NEM Reform Implementation Forum

Integrating Energy Storage Systems Bidirectional Unit (BDU) implementation - Stakeholder feedback & responses

31 May 2023

We acknowledge the Traditional Owners of country throughout Australia and recognise their continuing connection to land, waters and culture.

We pay respect to their Elders past, present and emerging.

Agenda

#	Time (AEST)	Topic	AEMO presenter(s)
1	11:00 AM – 11:05 AM	**Welcome & Context**	Ulrika Lindholm
2	11:05 AM – 11:15 AM	**Stakeholder feedback summary**	Luke Barlow
3	11:15 AM – 11:45 AM	**Changes to Bidirectional unit implementation design**	Luke Barlow Basilisa Choi
4	11:45 AM – 11:50 AM	**Next steps**	Emily Brodie
5	11:50 AM – 12:00 PM	**Questions & Other Business**	Ulrika Lindholm

Appendix A:
Glossary
Appendix B:
Detailed feedback and responses on BDU model
Appendix C:
Competition law meeting protocol and AEMO forum expectations

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1. Welcome & Context

Engagement on BDU Design Implementation

AEMO thanks stakeholders for their participation and feedback received.

Glossary*

IRP	Integrated resource provider
BDU	Bidirectional unit

*Refer to IESS Glossary in Appendix B for full list of acronyms

Ongoing industry readiness engagement via the NEM Reform Implementation Forum and 1to1 conversations.

2. Stakeholder feedback summary

Feedback summary (1/2)

Detailed responses to stakeholder feedback are provided at the back of this slide pack

TOPIC	KEY FEEDBACK	AEMO RESPONSE
Regulation Frequency Control Ancillary Services (FCAS) trapeziums	The originally-proposed single-Dispatchable Unit Identifier (DUID) model for BDUs in NEMDE does not allow the use of conditional bidding of regulation FCAS and energy on the generation and load sides.	To minimise impacts to market participants, AEMO has investigated and developed a revised model that retains conditional bidding functionality under a single-DUID model. Details are presented in Section 3 of this slide pack.
Value of single DUID model	The single DUID model introduces additional complexity and work for industry to redesign bidding systems, without clear benefits for industry.	• IESS rule requires that BDUs participate under a single classification. • Maintaining bidding and dispatch for two units for each BDU carries operational complexities and inefficiencies in managing the power system, worsened by expected significant increase in BESS connections. • BDU model has been designed to reduce operational complexity for AEMO, while managing the risk of over-scheduling of contingency FCAS for participants. • AEMO aims to, where possible, ensure that the IESS implementation minimises impacts to participants (example above). Details are presented in Section 3 of this slide pack.
Commercial sensitivity of state-of-charge	Publishing/reporting on the state-of-charge for individual scheduled BDUs releases commercially sensitive information, and equivalent information (e.g., fuel stockpiles) is not released for other unit types.	• AEMO agrees with this, and will not publish state-of-charge information from pre-dispatch. • State-of-charge will be tracked in pre-dispatch, but this information will be made available only to the registered participant of the respective unit.

Feedback summary (2/2)

Detailed responses to stakeholder feedback are provided at the back of this slide pack

TOPIC	KEY FEEDBACK	AEMO RESPONSE
Energy storage limits	The energy limit model should be included in pre-dispatch, but not in dispatch.	As suggested, AEMO has decided not to include the energy limit model in dispatch, which aligns with the current application of daily energy limits.
Composite ramp limits	Could you please provide one worked example (using the formulas) of the ramp constraint where the charge/discharge transition is not symmetric (+5 MW to -15 MW for example)?	AEMO has included an example in its Final BDU Model for NEMDE. Details are presented in this slide pack.
Implementation timing	Appropriate support needed from AEMO, in particular the need for timely tech spec publication.	AEMO to: • Review delivery timelines for technical specification and data model. • Manage the risk of AEMO delays by monitoring against agreed milestones (visible to industry via Implementation Forum) and will include contingency planning in discussion with industry.

3. Changes to Bidirectional unit implementation design

Section outline

This section will address:

a) Background and issue
b) BDU design objectives
c) Options considered
d) Revised BDU model

Background and issue

- Australia's first grid-scale battery (Hornsdale Power Reserve) was commissioned and registered in 2017.
- To quickly register and integrate HPR into NEM systems with as little disruption as possible, the BESS was represented as two units:
  - Registered twice – generation and load sides
  - Operates in the energy and FCAS markets as separate generation and load DUIDs
  - Contingency FCAS limited to one DUID only to prevent over-scheduling
- This workaround is:
  - Now inefficient owing to the number of BESS that have connected since 2017 (~14).
  - Heightens operational risk for both BESS participants and AEMO
  - Not suitable for scaling to match the forecast significant increase in BESS connections over the coming years (see next slide)
- To address these challenges, the IESS Rule introduces a single DUID model for bi-directional units that:
  - improves the efficiency and reduces operational risk
  - manages the risk of over-scheduling contingency FCAS thereby allowing BESS to provide these services while discharging or charging.

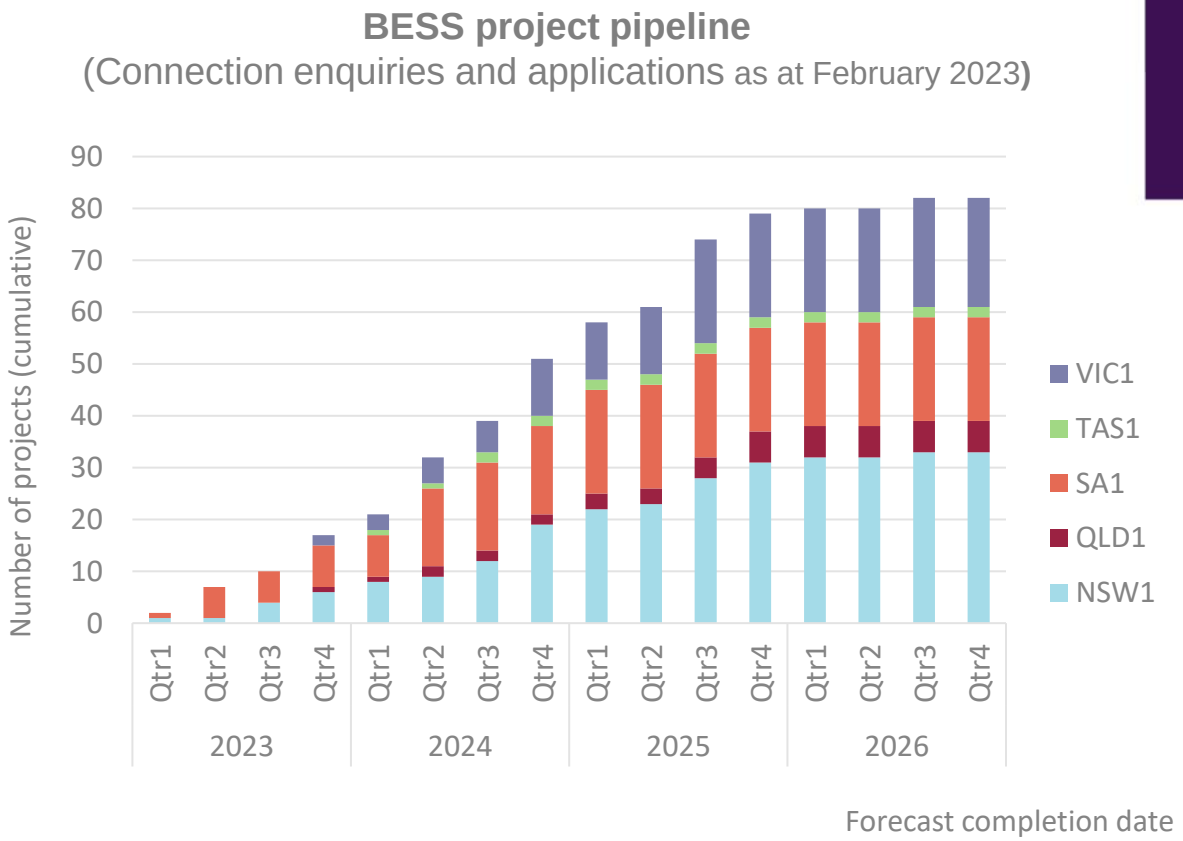
Reducing operational complexity

AEMO currently carries operational complexities and inefficiencies associated with the existing 2-DUID arrangement:

- → Requires custom logic to translate between single SCADA point and 2-DUID dispatch → cost to maintain
- → During market interventions, processing of both DUIDs is required despite being a single asset
- → Instances of simultaneous dispatch of load and generation can occur

Continuing this arrangement for BESS would exacerbate problem, particularly considering significant increase in BESS connections (see figure)

1-DUID arrangement for BDUs will assist AEMO in managing operational complexities.



BDU Model: Objectives

AEMO

- Dispatch targets (energy/FCAS) are physically realisable
  - Avoid lack of service to operate the power system or the need to claw back FCAS payments
  - Allow Contingency FCAS to be provided across full BESS operating range
- Single DUID per BESS simplifies market and power system operation for AEMO RTO, particularly during atypical operation
- Energy model supports opt-in to energy constraints for BESS operators and tracking of energy storage for AEMO.

BESS operators

- Maintain ability for regulation FCAS bidding
  - Pricing of regulation FCAS able to be offered in separate bid bands while generating and consuming
- Minimise implementation costs
  - Minimise changes to bid structures in use industry today

Based on feedback received, AEMO understands that these are BESS stakeholders' main objectives

BDU model options summary

ID	Model	# DUID	Conditional Regulation FCAS bids	Contingency FCAS across full range	Energy Limit model	Reduced operational complexity
A	Gen and Load DUIDs (current status)	2	Y	N	N	N
B	Gen and Load DUIDs linked	2	Y	N	Y	N
C	Initial BDU model	1	N	Y	Y	Y
D	BDU with conditional Regulation FCAS bids	1	Y	Y	Y	Y
E	Gen and Load DUIDs in the market but one BDU in Operational Displays	2	Y	N	Y	Y

IESS NEMDE models: Context

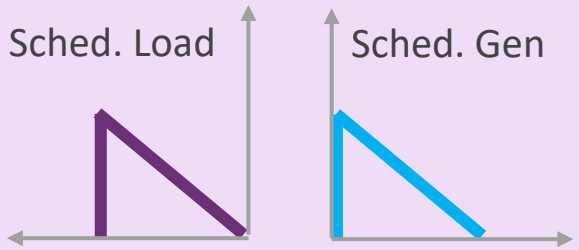
NOTE: All trapeziums are for a typical raise service

PRE-IESS MODEL: 2 DUIDs

Independent capacity, bids, etc.

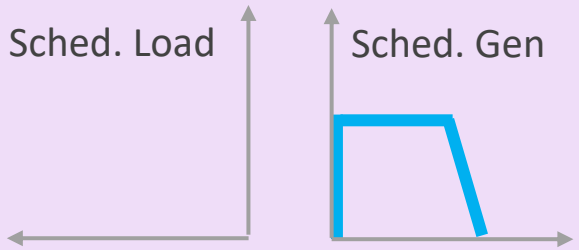
REGULATION

One trapezium per DUID, but resolved back to a single unit for AGC



CONTINGENCY

Limited to single DUID (raise on gen-side, lower on load-side)

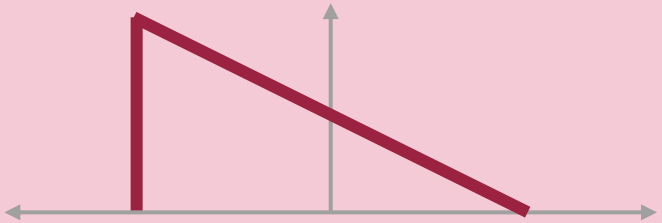


ORIGINAL IESS MODEL: 1 DUID

20 bids bands for energy, 10 per FCAS.

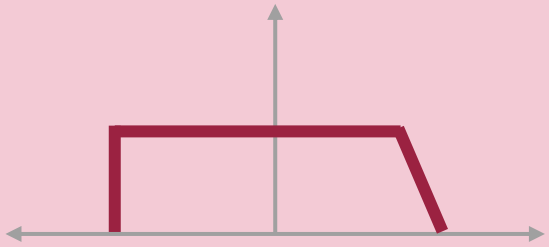
REGULATION

One trapezium – does not support conditional bidding



CONTINGENCY

Offered across full range – better manages droop limits

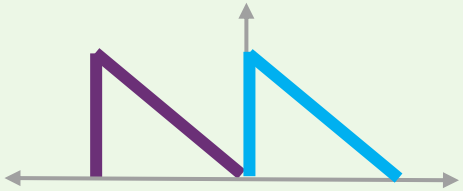


REVISED IESS MODEL: 1 DUID

Regulation bands increased to 20

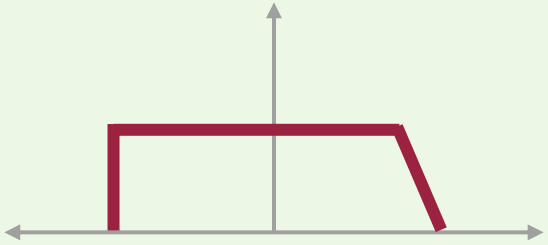
REGULATION

Two trapeziums per DUID – supports conditional bidding



CONTINGENCY

As for *Original IESS Model*



FCAS Trapeziums in Revised BDU Model

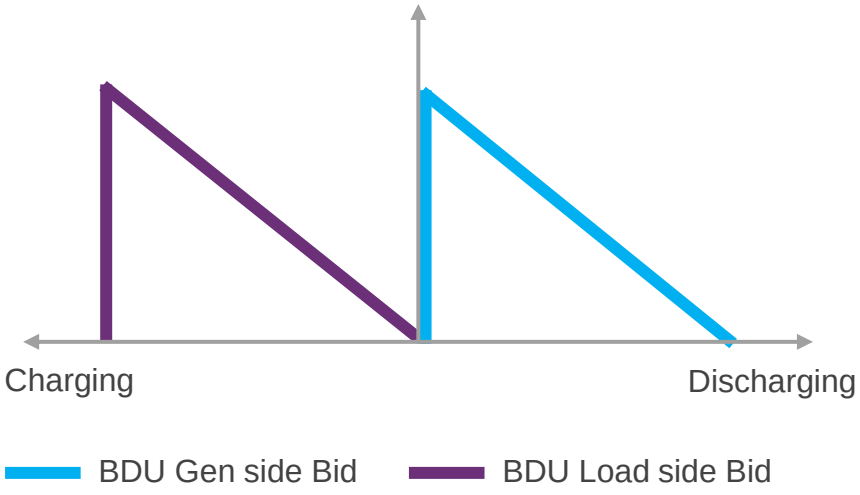
Regulation FCAS trapeziums

- Separate trapezium on the load and generation sides.
- Allows for conditional FCAS offers, with regulation FCAS across 10 bid bands per side (20 bands in total) for each raise and lower service
- Exploring design options to minimise changes to bid structures for industry, reducing implementation costs

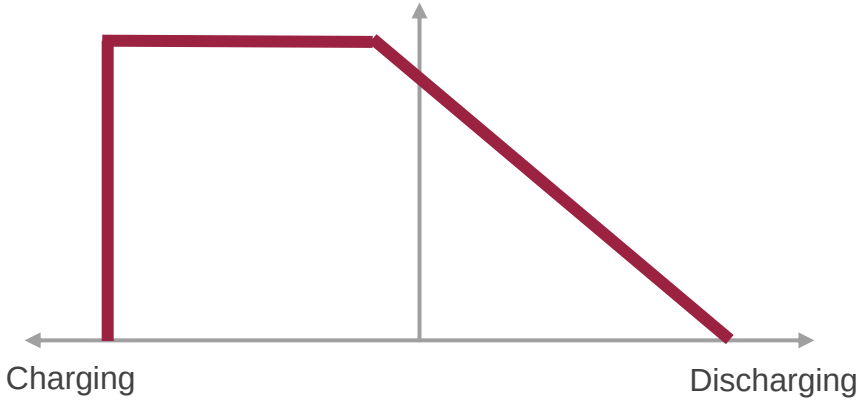
Contingency FCAS trapezium

- Single trapezium per service covers both load and generation sides.
- Allows enablement to cross the zero point.
- 10 bid bands across whole range, per service.

Regulation FCAS trapeziums (raise)



Contingency FCAS trapezium (raise)



Regulation FCAS trapezium parameters

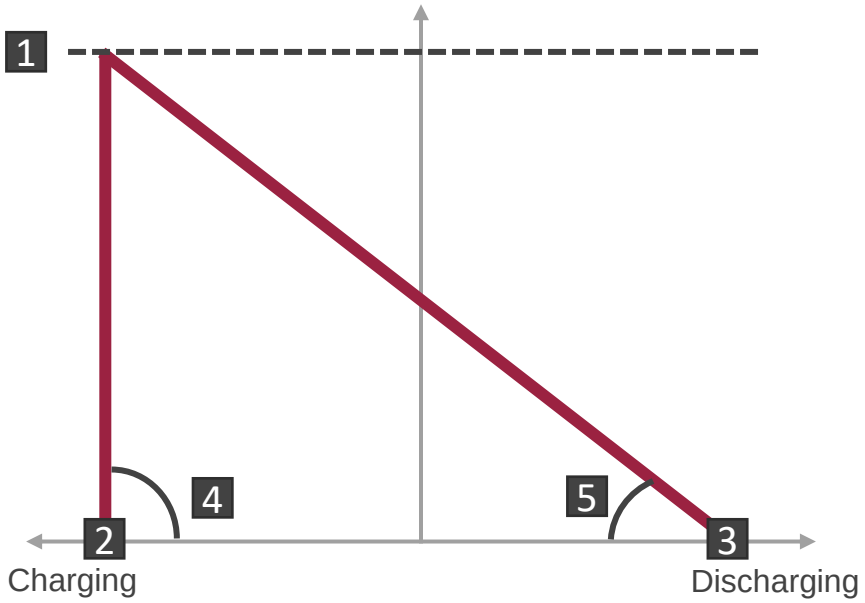
Registration data (Sch 3.1 Bid Validation Data)

- Maximum Capacity (1)
- Minimum Enablement Level (2)
- Maximum Enablement Level (3)
- Maximum Lower Angle (4)
- Maximum Upper Angle (5)

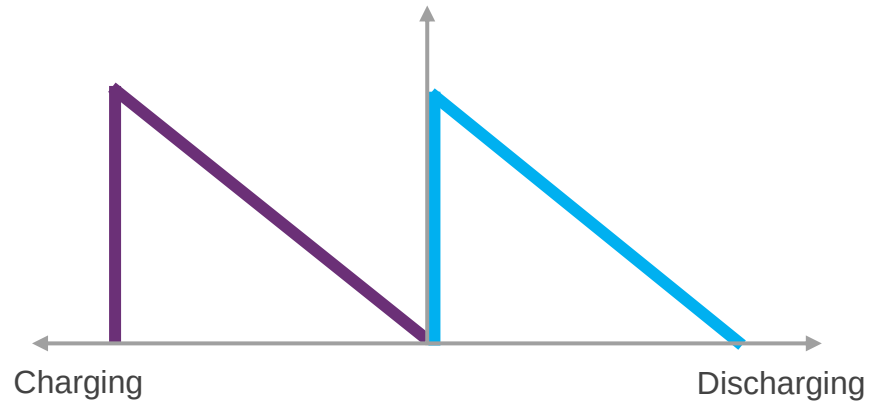
Separate bids for load + gen sides, but bids for both sides must be submitted simultaneously for validation

Load side	Generation side
$MaxAvail_{Load}$	$MaxAvail_{Gen}$
$EnablementMin_{Load}$	$EnablementMin_{Gen}$
$EnablementMax_{Load}$	$EnablementMax_{Gen}$
$LowBreakpoint_{Load}$	$LowBreakpoint_{Gen}$
$HighBreakpoint_{Load}$	$HighBreakpoint_{Gen}$

Conceptual registration trapezium



Regulation FCAS trapeziums in NEMDE (raise)

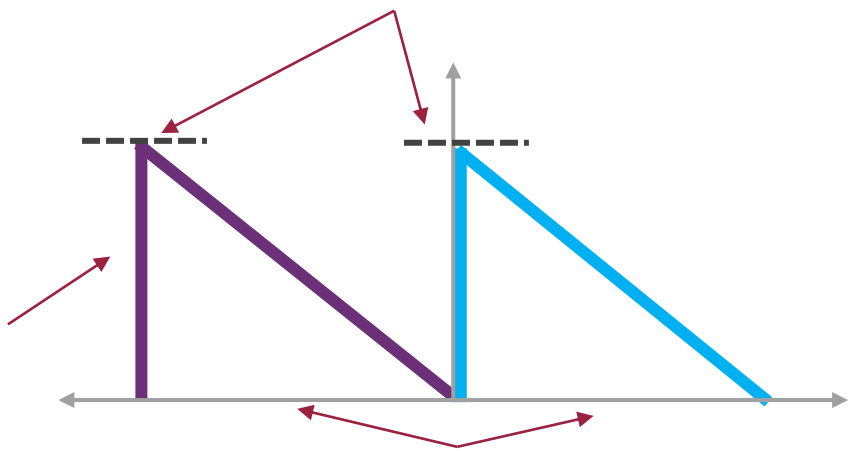


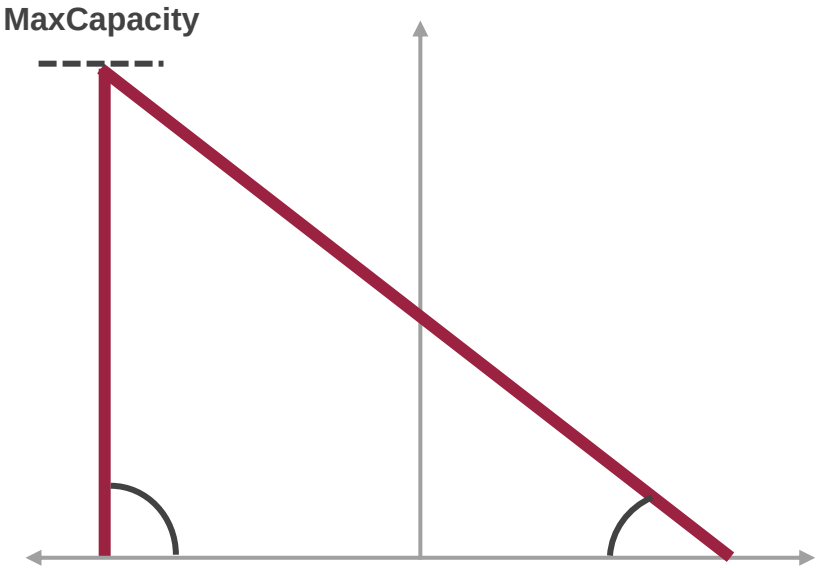
Validation of regulation FCAS trapeziums (1)

Ensures the trapeziums have a standard shape, and – when combined - are within the registered trapezium.

1. Combined load and generation regulation max availability must not exceed registered regulation max capacity: $MaxAvail_{Load} + MaxAvail_{Gen} <= MaxCapacity$
2. Gen trapezium is defined on the positive side, and load trapezium is defined on the negative side.
3. Trapezium has a 'standard' shape: *EnablementMin <= LowBreakpoint <= High Breakpoint <= EnablementMax*.

Parameters define a standard trapezium shape.

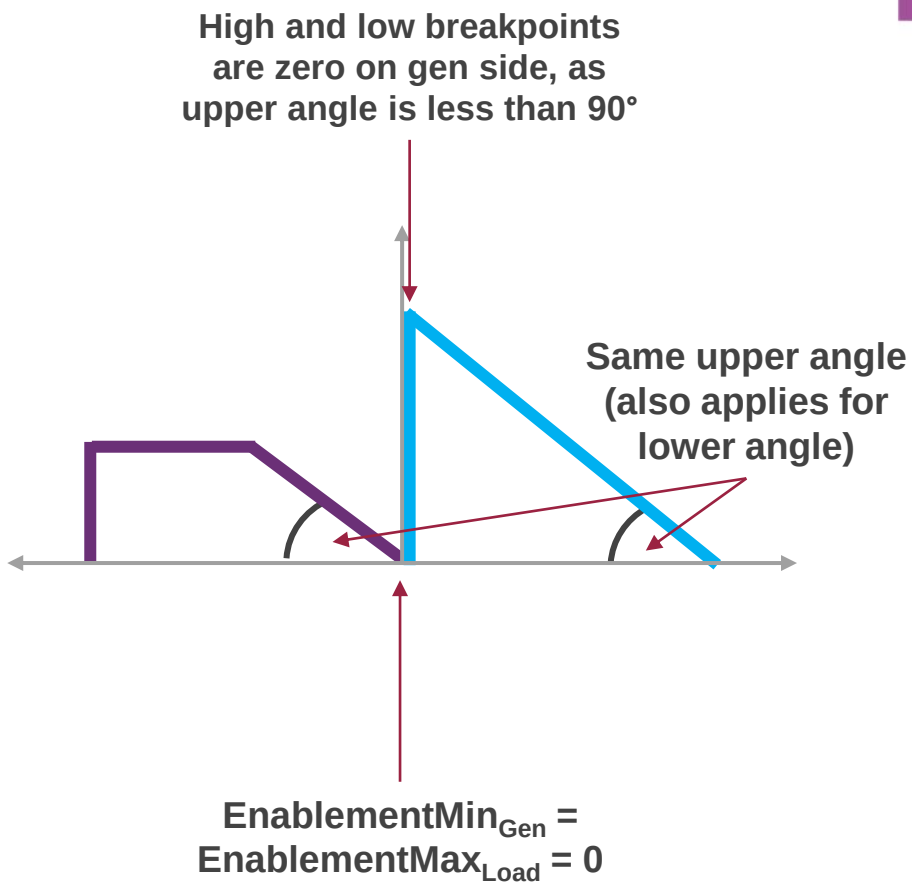




Validation of regulation FCAS trapeziums (2)

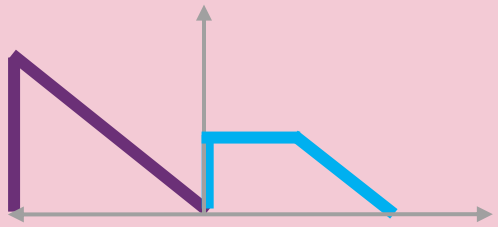
The following apply only if there is bid non-zero regulation max availability on <u>both</u> the load and gen sides:

1. Must be no ‘gaps’ between trapeziums:
   - $\text{EnablementMin}_{\text{Gen}} = 0$
   - $\text{EnablementMax}_{\text{Load}} = 0$
2. Both trapeziums must have the same upper angle.
3. Both trapeziums must have the same lower angle.
4. If the upper angle is less than 90°, high and low breakpoints <u>on the generation trapezium</u> must be set to zero.
5. Similarly, if the lower angle is less than 90°, high and low breakpoints <u>on the load trapezium</u> must be set to zero.

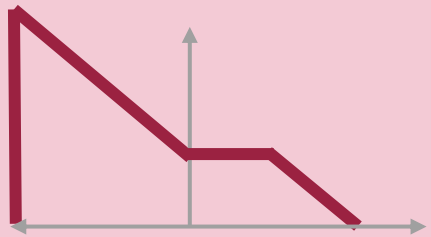


Examples of invalid regulation trapeziums (1)

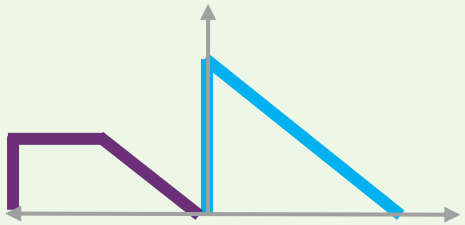
Invalid trapezium



Combined



Valid alternative



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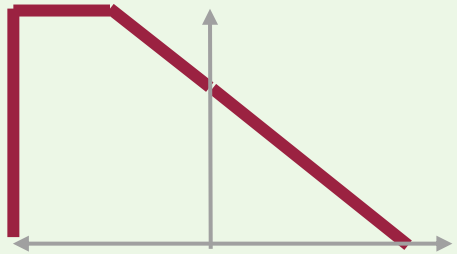
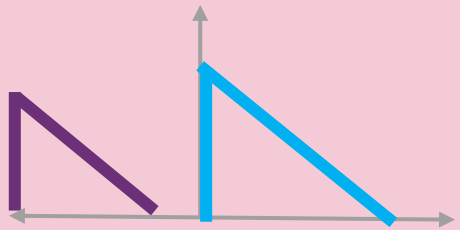


Explanation

If the upper angle is less than 90°, both the low and high breakpoint on the generation side must be zero.

Examples of invalid regulation trapeziums (2)

Invalid trapezium



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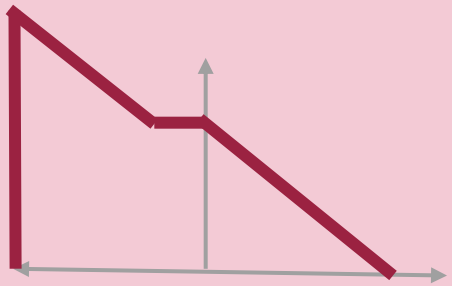
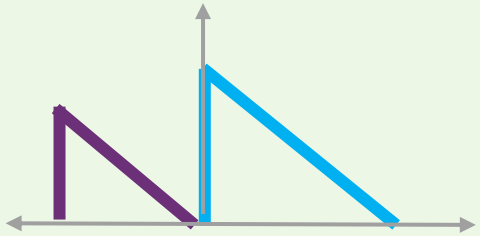


Valid alternative



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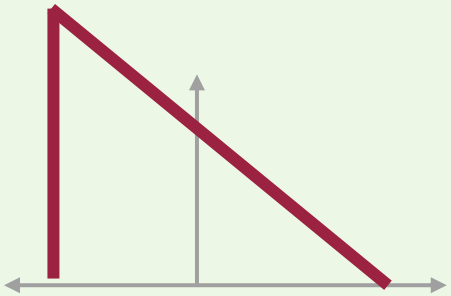


Explanation

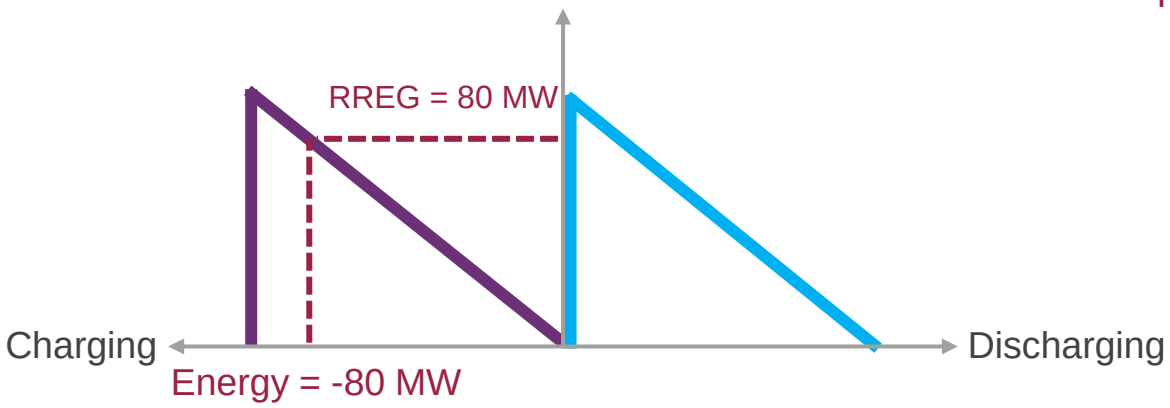
A gap between the trapeziums allows for non-convex solutions.

Resolved by setting $MaxEnablement_{Load} = 0$ (shown)
or $MaxAvail_{Gen} = 0$

Example of enablement for regulation FCAS

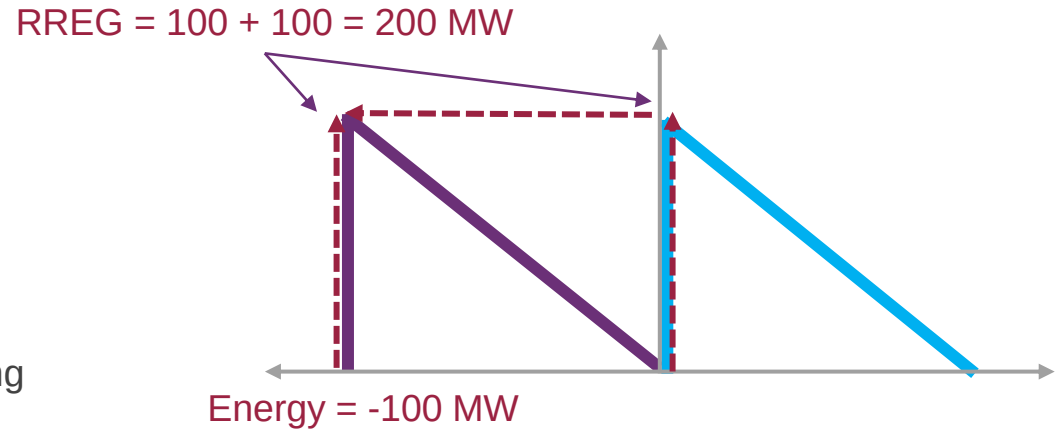
Conditional dispatch of energy with regulation FCAS enablement can be used.

- In the figure, a BDU is dispatched for raise regulation, only if it is dispatched to consume energy.
- This can be utilised by i) setting a generation-side reg MaxAvail of zero, or ii) making the load-side regulation bids relatively cheaper than the generation-side.



Also possible to enable regulation from both trapeziums.

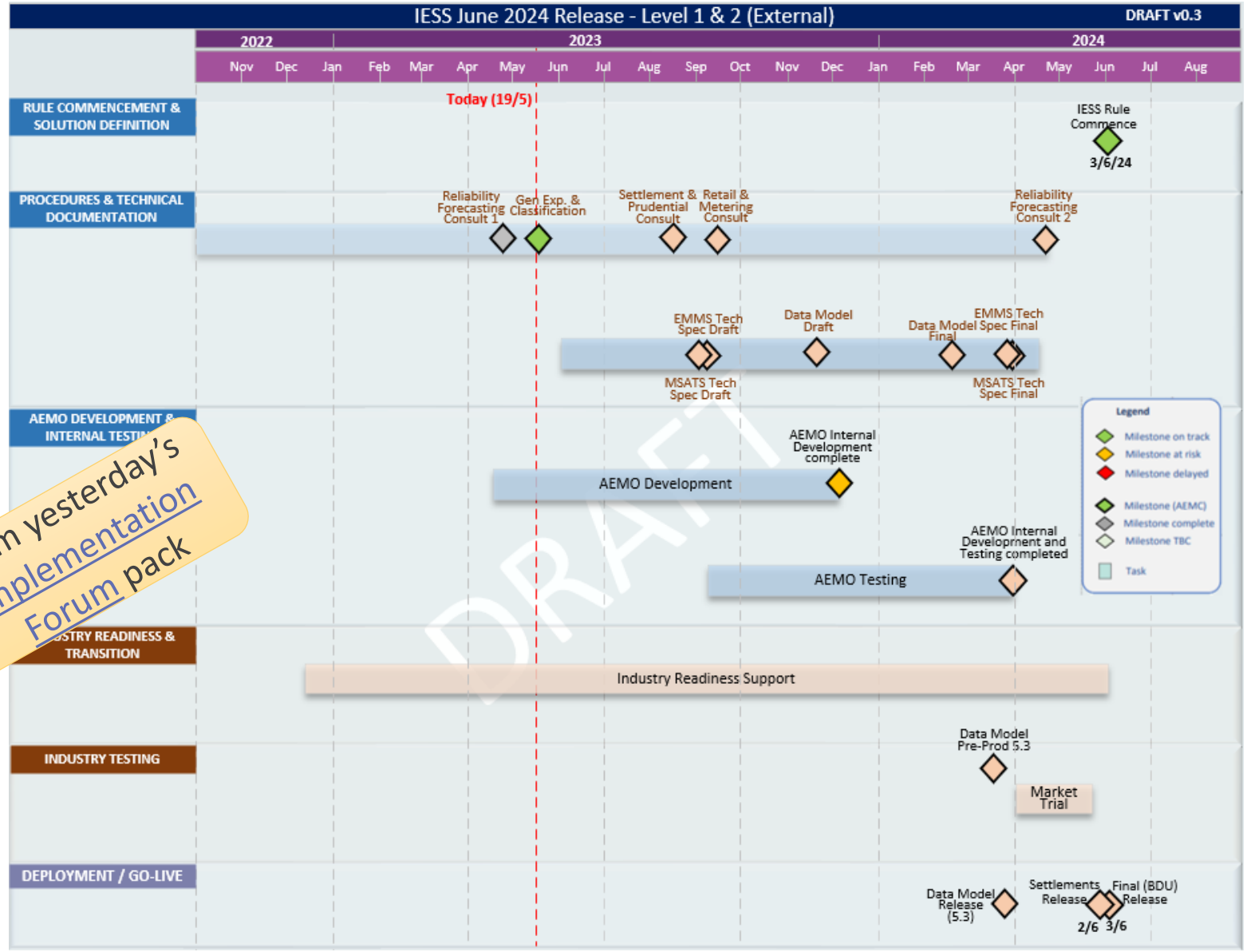
- For example, a 100 MW battery could be dispatched to fully consume (energy = -100 MW)
- NEMDE could then dispatch 100 MW raise regulation from each of the load and generation trapeziums.
- This works as there are separate regulation FCAS variables for load and generation sides



BDU Gen side Bid BDU Load side Bid

4. Next steps

June 2024 - IESS Final Release



From yesterday's Implementation Forum pack

RELEASE COMMENTARY

- Procedures consultation in progress via EWCF/ ERCF*
- BDU model stakeholder session held Tue 21 Mar and listening session Thu 20 Apr.
  - → Will discuss/publish BDU model and feedback summary for info session on Wed 31 May
- AEMO development completion milestone rated amber with resourcing and scope (BDU) considerations to be addressed to return to green
- Participant impact feedback (particularly on IESS Settlements) is being assessed and discussed with industry.
- Following milestones being defined and confirmed:
  - → Draft technical documentation
  - → Industry readiness support
  - → Market trial plan
  - → Transition and go-live plans

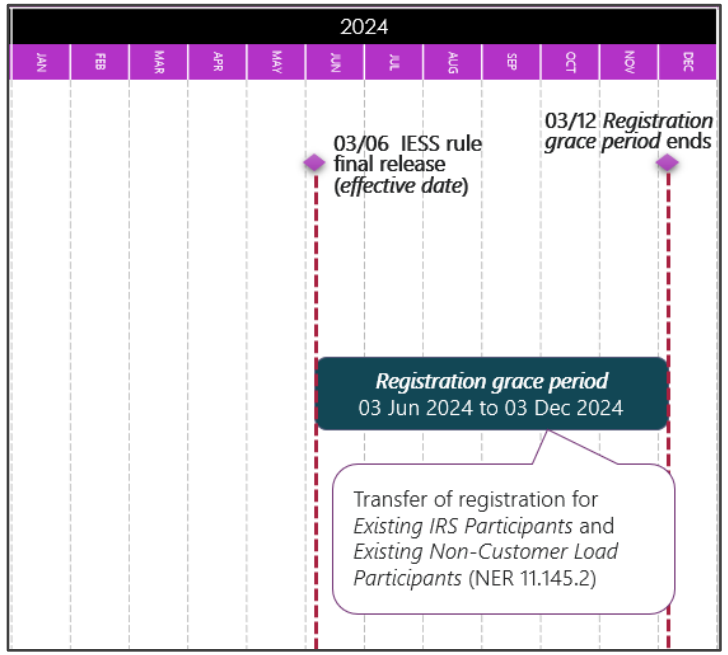
*Electricity wholesale / retail consultative forums

Transitional arrangements

AEMO is proposing a more flexible transition in response to feedback.

PARTICIPANT TYPE	IESS RULE TRANSITION*	PROPOSED TRANSITION
"New" BDU/s • BESS operational since Dec 2021	Must **move** to the 1-DUID model on Mon 03 Jun 2024	AEMO is planning a staggered go-live for new BDUs over ~6 weeks to mitigate risks of cutting over to 1-DUID during live system/market operation.
"Existing" BDU/s • BESS operational prior to Dec 2021	Registration grace period: • Must **apply** to register as an IRP by 03 Sep 2024. • Registration must be transferred and units reclassified as BDU by 03 Dec 2024.	AEMO is planning to offer an extended Registration Grace Period, into 2025, to certain existing participants.
Operators with both 'new' and 'existing' BDUs	Not considered	Proposing to allow these participants to move all of their bidirectional resources to the 1-DUID model at the same time (on or after 03 Jun 2024).

REGISTRATION GRACE PERIOD



***As set out in:** AEMC IESS determination and rule

IESS readiness approach: Indicative timing

ELEMENT		DOCUMENT	IF / ITWG ENGAGEMENT	FINAL	STATUS
STRATEGY		Readiness approach	28 Mar 2023	26 Apr 2023	Complete
		Participant impact assessment	26 Apr 2023	TBC	On track
READINESS CRITERIA		Go-live criteria and monitoring	Oct 2023	Q4 2023	Not started
TEST / TRIAL	★	Market trial & industry test **strategy**	Jul 2023 (Implementation Forum)	Oct 2023 ITWG	Not started
	★	Detailed market trial/industry test **plan**	Dec 2023 ITWG	Jan/Feb 2024 ITWG	Not started
TRANSITION	★	**Reclassifications**: • SGAs become IRPs • Existing BDUs become IRPs • Relevant loads & generators become Ancillary Service Units (ASU)	n/a	15 Dec 2023	Not started
	★	**NMI classification codes (NCC)** where a new code needs to apply (links to NCC go-live plan)	Nov 2023	Dec 2023	Not started
		Bi-directional units: • **Existing** BDUs to single DUID participation, including consolidating NMIs & moving to single bid forms. • **"New"** BDUs start single DUID participation 03 Jun 2024	Aug/Sep 2023	Dec 2023	Not started
GO-LIVE	★	New NMI classification codes (links to NCC transition plan)	Oct 2023	Dec 2023	Not started
		Go-live plans for data model releases (wholesale and retail)	Dec 2023	Feb 2024	Not started

Appendix A: Glossary

IESS Glossary

Term	Definition
5MPD	5-minute pre-dispatch
AGC	Automatic generation control
ASL	Ancillary service load
ASU	Ancillary service unit
B2B	Business-to-business
B2M	Business-to-market
BDU	Bidirectional unit
BESS	Battery energy storage system
CR	Change request
CRMP	Cost recovery market participant
DRSP	Demand response service provider
DUID	Dispatchable unit identifier
FRMP	Financially responsible market participant
IESS	Integrating Energy Storage Systems rule
IRP	Integrated resource provider

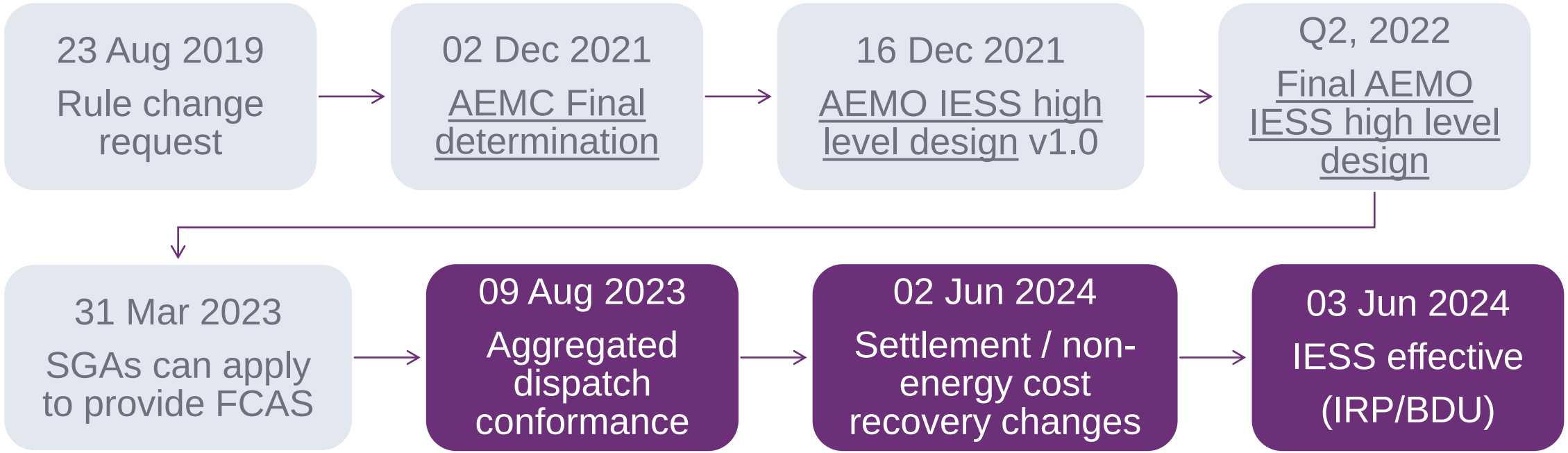
Term	Definition
IRS	Integrated resource system
MSATS	Market settlements and transfer solutions
MSGA	Market small generation aggregator
MT PASA	Medium-term PASA
NCC	NMI classification code
NECR	Non-energy cost recovery
NEMDE	National electricity market dispatch engine
NMI	National metering identifier
PAE	Profiling and allocation engine
PASA	Projected assessment of system adequacy
PD	Pre-dispatch
PMS	Portfolio management system
SCADA	Supervisory control & data acquisition
SoC	State of charge
UFE	Unaccounted for energy
WDRU	Wholesale demand response unit

Appendix B: Detailed feedback and responses on BDU model

Introduction

- AEMO's IESS project has engaged with affected industry participants on the Bidirectional Unit (BDU) implementation design. This has been in preparation for the Integrating Energy Storage Systems (IESS) rule commencement on Mon 03 June 2024.
- Participants have been engaged through:
  - Information session on 21 Mar 2023. Session outlined bidding and dispatch changes for BDUs and sought industry feedback on implementation arrangements.
  - Call for industry feedback on implementation arrangements in writing by 04 Apr 2023.
  - Listening session on 20 Apr 2023. Session allowed stakeholder to provide verbal feedback on BDU implementation design and industry transition.
  - Bilateral discussions with existing energy storage participants in April-May 2023.
- AEMO thanks stakeholders for their participation and feedback received.
- The tables below summarise feedback received and provide AEMO's response, arranged by topic area. Descriptions in the 'Detail' column are a summarised interpretation of the original comment. In some cases, similar comments from separate stakeholders have been addressed together.

IESS: High-level Timeline



SGA	Small generation aggregator
FCAS	Frequency control ancillary service/s
IRP	Integrated resource provider
BDU	Bidirectional unit

REFERENCES

- **AEMC** IESS rule change
- **AEMC** Implementing IESS rule change
- **AEMO** IESS High Level Design and Implementation Strawperson
- **AEMO** IESS Participant Toolbox

List of feedback topics

1. IESS implementation timeline
2. Value of the IESS single DUID model
3. Bid parameters, validation, and interfaces
4. Energy storage limits
5. Price ties
6. Ramp rates
7. Treatment of regulating capability
8. Terminology and definitional questions

1. IESS implementation timeline

#	Question	Answer
1	When is the timing of the Market Trials for IESS?	Market trials are earmarked for April and May 2024.
2	The IESS timelines around market trials, release of draft technical specifications, go-live dates are challenging. They also overlap with the FFR changes, which raises further challenges for development of bidding systems.	AEMO acknowledges it needs to provide appropriate support, particularly the need for timely tech spec publication. As such, AEMO will: • Review delivery timelines for technical specification and data model. • Manage the risk of AEMO delays by monitoring against agreed milestones (visible to industry via Implementation Forum) and will include contingency planning in discussion with industry.
3	Will the existing tables be amended, or new tables developed for the proposed BDU changes?	Yes, under the current proposal, the existing tables will be amended. No new tables are likely to be developed.
4	Is it mandatory for participant to implement their single-DUID BDU by 3 June 2024?	It depends on *when* the BDU was registered and whether the operator has other BDUs. See “Transition arrangements” slide above.
5	We have a battery that is under construction that we aren't sure which category it fits under for switching over, and our software people are not ready to start using this in July.	Please contact us via iess@aemo.com.au so we can assist with specific scenarios. Please also note that further detail on transitioning batteries to BDUs will be developed in the BDU transition plan in consultation with industry.

2. Value of single DUID model

#	Issue	Detail	Response
6	Value of Single DUID Model	One of the key reasons for early industry support / industry value was the linkage to TUOS or RRO exemptions. When this position changed from the AEMC the value for industry of a single unit model seemed to mostly disappear. The IESS rule change creates additional complexity and work to redesign all of the bidding systems without justifiable benefit, particularly as aggregate conformance allows linking of DUIDs. Some stakeholders would prefer a different BDU model, or consider that aspects such as band cumulation is not necessary.	The IESS rule requires that batteries participate under a single classification (e.g., scheduled BDU). Maintaining two units for each battery creates additional complexity, e.g. maintaining constraints, processing SCADA data, as well as potentially creating simultaneous dispatch of load and generation. After stakeholder feedback, AEMO is implementing a revised BDU model that retains conditional bidding. Where possible, AEMO is seeking to minimise IESS implementation costs to participants.
7	Provision of regulation FCAS across full range	Would a 100MW battery with 2 DUIDs providing 200MW of raise reg be limited to 100MW under IESS? Or can it still provide 200MW?	The NEMDE model under IESS would allow a 200 MW battery to provide up to 200 MW of regulation service, (if technically capable).
8	Conditional bidding	The ability provide raise regulation conditionally with load is being lost under IESS with a single trapezium.	The revised BDU model for NEMDE retains the ability of batteries to utilise conditional bidding for regulation FCAS.
9	Pumped hydro	Does the FCAS trapezium implementation work for responses which require load changes i.e. pumped storage compared with batteries?	Pumped hydro units will continue to use their existing arrangements.

3. Bid parameters, validation & interfaces

#	Issue	Detail	Response
10	Fast start inflexibility profiles	No BESS has used the Fast Start Inflexibility Profile (FSIP) parameters.	NER change has been made to remove the ability for BDU to submit FSIP parameters.
11	Bidding interfaces	20 columns is clunky for user interface. Suggestion considering expander to minimise either load or generation	AEMO has adopted the expander in user interface redesign.
12	Bid structure and interfaces	The bid structures introduce unnecessary change, and retraining is required to align with a 20 price band methodology with negatives, positives and availabilities, ramp rates and convexity rules. Monotonically increasing price brands was initially presented as being 1-20 quite an easy way to throw negatives on one end and positives up the other end which would work out, but the two sets of 10 sitting beside each other, with large amounts of MaxAvail and the rest sitting there it seems a convoluted solution from a spot trading perspective. It feels like AEMO has decided not to re-engineer things and instead put a more difficult way for industry to do things by having the two sets of 10 sitting next to each other	AEMO appreciates that the IESS rule change requires some system and process change for existing participants, but considers that these changes are required to reduce operational complexity as the volume of NEM battery capacity increases in the coming years.

4. Energy storage limits (1)

#	Issue	Detail	Response
13	Energy storage limits model	The energy storage model • does not account for parasitic load or primary frequency response (PFR) energy in/out flows • should apply in pre-dispatch (PD) and PD5, but not in dispatch, where participants can manage min and max availability with bids • should initialise to current SCADA state-of-charge (SoC) as the model makes assumptions (e.g., utilisation factors) and does not account for parasitic load and PFR	AEMO considers that accounting for parasitic load or PFR would bring unnecessary complexity to the model. The energy available model will apply in pre-dispatch, but not in dispatch or 5-minute pre-dispatch. This will be consistent with the current arrangement for Daily Energy Constraint, which is applied only in pre-dispatch. It uses telemetered SoC for the first interval. In subsequent intervals, tracked energy accounts for both cleared energy and regulation usage (by applying regulation usage factors to enabled regulation).
14	Value of energy storage limits	Some stakeholders questioned the value of the energy storage limit model, as it was not included in the AEMC's final determination. As some participants may not use the energy limits, information to AEMO may be incomplete.	AEMO considers the opt-in model provides the best flexibility for participants. It allows participants that derive value from application of energy limits to use it, while avoiding requiring all participants to conform to this.
15	Storage values	Would a minimum energy storage limit of zero compromise the intent?	A value of zero for the minimum energy storage limit is valid.

4. Energy storage limits (2)

#	Issue	Detail	Response
16	Application of energy storage limits	Generation and load should be: • constrained on in PD to avoid violating SoC limits (or bring SoC into limits), or • constrained off in PD to avoid SoC limits being violated Energy storage limits should constrain FCAS enablements in Pre-Dispatch. How does this work?	Under the opted-in model, if a participant has opted-in to apply SoC model, PD target would be constrained on or off to avoid SoC limits. Pre-conditions for enabling FCAS is that the EnergyMaxAvail is not less than the EnablementMin for the service, and that the EnergyMinAvail is not greater than the EnablementMax for the service.
17	Commercial Sensitivity of State-Of-Charge	A participant noted that tracked energy (state-of-charge) should not be reported on a DUID basis as it gives competing participants insight into bidding algorithms, positions, and other detail. This level of detail (such as coal stockpiles) is not shared for other generator types. Further, the participant suggested energy could be reported in aggregate once each region has more than the greater of 250MWh or 5 batteries registered.	AEMO has considered this, and agrees that this state-of-charge information could be commercially sensitive. Therefore, the state-of-charge of a unit will be provided to the participant in respect of that unit, and not published/reported for the current trading day. That is, state-of-charge will be treated as for MW schedules.
18	Sensitivity of standing data	Would standing data for the energy model be public or private? Most participants would prefer this data is not made public.	Under the current arrangement, all standing data is published.

5. Price ties and ramp rates

#	Issue	Detail	Response
19	Price Ties	Price tie allocations will be dramatically changed where batteries are offering significantly less than their maximum into a tie situation, creating an inequal playing field.	For price ties, pro-rata tie-breaking (against band availability) would continue to be used, considering: • Constraints between BDU load bands, and scheduled load bands • Constraints between BDU generation bands, and scheduled/semi-scheduled units.
20	Ramp Rates	Stakeholders considered that the ramp rate proposal is suitable and flexible though most batteries would be unlikely to require 4 ramp rate limits. Could you please provide one worked example (using the formulas) of the ramp constraint where the charge/discharge transition is not symmetric (+5 MW to -15 MW for example)?	AEMO has included examples below

Composite Ramp Rates - Example (1)

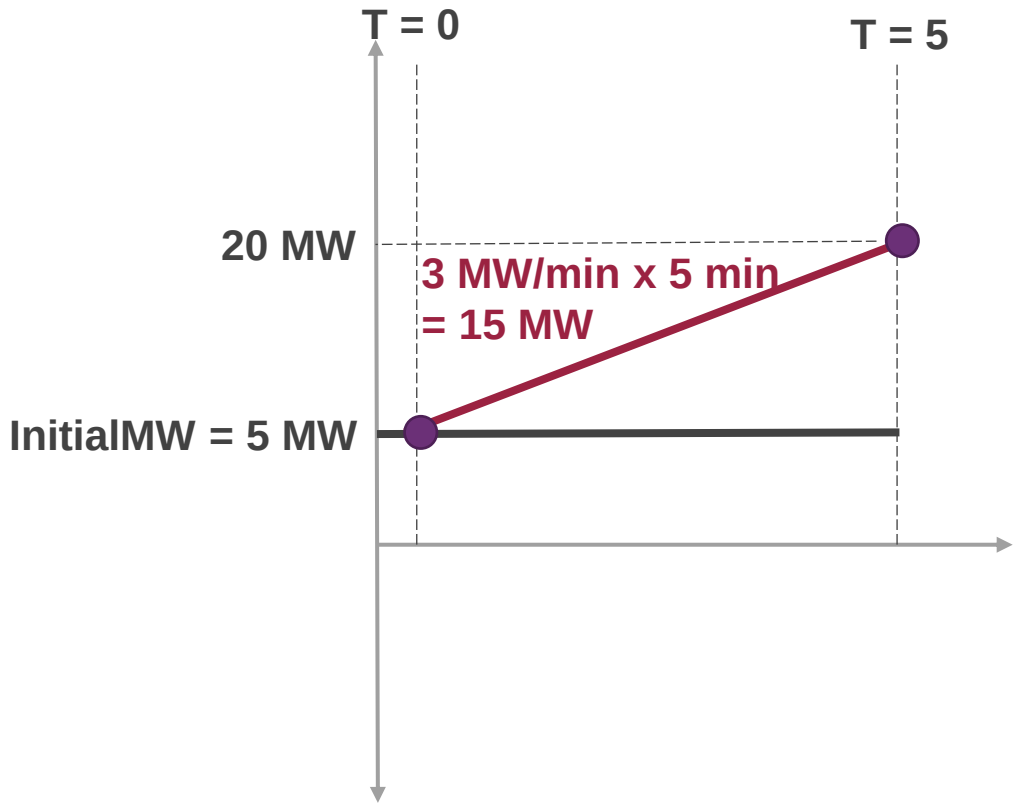
Stakeholder feedback requested an example of how composite ramp rates work in NEMDE.

For BDUs, separate load/gen-side ramp rates may be specified. Consider ramping in the direction of decreasing load/increasing generation, with ramp-rate limits of:

- **Load side:** 5 MW/min
- **Generation side:** 3 MW/min

If the InitialMW is in the generation side (5 MW), increases to the TargetMW will be limited by the gen-side rate only.

TargetMW <= 5 MW + 3 MW/min × 5 min = 20 MW



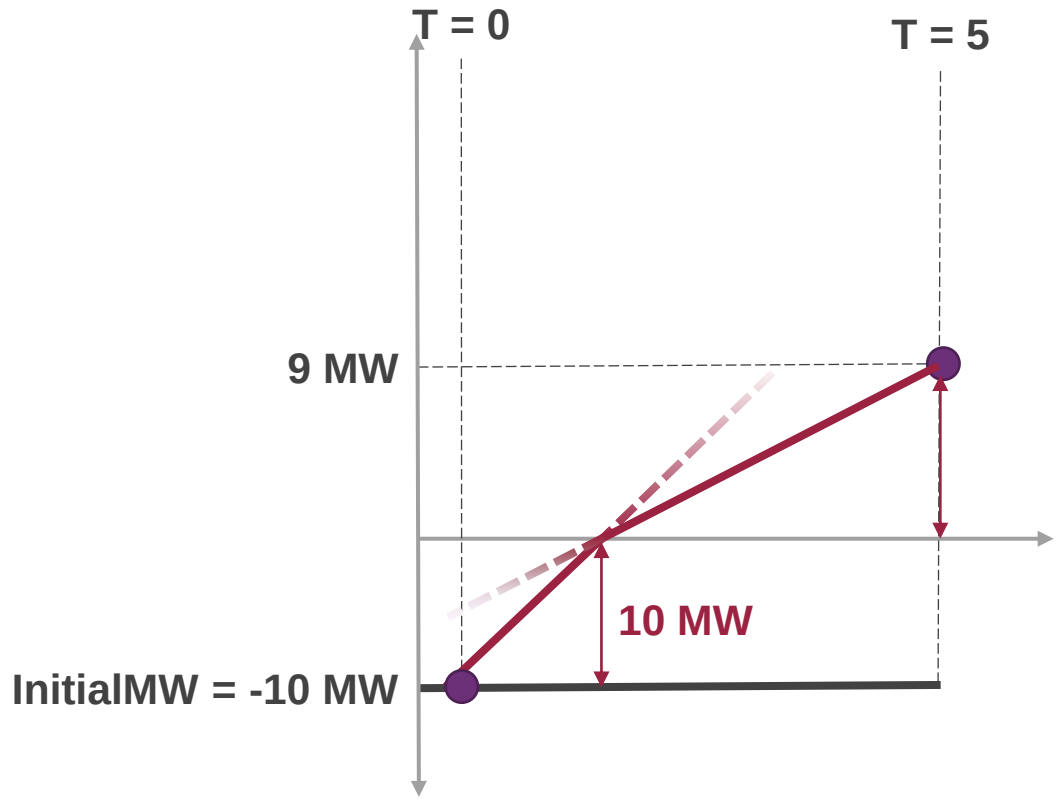
Composite Ramp Rates - Example (2)

Instead consider that the InitialMW is in the load side (-10 MW).

TargetMW will be limited by the load-side rate… but may also be limited by the gen-side rate.

TargetMW <= MIN(0, 5MW/min × 5min)
+ 3MW/min × MAX(0, 5min - ABS(-10 MW) / 5MW/min)
= 9 MW

Ramp rates will also be limited by the SCADA ramp rate limit.



7. Treatment of regulating capability

#	Issue	Detail	Response
21	FCAS capability	Question: In the transition from a single DUID unit to a BDU registration, would you restrict the regulation registrations that would need to change [from 100 to 200] in order to allow a 100MW unit transitioning to 200MW?	The single DUID would have the regulation capability of the combined units. That is, considering a battery that is currently registered as • A scheduling generating unit with 100 MW of regulating capability • A scheduled load with 100 MW of regulating capability. This battery would be transitioned to a scheduled BDU with 200 MW of regulating capability.

8. Terminology and definitions

#	Question	Answer
22	The term "MinAvail" is somewhat confusing and suggest alternative labels such as “MaLoadAvail be considered.	AEMO has decided to retain the MinAvail term.
23	Could you please define Target SOC? How is this used? Is this used in dispatch?	Target SoC is the expected SoC level at the end of the interval. Under the new proposal, SoC model will not apply in dispatch.
24	Regulation usage factor could change with time but is a registered value. How volatile is the regulation use factor?	AEMO is considering a static 30 minute profile for the Regulation usage factor, updated annually.
25	Could you please clarify the difference between initial state of charge and initial max state of charge?	Initial SoC is the real time SoC level. Max SoC is the maximum level that the target SoC can reach.
26	Could you provide definition for current max state of charge in SCADA (as opposed to max energy in bid)?	MaxAvail in bid is the power in MW. SoC is the energy in MWh.
27	Are you going to use any dynamic loss factors for import and export as these can be load and temperature dependent? This is currently listed in registration.	Currently, temperature and load dependent loss factors are not planned.

Appendix C:
Competition law meeting protocol

AEMO Competition Law - Meeting Protocol

AEMO is committed to complying with all applicable laws, including the Competition and Consumer Act 2010 (CCA). In any dealings with AEMO regarding proposed reforms or other initiatives, all participants agree to adhere to the CCA at all times and to comply with this Protocol. Participants must arrange for their representatives to be briefed on competition law risks and obligations.

Participants in AEMO discussions **must**:

- Ensure that discussions are limited to the matters contemplated by the agenda for the discussion
- Make independent and unilateral decisions about their commercial positions and approach in relation to the matters under discussion with AEMO
- Immediately and clearly raise an objection with AEMO or the Chair of the meeting if a matter is discussed that the participant is concerned may give rise to competition law risks or a breach of this Protocol

Participants in AEMO meetings **must not** discuss or agree on the following topics:

- Which customers they will supply or market to
- The price or other terms at which Participants will supply
- Bids or tenders, including the nature of a bid that a Participant intends to make or whether the Participant will participate in the bid
- Which suppliers Participants will acquire from (or the price or other terms on which they acquire goods or services)
- Refusing to supply a person or company access to any products, services or inputs they require

Under no circumstances must Participants share Competitively Sensitive Information. Competitively Sensitive Information means confidential information relating to a Participant which if disclosed to a competitor could affect its current or future commercial strategies, such as pricing information, customer terms and conditions, supply terms and conditions, sales, marketing or procurement strategies, product development, margins, costs, capacity or production planning.

Please visit: https://aemo.com.au/en/consultations/industry-forums-and-working-groups

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