Arena Insights forum

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NEOEN
BOUNDLESS ENERGY

Hornsdale Power Reserve

Clément Viaud – Asset Manager (Neoen Australia)
30/11 – Arena Insights forum

Project overview: key points

Key information:

- 100MW/129MWh Li-Ion battery owned and operated by Neoen
- Co-located with Neoen's 316 MW Hornsdale Wind Farm
- Installed and maintained by Tesla
- 792 Tesla Powerpacks with 189 Tesla inverters, 33 transformers
- Less than 6 months from project inception to generator becoming operational the 1st of December 2017.

Partly contracted with the South Australian Government:

- 70MW/10MWh are dedicated to providing services for the grid and SA Government
- 30MW/119MWh can participate freely in the NEM (Australian Electricity Market).

Project overview: key stakeholders

Government Sponsor

Government of South Australia

Approvals

AEMO – Australian Energy Market Operator

Essential Services Commission of South Australia

Hornsdale Wind Farm
Hornsdale Power Reserve

NEOEN

Owner's Engineer
Connection Stream Lead

GHD

Construction, EPC and O&M

TESLA

Consolidated Power Projects

Lloyd's Register

Manitoba-HVDC Research Centre

Transmission Connection

ElectraNet

Project overview: operation

Main objectives:

- Provide “grid stability” services
- Reduce risk of blackout
- Increase competition among electricity generators
- Put downward pressure on energy and FCAS prices
- Generate revenue.

Services provided by the battery:

- Energy (arbitrage)
- FCAS regulation (Lower and Raise REG)
- FCAS contingency (6sec, 60sec and 5min services)
- Participation in SIPS

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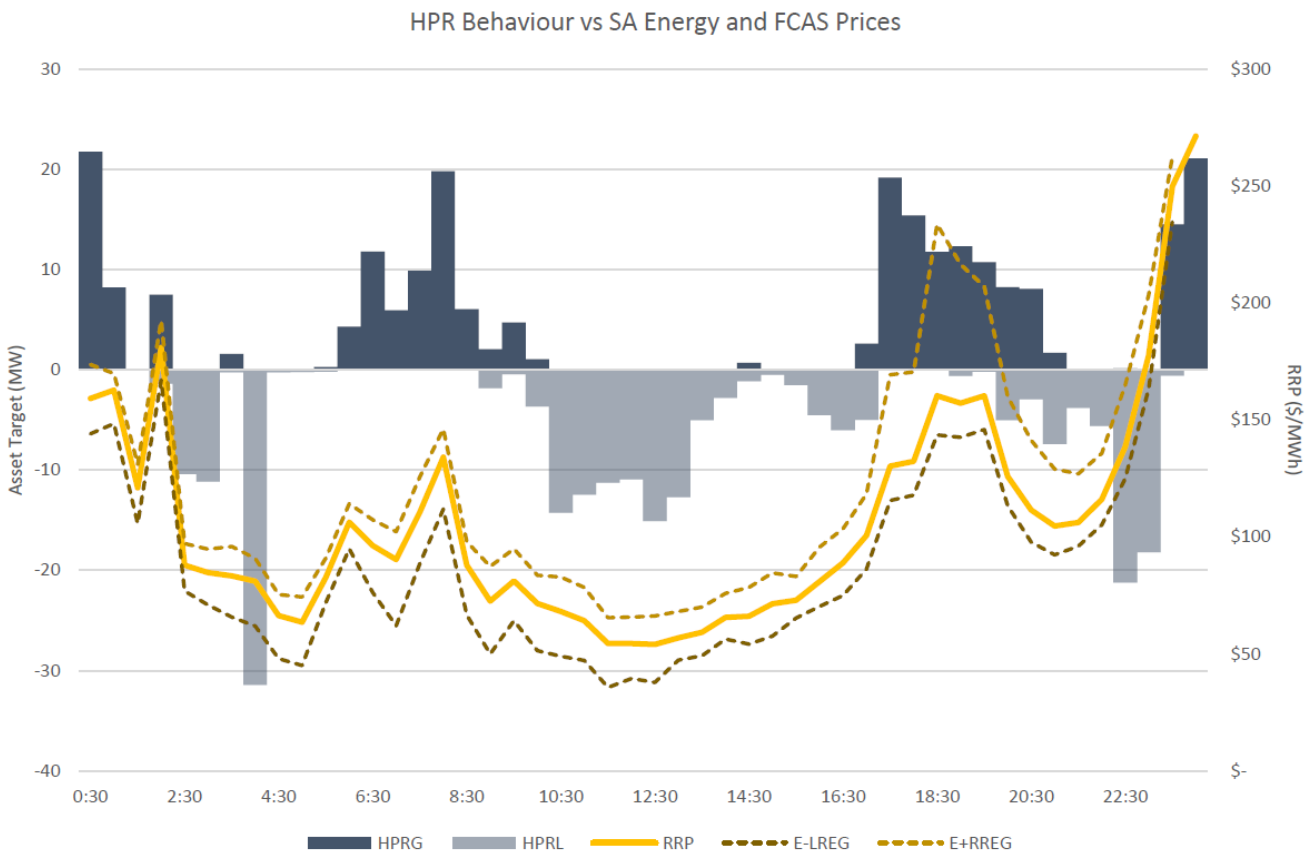
Services provided: Energy (arbitrage)

Principles of the arbitrage:

- Objective of generating revenue by trading energy
- Strategy based upon a basic principle: the battery imports low price energy and export it back to the grid when the prices are high.

Market operation:

- 119MWh of storage capacity and an output +30MW (generation) / -40MW (load) are available for trading
- Bidding mostly automatized thanks to:
  - the bidding optimisation algorithms developed for the project;
  - bidding engine platform (custom made software) able to transmit the bid to AEMO's bidding platform (Market Management System);
- 24/7 operations control centre in Neoen's Canberra Office (set up for the project) in charge of the monitoring/supervision of the battery.



Example of a typical day of trading

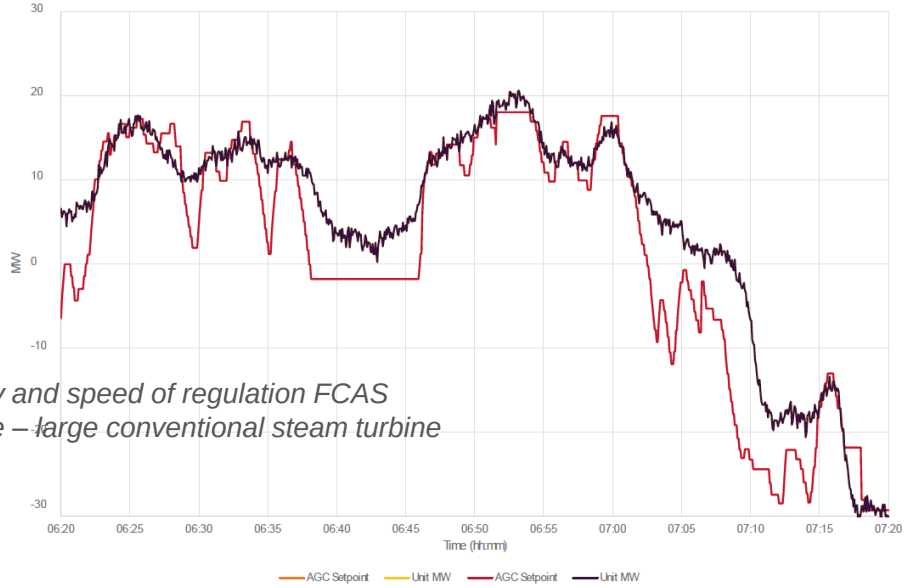
Services provided: FCAS Regulation (1/2)

Principles of FCAS regulation:

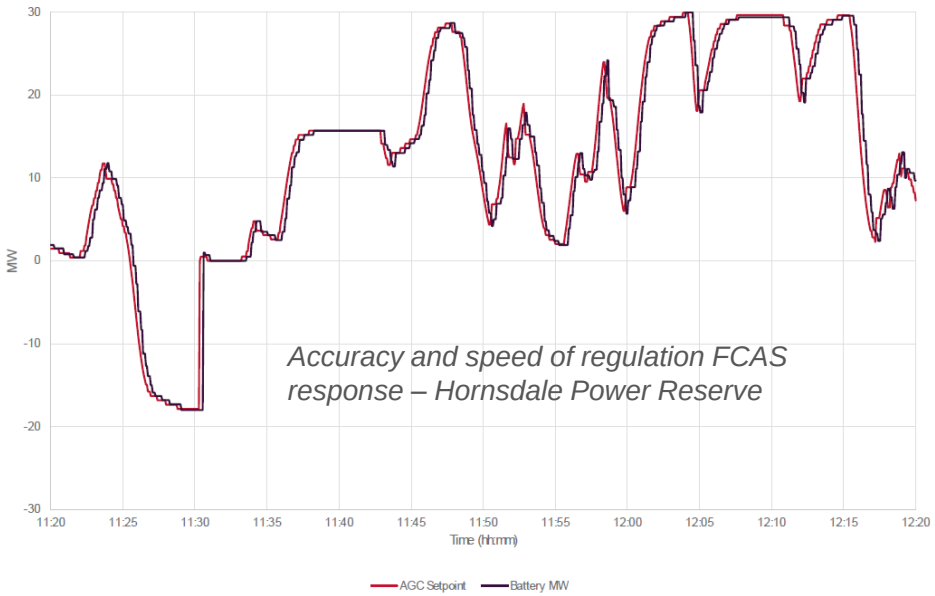
- Frequency Control Ancillary Services are necessary to keep grid frequency between 49.85 Hz and 50.15 Hz
- Regulation FCAS is required to continually correct the generation/demand balance in response to minor deviations in load or generation
- When enabled the battery follows every 4 seconds a dispatch signal from AEMO.

Performances:

- HPR is the first FCAS regulation provider using another technology than conventional synchronous generation
- Compared to conventional generators, the battery's response is both quicker and more precise:



Accuracy and speed of regulation FCAS response – large conventional steam turbine



Accuracy and speed of regulation FCAS response – Hornsdale Power Reserve

Graphs source: AEMO (Initial operation of the HPR – April 2018

Services provided: FCAS Regulation (2/2)

Impact of HPR on the SA Raise Regulation Market:

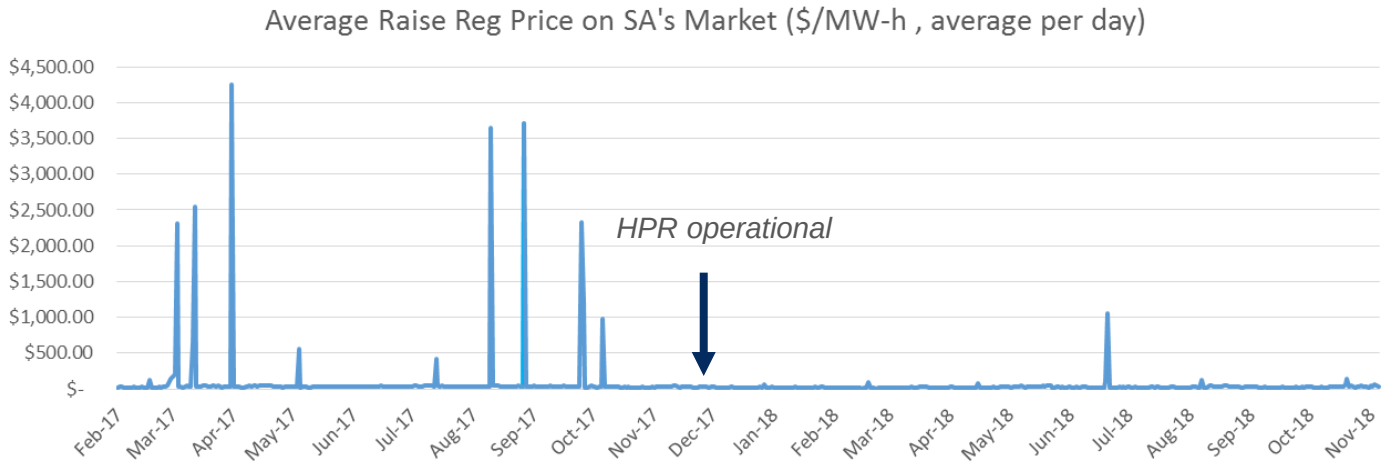
Under normal conditions

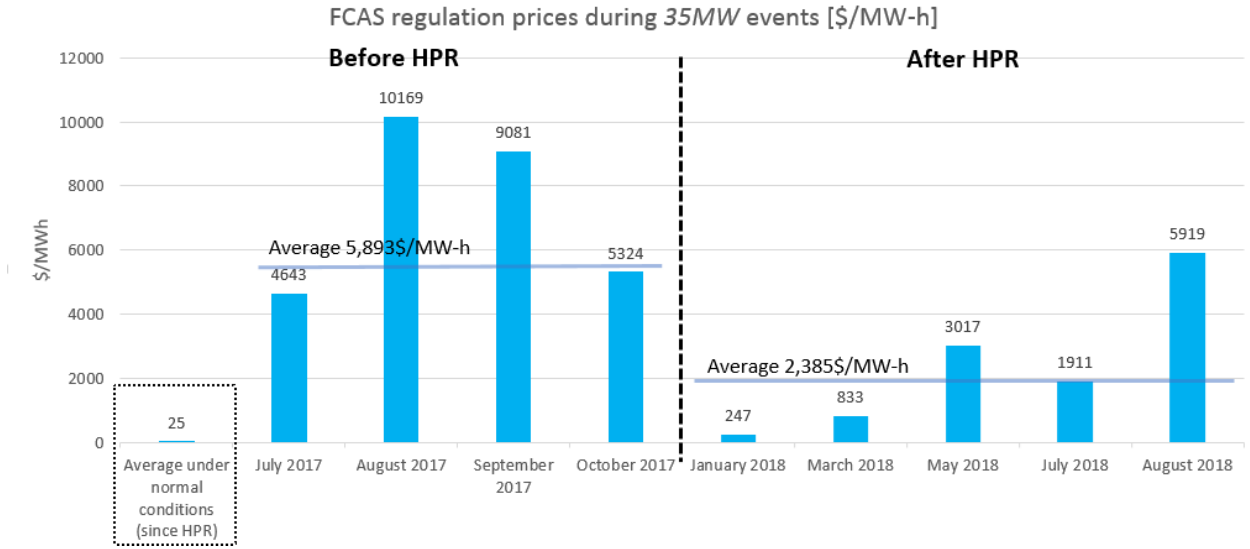
- Prior HPR, the regulation prices were **~35$/MW-h**
- Since HPR is operational, prices are **~25$/MW-h,** 30% lower than prior Dec. 2017

During SA 35 MW FCAS events

- Under certain conditions, the market operator calls for 35 MW of FCAS Regulation to be sourced from within SA
- Such events lead to high prices (~20 to 50 times the normal average) as a consequence of a very limited number of FCAS providers in SA.
- The battery is now providing competition and reduces prices.
- As an example: on 14 January (first 35MW event for HPR), the battery set the price reducing it by ~95%

Compared with the previous year SA Regulation costs declined by $40m. On January 14th savings for SA energy users were $3M in a single day (5 hours)





Services provided: FCAS Contingency (1/2)

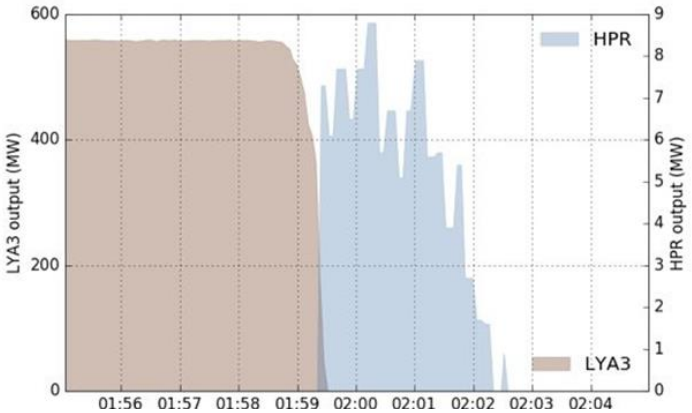
Principles of FCAS contingency:

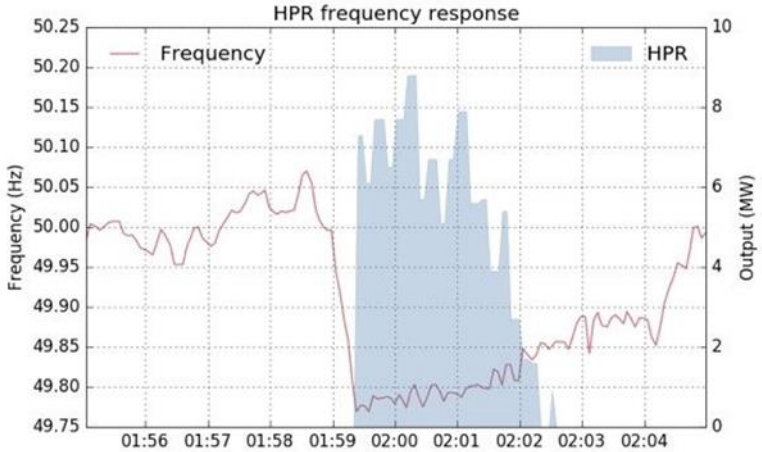
- Frequency Control Ancillary Services are necessary to keep grid frequency between 49.85 Hz and 50.15 Hz
- Contingency FCAS is required to correct the generation/demand balance following a major contingency event, such as the loss of a generating unit or major industrial load, or a large transmission element.

Performances - Loy Yang event, 14 December 2017

On 14 December, Loy Yang (in Victoria) tripped resulting in 560 MW loss of generation.

- The minimum frequency observed during this event was 49.77 Hz in the Mainland and 49.40 Hz in Tasmania
- First major event after the battery came online
- The response time for the battery was a matter of milliseconds





Graphs source: Renew Economy

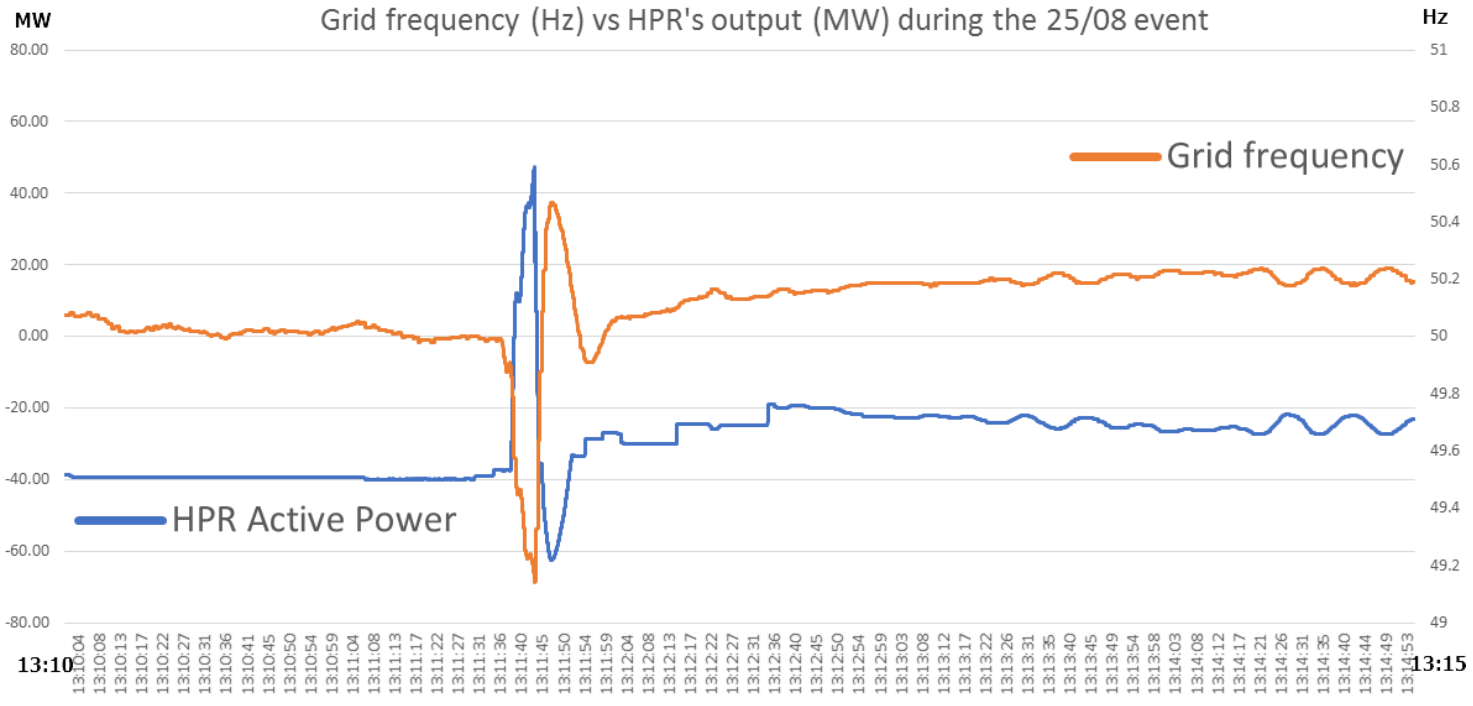
Services provided: FCAS Contingency (2/2)

Performances – QLD SA System separation, 15 August 2018

On the 25/08, the NSW-QLD interconnector tripped due to a lightning strike, causing significant instability in the entire grid. The sudden drop in frequency, combined with change in power flow on the VIC-SA interconnector, led to the separation of SA from VIC around 8 seconds later.

- Prior the event the battery was charging at -40MW
- As a response to the drop of frequency, the battery jumped straight up to +47MW, providing an equivalent of +87MW of generation
- Then to absorb the following frequency hopping, the battery went straight to -62MW providing a response equivalent to 109MW of drop of generation

- This event caused the load shedding of
  - 724 MW in NSW
  - 280 MW in VIC
  - But 0MW in SA most likely thanks to the HPR.



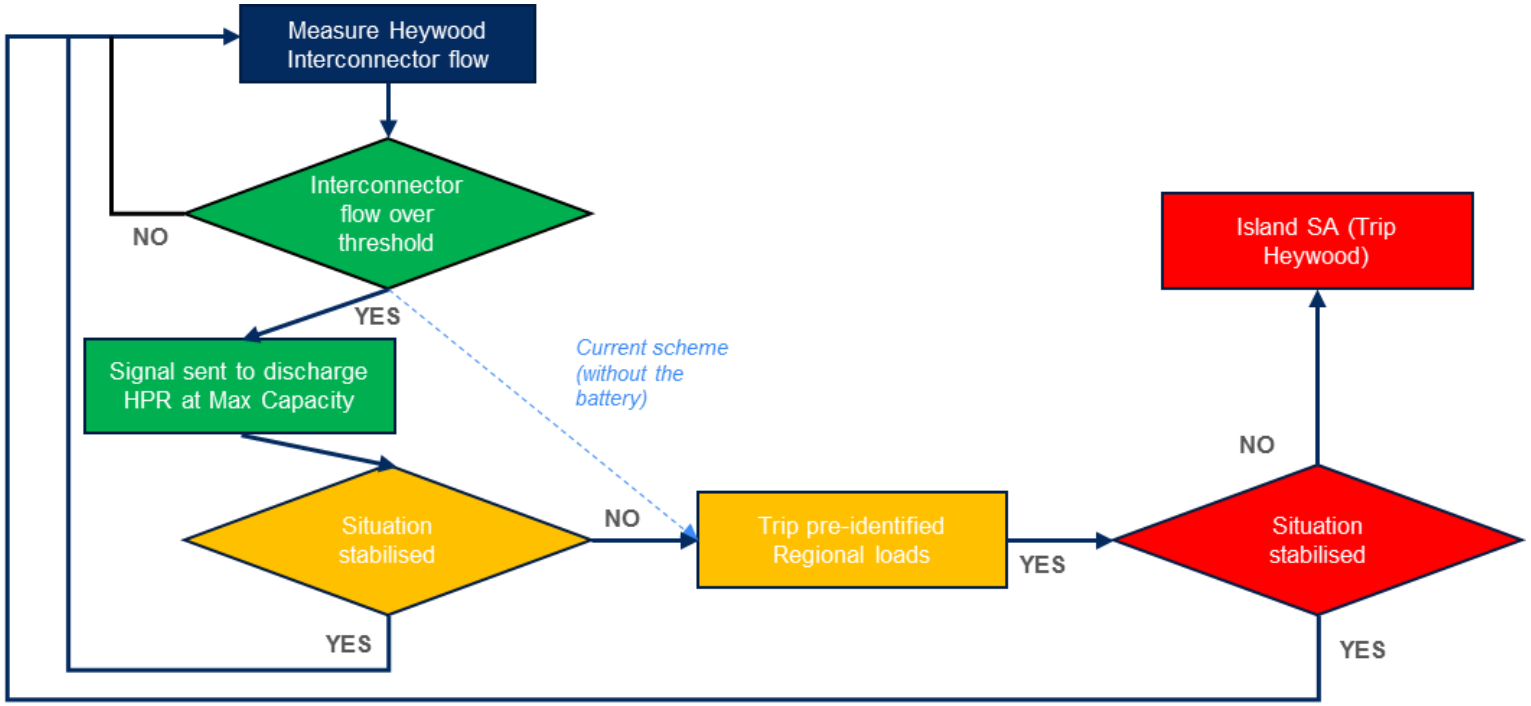
Services provided: SIPS (end of 2018)

Following the SA Black-out (Sept 16) AEMO suggested to develop with ENet a Special Integrated Protection Scheme (SIPS) that would detect sudden excessive flows on the Heywood interconnection (ensuring the SA-VIC connection) and, initiate, if necessary:

- Emergency load shedding or
- Quick additional generation

The battery will be part of the following scheme to be used as :

- an additional link in the existing logic chain (the battery would be the primary response to an event on Heywood);
- a buffer before triggering regular “load-shedding”.



SIPS logic scheme

Conclusion

- Significant impact on the market

HPR ability to trade energy and the addition of new FCAS capacities in a SA market relatively limited in term of number of actors have contributed significantly to the lowering of energy and FCAS prices.

- Ability to participate in all FCAS services

HPR can provide a range of valuable power system services, including rapid, accurate frequency response and control.

- Part of the New System security services

Once fully integrated in the SIPS scheme, HPR can provide a valuable new layer of security to avoid SA islanding.

Thank you for listening

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