‘No regrets’ power system studies relating to frequency

Common Quality Technical Group

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ELECTRICITY AUTHORITY
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Purpose of ‘no regrets’ power system studies

Study 1

- Lower 30 MW threshold for generating stations to be excluded by default from complying with frequency-related AOPOs

Study 2

- Set permitted deadband beyond which generating station must contribute to frequency keeping
- Procure more frequency keeping to manage frequency within normal band (49.8–50.2 Hz)

Study 3

- Set permitted deadband beyond which generating station must contribute to instantaneous reserve
- Procure more instantaneous reserve to keep frequency above 48 Hz for contingent events and above 47 Hz (North Island) and 45 Hz (South Island) for extended contingent events

CQTG Frequency Subgroup feedback

- < 30 MW generation plant with a frequency controller should be able to enable the frequency controller at relatively low cost
- Some fuel types (solar, wind, geothermal) cannot provide under-frequency reserve
- Consider secondary risk
- Consider how much Net Free Reserve (NFR), or free-riding reserve, exists at present
- Suggestion to analyse the Asset Capability Statements of < 30 MW generators to see the extent to which they could be compliant with the > 30 MW requirements
- Study the benefits of additional frequency reserve provided by lowering the 30 MW threshold
- Discussion on deadband, frequency band and normal band
- Study the effects of widening the frequency keeping band with different deadbands, assuming that the normal band is maintained as 49.8 Hz – 50.2 Hz

Requirements in other jurisdictions

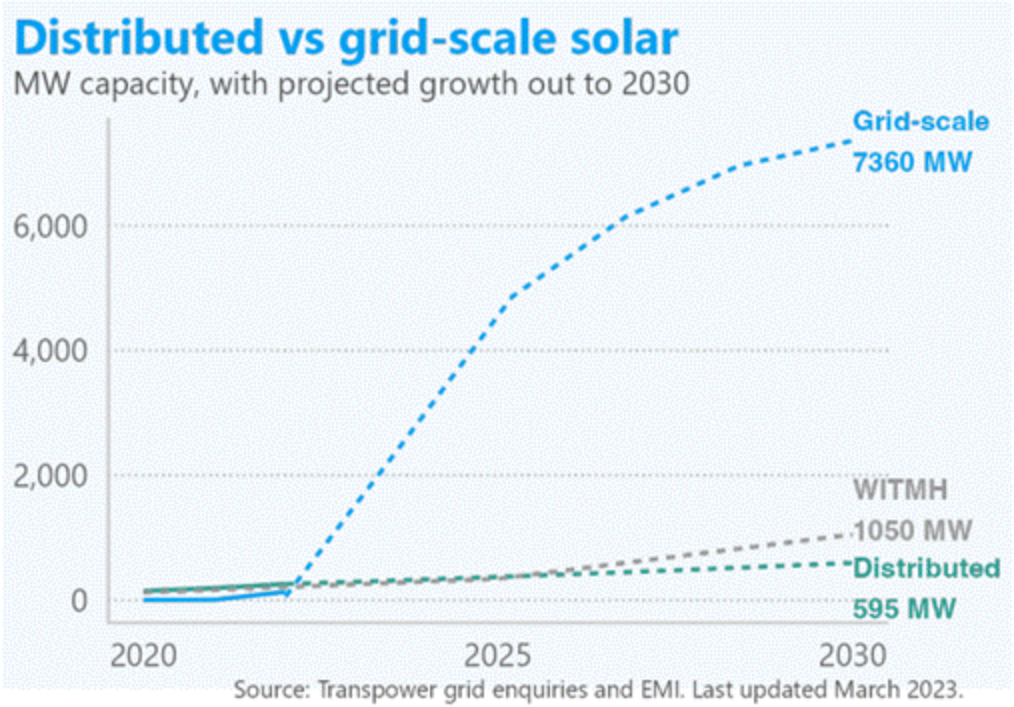
Synchronous areas	Threshold (MW)	Deadband	Droop
Brazil	30 MW (wind = 10 MW)	+/-40 mHz	2-8%
Great Britain	> 100 MW	+/- 15 mHz	3-5%
Finland	> 10 MW	+/- 10 mHz	2-12%
Italy	> 10 MW	+/- 10 mHz Hydro +/- 20 mHz GT and CC	2-5% Hydro 5-8% Thermal
Ireland	> 2 MW	+/- 15 mHz (Sync Gen) +/- 15 mHz (Wind)	3-5% (Sync Gen) 2-10% (Wind)
New Zealand	> 30 MW	Not specified	0-7%
Singapore	> 10 MW	+/- 50 mHz	3-5%
Spain	All units	+/- 10 mHz	1.5% output @ 0.2Hz deviation
Switzerland	All units	+/- 0-500mHz	2-12%

Source: System operator

Statistical study

Present

- 7,656 MW is the total installed capacity of generating units with a capacity of 30 MW or more
- 1,784 MW is the total installed capacity of generating units with a capacity of less than 30 MW
- 101 generating units have a capacity of 30 MW or more
- 214 generating units have a capacity of less than 30 MW
- Almost all generating units with capacity less than 30 MVA are synchronous generators



Engineering studies – Study 1

Study cases for years 2023 & 2035

Create study scenarios – baseline + others

Create dynamic models & contingencies

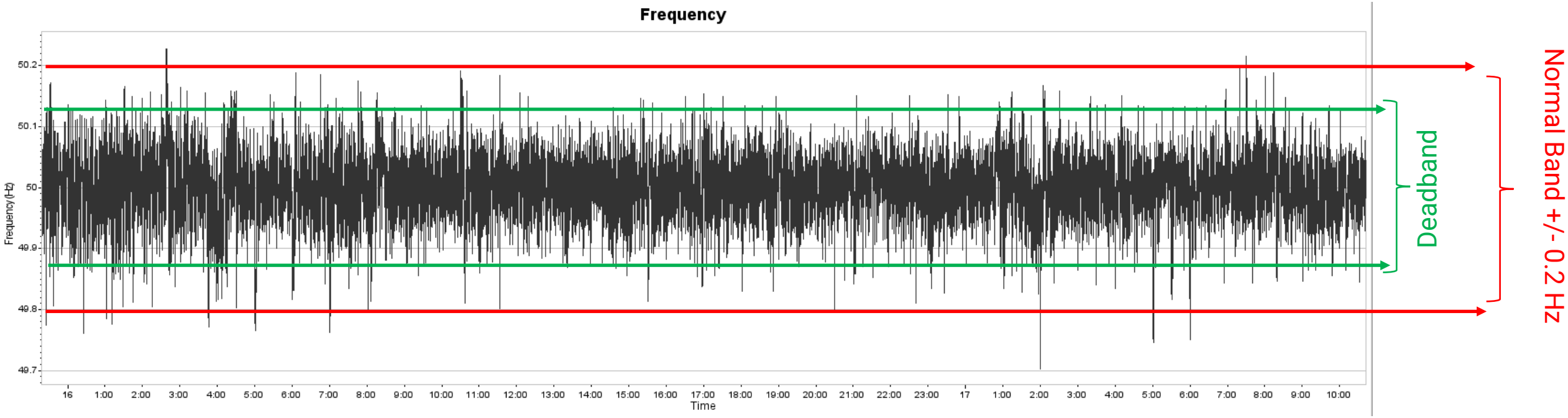
Frequency support study

- Consider 30 MW threshold
- 50% of new generators below the threshold to trip
- Check & compare minimum frequency with baseline case
- Repeat study with different threshold

Frequency regulation study

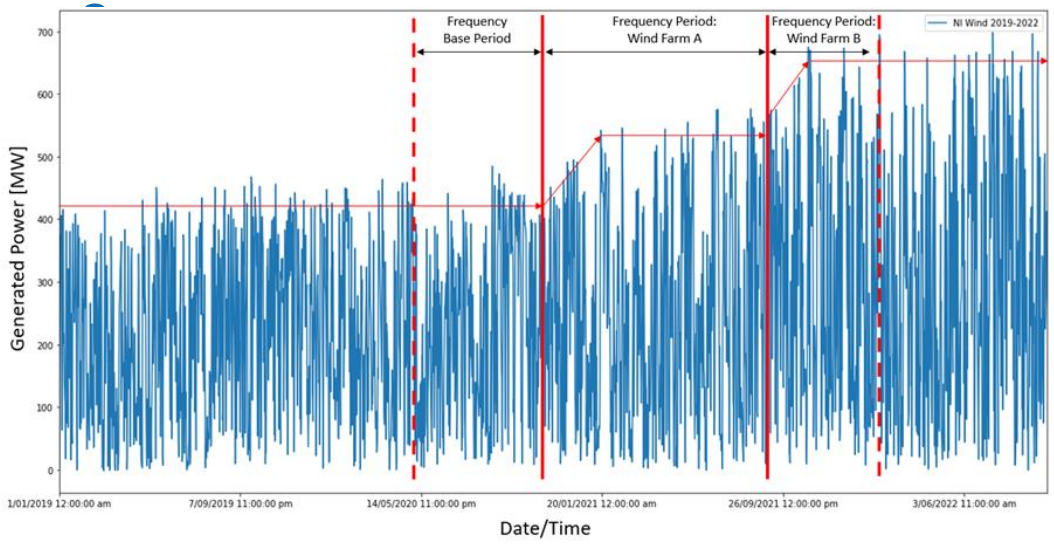
- Consider 30 MW threshold
- Set new generators below the threshold to have MW control
- Check & compare minimum frequency with baseline case
- Repeat study with different threshold

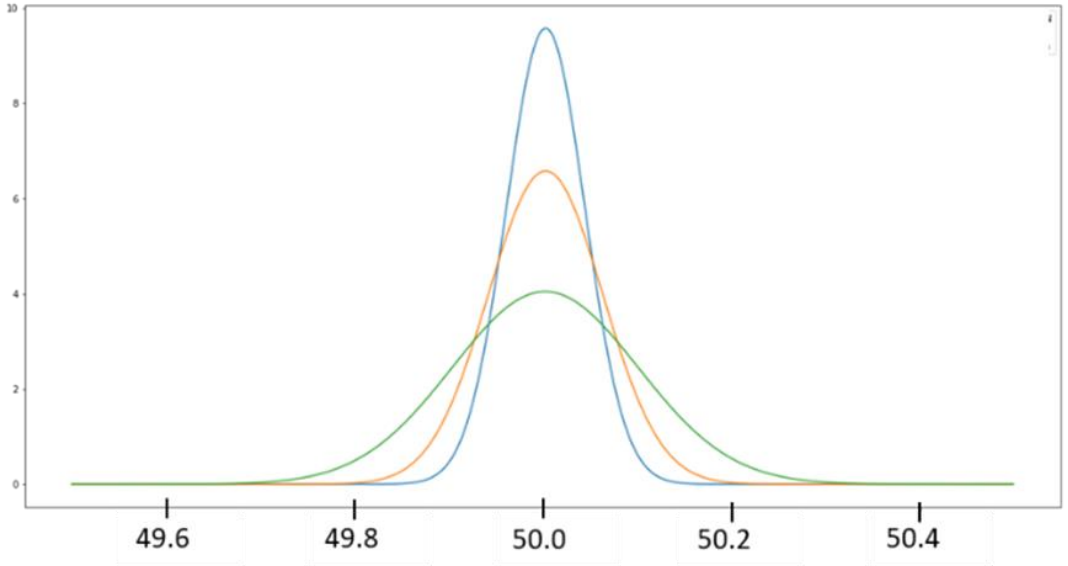
Clarification of the terms used for Study 2

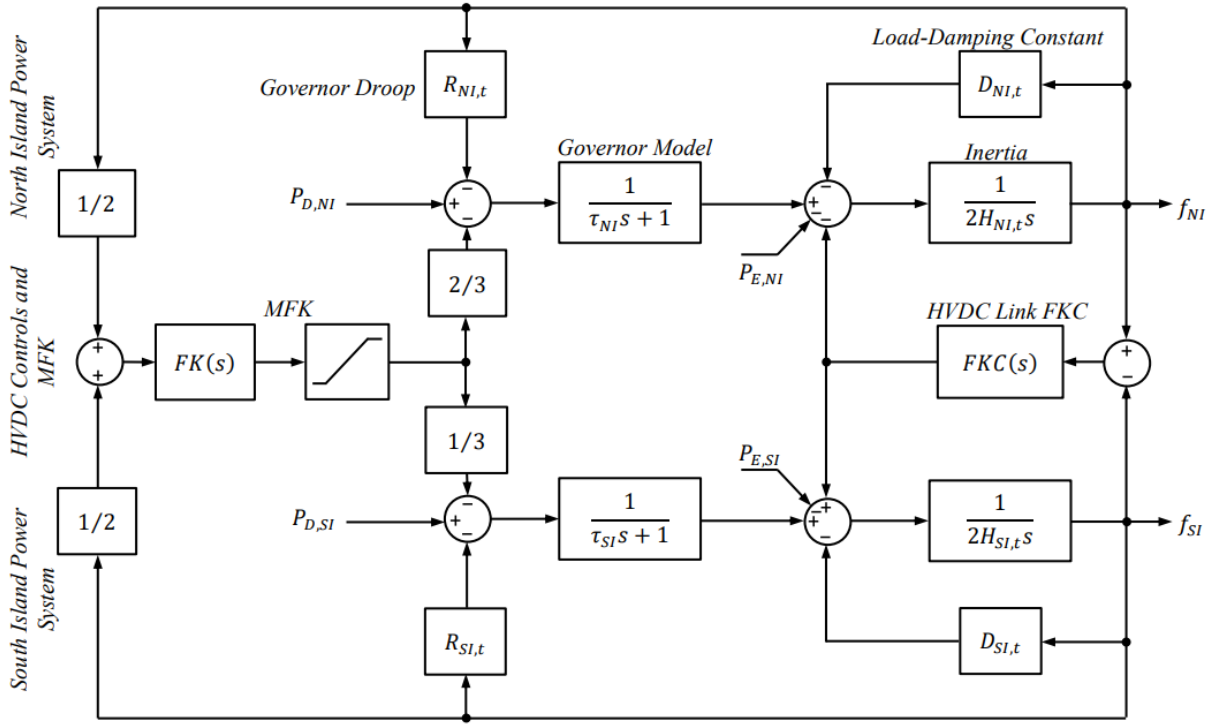


Frequency keeping band is the offers in MW by the frequency keeping plant to increase and decrease generation in response to short-term supply and demand imbalances.

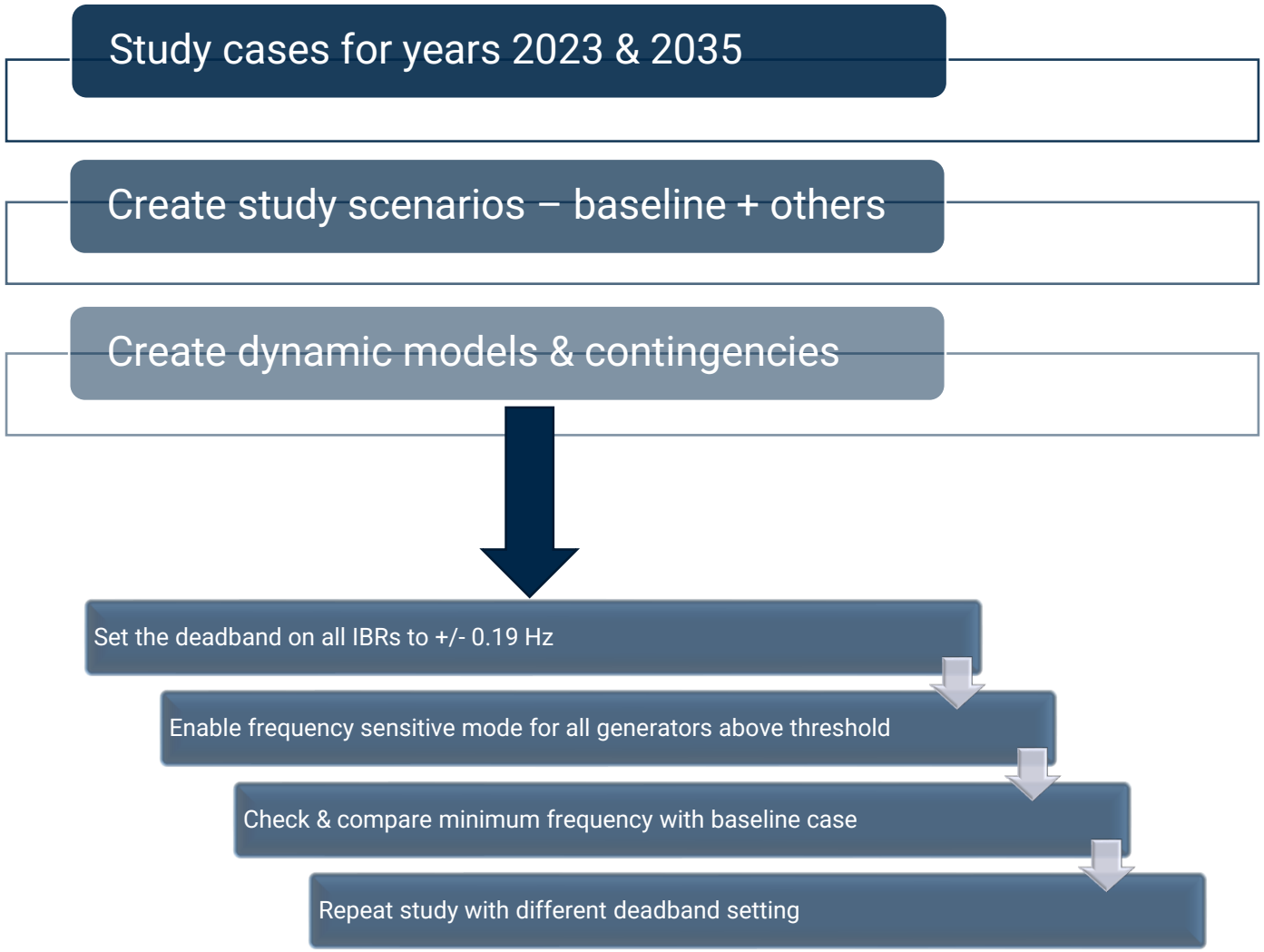
Engineering studies – Study







Engineering studies – Study 3



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