IESS BDU Readiness Focus Group

Including session notes

Integrating Energy Storage Systems

8 February 2024

Attendees

Name	Organisation	Name	Organisation
Carlo Poliseno	AGL	Alice Michener	Australian Energy Market Operator (AEMO)
Kieran O'Leary	AGL	Andrew Groom	AEMO
Shane Kerr	Amplitude Power	Basilisa Choi	AEMO
Rachel Rundle	EKU Energy	Boris Basich	AEMO
Gagan Sharma	Energy Australia	Carla Ziser	AEMO
Ranjan Thakur	Energy Australia	Darren Gatty	AEMO
Dan Mascarenhas	Energy Australia	Demi Chau	AEMO
Joseph Giddings	Energy One	Duncan Swijnenburg	AEMO
Matt Grover	Fluence Energy	Emily Brodie	AEMO
Michael Woodruff	Fluence Energy	Karen Clarke	AEMO
Glen Thomsen	Quintas Energy	Kavita Ziomek	AEMO
Bruce Miller	Shell Energy	Lenard Bayne	AEMO
Steven Frimston	Shell Energy	Luke Barlow	AEMO
Emma Fagan	Tesla	May Cotoner	AEMO
Trent Morrow	Vena Energy	Paul Lyttle	AEMO
		Ross Gillett	AEMO
		Serena Li	AEMO
		Trent Smith	AEMO
		Ulrika Lindholm	AEMO
		Vinodini Dissanayake	AEMO

1. Welcome

Ulrika Lindholm

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.

Introductions

Objectives

- This Focus Group aims to promote detailed discussion around how AEMO, battery operators and bidding vendors collaborate on industry readiness. The initial focus is on the development of the BDU Transition plan and detailed cutover plans.
- This session is a deeper dive into BDU cutover activities, either as requested by Participants or identified by AEMO as needing Participant awareness.

Ways of collaborating

- Questions and comments are welcome, either in the chat or by raising your virtual hand. AEMO will answer questions throughout the presentation, as well as a at dedicated Q&A time at the end.
- Please introduce yourself (name & organisation) in any interactions.
- Before attending, participants should peruse the appropriate meeting protocol (following slide).

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, all participants agree to adhere to the CCA at all times and to comply with appropriate protocols where required to do so.

AEMO has developed meeting protocols to support compliance with the CCA in working groups and other forums with energy stakeholders. Before attending, participants should confirm the application of the appropriate meeting protocol.

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

AGENDA

#	Timing (AEDT)	Topic	Presenter(s)
1	1:00 – 1:05 PM	**Welcome**	Ulrika Lindholm
2	1:05 – 1:10 PM	**Actions from previous meeting**	Ulrika Lindholm
3	1:10 – 1:15 PM	**IESS timeline updates**	Carla Ziser
4	1:15 – 1:25 PM	**SCADA changes for BDUs**	Kavita Ziomek and Ben Blake
5	1:25 – 1:35 PM	**BDU DUID setup**	Basilisa Choi
6	1:35 – 1:40 PM	**Compliance Monitoring**	Trent Smith
7	1:40 – 2:00 PM	**NMI cutover**	Alice Michener
8	2:00 – 2:20 PM	**Q&A**	Ulrika Lindholm
9	2:20 – 2:30 PM	**Next steps & close**	Ulrika Lindholm
APPENDICES			
A	IESS Glossary		
B	BDU Readiness Focus Group participation and administration		
C	NEM Reform Program engagement calendar		
D	NMI Cutover timeline		
E	BDU Energy Storage Model: Tracking Energy Storage		

"Please note that this meeting will be recorded by AEMO and may be accessed and used by AEMO for the purpose of compiling minutes. By attending the meeting, you consent to AEMO recording the meeting and using the record for this purpose. No other recording of the meeting is permitted"

2. Actions from previous meeting

Ulrika Lindholm

Actions from Previous Meeting

(Item = Meeting # – Agenda # – Reference)

#	Topic	Action	Responsible	Status
2.5.0.1	Upcoming participant readiness activities	AEMO to follow up regarding conformance monitoring process and just make sure that we're clarifying how that might change when we move into the one DUID model.	AEMO	Closed. Address in Section 6.
2.8.0.1	Next steps & close	AEMO to share previously presented BDU information slides when distributing the November meeting minutes.	AEMO	Closed
Raised post meeting	Periodic update of maximum storage capacity of bidirectional units	AEMO to advise whether storage capacity registration information needs to be updated over time as storage capacity changes.	AEMO	Closed Addressed in Section 5.

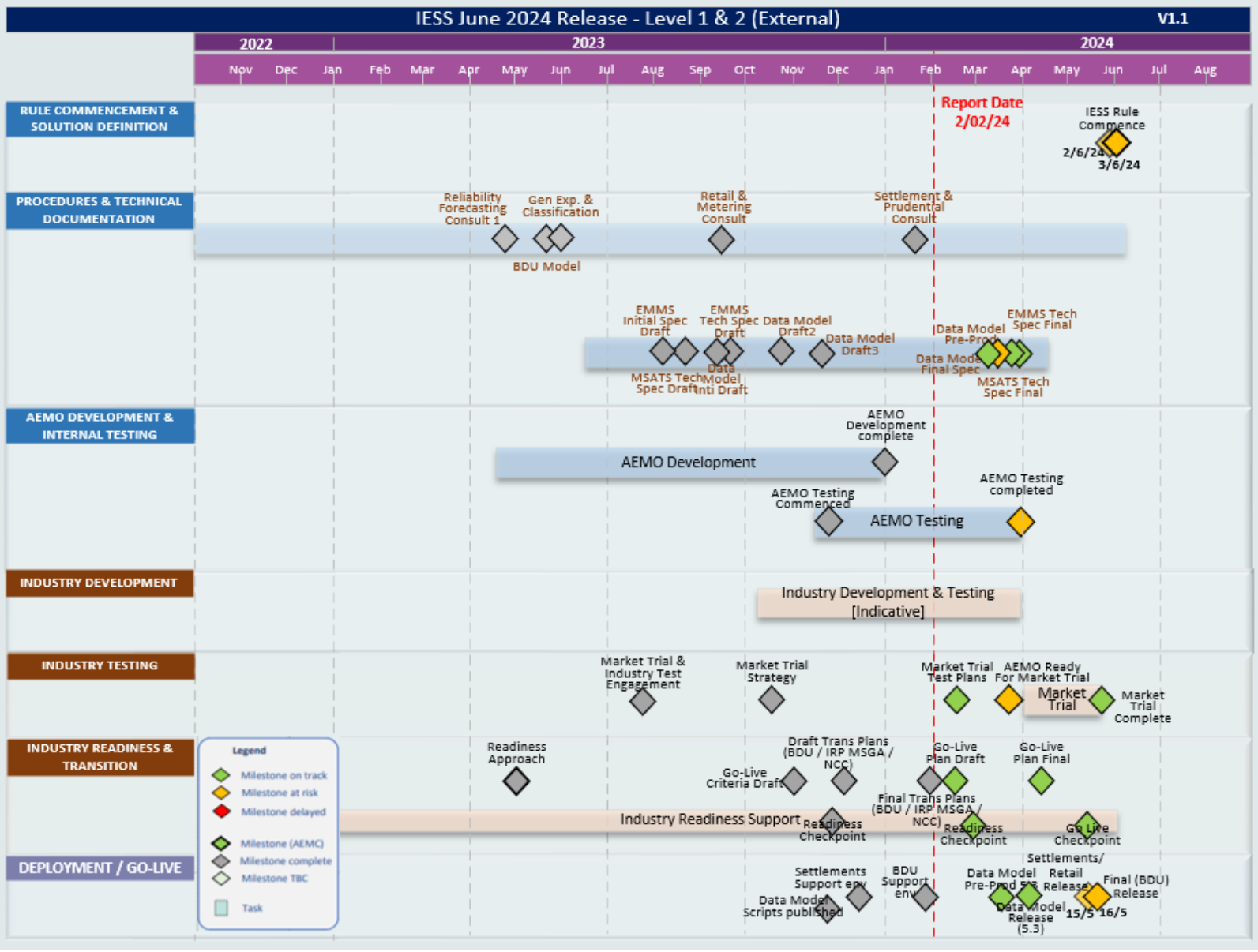
Notes

- No feedback was received from participants on the actions from previous meeting.

3. IESS June 2024 Timeline

Carla Ziser

IESS timeline update



Participants can access the latest status on this timeline via the NEM Reform Program Consultative Forum and Implementation Forum

RELEVANT INFORMATION

- **Overall project status** remains **AMBER.**
- **BDU Cutover schedule** in progress
- **IRP Registration and BDU forms** in progress

Tech specs:

- Updated EMMS tech spec Data Model v5.3 published 20 Nov 2023
- Next tech spec update scheduled for Friday 19th Jan

Industry testing

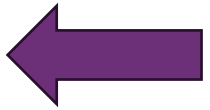
- BDU component of PDSE made available Mon 22 Jan
- Draft Data model scripts for PDSE released Wed 22 Nov
- Draft IESS market trial plan released Fri 19 Jan

Industry readiness:

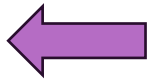
- 3x IESS transition plans – finals published Wed 31 Jan.
- Draft Industry go-live plan will be released for comment Mon 26 Feb

BDU Transition schedule update

	AEMO	Participant	Vendor
1 Confirm AEMO-Vendor coordination (refer below)	X	X	
2 Complete understanding of vendor preferences	X		X
3 Resolve timing mismatches with participant/vendor	X	X	X
4 Develop alternative cutover dates to resolve congestion	X		X
5 Confirm suitability of cutover dates	X	X	X



Indicative timing mid-Feb



Indicative timing late-Feb

Notes

- AEMO advised that the overall project status is amber and noted that the BDU Cutover schedule and IRP Registration and BDU forums are progressing with detailed information available in the accompanying slide pack. Further information on Tech Specs, Industry Testing and Industry Readiness are also included.
- AEMO presented an updated BDU Transition schedule and AEMO noted that work is progressing with regards to registration paperwork and will be distributed soon.
- Participants can access the latest status on this timeline via the NEM Reform Program Consultative Forum and Implementation Forum.

Raised by	Question/Issue Raised	Response
Rajan Thakur – Energy Australia	When will the registration forms be released?	The forms are currently in review and will be issued in the coming week. Priority for those participants that are planning to participate in market trial.
Carlo Poliseno - AGL	Regarding further documentation required on batteries, will the data need to be updated on a regular basis?	See Section 5 and Appendix E of this pack for details.

4. SCADA Changes for BDUs

Kavita Ziomek

Real Time Systems (SCADA)

The following applies for participants who receive Energy MW targets and/or Ancillary Service enablement values via SCADA systems.

- **Automatic Generation Control (AGC) MW targets:**
  - No changes will occur. Participants will continue to receive AGC MW targets via existing mechanisms.

- **Backup Market Management System (MMS) signals (outside of AGC) will change as follows**

Backup signal type	Signal name	Values currently received	Values received post cutover
MMS 5 min target	MWB	Two positive-sign signals received (one for each DUID) **OR** One signal received, can be positive or negative.	Once signal received that will have either positive or negative values.
Regulation FCAS enablement	ARA and/or ALA	One signal received per signal name, can be positive values only.	One signal received, can be positive values only.
Contingency FCAS enablement	1RA/6RA/5RA/FRA/1LA/6LA/5LA/FLA	One signal received per signal name, can be positive values only.	One signal received per signal name, can be positive values only. Signal will now apply to whole unit, not either of charge/discharge side of BESS.

MWB – megawatt base, ARA/ALA = Ancillary Raise/Lower regulation, 1RA/1LA = 1min raise/lower contingency FCAS

SCADA Cutover

AEMO is proposing to establish new 'ICCP' IDs for all MMS backup signals.

- This means cutover can be planned in advance and will occur automatically.
- At cutover time, all existing signals will stop updating and new signals will apply.
- *What's involved for participants here?*
  - On site - will need to program new points (at the RTU) and link to the NSP master station.
  - AEMO anticipates this could be done in advance of cutover.
  - AEMO/NSP/site would need to test new linkage works well before cutover.

An alternative option is reuse existing ICCP IDs.

- Cutover would need to be done manually in and in real-time
- Carries a potential for data gaps.
- NSP involvement not required as existing links are already tested and online.
- Participants may need to update logic on site if using this option.

AEMO plans to engage NSPs next month regarding these changes.

AEMO will also reach out to each affected participant to understand their preference during February/March, so that New ICCP IDs can be agreed on by mid-April.

ICCP	Inter-Control Center Communications Protocol
MMS	Market Management System
RTU	Remote Terminal Equipment
NSP	Network Service Provider

NOTE: AEMO will update its IESS BDU Transition and Cutover Plan to include activities relating to SCADA Cutover.

Notes

- AEMO advised that AEMO are proposed to establish new ICCP IDs for all MMS backup signals. Further details relating to the SCADA cutover are outlined on slide 14 of the accompanying slide pack. In addition, AEMO plan to engage with NSPs over the coming month regarding these changes and in addition reach out to each affected participant to understand their preference during February/March to enable new ICCP IDs cab be agreed on by mid-April.

Action: Participants to take proposal to establish new ICCP IDs for MMs backup signals back to their organisation and let us know if any concerns.

5. BDU DUID Setup

Basilisa Choi

BDU DUID Setup

- AEMO will release a form for Participants to complete in mid-February
- AEMO will use this information to establish the new BDU DUID in its systems
- The following slides provide an overview of what information will need to be provided to complete this form.
- This is being provided so participants can prepare necessary information to complete the form.

BDU DUID specific fields

Participants will provide these fields within the application form

Field	Units	Definition	Use in AEMO's dispatch systems
DUID Maximum Storage Capacity	MWh	The rated energy storage capacity of the dispatchable bidirectional unit.	Used to validate min and max EnergyLimits in bids
Individual Unit Maximum Storage Capacity	MWh	The unit rated storage capacity (where several physical units comprise the DUID).	Required information for a dispatchable unit containing multiple physical units.
Apply operational state of charge constraint (SOC Constraint)?	Yes or No	If 'Yes', apply the Min and Max Operational SOC constraints if EnergyLimits are not provided in bids.	Triggers use of the min and max Operational SOC as defaults in AEMO's Predispatch and 7-day Predispatch.
Min Operational State of Charge	MWh	The minimum operational state of charge (MWh)	To be applied if SOC Constraint is 'Yes'. Overwritten if min EnergyLimit is provided in bids.
Max Operational State of Charge	MWh	The maximum operational state of charge (MWh)	To be applied if SOC Constraint is 'Yes'. Overwritten if max EnergyLimit is provided in bids
Storage Import Efficiency Factor*	0 ... 1	The storage energy import conversion efficiency. Number from >0 to 1 where 1 is lossless. Calculated as (increase in SOC / imported energy.)	Used to calculate EnergyStorage at the end of each interval.
Storage Export Efficiency Factor*	0 … 1	The storage energy export conversion efficiency. Number from >0 to 1 where 1 is lossless. Calculated as (sent out energy / reduction in SOC)	Used to calculate EnergyStorage at the end of each interval.

AEMO understands that storage capacities will change over time and anticipates participants will update these values on an annual (or as needed) basis – similar to Schedule 3.1 Notification process.

*Further detail regarding the Energy Storage calculation using efficiency factors is provided in Appendix E.

Existing DUID information transfer

The below table lists registration information that will be moved from either the generation or load side DUID* to the new BDU DUID. Participants will verify these values as part of the application submission.

Field	Units	Definition
Registered Maximum Capacity of the dispatchable unit (MW)	MW	Registered maximum capacity for generation side of BDU .
Registered Minimum Capacity of the dispatchable unit (MW)	MW	Registered minimum capacity for load side of BDU .
Maximum Capacity of the dispatchable unit at *dispatch point* (MW)	MW	Maximum capacity, pertaining to the generation side of BDU.
Minimum Capacity of the dispatchable unit at *dispatch point* (MW)	MW	Minimum capacity, pertaining to the load side of BDU.
***Maximum ramp rate* of the generation side of the dispatchable unit (MW/min)**	MW/min	Maximum rate of change applied to generation side of bidirectional unit (MW/min). Calculated based on the combined Maximum Capacity and Minimum Capacity.
***Maximum ramp rate* of the load side of the dispatchable unit (MW/min)**	MW/min	Maximum rate of change applied to load side of bidirectional unit (MW/min). Calculated based on the combined Maximum Capacity and Minimum Capacity.

Existing FCAS registration information will also be transferred to the new bidirectional unit DUID. Please refer to IESS BDU DUID Bid Format for further information.

Further registration information (not listed above) that is common to both existing generation and load side DUIDs will be applied to the new bidirectional unit DUID.

*This information will also be requested at a unit level, where multiple physical 'genset' units comprise the DUID.

Notes

- AEMO will release a form in mid-February for Participants to complete to enable AEMO to establish the new BDU DUID in its systems.
- AEMO presented an overview of the required information required to complete this form. Further information on the required information is outlined on slide 17 of the accompanying slide pack with additional information outlined in Appendix E.

Raised by	Question/Issue Raised	Response
Carlo Poliseno - AGL	Will the ENERGYLimit MWh limit the MW for a full 30-minute period in the predispatch period or will it be assessed for just the first 5 mins of the 30 min period?	The full 30-minute period

6. Conformance Monitoring

Trent Smith

Conformance monitoring

What's changing

Current	Future
• The existing 2-DUID arrangement is represented as a "Target Aggregate Dispatch Group (ADG)" in AEMO's system so conformance is monitored in aggregate.	• Conformance will be monitored via the single BDU DUID

The status of the three DUIDs in the conformance report will change during the pre-cutover, cutover and post-cutover periods as illustrated in the table below.

Conformance report

The following STATUS will be observed in the participant dispatch conformance report

Status	Pre-cutover	Cutover	Post-cutover
BDU DUID	'SUSPENDED'	AEMO lifts 'SUSPENDED' status, immediately changes to 'NORMAL' & can move to other statuses	One of active statuses ('NORMAL', ' OFF-TARGET', 'NOT RESPONDING', 'NC-PENDING', 'NON-CONFORMING')
2-DUID & Target ADG	**2-DUID:** ('NORMAL', ' OFF-TARGET') **ADG:** One of active statuses ('NORMAL', ' OFF-TARGET', 'NOT RESPONDING', 'NC-PENDING', 'NON-CONFORMING')	2 DUIDs and ADG are 'SUSPENDED' by AEMO	'SUSPENDED' (until deregistration of 2 DUIDs, after which DUIDs and ADG are removed from reporting)

DUIDs in SUSPENDED status will be visible but with zero actuals, targets and errors

No carry-forward of non-compliances to BDU DUID when 2-DUID is SUSPENDED or deregistered

Participants will need to set up their systems to cutover from 2-DUID/Target ADG to BDU monitoring.

Notes

- AEMO outlined what will be changing in the conformance monitoring space. AEMO added that participants will be required to set up in their systems the requirement for cutover from 2-DUID/Target ADG to BDU monitoring.

Raised by		Question/Issue Raised
Kieran O'Leary	Will there be a value we can submit for energy decay (parasitic load) if we are starting to forecast the future State of Charge based on predispatch?	No, there is no value to separately submit for energy decay. AEMO would want the current State of Charge via SCADA .
Carlo Poliseno - AGL	Is there any obligation to update energy limits (in bids) if there is no MW avail change?	No rule obligation for these fields right now. Optional. To be done via bid submission.

7. NMI Cutover

Alice Michener

Overview

- All currently registered, scheduled battery storage facilities will be included in the cutover and will become BDUs.
- Each battery storage facility is currently assigned two NMIs, one for load, one for generation.
- As part of the BDU cutover,
  - Only one NMI is required for each BDU.
  - In most cases, the NMI currently used for generation will be retained and assigned to the BDU.
  - The NMI currently used for load will be made extinct effective after the cutover date.
- The following slides provide further detail of required activities for involved stakeholders.

NMI cutover: MSATS example

Current

METER ID/NMI	NMI CLASS CODE	NMI STATUS CODE	TNI CODE	DATA STREAMS	METER REGISTERS
2001111111	GENERATR	A	SZZZ	B1	B1
S111111111	LARGE	A	SZZ1	E1	E1

Post-cutover

METER ID/NMI	NMI CLASS CODE	NMI STATUS CODE	TNI CODE	DATA STREAMS	METER REGISTERS
2001111111	DIRS/TIRS	A	SZZZ	E1,B1	E1,B1
S111111111	LARGE	X	SZZ1	E1	E1

Required activities

The following activities will occur from cutover day onwards.

	AEMO	Participants			
		Metering Providers Category B (MPB)	**Meter Data Providers (MDP)**	**DNSP, TNSPs and Registered Network Service Providers**	**Financially Responsible Market Participants (FRMP)**
Responsibility	✓ AEMO will consolidate NMI data streams, moving load data streams over to the gen NMI.	✓ Consolidate the meter(s) and register(s) from the load side over to the gen side	✓ Send data to AEMO for the retained NMI only from midnight on the cutover day (retrospectively).	✓ Ensure that changes applied by AEMO are reflected in their systems, and AEMO changes are not overridden	✓ Update their systems to reflect changes applied by AEMO ✓ Review their settlement statements after cutover

BESS participants engaging with MSPs

BESS participants should engage with their MDPs and MPBs throughout the BDU cutover process to advise activities occurring and timing, such as:

- Communicating in advance the nominated BDU cutover date.
- Articulating when they expect to see changes in the NMI, as part of the planning process.
- Communicating regularly throughout the NMI cutover process as activities begin and complete (per BDU cutover and transition plan).
- Confirming the result of go/no-go decision in the lead up to cutover day, and (if applicable) any rescheduled cutover dates.

AEMO will also engage with MSPs to advise of activities they will need to be involved in and when via:

- Metering Service Provider Information Session next week (15th Feb).
- During the NMI cutover process in production.

Notes

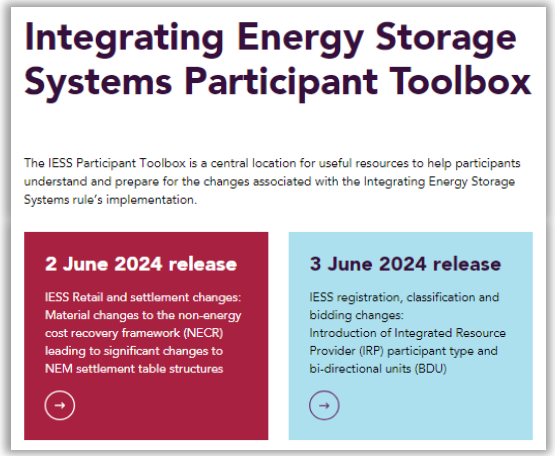
- AEMO provided a brief overview of the NMI cutover, including the required activities that will occur as part of the cutover on the day and onwards and the expectations for BESS participants.

8. Q&A

Ulrika Lindholm

Q&A

Note that FAQs are available through the IESS Participant Toolbox at AEMO's website. These are updated on an ongoing basis.



Link: https://aemo.com.au/initiatives/major-programs/integrating-energy-storage-systems-project/integrating-energy-storage-systems-faqs

Or contact the project directly at IESS@aemo.com.au

9. Next Steps & CLose

Ulrika Lindholm

Next steps

TIMING	ACTION	RESPONSIBLE
Mid February 2024	AEMO to provide BDU (and IRP transition) paperwork to participants	AEMO
February/March 2024	Endorsement of production cutover date for each BDU	Participants
February/March 2024	Clarify preference for SCADA MMS Backup signals with AEMO	Participants
As early as March 2024 (for Market Trial)	Participant completes required paperwork for BDU establishment (and IRP transition if required) and returns to AEMO	Participants
March 2024	Participants engage their Metering Data Provider once a cutover date has been agreed	Participants
14 March 2024 (TBC)	BDU Readiness Focus Group	AEMO
Anytime	Participants with interest participating in Market Trial may want to nominate to the Industry Testing Working Group	Participants

Actions

#	Topic	Action	Responsible
3.4.0.1	SCADA Changes for BDUs	Participants to take proposal to establish new ICCP IDs for MMs backup signals back to their organisation and let us know if any concerns	Participants
3.8.0.1	Q&A	AEMO and AGL to discuss circumstances around parasitic loads	AEMO & AGL

Session close

IESS@aemo.com.au

AEMO | IESS Participant toolbox

APPENDIX A

Glossary

IESS Glossary

Term	Definition
5MPD	5-minute pre-dispatch
ADC	Aggregated Dispatch Conformance
ADG_ID	Aggregate Dispatch Group identifier for an Aggregate System
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
NEM	National electricity market
NEMDE	National electricity market dispatch engine
NMI	National metering identifier
PAE	Profiling and allocation engine
PASA	Projected assessment of system adequacy
PD	Pre-dispatch
PDM	Participant Data Model
PMS	Portfolio management system
SCADA	Supervisory control & data acquisition
SoC	State of charge
UFE	Unaccounted for energy
WDRU	Wholesale demand response unit

APPENDIX B

BDU Readiness Focus Group participation and administration

Participation and administration

This Focus Group is open to nominations from participants.

Participation

- Aimed at participants with existing and planned grid scale batteries and bidding system vendors, that are affected by the IESS rule and will transition from dual to a single DUID.
- Nominees with suitable experience and expertise, for example regulatory managers, trading and product managers.
- A detailed understanding of the IESS reform initiative and authority to participate in discussions about implementation activities is required.
- One primary and one alternative contact to be nominated

Format

- Short term Focus Group under NEM Reform Implementation Forum (IF)
- Readiness and transition related risks and issues escalated to IF. Outcomes from Focus Group reported back to IF.
- Collaborative and consultative rather than a decision-making group
- Focus on readiness-related matters rather than debating specific policy.

Meetings

- Video conference
- Monthly cadence (last 2023 meeting in Nov, recommence Feb 2024)
- 1-1.5hr duration
- Additional meetings as required.

Administration

- Meeting material distributed prior
- Minutes and presentations made publicly available.

Feedback on the approach is welcome.

APPENDIX C

NEM Reform Program Engagement calendar

Upcoming engagements

February

M	T	W	T	F	S	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29			

March

M	T	W	T	F	S	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

April

M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

May

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

NEM Reform Program Committees/Forums

- Executive Fourm
- Reform Delivery Committee
- Reform Delivery Committee Collaborative Workshop
- Program Consultative Forum
- Electricity Wholesale Consultative Fourm
- Implementation Forum
- Industry Testing Working Group

NEM Reform Initiative Specific

- Intergrated Energy Storage Systems BAU Focus Group

Other Forums

- Electricity Retail Consultative Forum

Other

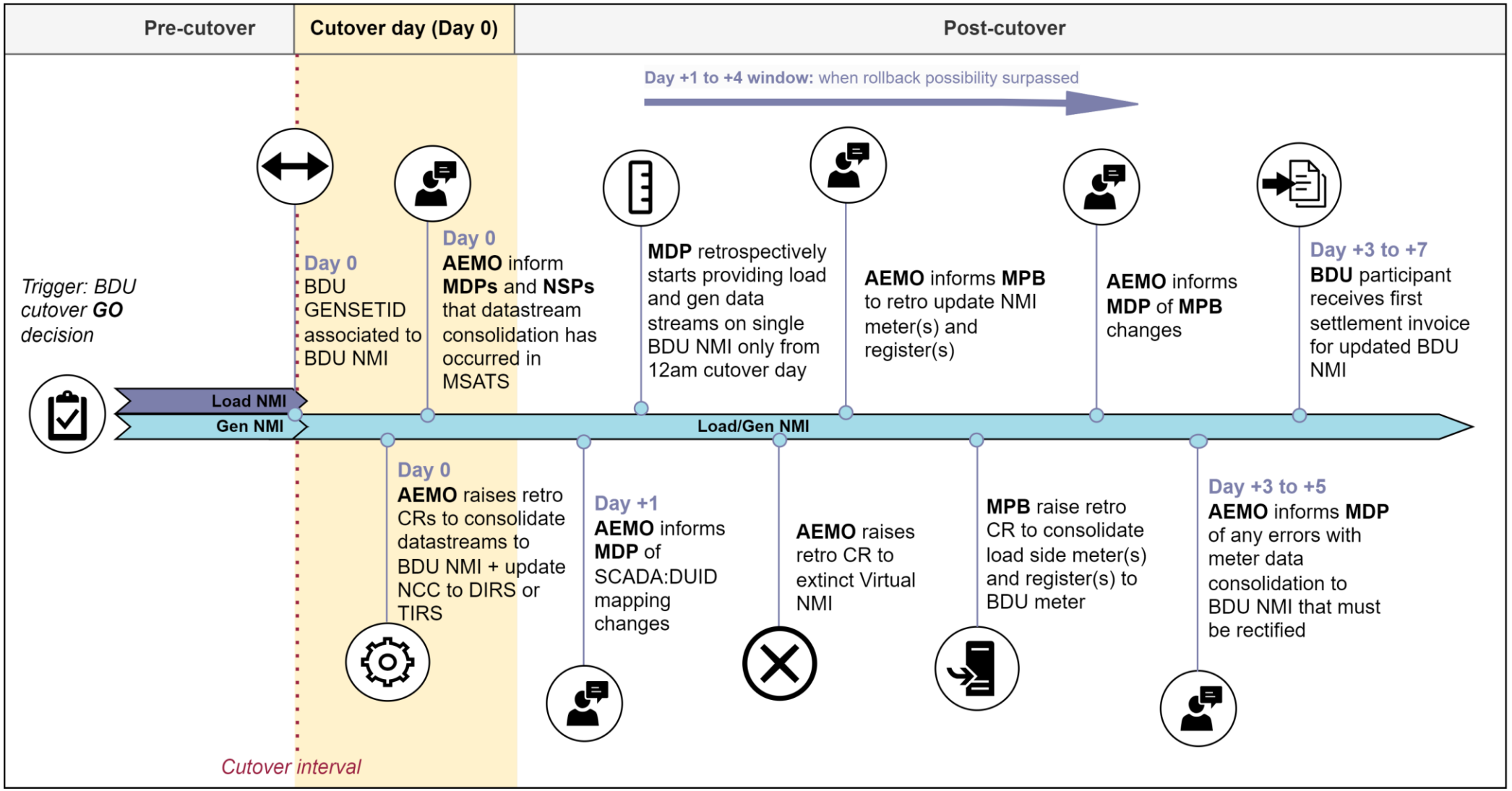
- National Public Holiday
- State/Territory Public Holiday

APPENDIX D

NMI cutover timeline

IESS Indicative NMI Cutover Timeline

This diagram outlines the high-level approach AEMO intends taking to cutover existing batteries with separate load and gen NMIs to a single, existing NMI.
Cutover to occur in line with the BDU cutover.
Days and times depicted are indicative only and represented by all day types, i.e. not business days only.



APPENDIX E

BDU Energy Storage Model: Tracking Energy Storage

BDU Energy Storage model: Tracking Energy Storage (1)

For each interval the remaining energy is calculated based on the cleared energy and regulation targets from the NEMDE solution for that interval.

Remaining Energy Storage = Initial Energy Storage – Efficiency Adjusted Energy Used

If the unit is not transitioning between generation and consumption within the interval:

Efficiency Adjusted Energy Used = Adjusted efficiency Factor *
{
(Initial MW + Target MW) / 2
+ (Raise Reg Enabled MW * Raise Reg Usage Factor)
- (Lower Reg Enabled MW * Lower Reg Usage Factor)
}
*** Time Period**

Where:

Adjusted efficiency Factor : If importing then 'import efficiency factor' else 1/'export efficiency factor'.

Initial MW = current SCADA active power (first interval) , or previous trading interval's Target MW; positive or negative

Initial Energy Storage = current SCADA SOC (first interval), or previous trading interval's Remaining Energy Storage;

For the first interval, the value is floored to zero if SCADA SOC is negative. For the subsequent intervals, the value can be negative, zero or positive.

Target MW = NEMDE dispatch target ; positive or negative

Raise Reg Enabled MW , Lower Reg Enabled MW; positive

Raise Reg Usage Factor, Lower Reg Usage Factor; positive between 0..1 .

Time Period = Interval Length (hours)

BDU Energy Storage model: Tracking Energy Storage (2)

If the unit is transitioning between generation and consumption within the interval:

Efficiency Adjusted Energy Used = Adjusted efficiency Factor 0 *
{
(Initial MW) / 2
+ (Raise Reg Enabled MW * Raise Reg Usage Factor)
- (Lower Reg Enabled MW * Lower Reg Usage Factor)
}
*** Time Period 0**
+ Adjusted efficiency Factor 1 *
{
(Target MW) / 2
+ (Raise Reg Enabled MW * Raise Reg Usage Factor)
- (Lower Reg Enabled MW * Lower Reg Usage Factor)
}
*** Time Period 1**

Where:

Adjusted efficiency Factor 0: If Initial MW <0 then 'import efficiency factor' else 1/'export efficiency factor'.

Adjusted efficiency Factor 1: If Target MW <0 then 'import efficiency factor' else 1/'export efficiency factor'.

Time Period 0 = Time Period * Absolute[Initial MW / (Initial MW – Target MW)]

Time Period 1 = Time Period – Time Period 0