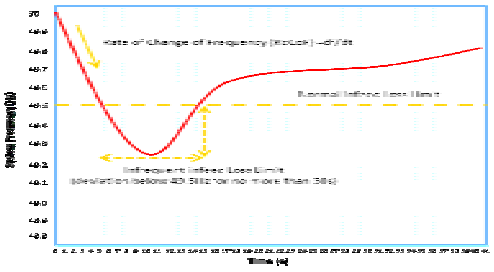


RoCoF (Hz/s)	Slow Progression	Gone Green	Inertia GW.s	Action Time (to reach 49.2 Hz)	Response Rate (MW/s)
0.125**	2013/14	2013/14	360	9	185
0.2	2019/20	2018/19	225	4	400
0.22	2022/23	2019/20	205	3.4	489
0.25	2023/24	2020/21	180	2.4	679
0.3	2024/25	2021/22	150	1.2	1148

*Figures assume a 2s delay between detection/response activation time

Example – Frequency Control (3)





	Solution	Cost (2020 Gone Green)
Conventional Services	Constrain generators	Extra £600m
	Constrain largest infeed/outfeed	Extra £130m-£270m (depending on when the large infeeds are connected)
	Carry larger volumes of response	Extra £210m

	Solution
New Services	Enhanced Frequency Control (Fast Response)
	Low Load Operation of Thermal Plants
	Synchronous Compensator

System Operability Framework Consultation

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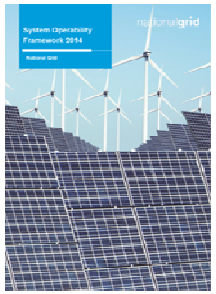
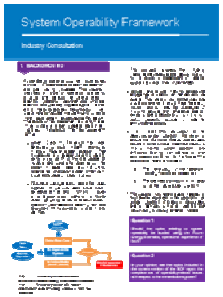
- Over 30 Responses
- Mainly from Technology/Service Providers





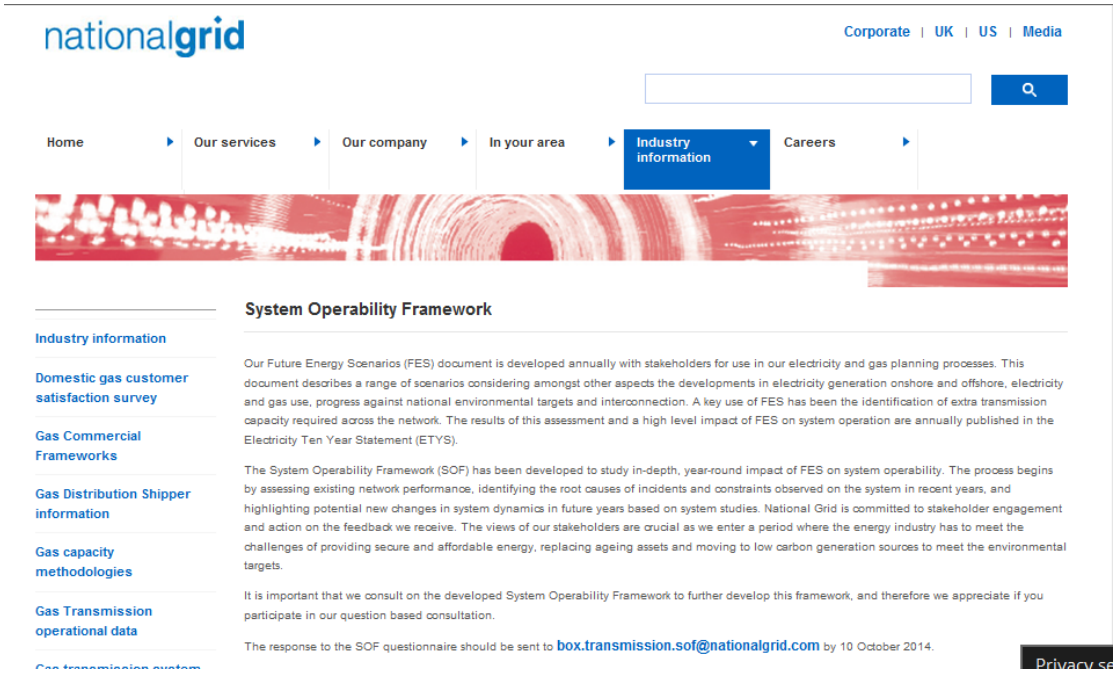
- Feedbacks (relevant to Operational Forum)
  - Least cost solution (market/mandatory requirement)
  - Clear focus on need for new services
  - Solutions in future years requiring contracts at early stages of development
  - More collaboration on new services
  - More innovation on new technologies

System Operability Framework

Thank you for your attention

For more information please email:

box.transmission.SOF@nationalgrid.com



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

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