17 September 2021

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Ms Anna Collyer
Chair
Australian Energy Market Commission
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By online submission

Dear Ms Collyer

Integrating energy storage systems into the NEM (ERC0280)

AEMO welcomes the opportunity to comment on the Australian Energy Market Commission's (**AEMC**) draft determination for the Integrating energy storage systems into the NEM rule change (**Draft Determination**).

The Draft Determination generally addresses most aspects of AEMO's rule change proposal to introduce a new participant category to aid the integration of energy storage systems. The scope of the original proposal has expanded to include changes to non-energy cost recovery and rule amendments to rights and obligations in respect of loads and generating units.

With the increased scope of the rule change, and the scale of concurrent change in AEMO's processes and systems, AEMO advises that:

- it will be unable to commence implementation for this rule change for several months after the Final Determination; and
- 18 months will be insufficient for it to implement all of the changes set out in the Draft Determination.

AEMO would welcome an opportunity to work with the AEMC and stakeholders to develop a flexible and staged approach to the implementation of this rule that accounts for resource availability, and the relative priority of the elements for the AEMC and industry. Our existing focus with industry in developing a regulatory implementation roadmap and the development of a technology roadmap should help ensure that AEMO and the industry deliver this rule change and other reforms in a cost-effective and timely manner.

AEMO has also identified a range of issues, ambiguities and recommendations in the Draft Determination and the draft rule. Further information on these matters, and other aspects of the Draft Determination, is provided in Attachment A.

We would welcome the opportunity to discuss the matters raised in this submission further. Should you have any questions, please contact Kevin Ly, Group Manager Regulation at kevin.ly@aemo.com.au.

Yours sincerely

Tony Chappel
Chief External Affairs Officer

Attachment A: AEMO submission to the Draft Determination

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

AEMO Submission to Integrating Energy Storage Systems (IESS) Draft Determination

September 2021

Contents

1. Background

AEMO lodged the Integrating Energy Storage Systems (IESS) rule change request in August 2019, with the objectives of:

- explicitly recognising energy storage systems in a way that was intentionally technology-neutral, defined conceptually as a 'bi-directional unit' plant that consumes and stores energy to produce electricity; and
- accommodating increasing numbers of grid-scale connections with bi-directional flows more efficiently in dispatch, with a single dispatchable unit ID (DUID) and consistent technical and financial requirements.

The AEMC published a Draft Determination for the IESS rule change on 15 July 2021. The scope of the original rule change request has expanded to include changes to non-energy cost recovery and elements of the Post 2025 Market Design Options. The Draft Determination estimates that implementation would take 18 months, with rule commencement occurring in April 2023.

2. Scope of the Draft Rule and outstanding issues

The more preferable Draft Rule generally addresses most aspects of AEMO's rule proposal, although the scope of the IESS rule has significantly expanded beyond the original proposal for a new participant category to aid the integration of energy storage (now the Integrated Resource Provider, or IRP).

The Draft Rule includes a plant definition (now the integrated resource unit, or IRU) that is expressed differently from AEMO's proposal but is nevertheless directed at controllable two-way flows and can be treated as a single dispatchable unit for bidding and dispatch, with appropriate 'two-sided' performance standards at the registrable level.

The Draft Rule also incorporates a number of other important reforms that AEMO supports, as canvassed in its rule proposal or subsequent submissions. These include changes to non-energy cost recovery that will allow AEMO to recover these costs in an equitable way, and to remove the regulatory links of the provision of ancillary services from either a 'load' or a 'generating unit'. The concept of the IRP has, however, been expanded in the Draft Rule to cover several existing registration categories both at grid scale and at the small customer end of the market (retailers and aggregators). The IRP able to classify connection points where there is load or generation or IRUs and provide frequency control ancillary services (FCAS) from the same connection points.

The resulting Draft Rule has seen one of the most extensive rewrites of the National Electricity Rules (NER) to date; including changes to the definition of load and the revision of clauses to allow for the flow of energy to be reflected, as opposed to reliance on the concepts of load or generation. Changes have also been included to allow for, or not disincentivise, hybrid generating systems, including those with DC-coupled storage devices connected.

The scope of change in the Draft Rule has left a number of issues to be addressed and a substantial body of work for AEMO to complete to implement the rule in its entirety. AEMO anticipates that it will be unable to commence the necessary work for several months after the Final Determination due to competing commitments for the relevant subject matter experts. AEMO also considers that 18 months will be insufficient to implement all of these changes, and recommends a flexible implementation approach.

AEMO considers that the definitions of IRU and integrated resource system need further consideration. AEMO understands the AEMC's intent is for "integrated resource" to be a generic label, however the term "integrated" implies multiple units being integrated, rather than a single technology asset such as a battery or pumped hydro installation. AEMO recommends that a "bi-directional resource unit" is a more logical term to use for these types of units or asset installations – while the IRP and integrated resource system are still the appropriate labels to give to these participants and generating systems as they will be able to integrate multiple resources. Whilst the materiality of this point is not substantial at this time, AEMO expects that participants will look to expand the nature and complexity of their asset installations in the network and, as such, clarity will become increasingly important for registration and classification of units and generating systems.

AEMO has identified these and other issues in the Draft Determination that it considers require resolution, and additional areas where clarification is sought. These are summarised in Table 1 and articulated further in subsequent sections. In addition, given the extent of the changes to the rules, there will be additional areas of detail on which AEMO would like to continue collaborating with the AEMC, to identify and address any potential ambiguities or opportunities to simplify drafting.

Finally, AEMO would encourage the AEMC in its Final Determination to more clearly quantify the benefits associated with this change, and to whom these benefits will accrue. This change will be a significant cost to AEMO, and this analysis would help AEMO to allocate the costs associated with the changes more accurately.

Table 1 Summary of AEMO issues or clarifications required to Draft Determination

Topic and section	AEMO recommendation	NER
Registration (section 3)	Add new clause in 2.4.2(d) to clarify an IRP Classification change Address various ambiguities in chapter 2 drafting	Ch 2
Registration (section 3)	AEMO will require a retail licence for all small customer market connection point classification	N/A
Retail systems and Metering (section 4)	Allow IRP access to all market systems currently afforded to Retailers – 7.15.5(e)	Ch 7
Single DUID (section 5)	Maintain single DUID approach for IRUs Clarify arrangements for existing participants Change clause regarding FCAS bids to 20 bid bands	Ch 2, 3
Hybrid generating systems and DC-coupled production units (section 6)	Aggregated conformance should be made available on application and may be denied by AEMO in specific circumstances All 5MW IRUs should be scheduled – DC- and AC-coupled. DC-coupled production units must be either scheduled or semi-scheduled	Ch 2, 3
Non-energy cost recovery and Retailer Reliability Obligation (RRO) (section 7)	AEMC should align changes to compensation framework with IESS and not make an IRP a liable entity for RRO	Ch 3, 4A
Transmission use of system (TUOS) treatment of IRUs (section 8)	Application of TUOS should be consistent between generation and load from IRUs	Ch 5
Implementation scope and timing (section 10)	AEMC should consider a more flexible approach to final rule implementation or extend the implementation period to at least 24 months	N/A

3. IRP Registration, Classification and AEMO fees

As part of the implementation of the IESS rule, AEMO will implement a new participant category termed the Integrated Resource Provider into NEM procedures, processes and systems. This category will allow for many currently separated roles to be performed by an organisation that would currently need to register as a Generator, Customer or Small Generation Aggregator (SGA), based on the current rule requirements. However, with the exception of the SGA, those participants would effectively be able to choose to register as an IRP or in an existing category.

The universal nature of the IRP registration category will drive changes to AEMO process and systems, as it will break the existing links between a registration category and the participant's role in the market, access to systems and the processes that AEMO manages such as prudential requirements and settlements. However, AEMO will also need to maintain existing registration categories and processes. Further changes to make the IRP a truly universal category and transition all current participants to this model are expected to be laid out in the Trader Services initiative outlined in the Energy Security Board (ESB) Post 2025 Demand Side Initiatives, with the timing and nature of associated changes yet to be determined.

While this new registration category will allow for IRPs to complete these multiple roles, AEMO will still need to ensure the appropriate registration and classification, technical and market requirements are met. With respect to grid-scale assets, an IRP will need to register these assets if they are above the relevant threshold, which will be 5 MW for IRUs and Generators.

3.1 AEMO process for Registration and Classification of Units or Plant by an IRP

The IESS Draft Determination will require AEMO to develop or amend the registration and classification processes set out in Table 2. These are included in this submission for information only.

Table 2 Registration and classification processes requiring development or amendment

IRP registration and classification types	AEMO registration process
Integrated Resource Provider registration	Application to be registered as an IRP. This process will need to take into account the classifications intended by the applicant and notified at the time of registration.
Generating unit classification: • scheduled/semi-scheduled/non-scheduled • market/non-market	Application to classify a generating unit. This process will be an IRP or Generator subset registration process.

IRP registration and classification types	AEMO registration process
Integrated resource unit classification: • scheduled/non-scheduled • market/non-market	Application to classify an IRU. This will be an IRP subset registration process
Market connection point classification: • connection point or child connection point • connection point for small generating units or small integrated resource units	Retail market system classification processes*
Scheduled load classification	Application to classify plant connected at a market connection point as a scheduled load. This will be an IRP or Customer registration process.
Ancillary service unit classification	Application to classify plant connected at a market connection point as an ancillary services unit. This will be an IRP, Generator, Customer or Demand Response Service Provider registration process.

*For these categories AEMO will require participants hold a Retailer authorisation or jurisdictional licence as applicable (unless exempt from the requirement) to access retail market systems.

3.2 AEMO fee methodology review

The IESS Final Determination may drive the need for AEMO to consider its fee methodology which may be applicable to the new category of IRP in the current fee determination period. This may have implications for the way fees are apportioned to Registered Participants. This consideration will include the relevant fees for the implementation of IESS and the ongoing operational and administration costs applicable to the IRP, i.e. registration, classification and aggregation processes.

The development and implementation of the IESS rule change will be a regulatory obligation imposed on AEMO. AEMO's recovery of its budgeted revenue requirements through participant fees is addressed in rule 2.11 of the NER, which sets out how AEMO can recover development, implementation, and ongoing costs through electricity participant fees.

AEMO may consider using the declared NEM project provisions in the NER to facilitate recovery of costs associated with the IESS rule change during the current NEM fee determination period.

3.3 Registration issues

Market Participant registration eligibility requirements

The Draft Rule amends the current Market Participant registration eligibility requirements. The Draft Rule:

- deletes clause 2.4.2(b), which requires a registration applicant to satisfy AEMO that it meets any relevant requirements imposed under relevant jurisdictional electricity legislation; and
- amends clause 2.4.2(d), such that a registration applicant will only be required to satisfy AEMO that it is complying, and will comply, with the relevant obligations set out in the Rules associated with the classification types that the applicant indicates in their registration application.

This means a person registered as an IRP in relation to an exempt or non-exempt generating/integrated resource system can classify retail customer connection points under clauses 2.3.4(b), 2.3.4(d) or 2.2.8, without initiating or requiring any further assessment by AEMO of the IRP's ability to comply with:

- any relevant jurisdictional classification requirements under rule 2.3.1A; or
- the obligations set out in the Rules in relation to connection points classified under clause 2.9.2(b)(3) or 2.4.2(d).

While AEMO understands the intent that responsibility for compliance will rest with the participant, with the AER responsible for enforcement, it is important that – as far as practical – access to transfer and classification functionality in AEMO's systems is restricted to those who are entitled to that access.

AEMO therefore recommends an amendment to the Draft Rule to ensure that where an IRP has not previously classified connection points as a Market Customer or Small Resource Aggregator (SRA) then AEMO must ensure that appropriate obligations set out in the rules and in other jurisdictional instruments should be met before it classifies retail connection points.

Drafting ambiguities

Table 3 lists the drafting ambiguities that AEMO has identified in Chapter 2 of the Draft Rule. **AEMO suggests the Final Determination or Final Rule should clarify these ambiguities.**

Table 3 Drafting ambiguities identified in Chapter 2 of the Draft Rule

Ambiguity	Details
Do IRPs need to be SRAs where a small unit is connected behind the meter, should a separate connection point be a pre-requisite, and how do SRA provisions apply if there is no separate 'end user'?	Clause 2.2.8(a) as drafted appears to apply to small generating units/IRUs whether they have a separate connection point or are behind the meter of an end-user's traditional 'load' connection point. In theory this would allow a person to classify a small unit and act as an SRA for a connection point that has both load and embedded generation. Is this the intended outcome, and if so why would this be necessary? AEMO understands that the SRA concept should be parallel to an existing SGA, which can aggregate these resources only if a separate connection point is established. It would be helpful to clarify: (1) whether SRAs can continue to classify small units where 'child' connection points have been established. (see below), (2) whether the 'end user' can be the SRA itself for standalone small facilities.
Can child connection points be established for exempt generation/IRUs?	Clause 2.3.4(d) addresses the classification of child connection points, requiring the consent of the 'retail customer' at that connection point. Clarification would be helpful on the market classification of child connection points at which there is no retail customer, including non-market or exempt units in an embedded network.
Can multiple Ancillary Service Providers classify separate plant at the same connection point?	Clause 2.3D.1 could be read to suggest that different persons can each classify separate plant connected at the same market connection point, as separate ancillary service units. AEMO wishes to clarify that this is not currently possible. While the capability to provide FCAS depends on the installed plant, FCAS delivery is

Ambiguity	Details
	measured as at the connection point and therefore it is only practicable for one ancillary service provider to classify a single connection point.
Can non-scheduled generating units and non-scheduled IRUs participate in central dispatch in relation to market ancillary services?	Clause 2.2.3(f) states that, subject to clause 3.8.2.(e), non-scheduled generating units and non-scheduled IRUs do not participate in the co-ordinated central dispatch process operated by AEMO. The glossary definition of central dispatch includes the process for dispatch of market ancillary services. Clause 2.3D.1 does not restrict non-scheduled generating units and non-scheduled IRUs from being classified as ancillary service units.
Ability to classify non-market generating units/IRUs	Clauses 2.2.4 and 2.2.5 respectively preserve the non-market classification for generating units and introduce it for IRUs (if required). However, clauses 2.1B.1 and 2.1B.2 indicate that all generators and IRPs must meet the requirements to be a Market Participant, which may be inconsistent.

4. Retail and Metering changes

The IESS Draft Rule will necessitate extensive changes to AEMO's retail and metering systems and processes. Almost all AEMO procedures relating to these functions will require changes to add the IRP category and ensure that IRPs looking to classify small generating units, load or small IRUs (or any combination of these at the connection point) will be able to do so, and that the relevant metering and customer switching processes and procedures that apply to Retailers will apply to IRPs as well. This must be done without materially altering the market interface for participants registered in existing categories (other than SGAs, which AEMO understands will transition to IRPs).

This section describes the need for IRPs to have access to data and functions in their role, which will need to be accommodated in AEMO's systems and procedures.

4.1 Access to data

AEMO recommends that provisions in clause 7.15.5(e) be extended to IRPs. Currently there is no facility for SGAs to access NMI standing data and NMI discovery in MSATS (unless they are also a retailer). As the IRP will be the financially responsible market participant (FRMP), appointed by a customer, the NER should enable any party with a right to become the FRMP for a connection point to have access to this facility. AEMO has made specific recommendations regarding this clause in the recent response to AEMC's review of the regulatory framework for metering services, as follows:

> *Access to National Metering Identifier (NMI) Standing Data – AEMO considers that the provisions of NER 7.15.5(e) might be unnecessarily limiting. The current drafting provides that a retailer may access and receive NMI Standing Data. Other market participant roles, such as a Market Small Generation Aggregator, might also benefit from access to NMI Standing Data in order that they can be similarly informed as a retailer when seeking to offer services to a customer at a connection point.*

4.2 Role appointments in MSATS

AEMO understands that the IRP role will incorporate that of the retailer, in that the IRP can assume the role of FRMP at a connection point in MSATS. Similarly, customers would have the ability to switch to an alternative IRP using the customer switching mechanisms in MSATS.

If the IRP becomes the FRMP for a connection point, it will be able to appoint the Metering Coordinator. IRPs will require access to the suite of change requests to enable this, matching those currently accessible to retailers.

5. Single DUID and 20 bid bands for dispatch

The Draft Determination:

- Introduces the IRP category to support future single-DUID dispatch for batteries, hybrid units, and aggregators in a future two-sided marketplace.
- Enables batteries to participate in dispatch using a single DUID by registering as an IRU.
- Provides flexibility for IRPs to choose to operate hybrid DC-coupled systems with one or multiple DUIDs.

The AEMC has since indicated that is has received significant stakeholder opposition to mandatory single DUIDs for batteries and for other participants, and is. seeking AEMO feedback on the Draft Determination and alternative options.

5.1 Single DUID

AEMO considers the implementation of a single DUID for IRUs as proposed in the Draft Rule, with 20 bid bands split between 10 bid bands each for load and generation, is preferable to a dual classification model or 20 fully flexible bid bands. AEMO expects it can implement this approach largely by applying existing functionality, minimising the complexity and cost as compared with the implementation of a fully flexible 20 bid-band. IRPs would bid and be dispatched under a single 'parent' DUID for their IRUs, but NEMDE itself could continue to optimise separate (but linked) child DUID bids for the load and generation components of the battery. The dispatch instruction for the parent DUID would be the sum of those for the child DUIDs, and bid validation rules for IRUs can be developed to ensure that in any interval the bids are increasing in price from "full import" to "full export", meaning in the majority of circumstances only one of the two child DUIDs would have a non-zero dispatch target. Similarly, this approach retains flexibility for how AEMO manages constraints associated with IRUs, with an opportunity to reduce operational risk through application at the parent DUID (or netted child-DUIDs).

This implementation approach provides some incremental benefits to the current 2-DUID approach, whilst maintaining the ability of IRUs to provide energy and FCAS to the market. **However, AEMO advises that devices with a dead band around their zero point of zero generation/consumption should not use the single DUID model,** as this would require integer constraints in order to be incorporated in NEMDE, which would increase the complexity and hence time to find an optimal solution.

5.2 FCAS bidding

AEMO has also considered how FCAS bidding could be implemented for IRUs, and specifically whether 10 or 20 bid bands for FCAS should be used. To align with energy bidding, **AEMO recommends that 20 bid bands (10 bands for load, and 10 bands for generation) for each FCAS service be available**.

It is important to note that batteries may continue to be limited to providing less contingency FCAS than they are physically capable of, due to system stability limits associated with droop settings. This limitation is fundamentally due to physical system constraints, rather than whether a single or dual DUID approach is used. For example:

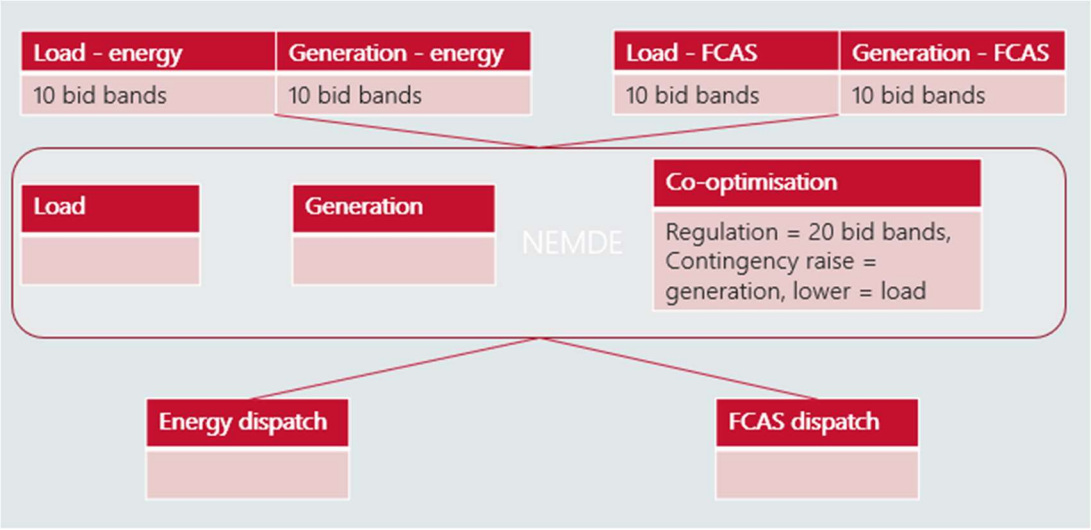
- A 100 MW battery consuming at 100 MW may be technically capable of providing 200 MW of Raise FCAS (-100 MW to +100 MW). However, droop settings may restrict this value to ensure system stability, to say 40 MW.

- The unit can physically provide this quantity across its full range up to the point where it is limited by the battery capacity – i.e. if it is consuming at 10 MW, it can still provide 40 MW of Raise FCAS (from -10 MW to +30 MW).[1]
- The FCAS trapezium(s) should reflect this, to ensure that the enabled quantity will not exceed the allowed value (40 MW) in cases when both the load and generation child DUIDs receive targets. This can be done through a contingency FCAS trapezium which allows enablement on either the generation or the load side (not both).
- It will then submit all its raise FCAS bids on the generation side (effectively only using 10 bid bands), and its lower FCAS bids on the load side.

To be clear, this does not prevent the battery from providing raise FCAS when it is in a net state of consumption (or vice versa). NEMDE could, for example, dispatch the load child DUID to be consuming 100 MW energy and 0 MW (FCAS), and the generation child DUID to 0 MW energy and 40 MW FCAS. The net position of the parent DUID would then be -100 MW of energy (i.e. consuming), and 40 MW of Raise FCAS.

The restriction described above affects contingency FCAS only, not regulation FCAS, because regulation FCAS is deployed under centralised control. AEMO's Automatic Generation Control (AGC) determines and instructs units to provide certain amounts of regulation FCAS every four seconds. For contingency FCAS, deployment is decentralised, and so limits on maximum enablement are required.

Figure 1 Example of Bidding and Dispatch for IRUs



This approach will allow for improved energy bid validation rules (i.e. that bids monotonically increase per interval) to be implemented and an FCAS trapezium, with a co-optimisation approach that would remove the opportunity for IRPs to provide non-conforming energy or FCAS bids and allow AEMO to receive and validate bids which relate to a single storage unit.

This is largely left to the bidder of the storage device to manage on their own today, and may result in the bids for the load and generation DUIDs being submitted independently.

In addition, the implementation of the single DUID as proposed above will allow:

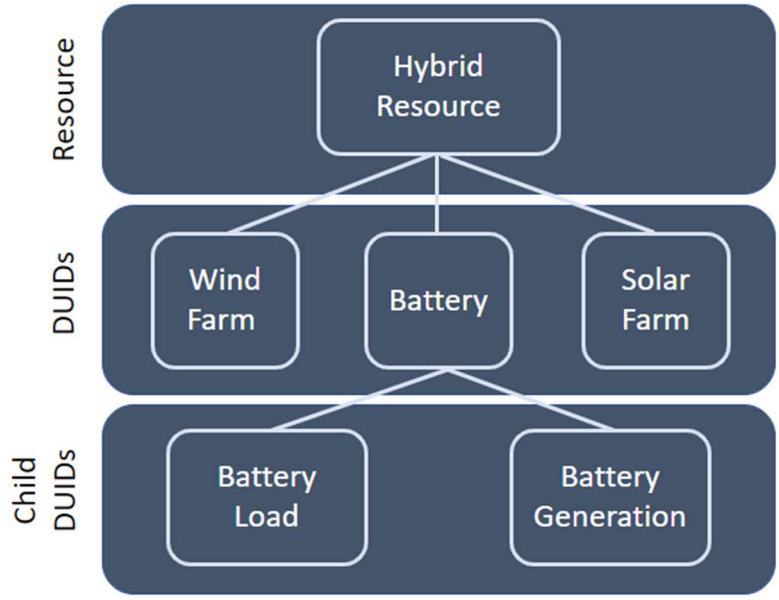
- DC-coupled storage device and generating unit to operate as a single DUID (first option in the DC-coupled examples in the Draft Determination) without the need to split the generation DUID between two units or to have 3 DUIDs to manage this scenario.

[1] Note: batteries have some special end effects associated with the amount of FCAS they can provide at the limits of their capacity associated with droop settings due to the speed at which they deliver their FCAS.

- AEMO to implement the dispatch system changes in a way that facilitates the future integration of distributed storage or distributed DER into the dispatch engine. The next step along this path is envisaged in the ESB's proposed 'Scheduled Lite' reforms.
- Current participants to continue to operate using the 2-DUID approach. Whilst we recommend that all new classifications of IRUs (except those with a deadband) use a single DUID and the 20-bid band approach, AEMO could continue to support existing battery storage participants who wish to retain their current model. Currently the Draft Rule forces all existing and new participants to move to the Single DUID once the rule is implemented.

It should also be noted that in a similar rule making process, ERCOT recently introduced a single dispatch identifier approach for storage devices connected into the Texas electricity system, for many of the same reasons highlighted above.

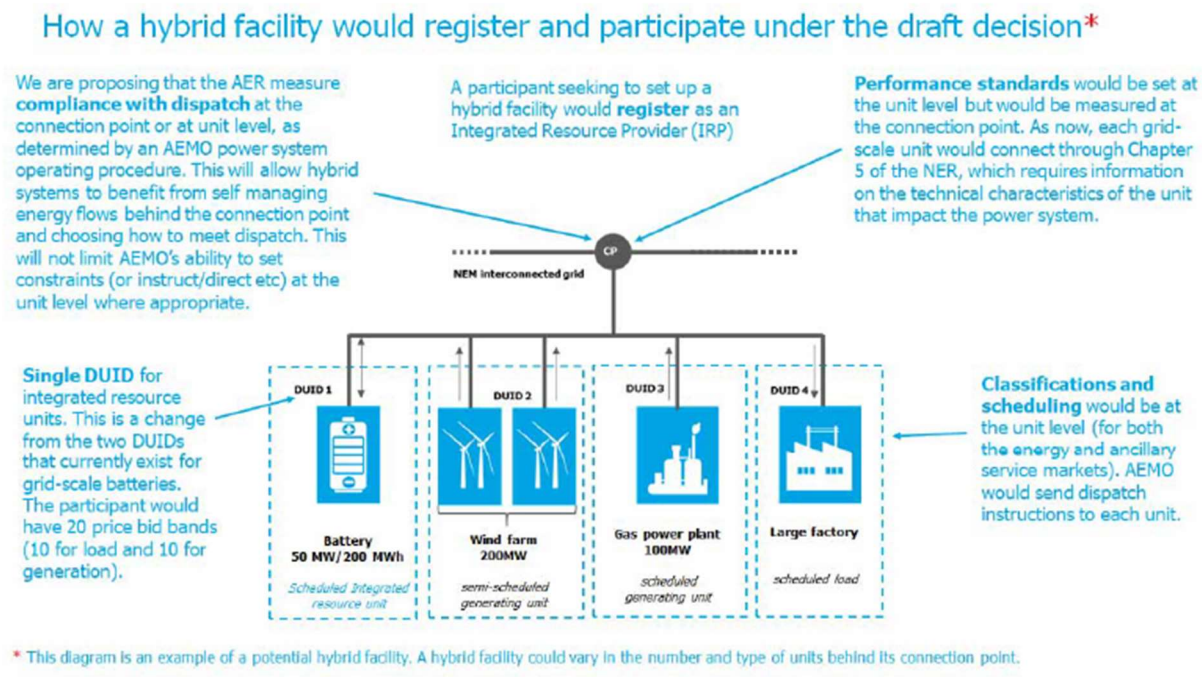
Figure 2 Example of Hybrid Resource system and AEMO DUID treatment



6. Hybrid and DC-coupled generating systems

6.1 Hybrid generating systems

Figure 3 Example of a hybrid facility registered as an IRP (Figure 2.2 from the Draft Determination)



AEMO has been investigating whether the approach taken in the Draft Determination with respect to hybrid generating systems can be implemented, while maintaining adequate safeguards to manage system security and reliability.

As indicated in Figure 3 above, hybrid facilities will become increasingly complex and will require AEMO to consider the implications across a range of areas it manages today and integrate these into the way we operate the system.

Once the rule is made, AEMO will need to review current dispatch and operating Procedures and definitions to accommodate hybrid and DC-coupled generating systems, and either update or in some cases write new procedures to outline our approach to managing these systems and the requirements of the IRPs who operate them.

AEMO supports the proposed use of separate DUIDs for each of the units of a hybrid facility, as this will allow each unit to be dispatched separately, any constraints to be applied at the unit level not just universally to the connection point (which may be important if the hybrid generating system comprises old and new technology, such as inverters) and for the consistent and equitable application of Causer pays and other cost recovery calculations.

As AEMO noted most recently in its Engineering Framework report and in other reports, the NEM is becoming less stable to operate. The system is experiencing more events, disturbances and outages and we expect this situation to continue as further investment in variable renewable energy (VRE) continues to displace synchronous generators. In this challenging environment, a default aggregated conformance

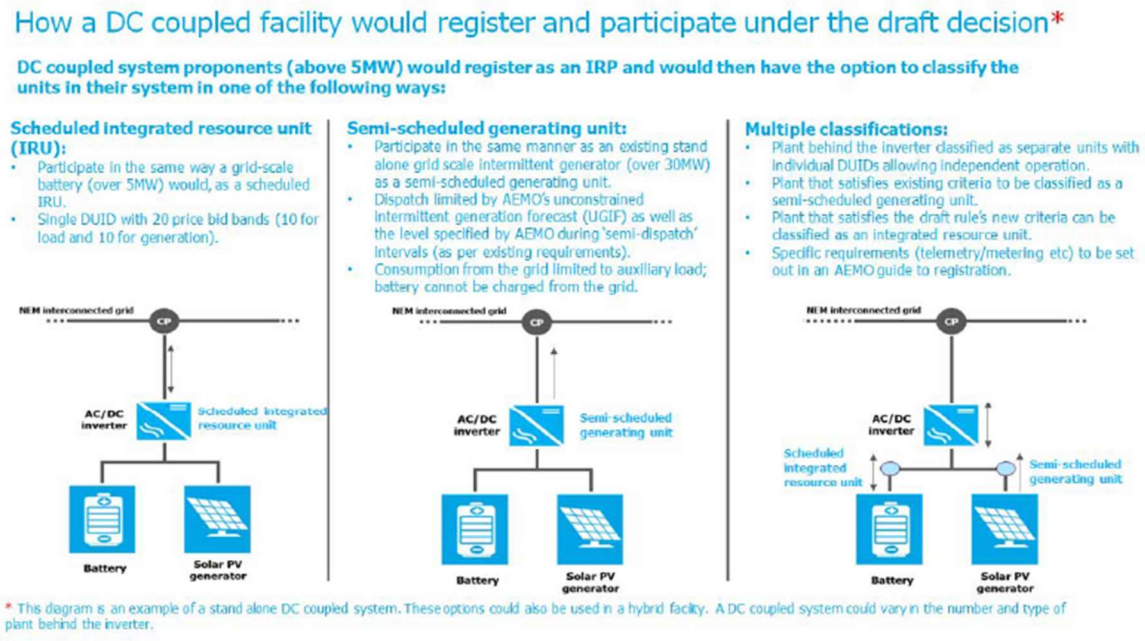
approach to all hybrid generating systems will provide AEMO with another set of variables to manage – which will involve different aggregated combinations of assets and inverters. AEMO advises that it may also result in a mismatch between what is predicted in STPASA and what is dispatched. To best manage these scenarios with respect to hybrid generating systems, AEMO needs the ability to undertake due diligence on hybrid facilities, including consideration of potential locational issues such as system strength or voltage disturbance, and the ability to reject the use of an aggregated conformance approach for a hybrid generating system where these issues are acute. Consequently, **AEMO recommends that aggregated conformance should be made available for hybrid generating systems on application, and may be rejected by AEMO in specific circumstances.**

AEMO also recommends that aggregated conformance targets should apply to hybrid generating systems that include battery systems with a capacity of 5 MW or greater, or other scheduled generating units or loads; otherwise, aggregated conformance caps apply (akin to semi-scheduled facilities).

It is important that metering arrangements for hybrid generating systems are consistent with the policy objectives, including non-energy cost recovery and TUOS charging.

6.2 DC-coupled systems

Figure 4 Options for a DC-coupled connection to connect to the power system (Figure 2.3 from the Draft Determination)



DC-coupled batteries have been included by the AEMC in this rule determination. However, AEMO notes that there is not a widespread adoption of this approach as yet in the NEM. These systems will require a unique approach by AEMO to the way these systems are defined, bid and operate in the market.

New or revised operating procedures will be required to define the arrangements for DC-coupled DUIDs, aggregated conformance operation and operating instructions where system strength, voltage constraints or other issues occur in the transmission network.

To clarify the rules, **AEMO recommends that the definition of coupled production unit should clarify that such a unit may only classified as scheduled or semi-scheduled**. AEMO advises that it intends that DC-coupled battery systems with a capacity of 5MW or greater will need to be scheduled, as is currently the case for AC-coupled battery systems.

Table 4 outlines additional implementation considerations that AEMO has identified to date.

Table 4 Implementation considerations in respect of DC-coupled systems

AEMC Draft Determination Policy	AEMO implementation
For a DC-coupled system, two DUIDs can exist behind one inverter	AEMO would need to define a new control point and associated SCADA for each dispatchable unit that shares an inverter
DC-coupled battery and generator may be a single scheduled DUID	With single-DUID bidding, the operator can bid the combined unit in 20 bid bands – AEMO may need to review information provision requirements for these units (i.e. generator information)
Semi-scheduled unit and DC-coupled battery may be a single semi-scheduled DUID	In this scenario a battery does not have its own DUID and cannot charge from the grid, so we expect that this will have limited applicability to the NEM. AEMO would also prefer limits on the battery capacity proportion in systems which can classified as a single semi-scheduled resource, e.g. a 100 MW battery with a 10 MW solar farm should not be semi-scheduled.
DC-coupled batteries between 5-30MW may apply for an exemption to be registered and scheduled	AEMO would prefer all batteries >= 5MW to be scheduled, but as it may impose scheduling requirements on non-scheduled units[2], AEMO can work with the IESS rule
AEMO may determine DUID-level constraints and dispatch targets	In a single-DUID arrangement, these will be applied on a DC-coupled battery and generator as if they are a single unit.
Aggregated conformance	Same as for hybrid generating systems; although this is not applicable for a single DUID as conformance is assessed at the DUID level

6.3 Use Case analysis

To assist in the process of analysing the implications of the IESS rule implementation, AEMO has analysed a set of use cases to determine the outcomes for different installations, with a summary of this analysis shown in Table 5. AEMO notes this analysis is preliminary and will be refined as we progress to system and procedure changes, and will be consulted on with stakeholders prior to finalisation. The full use case analysis is provided in the appendix to this consultation response.

[2] AEMO's powers in this respect are contained in clauses 2.2.3(c) and 3.8.2(e).

Table 5 Summary of use case analysis

Topic	Design consideration
Dispatch	• Semi dispatch cap applies for VRE, Batteries >=5MW are scheduled.
Aggregated conformance target	• Operator has flexibility to change DUID-level dispatch to match an aggregated dispatch target. AEMO will be able to "turn-off" aggregated dispatch flag OR "turn-on" individual conformance flag which results in the remaining units in the hybrid using aggregated compliance.
Real time operations	• If AEMO needs to control VRE for system strength, then this is done at DUID level. • May require new or updated operating procedures.
FCAS	• Aggregated conformance would hinder the ability to supply the system's maximum FCAS due to additional headroom requirements to manage VRE forecast errors. • Where DUID operates as dispatched, FCAS capability of hybrid is not diminished.
Causer pays	• Causer pays applies at the DUID level. • Aggregated conformance may incur DUID-level charges, but should be balanced by equal and opposite dispatch errors at co-located DUID.
Constraints	• Will apply at the DUID or (for non-legacy IRU with two DUIDs) at the facility level.

7. Non-energy Cost Recovery and RRO

AEMO notes that the AEMC has largely adopted suggestions related to non-energy cost recovery that AEMO has made in the course of consultation on the IESS rule. AEMO considers that the proposed changes to the settlement rules will deliver a recovery framework for non-energy costs that is both equitable and sustainable through the current power system transition.

AEMO is committed to these outcomes but is conscious of the significant implementation effort in system and process design, and change management for AEMO and participants to operationalise these changes – in an already busy environment of regulatory and system change. Accordingly, as explained further in section 10, AEMO considers that some flexibility will be needed in implementation timing, and would welcome the opportunity to explore regulatory options in this regard.

Regarding the design of the framework as reflected in the Draft Rule, AEMO makes the following observations:

- The compensation framework review is running in parallel to this rule change, and will likely require some further changes to the settlement calculation clauses that are not yet included in the IESS Draft Rule. **AEMO recommends that implementation timing for the review and this rule change should be aligned to enable synergies by implementation at the same time**.
- The Draft Determination makes an IRU a "liable entity" in relation to the RRO. **AEMO does not agree with this treatment** and would welcome a change to this approach to reflect the increased dispatchability that IRUs will provide, including in hybrid generating system configurations.

8. TUOS application to IRUs

In its recently submitted draft Pricing Methodology for Prescribed Shared Transmission Services for the 2022-2027 period[3], AEMO (in its capacity as Victorian shared transmission network service provider) proposed the following approach to TUOS for Energy Storage systems:

> *"Subject to the NER and the exceptions below, AEMO will not determine a charge under this Pricing Methodology in respect of Connection Points at which Energy Storage Systems are directly connected, either in respect of supply (discharging), or consumption (charging). This will apply to arrangements where the Energy Storage System is co-located with a generating system and is located behind the generator's energy meter,*
>
> *For the avoidance of doubt, and subject to the exceptions below, the point of connection of an Energy Storage System that is directly connected to the* [declared transmission system] *will not be considered as a Connection Point for the purposes of this Pricing Methodology.*
>
> *The exemption from being charged under this Pricing Methodology is subject to the following exceptions:*
>
> *• an Energy Storage System that is co-located with a customer's load that is directly connected to a transmission system (that is, a load that is not supplied through a connection point to a distribution system) and is itself located behind the meter.*
>
> *• pumped hydro storage systems that are recharged by use of electrically powered pumps, will not be exempted where the electrically powered pumps are used to recharge the hydro reservoir(s) are used for other purposes than exclusively for the pumped hydro storage system. The customer will be required to agree to the exclusive use of the pumps for the pumped hydro storage system in its Use of System Agreement and maintain that obligation for the duration of the term of the agreement.*
>
> *• Energy Storage Systems that are connected to distribution systems are not directly charged the prices set out in clause 1.3 but such prices (in the form of charges to the relevant DNSP) may form part of the customer's connecting DNSP's tariff charges. No accommodation can be made to "remove" any TUOS component of that charge, however, the customer may be able to negotiate an "avoided TUOS" rebate in recognition of the contribution of the Energy Storage System's towards overall reduction in energy or demand over the transmission connection point.*
>
> *• AEMO retains the right to determine whether to allow an exemption on any other arrangement involving an Energy Storage System at the time that the facility's connection application is made"*

AEMO supports a consistent approach to the imposition of TUOS charging across the NEM and between generation and storage technologies, to be specified in the NER. **AEMO considers that there should be consistency between the application of TUOS to generation and load from IRUs,** so that energy storage systems are not disincentivised from connecting to the transmission network, as they generally provide a net benefit to the power system by charging at periods of low demand. A clear exemption from TUOS on load from IRUs would provide certainty for TNSP planners to contract with every IRU, regardless of technology type or ability to negotiate. Without this change, the ability of market participants to contract the offtake of their facilities will also be hampered by the potential for a TNSP to charge TUOS on these devices at some point in the future, whether by design or because of a change to the legal interpretation of the discretion afforded by the NER; pricing this risk will increase cost for all consumers.

[3] Available at https://www.aer.gov.au/networks-pipelines/determinations-access-arrangements/aemo-determination-2022-27, page 14.

9. Procedural Change and Consultation

To evaluate the scale of procedural change required by the Draft Rule, AEMO has undertaken a high-level survey of existing documents (procedures, methodologies, guides, fact sheets etc) which would be affected, as well as identifying new required procedures.

Due to the fundamental nature of the rule change – being an initial step towards a universal participation model but retaining parallel categories – and associated changes in terminology, wide-ranging changes to AEMO's procedures will be required, with over 100 documents identified as affected. While a number of these documents will only require changes that are directly consequential on the rule, the sheer number of those changes still makes this a significant task, and in some cases the Rules can still require consultation on such changes. Substantial AEMO resources are expected to be required to undertake the necessary changes and applicable consultation for both minor and more material changes.

The following new procedures will be required as a result of the rule change:

- IRP registration and IRU classification - procedures, guides, fact sheets and application forms
- Hybrid and DC-coupled unit classification procedures, guides and fact sheets.
- Single DUID bidding guide
- Power system operating procedures for conformance of hybrid units
- Transfer to IRP category and reclassification.

Existing documents that are expected to require material or consulted changes across AEMO business areas are shown in Table 6. This table does not provide an exhaustive list but aims to convey the scale of change required.

Table 6 AEMO documents expected to require material or consultative change

Area	Document(s)
Registration	Guide to generator exemption and classification of generating units Application forms, application and transfer guides, fact sheets and related registration documents relating to the Generator, Customer, Demand Response Service Provider, Small Generation Aggregator and Trader categories.
Metering and Retail	Retail Electricity Market Procedures – Glossary and Framework Metrology Procedure: Part A National Electricity Market Metrology Procedure: Part B Metering Data Validation, Substitution and Estimation Exemption Procedure MSATS Procedures: CATS Procedure Principles and Obligations Operating Procedure MSATS CATS History Model Operating Procedure MSATS – NMI Discovery Questions and Answers DER Register Information Guidelines
B2B Procedures (IEC)	B2B Procedure Customer and Site Details Notification Process

Area	Document(s)
	B2B Procedure Service Order Process B2B Guide
Settlement and Prudentials	NEM Settlements Estimation Guide Settlements Guide to Ancillary Service Payments and Recovery NEM Direction Compensation Recovery Credit Limit Procedures NEM Direction Compensation Recovery PoLR Cost Procedures
Electricity Market Monitoring	Schedule of Constraint Violation Penalty Factors SO_OP_3705 Dispatch Pre-Dispatch Process Description Factors Contributing to Differences between Dispatch and Pre-dispatch Outcomes Market Suspension Compensation Methodology SO_OP_3707 Procedures for issue of directions and clause 4.8.9 instructions SO_OP_3708 Non-market ancillary services
Systems Performance and Commercial	Market Ancillary Service Specification Forward Looking Loss Factor Calculation Methodology Regulation FCAS Contribution Factor Procedure Intervention Pricing Methodology FCAS Model in NEMDE SO_OP_3717 Procedure for the exercise of the reliability and emergency reserve trader
Operational Forecasting	SO_OP_3710 Power system operating procedures - load forecasting
Operational Planning	ST PASA Process Description SO_OP_3718 Outage Assessment SO_OP_3719 Procedure for submitting recall information of scheduled generator outages
Congestion & Grid Modelling	Constraint Formulation Guidelines
Forecasting	MT PASA Process Description ESOO & Reliability Forecast Guidelines ISP Methodology and database
Network Development	Power System Model Guidelines Generator Performance Standards Template

10. Implementation timeframes and flexibility

10.1 AEMO Work Effort and Resourcing

The IESS rule change will entail a program of work that requires significant changes across most of AEMO's business areas, and the corresponding systems that support the business. The key areas identified where implementation changes are required include:

- Registration – implementation of the IRP category and downstream systems implications
- Settlements and retail – changes to Settlement calculations, metering and retail systems
- Dispatch and Market Operations – implementation to support operation of single DUID and hybrid generating systems, which may include DC-coupled systems

As a dependency to implementing system changes, AEMO has also identified a large number of procedures that are impacted by the proposed draft rules. It is estimated that the requisite procedure changes, many of which will require consultation and business change implementation, could be as much effort as system change implementation.

A large proportion of AEMO's experienced subject matter experts (SMEs) will be required as key resources for the IESS implementation, given their domain knowledge, and their availability is a key factor to enable implementation start. Many of these resources are currently, or will be, involved with a number of industry programs (including projects related to Global Settlement, Short Term PASA, Stand-Alone Power Systems (SAPS) and the ESB Post 2025 initiatives) and internal forecasting and operational system upgrades that overlap with the proposed implementation timeframes and resourcing requirements for the IESS changes.

10.2 Implementation approach

AEMO recommends that the Final Determination provides AEMO with the flexibility to effectively manage delivery and specify go-live dates as part of the implementation of the IESS rule. The breadth of the rule does not lend itself to a single delivery or go-live date for all the different elements of the rule implementation. As the rule itself encompasses a number of specific and (from an AEMO perspective) discrete pieces of work, AEMO would welcome an opportunity to work with the AEMC and stakeholders to develop a flexible and staggered approach to the implementation of this rule that accounts for resource availability, and the relative priority of the elements for the AEMC and industry.

Given the busy Regulatory Implementation Roadmap[4] over the next two to three years, including changes to areas also affected by this rule change, AEMO advises that its ability to commence work on the IESS changes could lag the Final Determination by several months. Current resource availability suggests a start date range between March and June 2022. In the absence of a flexible implementation approach, this rule change is unlikely to be able to be successfully implemented until at least 24 months from the publication of the Final Determination by the AEMC.

[4] Available at https://aemo.com.au/en/initiatives/major-programs/regulatory-implementation-roadmap.

Delivery flexibility may allow earlier delivery of components of the rule change, given the overlapping and interdependent industry programs in play, noting that delivery contingency needs to be considered to allow for transition adjustments of IESS changes by the impacted industry bodies.

A1. Use Case analysis for Hybrid and DC coupled generating systems

AEMO has assumed batteries to be >= 5 MW for these use cases. Additional use cases for hybrid and DC-coupled facilities with smaller batteries will be prepared by AEMO to assist with implementation activities

#	Use case	Constraints and application to DUIDs	Dispatch of units, and operational forecasting	Aggregated conformance cap/target	Real-time operations – e.g. what to do with issues with plant	Implications for FCAS
	Hybrids					
1	Existing semi-scheduled solar with scheduled retrofitted battery	AEMO will apply separate constraints to each technology at the DUID. (Noting that currently, from a constraint perspective, DUID and connection point constraint application results in similar outcomes)	If solar SDC = 1, unit must cap at its dispatch target. If it is not binding, solar receives UIGF as dispatch target and SDC = 0. Batteries bid and receive a dispatch instruction.	Generating system operator has flexibility to change DUID-level dispatch to meet aggregated dispatch target when both DUIDs are marginally dispatched or assuming constraints are applied to the system, not separately to DUIDs. Aggregate conformance is with a dispatch target. Aggregate conformance wouldn't apply if the battery has been enabled for FCAS. This might require a second flag, similar to the SDC flag. Currently causer pays can be applied to a portfolio of units, allowing the impact on frequency to be netted off. Aggregated conformance would have the same impact – so no change to Causer Pays required.	If SDC is active due to system strength or network constraints, the solar unit cannot generate to offset load of the battery. If AEMO needs to constrain the solar farm to zero output for system strength reasons, the battery can still be dispatched provided it has been registered separately and has a distinct DUID.	The aggregated conformance approach would hinder (but not preclude) the participant from providing FCAS, because a) solar headroom is not interchangeable with battery headroom, and b) forecast errors would need to be incorporated in the battery FCAS trapezium.

#	Use case	Constraints and application to DUIDs	Dispatch of units, and operational forecasting	Aggregated conformance cap/target	Real-time operations – e.g. what to do with issues with plant	Implications for FCAS
2	Existing semi-scheduled wind farm with scheduled retrofitted battery	As for #1.	As for #1	As for #1.	As for #1	As for #1
3	Solar, wind and battery	As for #1. Wind and solar can use the same constraint when aggregated conformance applies, e.g., W + S < X	As for #1, but if solar and/or wind are new farms, AEMO would require technology-specific SCADA feeds to train and operate forecasting models. This will be fine if they are separate DUIDs with separate SCADA feeds.	As for #1, but can use wind and/or storage to substitute for solar, and vice versa. For hybrids with three or more DUIDs, aggregate conformance will apply to all DUIDs which are not on individual conformance. E.g., one DUID might be on individual conformance, and the other two remain on aggregated conformance.	As for #1	As for #1
4	Synchronous unit with retrofitted battery	Similar to #1.	Both synchronous unit and battery will bid and receive separate dispatch instruction.	Could use aggregated conformance target if the system is a genuine hybrid (except for intervals where AEMO requires unit-level conformance, as in the rows above). But if all units are scheduled, then existing aggregation rules apply.	AEMO may need to separately manage constraints and dispatch of batteries/synchronous plant for essential system services (i.e. inertia and system strength).	If participant opts to use the aggregated conformance, the most conservative trapezium would apply.
5	Synchronous unit and wind/solar and battery	As for #1.	Wind/solar will receive dispatch target as per #1. The synchronous unit and the battery will separately bid and receive (separate) dispatch targets.	As for #1, and a DUID is subject to aggregate conformance with all other DUIDs in the hybrid that are not on individual conformance.	For managing VRE and system strength it is the same as for #1.	As for #1 and #4
6	Scheduled load, solar and battery	As for #1, but with constraints on load as well.	Solar receives dispatch target as per #1. Batteries bid and receive a dispatch instruction. The load would bid and be dispatched separately to the other devices.	As for #1, but this may require the load to be included. May not be possible if the load is a WDRU as conformance is done for this after-the-event against a baseline.	Similar to #1, with the addition of constraining solar and battery to zero to access load – which may be useful at times.	As for #1

#	Use case	Constraints and application to DUIDs	Dispatch of units, and operational forecasting	Aggregated conformance cap/target	Real-time operations – e.g. what to do with issues with plant	Implications for FCAS
			Load is thought able to participate as a WDRU, but would have to be at the same connection point.			
7	Uncontrollable load, solar and battery	As for #1, but with load modelled on RHS of constraint, I.e. region load.	As for #1, but load as non-scheduled. Load would not bid or receive dispatch instruction.	Generating system operator has flexibility to change DUID-level dispatch to meet aggregated dispatch target, but this may require the load to be included.	As for #6	As for #1.
	DC-coupled units					
8	Solar with DC-coupled battery	Constraints apply to the production system if it is classified as Scheduled or Semi-Scheduled. Constraints applied to DUIDs behind the inverter if they are classified separately.	Participants can choose how to classify units 1) Participate as a Scheduled IRU. Can use 20 bid bands and receive a single dispatch instruction. Single DUID. No UIGF. 2) Participate as a semi-scheduled generating unit. Receives UIGF as dispatch instruction. Cannot charge battery from grid. AEMO would require technology-specific SCADA feeds to train and operate forecasting models. Single DUID. 3) Plant classified separately. Battery is a Scheduled IRU, can bid (20 bands) and receives a dispatch instruction. Solar is a semi-scheduled unit, and receives UIGF-based dispatch instruction. Multiple DUIDs.	If units are classified separately (3), then the generating system operator has flexibility to change DUID-level dispatch to meet aggregated dispatch target. If only one classification is used (1&2), this is irrelevant.	Real time management of plant will depend on classification choice. i.e. what procedures are relevant to that classification. If the system is constrained to zero for system strength, the solar and battery may generate & charge if the inverter does not exceed any constraints.	As for #1

#	Use case	Constraints and application to DUIDs	Dispatch of units, and operational forecasting	Aggregated conformance cap/target	Real-time operations – e.g. what to do with issues with plant	Implications for FCAS
9	Wind with DC-coupled battery	As for #8	As for #8	As for #8	As for #8	As for #8
10	Solar, wind and DC-coupled battery	As for #8	As for #8	As for #8	As for #8	As for #8