ESCRI-SA
Lessons learnt - ElectraNet

ESCRI Knowledge Sharing Reference Group

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In partnership with:

agl

ARENA
Australian Government
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Advisian
WorleyParsons Group

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ESCRI - Dalrymple North BESS

Presentation outline

- Innovation
- Modelling
- Generator Performance Standards
- Registration and Licensing
- Other Challenges
- Cycle count
- Fast Frequency Response

Innovation

- ***Innovative features of ESCRI BESS, relative to existing generation and energy storage installations connected in the NEM***

> Unique asset delivery & owner-operator model involving an NSP (owner) and generator / retailer (operator), overcoming current NER shortcomings for new, flexible energy storage technologies

> Largest (91 MW WF and 30 MW BESS) known indoor and climate-controlled BESS installation

> Largest autonomous regional microgrid development to-date. All-in-one control design co-optimised for both grid-connect and islanded operation, allowing seamless transition between the two operating modes

> Grid-forming capability implies ability to operate conceptually at very low Short Circuit Ratios (<<1.5), significantly beyond what existing grid-forming electronic converter-based generation can perform. Achieve transmission-level grid code compliance at a “weak” distribution-level (33kV) connection point

Innovation (cont.)

- “Synthetic inertia” - Unprecedented response speed (less than 100 ms) and bandwidth (frequency droop down to 0.2%)
- Non-synchronous Fault Level / System Strength support via short-term fault current overload (>1.0pu rating) capability
- Islanded grid master control including WF generation MW dispatch / curtailment
- Black-start capability for 8 MW island
- Topology-based Islanding Detection Scheme (IDS)

Modelling

- Should compliant models be a prerequisite for successful contract award? Advantageous if models have previously been used on another grid connected project in the NEM
- It is crucial for the OEM to understand the requirements, especially if they are unique
- Model development to be closely coupled with physical plant control development, and consistency ensured between them and the different models (e.g. PSSE, PSCAD, PowerFactory). Version control and design freeze
- Choose consultants with proven / practical / current experience
- Start process early and engage early with all participants, including AEMO. When a problem occurs clear and direct lines of communication between study consultants/reviewers and modelling developers will help to clear them

Generator Performance Standards

- It is crucial for the OEM to understand the regulatory requirements (i.e. Chapter 5 of the NER) and any jurisdictional requirements (i.e. ESCOSA license conditions in SA)
- Off grid vs. grid connected approach. Different mindset
- The requirements of the grid forming mode (seamless islanding) formed the fundamental basis of development – this in some instances constrained grid connected modes, e.g. speed of response
- Limited familiarity with the Frequency and Power clauses of the NER within ElectraNet – typically not reviewed by NSP
- Power Quality and response times from VSC BESS is high
- Temperature de-rating information – Installation indoor and climate controlled

Registration and Licensing

- Remember the jurisdictional requirements (these vary by state). ESCOSA board requires one month to review before granting license
- BESS registration required as both a generator and load, given the current limitations of AEMO's market systems
- TX or DX connection, NGM arrangement. Engage early…
- High speed disturbance recorders are an often overlooked requirement
- AEMO SCADA list – standard signals for BESS for future proofing
- Commissioning test plan (Typically AEMO requires 3 months prior to registration for a transmission connection). Good collaboration…
- Early energisation allowed (incl. TFs and auxiliaries) but no import, export or connection of the generating units allowed. Currently no pathway to charge (i.e. load) a BESS > 5 MW prior to registration completion.

Other Challenges

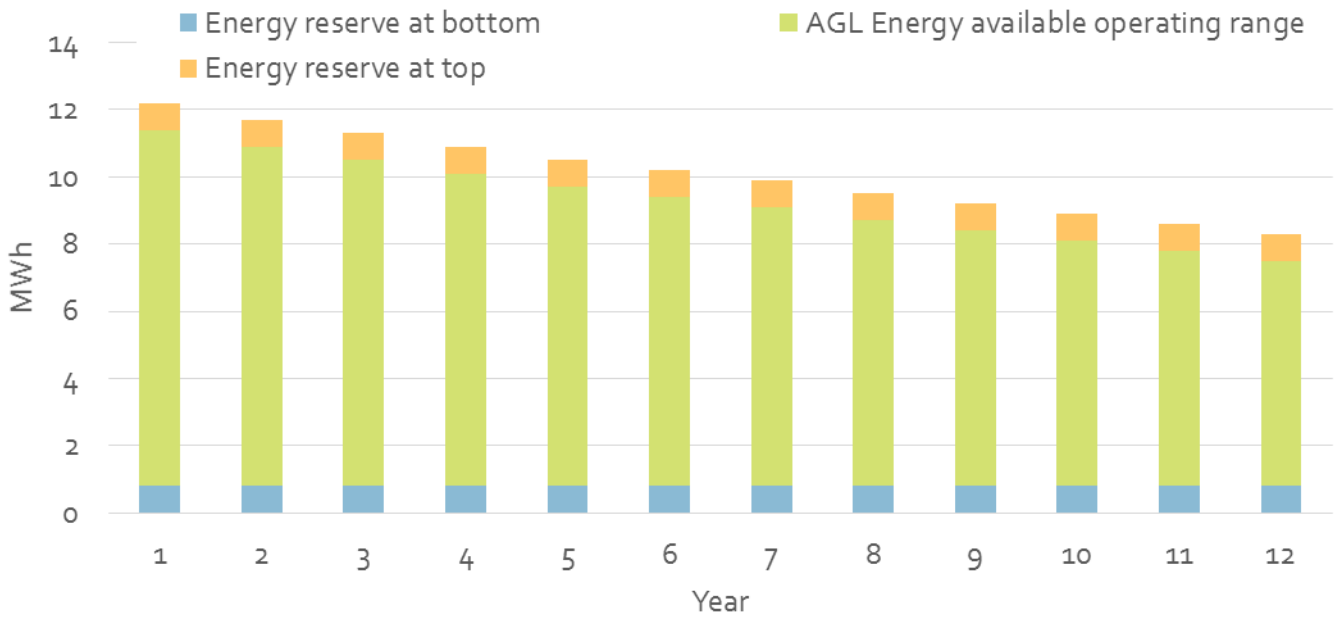
- Proof of concept / R&D style project. Expect multiple revisions before arriving at a suitable solution (hence schedule and risk allowance accordingly)
  - Timeframe, 8 month design and build very ambitious
  - Tight budget and risk allowance for variations
- Inconsistent understanding of the FCAS technical functionality and market requirements between the OEM (ABB) and BESS operator (AGL), in particular Contingency FCAS
- Islanding - How to detect an island? Island fault levels sufficient for protection operation? Protection challenges for distribution network and wind farm.
- Losses, battery rest periods after fast charging, availability guarantees
- New work methods (DC and LV new for ElectraNet)
- Engage SME early. Large number of stakeholders

ESCRI - Dalrymple North BESS

Operating principles

Battery Operating Agreement prioritises and protects regulated services

Level of charge at 33kV for non-regulated services	With Windfarm coordination	Without Windfarm coordination
Max allowable level of charge	X – 0.8 MWh	X
Min allowable level of charge	0.8 MWh	4.8 MWh



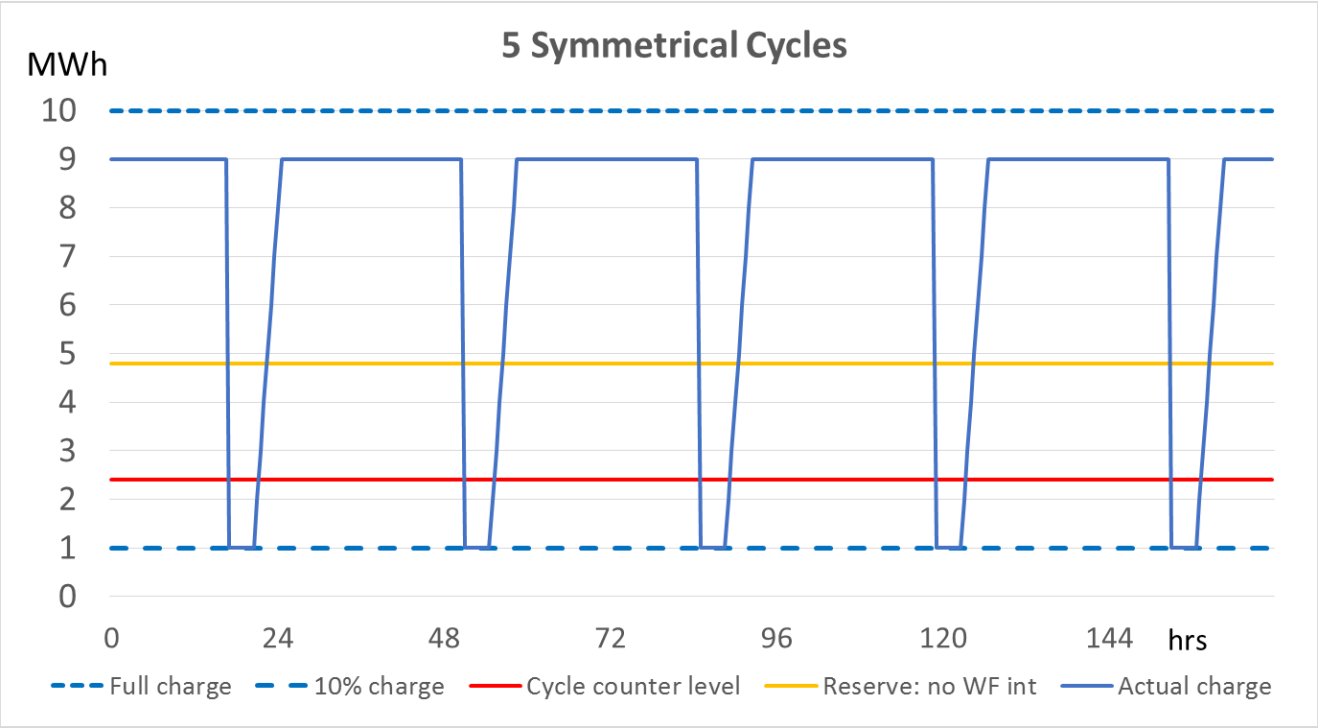
Cycle counts

- A cycle means the discharge of the BESS of more than 2.4 MWh that passes through a state of charge of 2.4 MWh. Cycles are counted in both grid connected and islanded modes.
- An annual cycle limit of 250 cycles applies.
- Learning opportunities:
  - Impact of charging rates
  - Battery rest period requirements
  - Improve definition of a cycle

Cycle count – Example 1

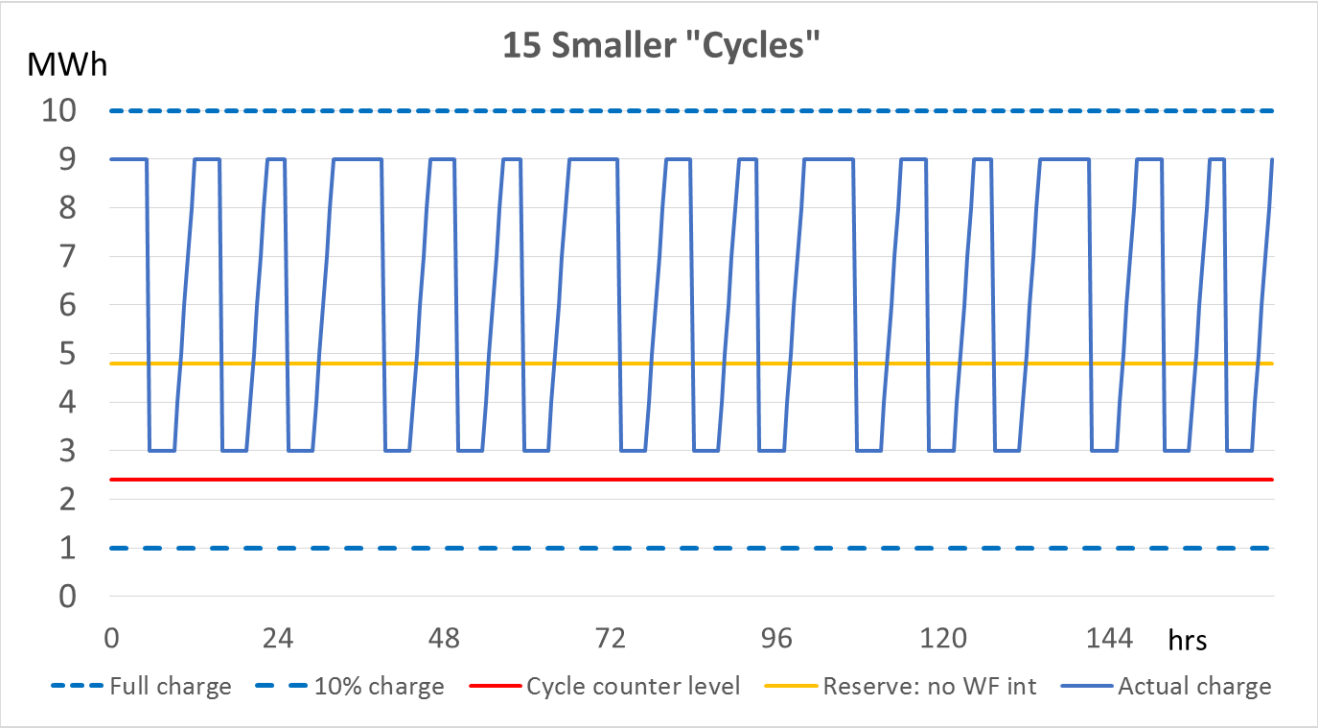
> Original idea – Battery charged most of the time

> Cycle count: 5 Energy throughput: 40 MWh



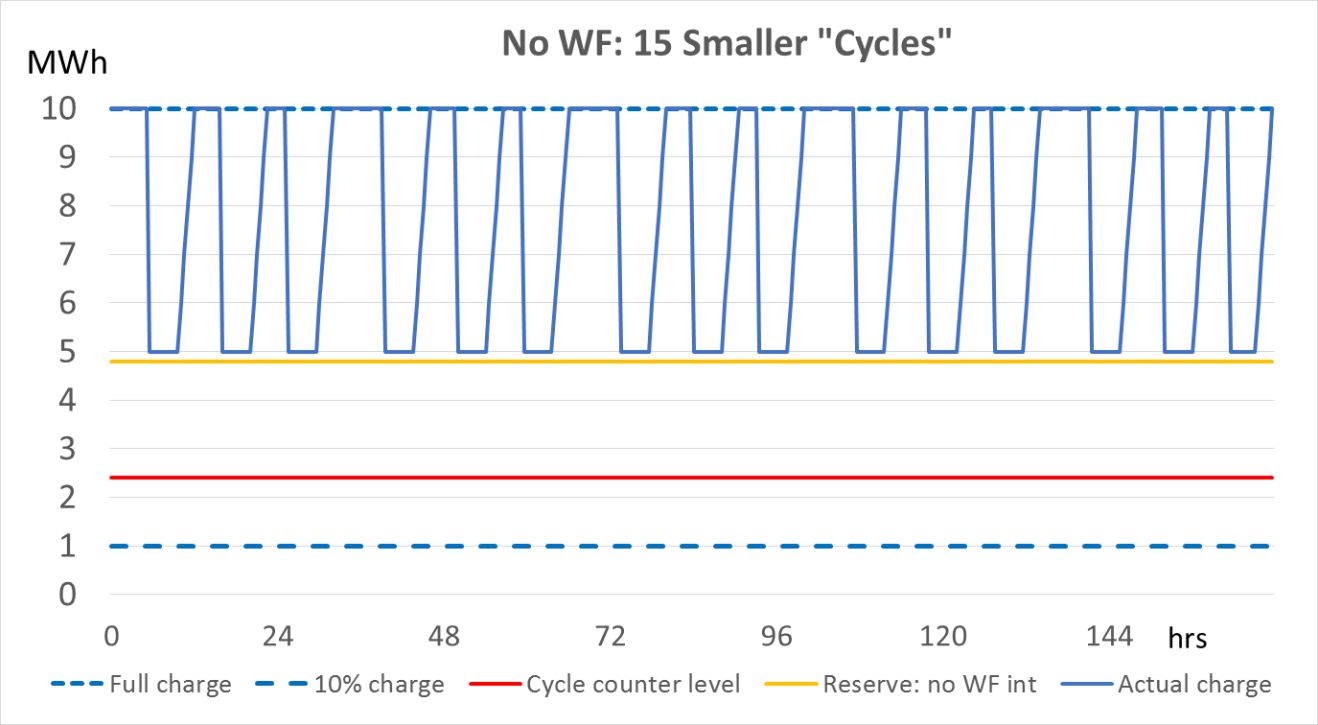
Cycle count – Example 2

- Use battery in range where cycling impact is less
- Cycle count: 0 Energy throughput: 90 MWh



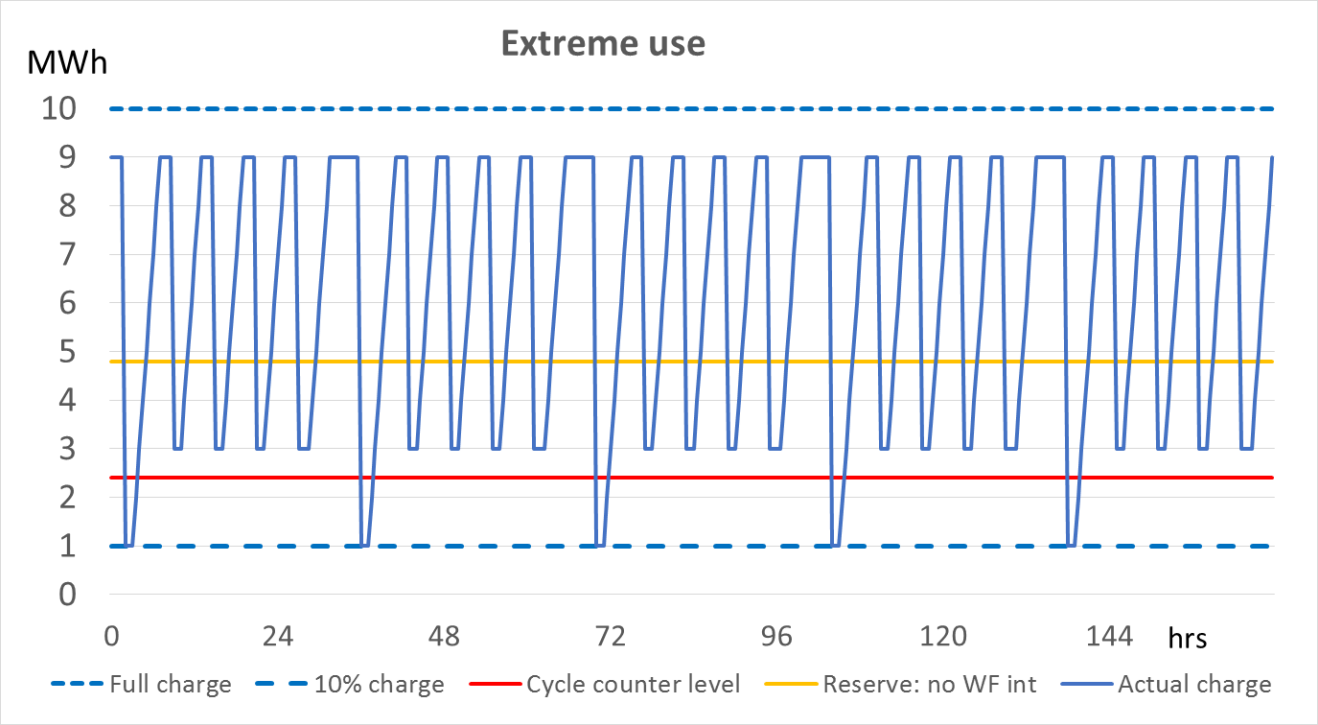
Cycle count – Example 3

- Minimum charge level limited to 4.8 MWh if wind farm integration is not successful
- Cycle count: 0 Energy throughput: 75 MWh



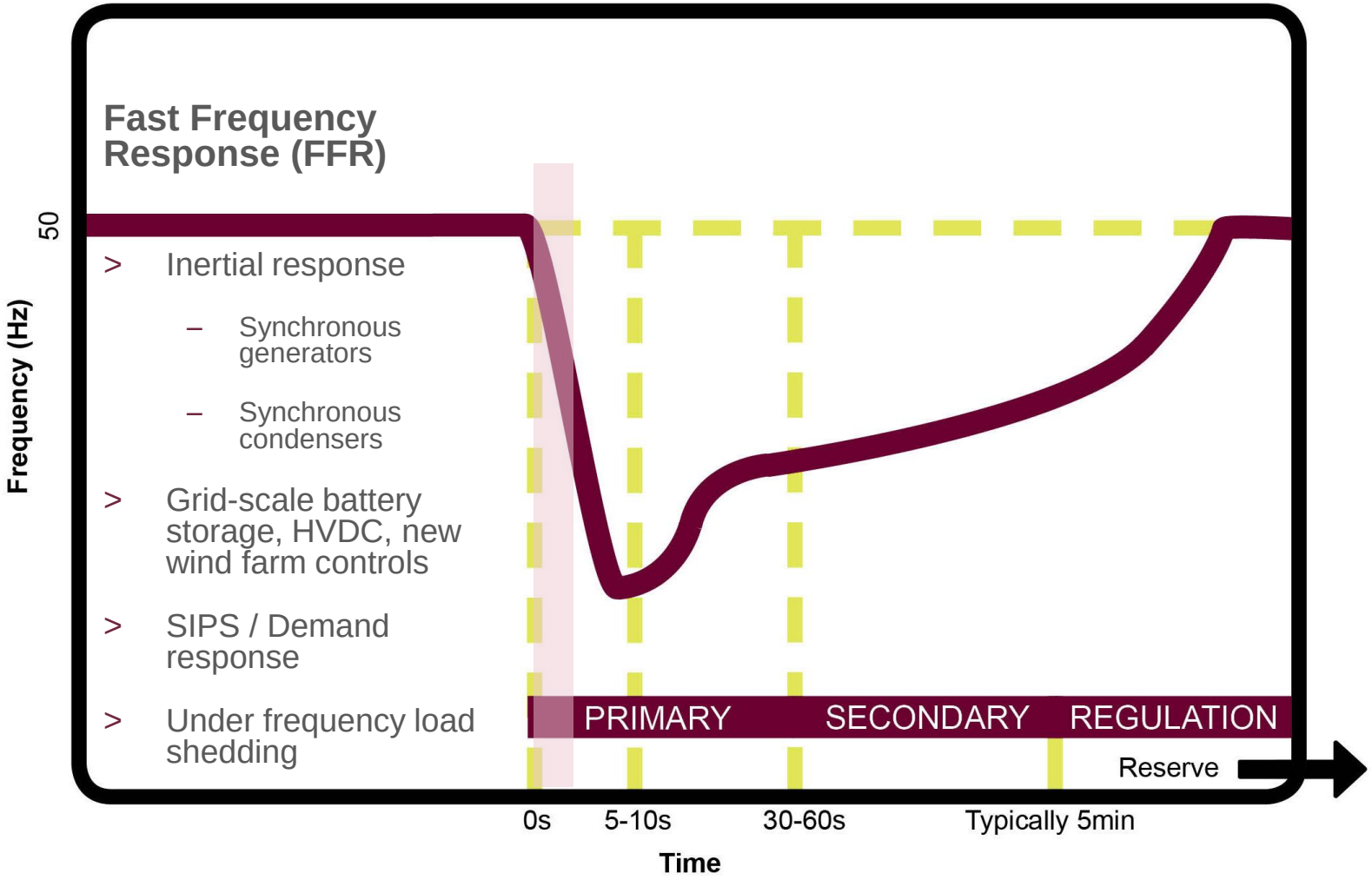
Cycle count – Example 4

- Use battery heavily, while staying within the defined cycle count
- Cycle count: 5 Energy throughput: 160 MWh



Arresting frequency after a contingency

A combination of inertia and FFR providers will be required in future



What exactly is FFR?

- Depends who you talk to…
- Various time frames:
  - System Integrity Protection Scheme – Act on an external signal before a frequency event occurs (Emergency control scheme)
  - “Synthetic inertia” – Very fast response based on significant RoCoF
  - Fast Contingency FCAS – Act within a second or two rather than 6 seconds

$$RoCoF = 25\left(\frac{\Delta P}{I}\right)$$

Questions

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Thank you

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