Energy Storage ISO Rule Amendments Stakeholder Session 1

September 13, 2022

Purpose of ES Rule Amendments

The AESO is consulting with Stakeholders on the development of the proposed Energy Storage ISO Rule Amendments that will:

- facilitate the integration of energy storage;
- improve the clarity required for market qualification and participation; and
- enable efficient, effective connection, monitoring, and control of energy storage when connected.

Initial Stakeholder Feedback

- In June 2022, Stakeholders provided an initial round of written comments on a first draft of the Energy Storage ISO Rule Amendments.
- The AESO's July 22, 2022 letter identified high-level themes emerging from the initial comments.
- AESO provided written responses to address comments and questions, where effective.
- Comments related to: (i) aggregated facilities; and (ii) certain discrete technical topics that require further discussion to ensure a common understanding of the Energy Storage ISO Rule Amendments.

Session 1 Focus

- Transition from “aggregated generating facility” → “aggregated facility” to use a single term to apply to aggregations of generating units, energy storage resources, or combo (aka “Option 1”)
  - What is an aggregated facility
  - Application of the current 9MW size limit going forward & use of waiver & variance process
  - Allowable dispatch variance
- Technical Topics
  - Application of power measurement definitions
    - Maximum authorized real power
    - Maximum authorized discharging power
    - Maximum authorized charging power

Session 1 Objectives

1. Ensure Stakeholders have a common understanding of:
   a) the “facility” definitions used in the ISO rules;
   b) what ISO rules apply to different energy storage configurations;
   c) what configurations meet the definition of aggregated facility;
   d) the go-forward application of the 9MW size threshold for resources within an aggregated facility;
   e) where and how power is measured for different energy storage configurations.

Session 1 Objectives

2. Seek feedback from Stakeholder on:
   a) the go-forward application of the 9 MW size threshold; and
   b) options to improve definition of allowable dispatch variance.
3. Address any other conceptual or rule-drafting questions from Stakeholders on aggregated facilities, power measurement, or allowable dispatch variance.

Session 1 Agenda

Topic	Facilitator
Welcome / Introduction / Housekeeping	Jackie Gow
Aggregated Facility • Evolution of ISO Rule Facility Definitions • Recap of Transition from “AGF” to “AF” • What is an Aggregated Facility? • 9 MW Resource Limit • *Questions/Group Discussion*	Steve Waller Jackie Gow Brad Coleman
Break	
Power Measurement Terms • Gross real power • Maximum authorized discharging/charging power • *Questions/Group Discussion*	Brad Coleman
Allowable Dispatch Variance • Clarification of “variable energy resource” • *Questions/Group Discussion* • Implementation example • *Questions/Group Discussion*	Steve Waller
Next steps	Jackie Gow

AESO Introductions

- Brad Coleman, Senior Engineering Analyst, Generation & Transmission
- Steve Waller, Senior Market Advisor, Market Implementation
- Jackie Gow, Legal Manager, ISO Rules and Alberta Reliability Standards, Legal and Regulatory Affairs
- Melissa Mitchell-Moisson, Regulatory Analyst, Legal and Regulatory Affairs

Session 1 Attendees (Sept. 12, 2022)

- Alberta Innovates
- AltaLink
- ATCO
- ATCO Electric
- Best Consulting Solutions Inc.
- BHE Canada
- BluEarth Renewables
- Capital Power
- Capstone
- City of Medicine Hat
- Customized Energy Solutions
- DePal Consulting Limited
- DIode Ventures
- EDF Renewables
- Enel North America
- Enerfin
- Energy Storage Canada
- Enfinite
- ENMAX
- ENMAX Corporation
- ENMAX Energy Corporation
- ENMAX Power Corp
- EPCOR
- EPCOR Utilities, Inc.
- Evolugen
- FortisAlberta
- Greengate Power
- Heartland Generation Ltd.
- Imperial oil
- IPCAA
- J J Power & Energy Inc.
- Lionstooth Energy
- Madstone Energy
- Market Surveillance Administrator
- METSCO Energy Solutions
- Neoen Renewables Canada Inc.
- NRG Curtailment Solutions
- Power Advisory LLC
- Solas Energy Consulting
- Suncor Energy Inc.
- TC Energy
- TransAlta
- TransAlta Corporation
- URICA Asset Optimization
- Utilities Consumer Advocate
- Voltus Energy Canada, Ltd.
- Westbridge Energy Corp
- Wolf Midstream Inc.
- Zenith Power Corp.

Session Recording

In accordance with its mandate to operate in the public interest, the AESO will be audio recording this session and making the session recording available to the general public at www.aeso.ca. The accessibility of these discussions is important to ensure the openness and transparency of this AESO process, and to facilitate the participation of stakeholders. Participation in this session is completely voluntary and subject to the terms of this notice.

The collection of personal information by the AESO for this session will be used for the purpose of capturing stakeholder input. This information is collected in accordance with Section 33(c) of the Freedom of Information and Protection of Privacy Act. If you have any questions or concerns regarding how your information will be handled, please contact the Director, Information and Governance Services at 2500, 330 – 5th Avenue S.W., Calgary, Alberta, T2P 0L4, by telephone at 403-539-2528, or by email at privacy@aeso.ca.

Meeting Minutes

- Meeting minutes will be prepared by AESO employees with the help of a minute-taking software program.
- Organization names will be used to identify contributions.
- Draft meeting minutes will be circulated to attendees for review and ultimately posted to the AESO website.

Asking questions over MS Teams

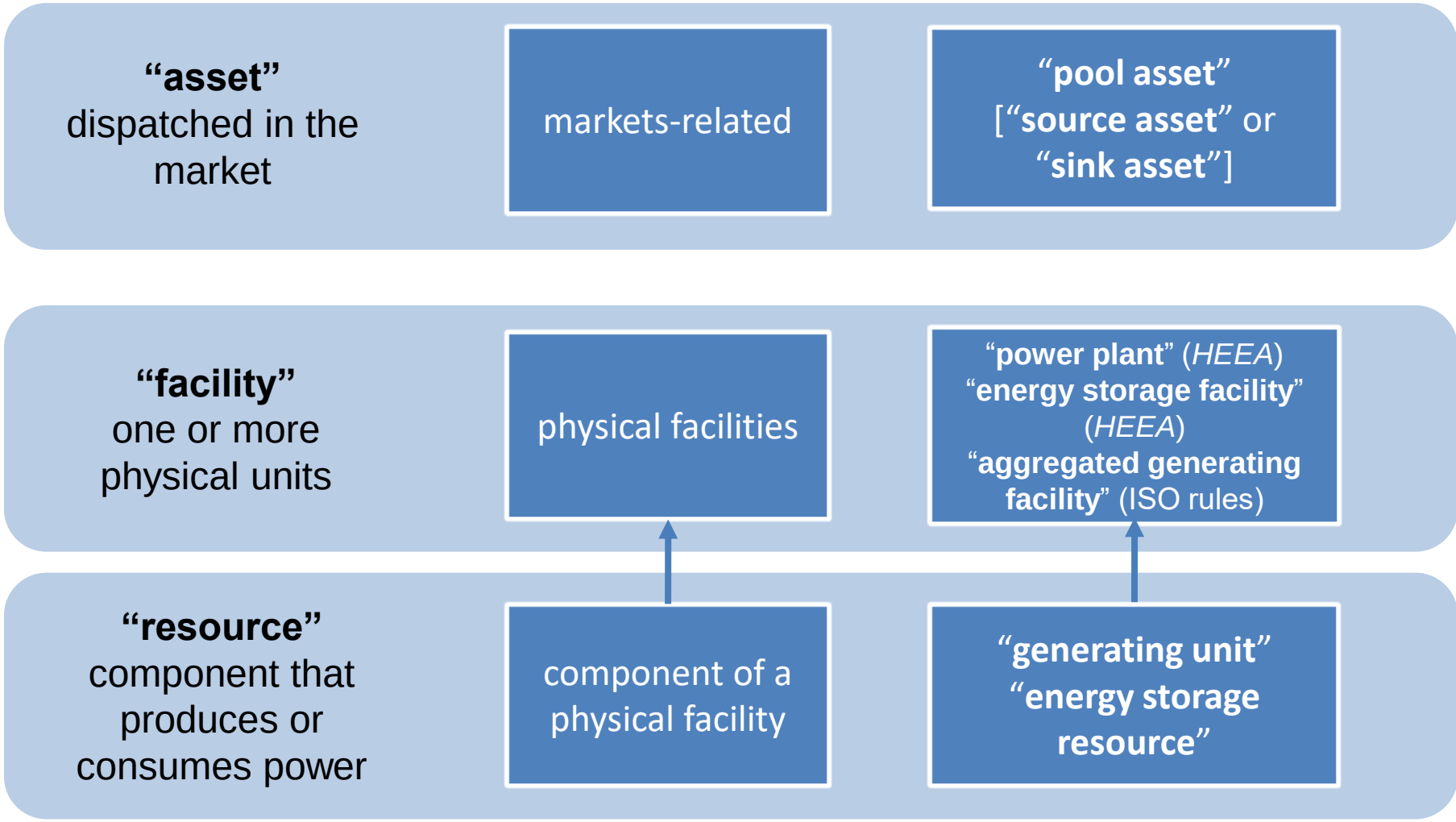
- Please introduce yourself, including the organization you work for, before asking your question
- If you are accessing the session via your computer or smartphone
    1. Click “Raise Hand” and the host will be notified that you would like to ask a question.
    2. You can also ask questions by clicking the “Q&A” button and typing them in. Please include the organization you work for when typing your question into the Q&A.
        - *You can up-vote questions that have been already asked.*
    3. Attendees are invited to turn on their cameras for this session, and are encouraged to do so when asking questions and participating in discussion.

AESO Stakeholder Engagement Framework

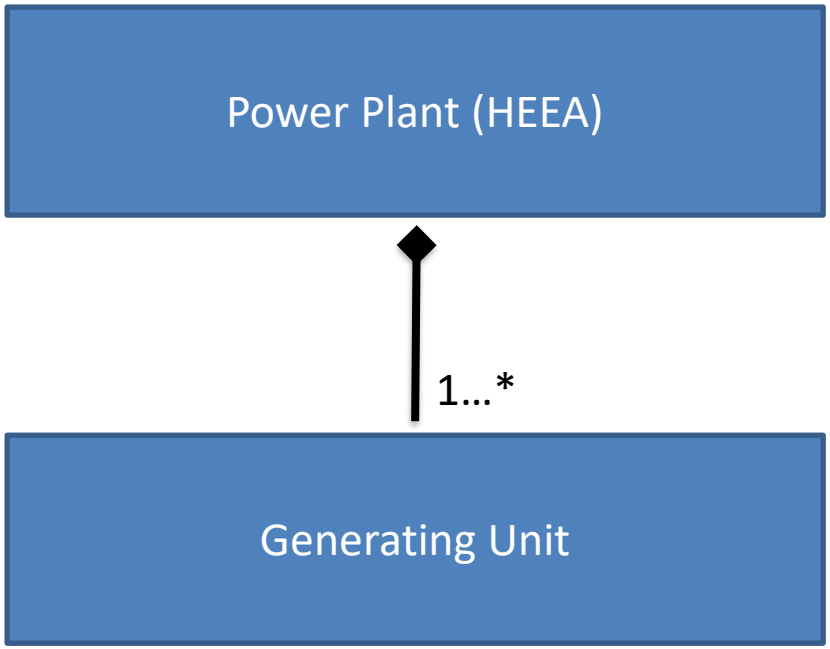
Questions or Comments?

Aggregated Facility
Evolution of ISO Rule Terms

Asset / Facility Terminology – Background

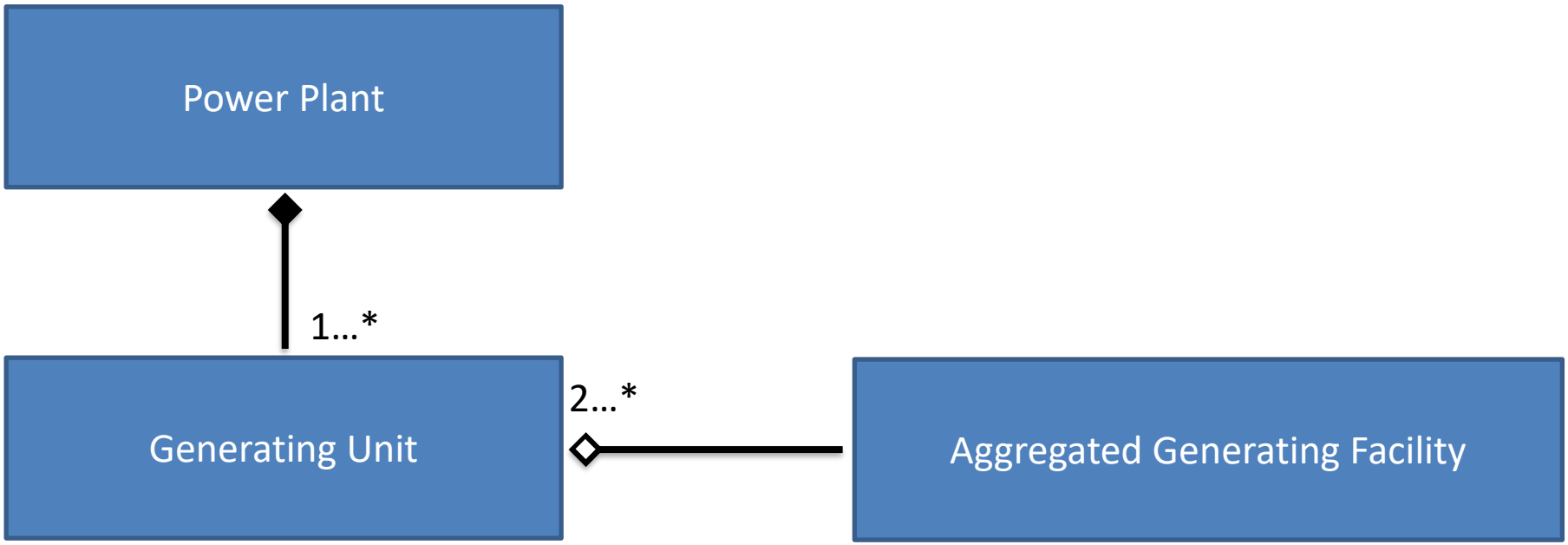


In the beginning…



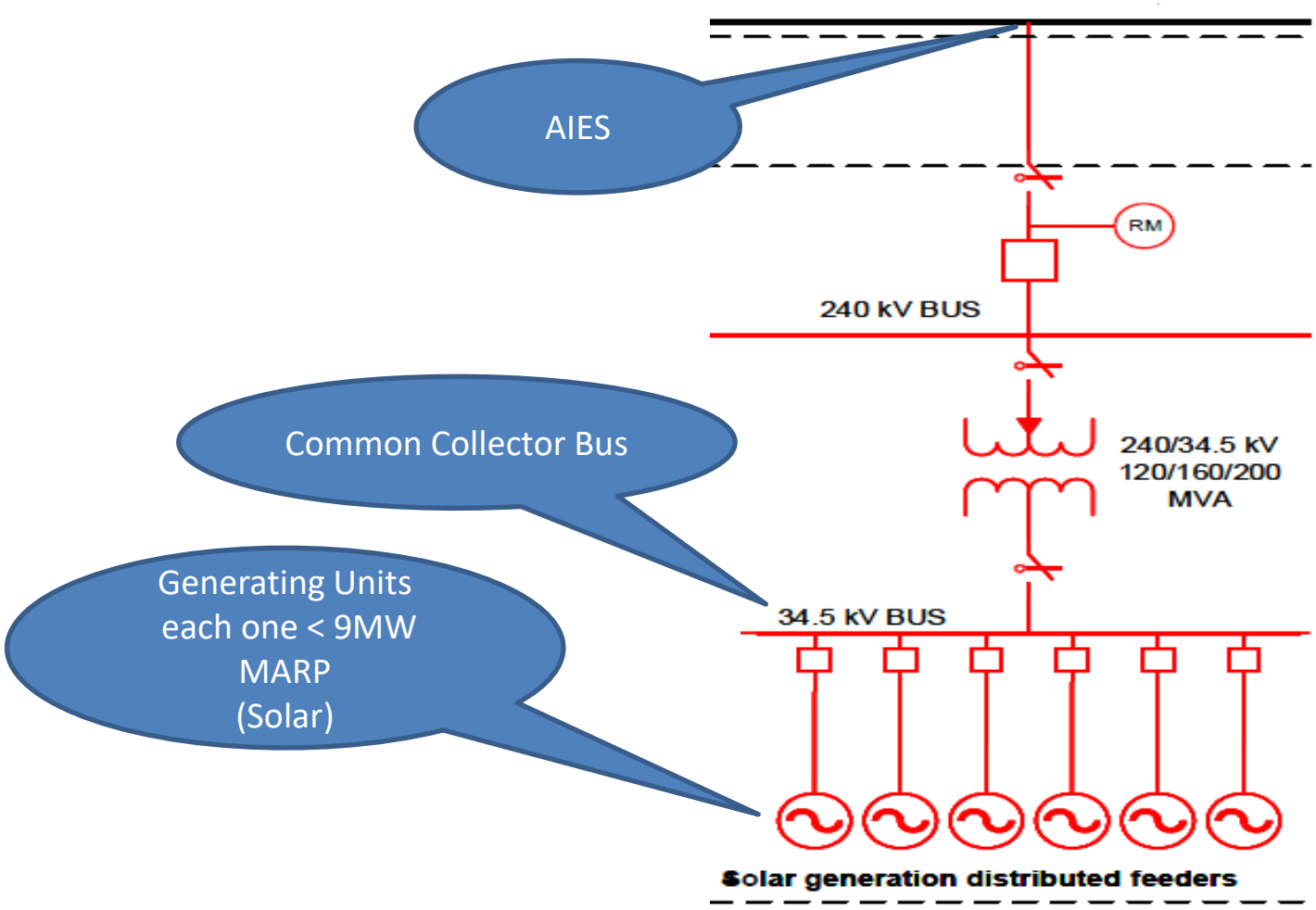
- Power plant is composed of 1 or more generating units

Along came wind and solar…



- Power Plant is composed of 1 or more Generating Units
- AGF is an aggregation of 2 or more Generating Units

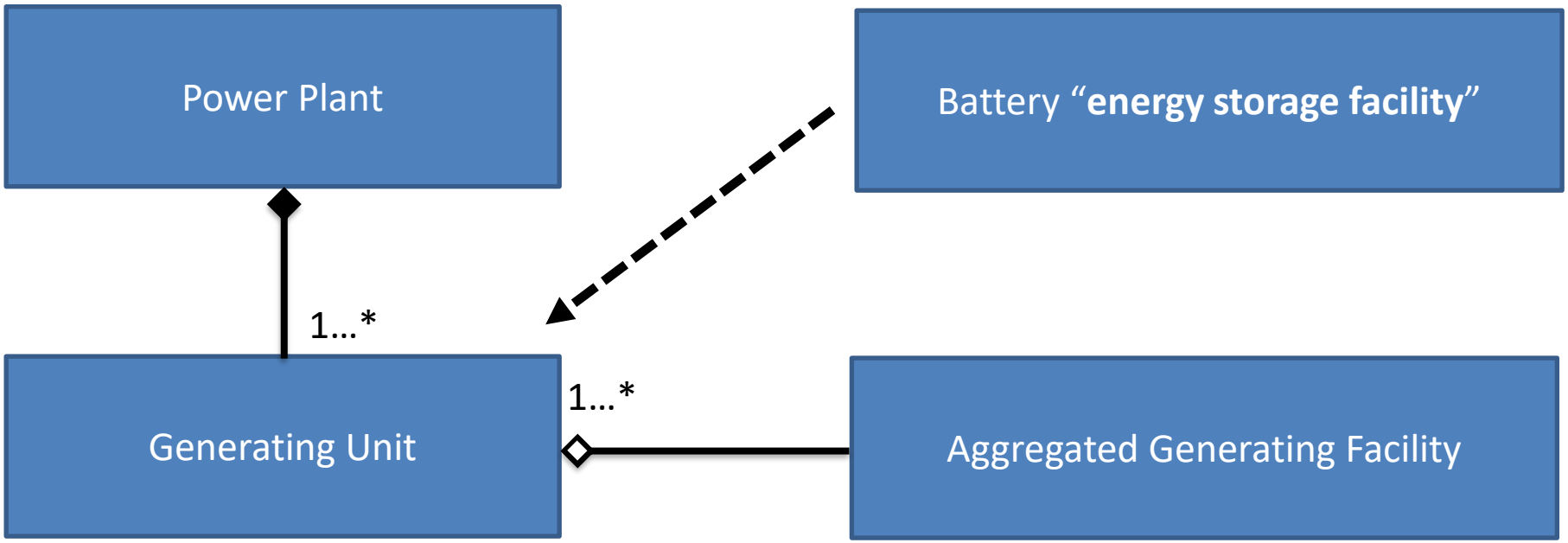
Typical Aggregated Generating Facility (AGF)



Aggregated Generating Facility - 9MW Resource Limit

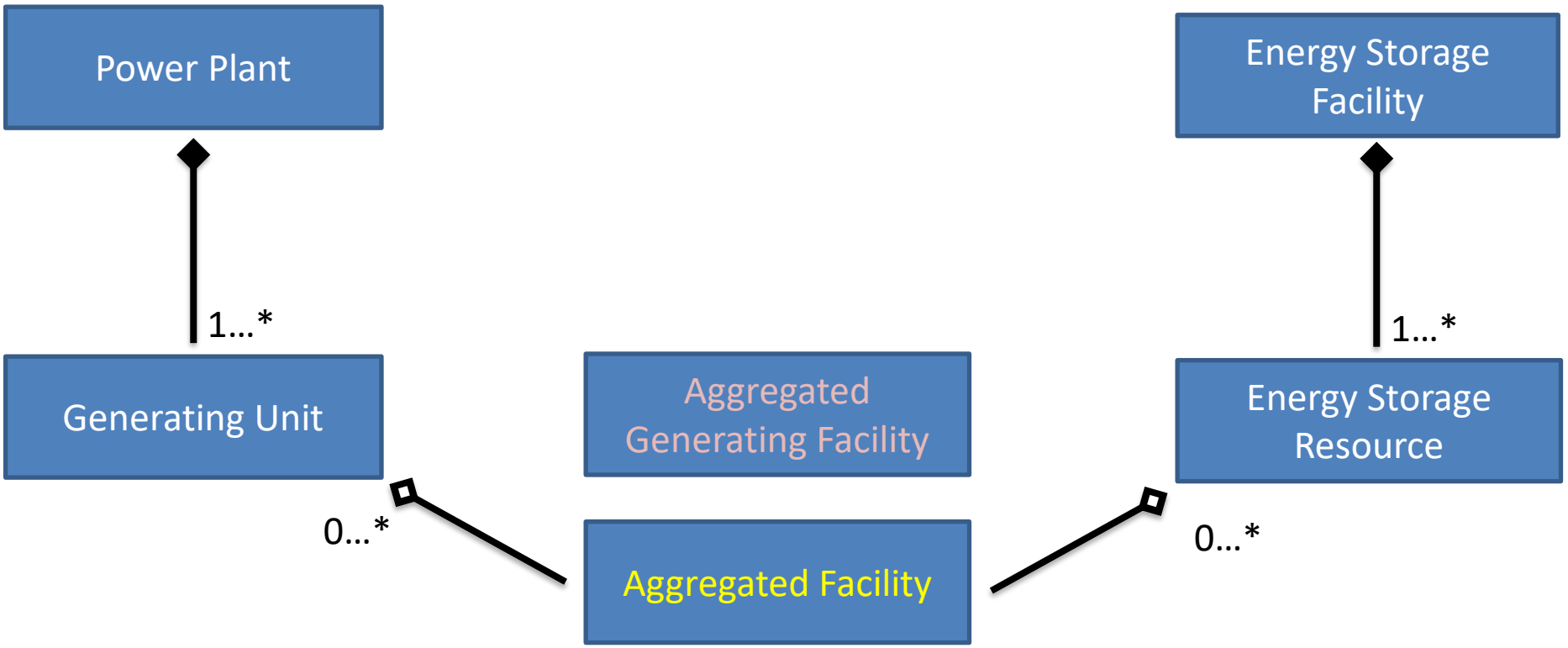
- The 9 MW restriction does not limit the size of the total aggregated facility, but rather the size of each individual element comprising the aggregated facility.
- The reasons for the 9 MW limit are as follows:
  - Individual wind turbines and solar panels (or small-footprint generation) on a common collector bus would not exceed 9 MW (10 MVA).
  - Units under 9 MW (10 MVA) do not require a governor.
  - The aggregated facility rules provide a framework for a collection of small power producing resources in a geographically localized area to optimize common control and power elements to meet technical requirements. If a collection of small generating units need to comply individually with technical requirements, this would be more onerous for market participants rather than complying with aggregated requirements.

Introduction of Batteries…



- Power plant is composed of 1 or more Generating Units
- AGF is an aggregation of 2 or more Generating Units
- ESF is loosely associated with Generating Units

More Than Batteries…



- Power plant is composed of 1 or more Generating Units
- ESF is composed of 1 or more Energy Storage Resources
- AF is an aggregation of zero to many Generating Units and zero to many Energy Storage Resources

Aggregated Facility

Transition from AGF to Aggregated Facility

Definitions for Hybrid Assets – Options Analysis

Option 1: Define "Aggregated Facility"	Option 2: Define "Hybrid Facility"
Pools together "aggregated generating facility" and "hybrid facility" under one term	**Separate and distinct concepts for "aggregated generating facility" and "hybrid facility"**

• Provides flexibility to:
  • introduce future tech-specific rules as needed;
  • easily allow for aggregations of things we don't know about yet;
  • adopt a definition of "hybrid facility" as a subset of "aggregated facility" should it be needed in the future.
• Compliance issue will be clarified through a separate ISO rule.
• Evaluate size threshold issue and update the definition of AF accordingly.
	• Less future proof in that the rules for hybrid facilities that we write today will assume that all configurations of generating units and energy storage resources have the same characteristics and requirements, regardless of the technology within the facility.
	• Anticipated to create more red tape considering permutations of variable & non-variable energy resources and energy storage resources.
	• Solves the Compliance issue (requirements will apply to facility level, not resource level)
	• The size threshold issue still needs to be evaluated to permit aggregations of larger generating units of different fuels.

Stakeholder Feedback

- Support for adopting a single, flexible definition that recognizes aggregations of different technologies.
- Requests for further information on the go-forward application of 9 MW limit for resources within an aggregated facility.

Aggregated Facility
ISO Rule Implementation of "Option 1"

- Amended "**aggregated generating facility**" to "**aggregated facility**" to apply to the aggregation of generating units, energy storage resources, or combination thereof:

*"**aggregated ~~generating~~ facility**" means, unless the **ISO** otherwise designates, an aggregation of 2 or more **generating units** or **energy storage resources**, or any combination of the two of them, including any associated **reactive power** resources , where:*

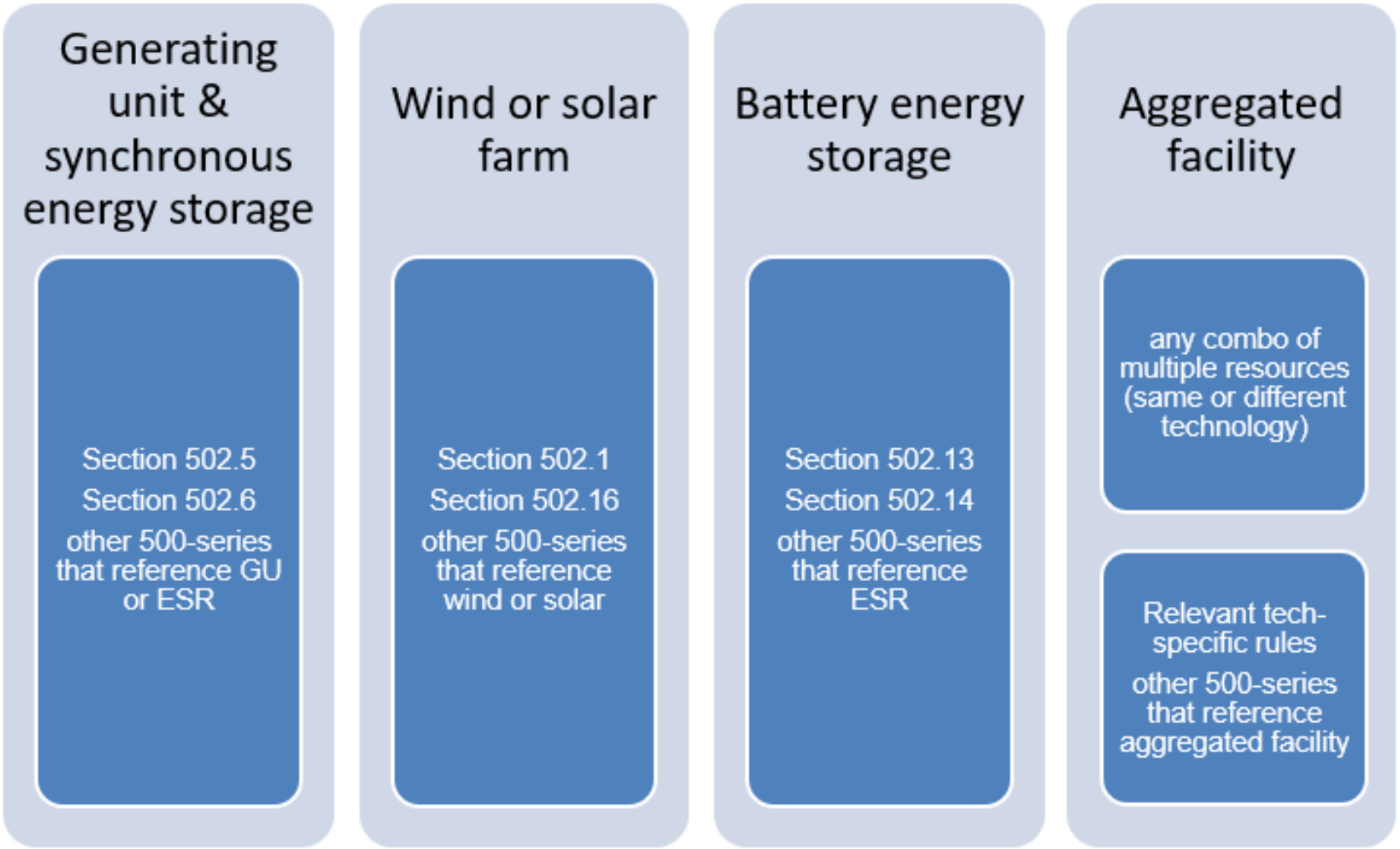
*(i) each **generating unit** or **energy storage resource** is rated less than 9 MW;*

*(ii) all **generating units** and **energy storage resources** are situated in the same proximate location and have a common **collector bus** or multiple **collector buses** that can be operated as common **collector bus**; and*

*(iii) the **aggregated facility** is connected to the **interconnected electric system** or the electrical system in the service area of the City of Medicine Hat.*

Aggregated Facility
ISO Rule Implementation of "Option 1"

- As explained in the ES ISO Rule Amendments Webinar:



Aggregated Facility
ISO Rule Implementation of “Option 1”

- New AF technology-agnostic structure:

Synchronous energy storage & generating units	Aggregated facility	Aggregated facility with energy storage
Section 502.5 Section 502.6 other 500-series that reference GU or ESR	Section 502.1 Section 502.16 other 500-series that reference AF	Section 502.13 Section 502.14 other 500-series that reference AF

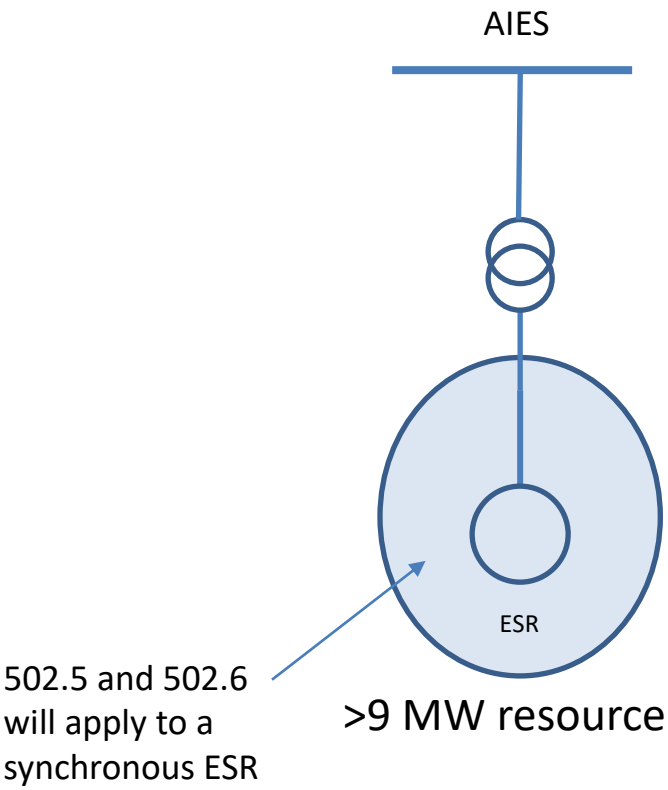
Aggregated Facility

What is an Aggregated Facility?

Synchronous ESR

- Physical Equipment
  - Large pumped storage hydro unit with bi-directional power flow

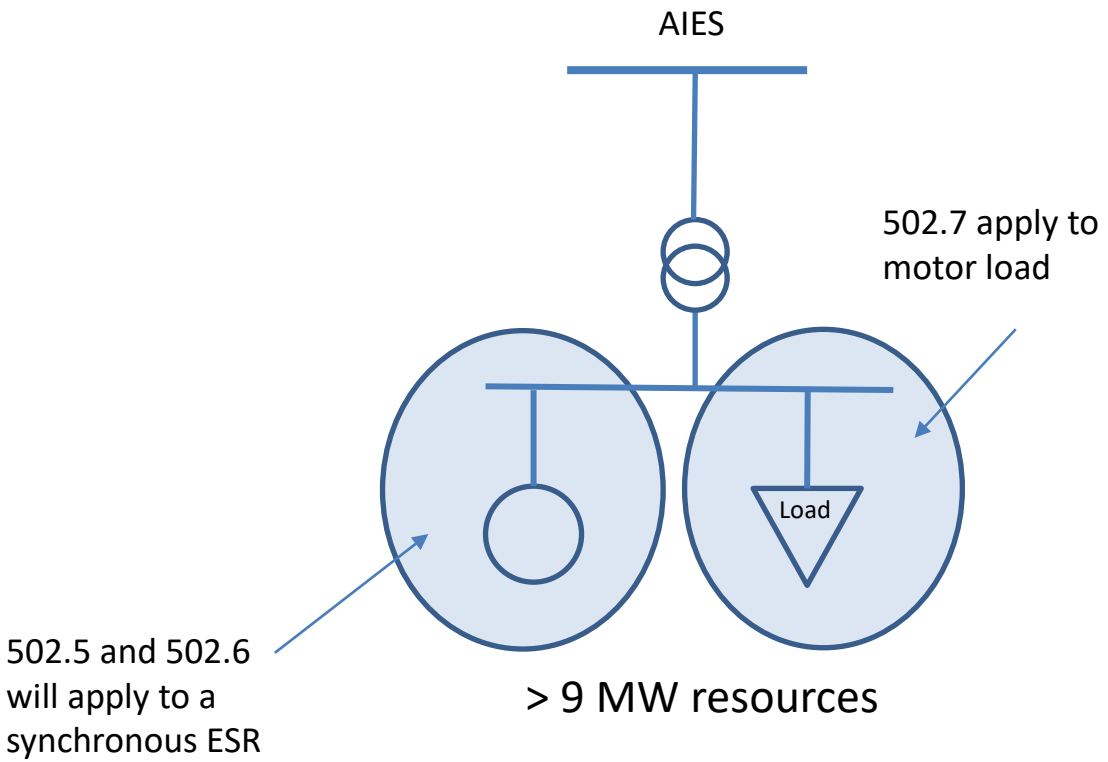
This is **not** an Aggregated Facility



Synchronous ESR

- Physical Equipment
  - ESR using a synchronous generator as power producing element and conventional motors as a ‘charging’ element

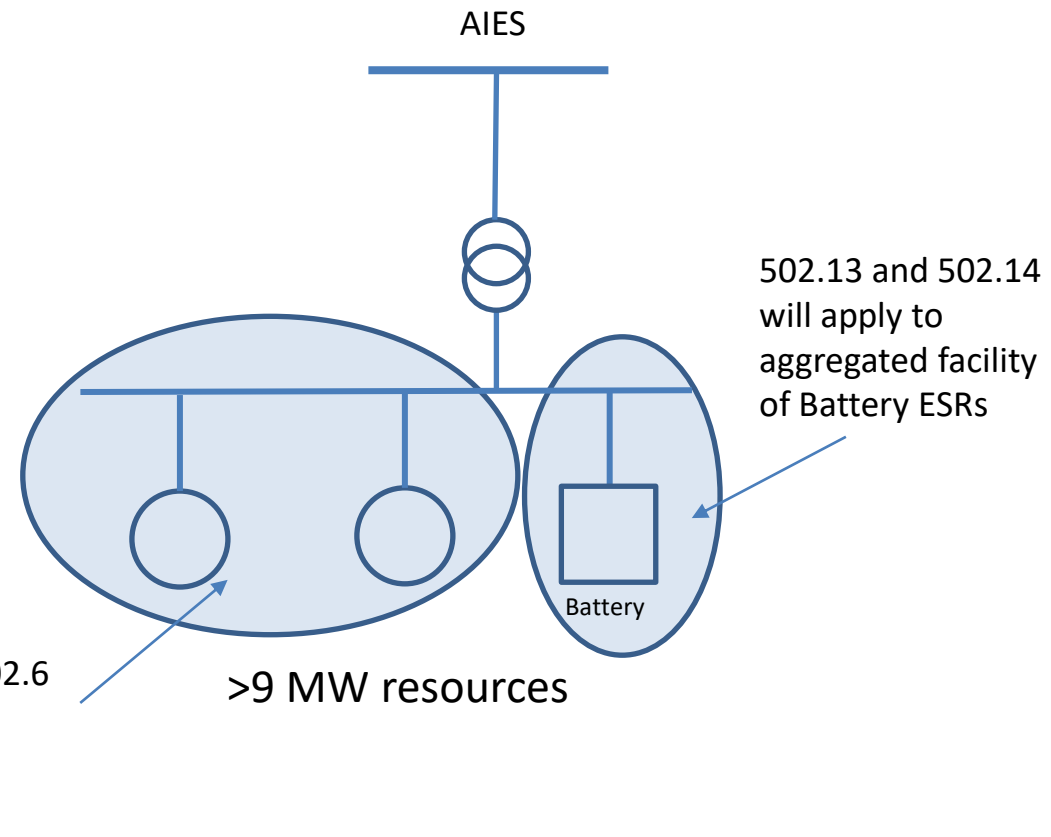
This is **not** an Aggregated Facility



Generating Unit and Battery Energy Storage

- Equipment
  - Single or multiple units larger than 9 MW
  - ESR is battery technology
- Notes
  - If to be controlled as one unit may require waiver and variance and clarification in functional specification.

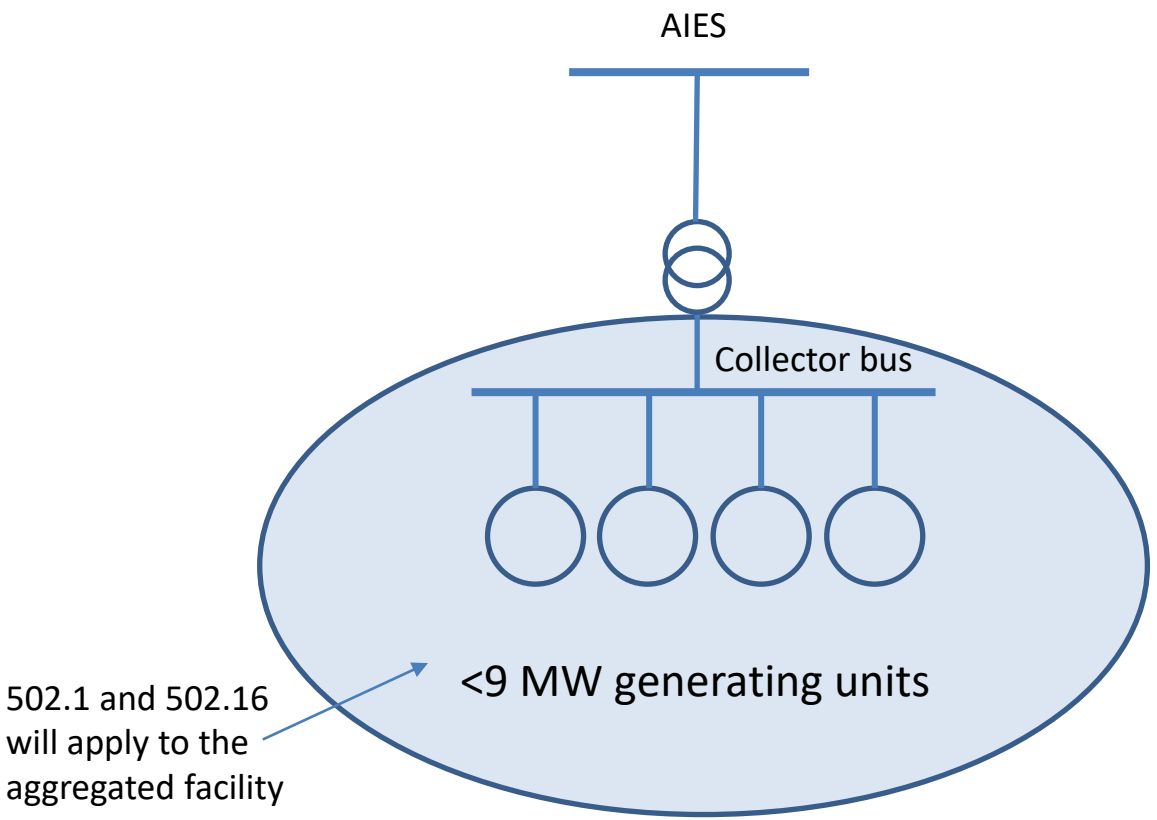
This is **not** an Aggregated Facility



Aggregated Facility – Wind/Solar

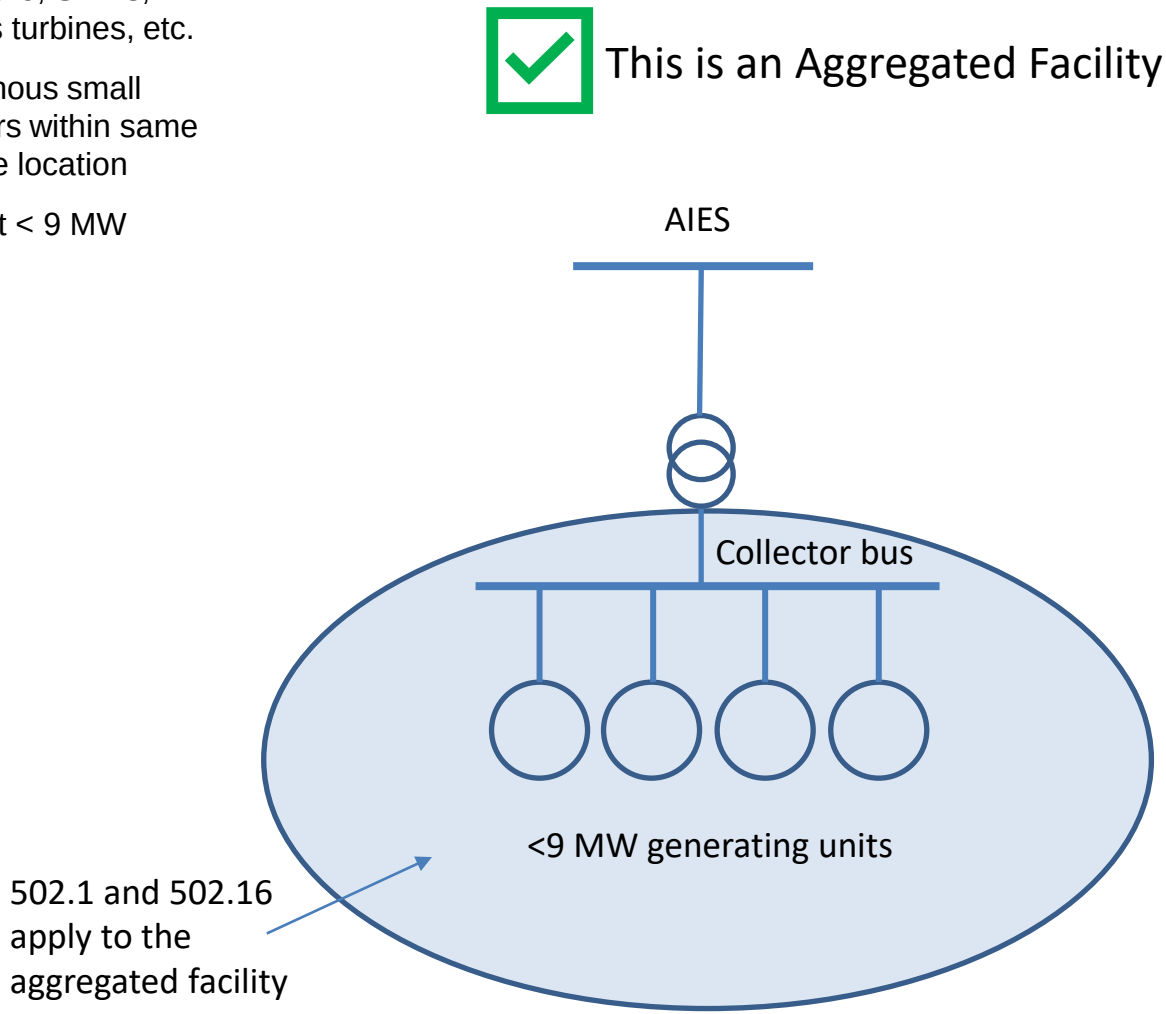
- Equipment
  - Homogenous wind or solar generation, within same proximate location

☑ This is an Aggregated Facility



Aggregated Facility – Other

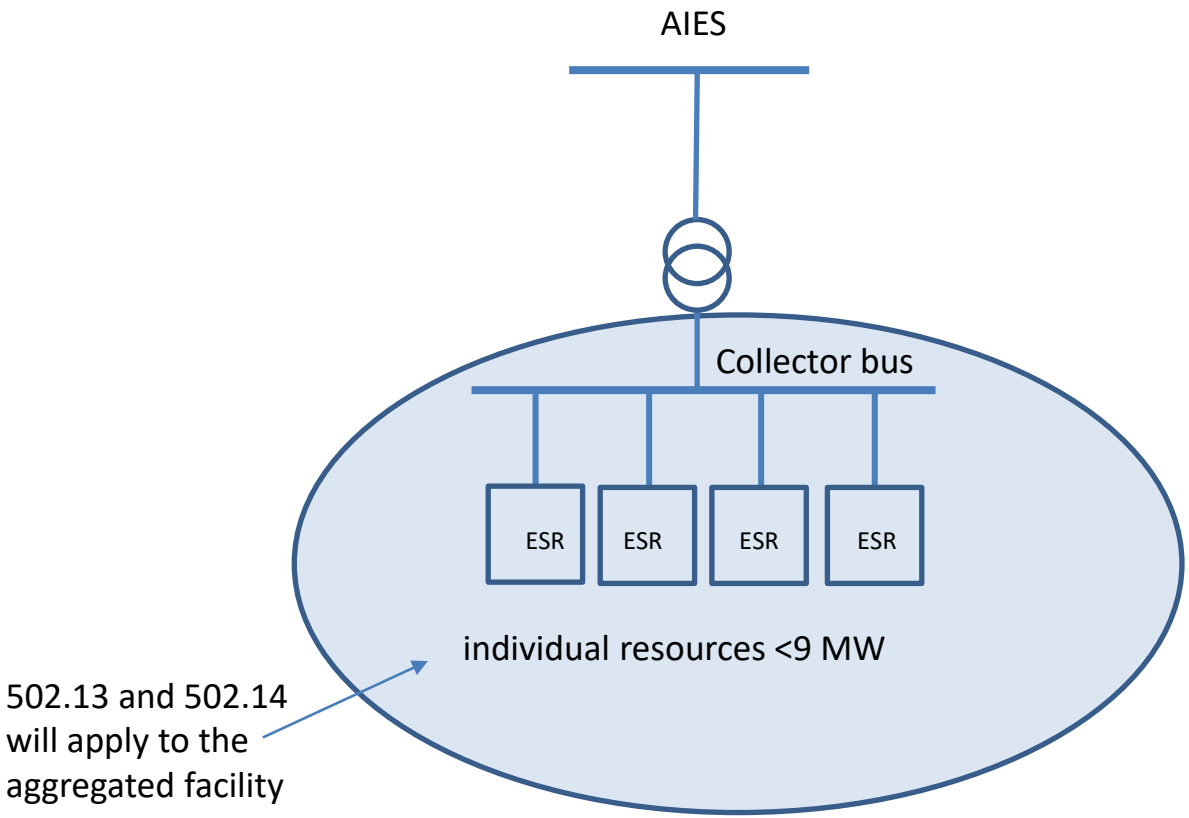
- Equipment
  - Small hydro, SMRs, small gas turbines, etc.
  - Homogenous small generators within same proximate location
  - Each Unit < 9 MW



Energy Storage Aggregated Facility – Battery ESRs

- Equipment
  - Homogenous ESR
  - Battery energy storage
  - Each bank < 9 MW

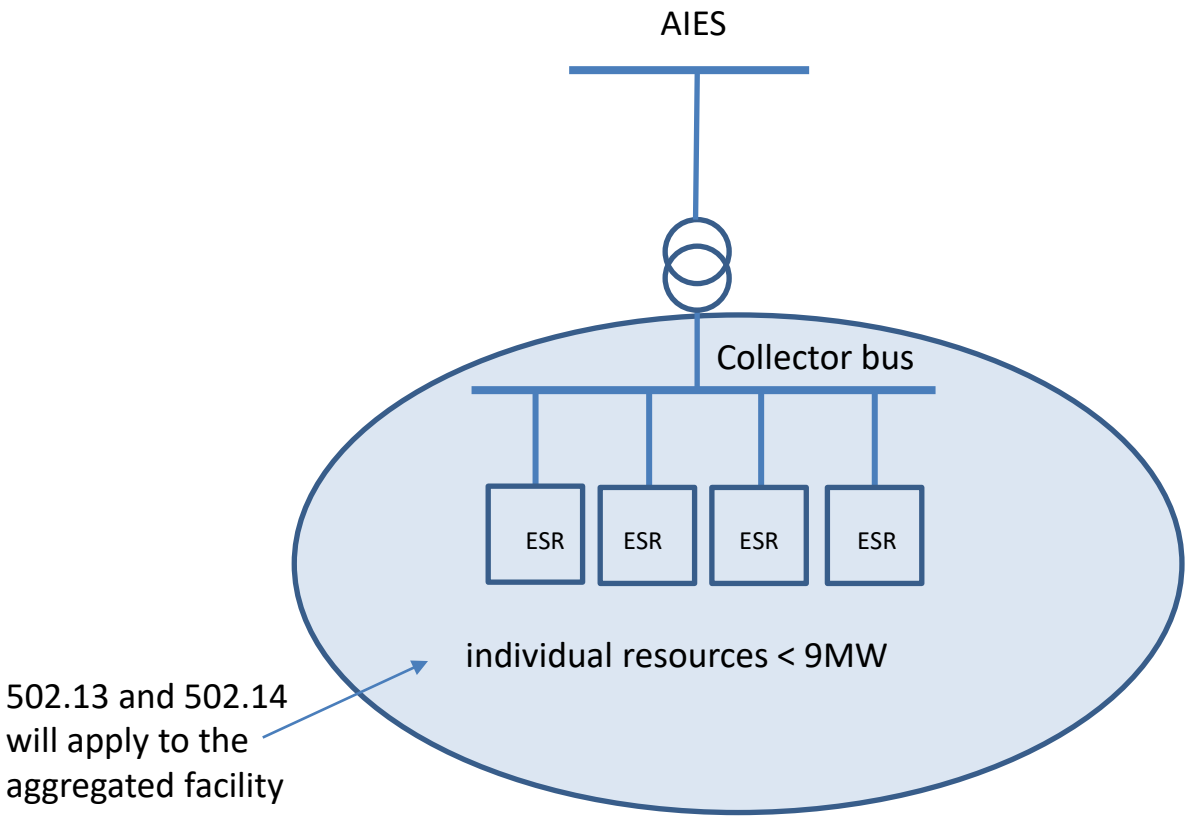
☑ This is an Aggregated Facility



Energy Storage Aggregated Facility – Synchronous ESRs

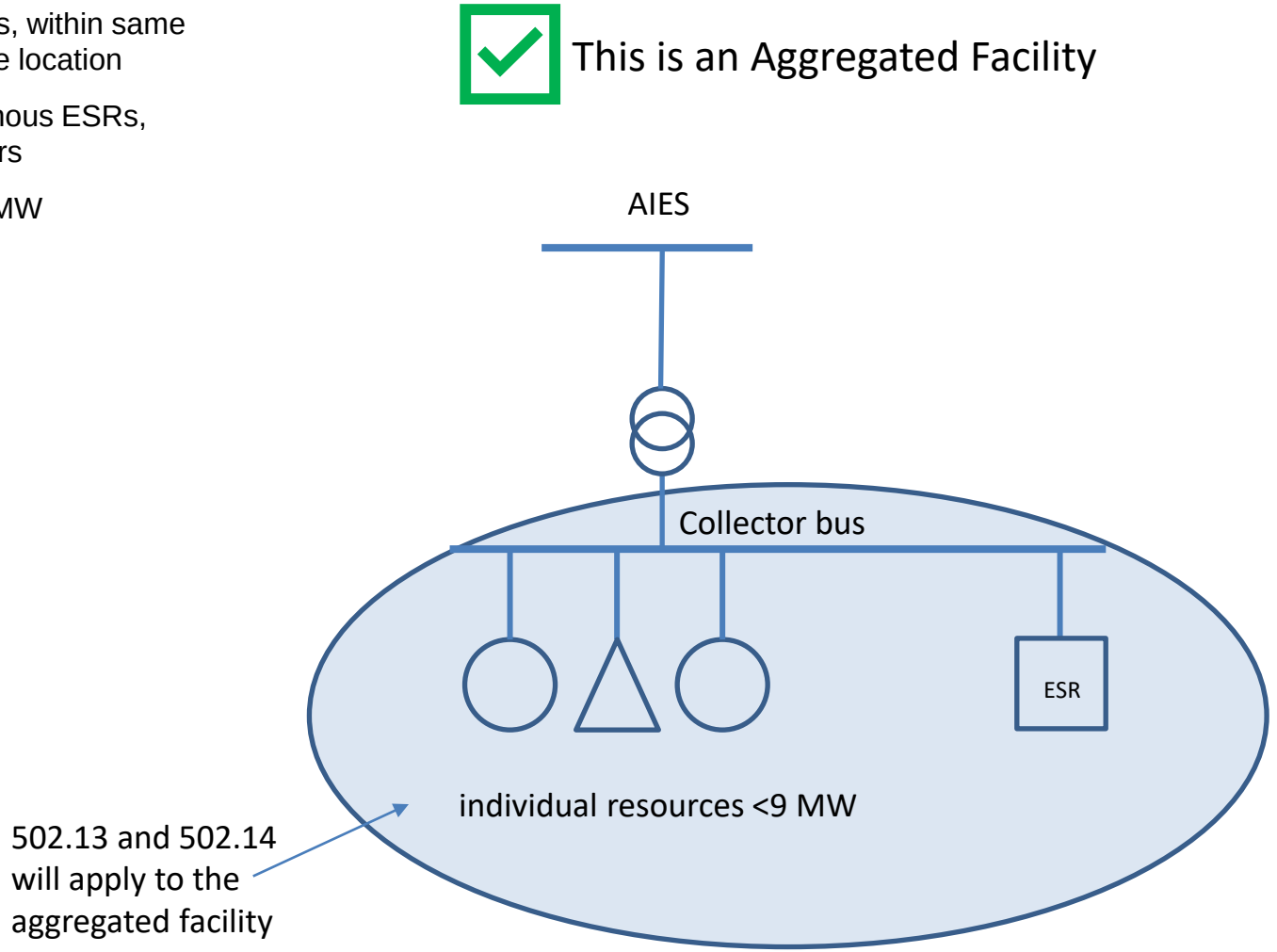
- Equipment
  - Homogenous ESR
  - Flywheel, small pumped hydro, or compressed air
  - Each unit < 9 MW

☑ This is an Aggregated Facility



Aggregated Facility – heterogenous resources

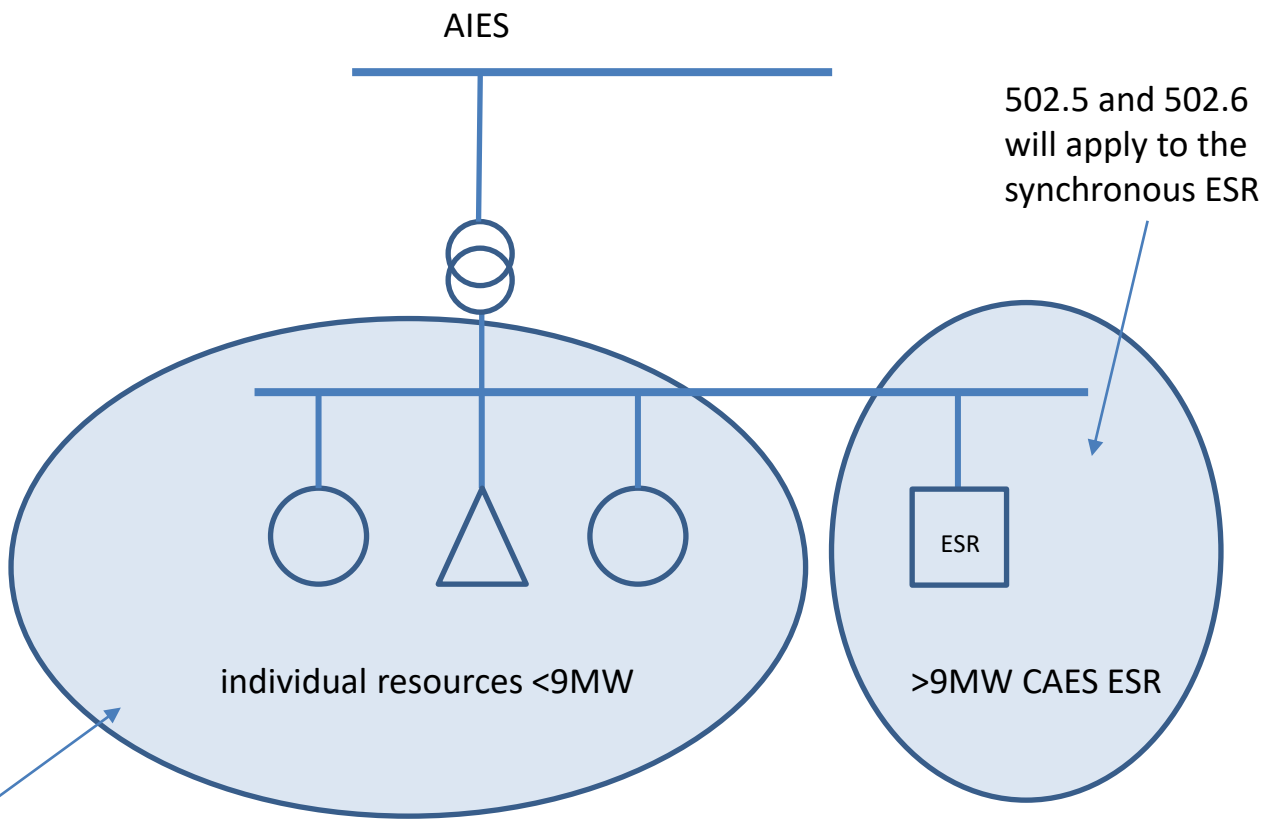
- Equipment
  - Heterogeneous resources, within same proximate location
  - Synchronous ESRs, generators
  - Units <9MW



Aggregated facility Co-located with Large ESR

- Equipment
  - Heterogeneous resources, within same proximate location
  - Large synchronous ESR (i.e. Compressed Air Energy Storage) combined with an aggregated facility
- Notes
  - If to be controlled as one unit may require waiver and variance and clarification in functional specification.

This is **not** an Aggregated Facility



Aggregated Facility
9 MW Resource Limit

Aggregated Facility – 9 MW Resource Limit

- Going-forward, the application is the 9 MW is the same:
  - Does not limit the size of the total aggregated facility, only the size of each individual resource within the aggregated facility.
  - Resources that make up an aggregated facility will likely continue to be less than 9 MW each.
  - Units over 9 MW should continue to have a dedicated governor.
  - Co-located facilities can still operate in the market as a single asset.

Aggregated Facility Discussion

Power Measurement Terminology

Stakeholder Feedback

- “maximum authorized real power”, “maximum authorized charging power”, and “maximum authorized discharging power”
  - Provide clarification of “maximum authorized discharging power” and “maximum authorized charging power” and explain why these definitions are not more agnostic.
  - How is maximum power defined for other non-battery forms of energy storage defined?
  - Provide diagrammatic clarity on power definitions.
- “gross real power”
  - Confusion exists between an “aggregated facility” with and without a collector bus.

Background on MACP/MADP for Batteries

- “maximum authorized charging power” and “maximum authorized discharging power”
  - The existing ISO rules only references these terms in Sections 502.13 and 502.14 for batteries.
  - Battery energy storge technology needs to provides reactive power support in both charging and discharging modes. These attributes (MACP and MADP) define this required support.
  - These terms also define governor system requirements and ramp rate limitations in both power flow directions for battery systems.

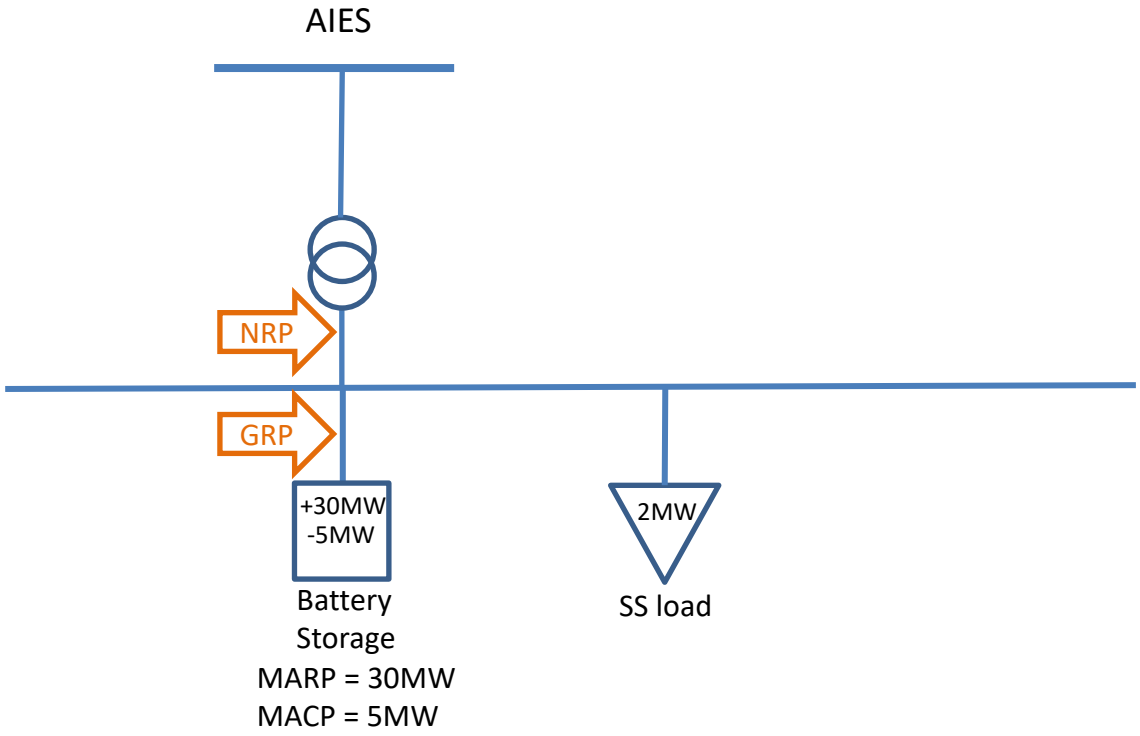
Further ES ISO Rule Amendments

- Terms that define expected frequency and voltage characteristics should be agnostic of technology. The AESO is proposing the following further amendments:
  - Delete “MADP” as a definition to reconcile the current overlap with the MARP definition.
  - Going forward, MARP and MACP will apply to all facilities that include energy storage regardless of technology.
  - This will be reflected in the new rule structure discussed above
- The definition of **“gross real power”** will be further amended to remove the reference to “aggregated facilities without a collector bus”.

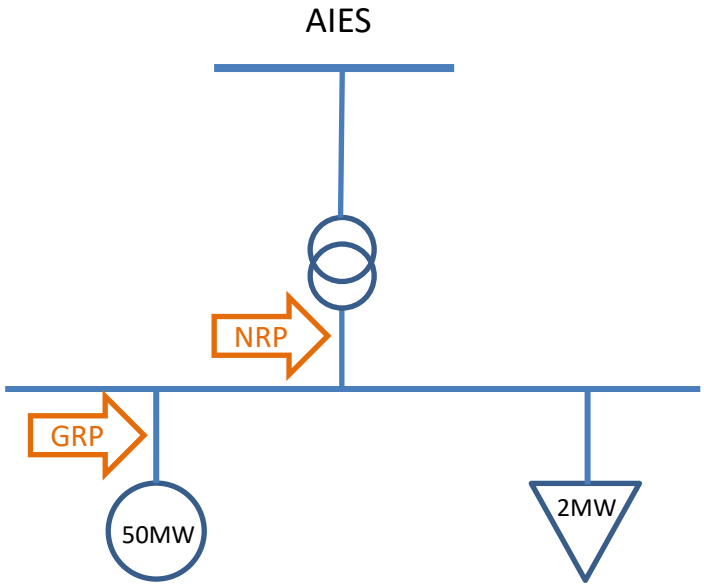
Battery Aggregated Facility

NRP Net Real Power

GRP Gross Real Power

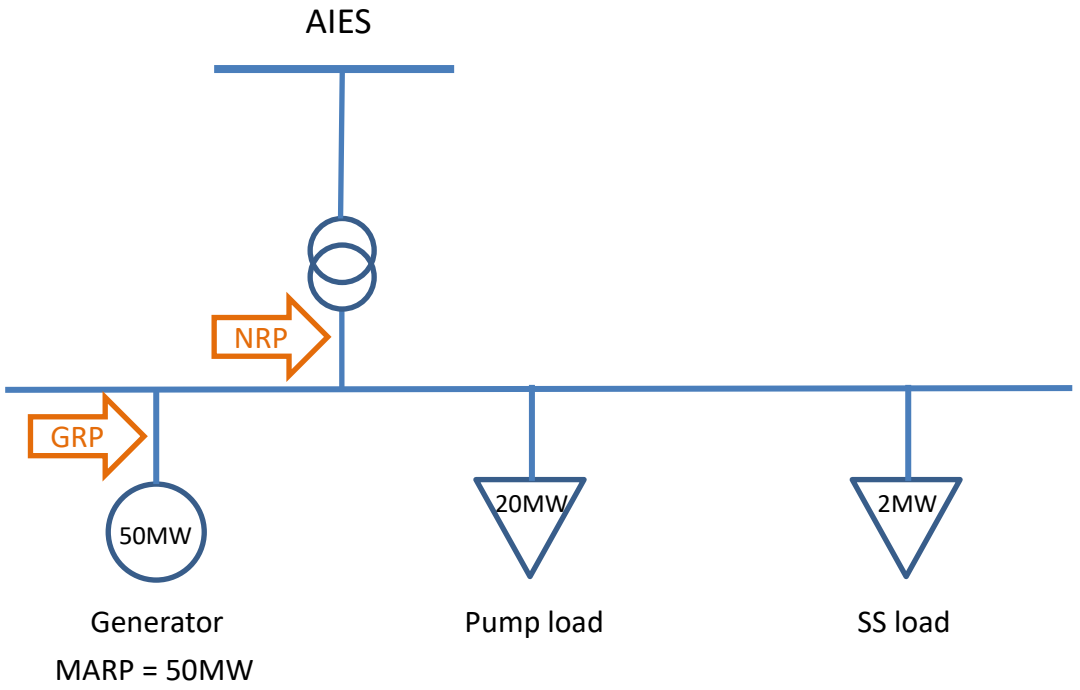


Pumped Hydro

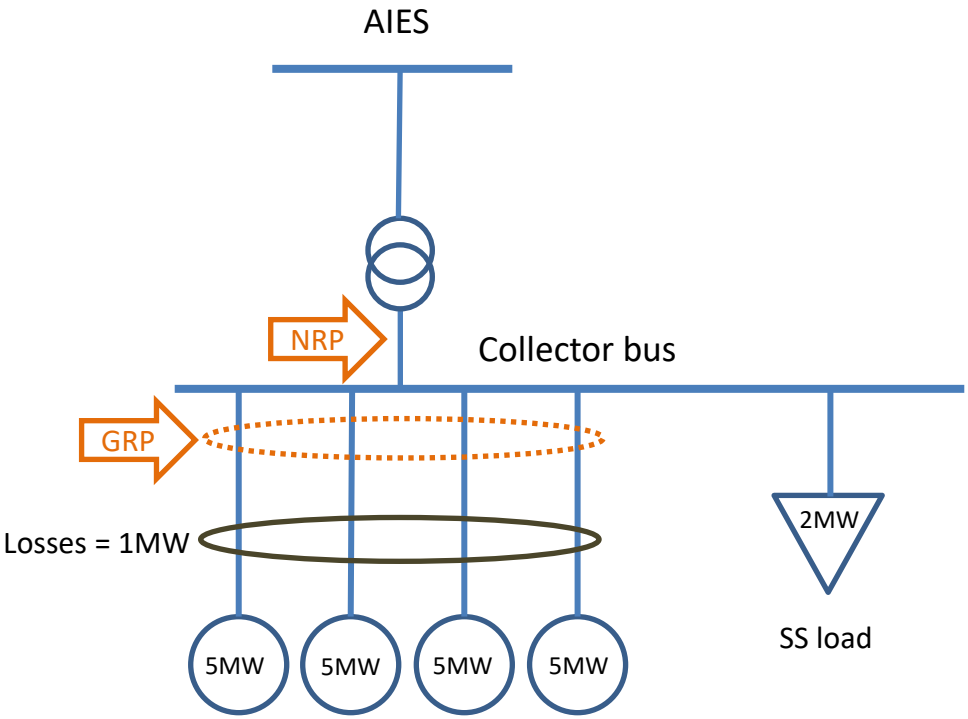


MARP = 50MW
MACP = 50MW

Pumped Hydro or Compressed Air Energy Storage



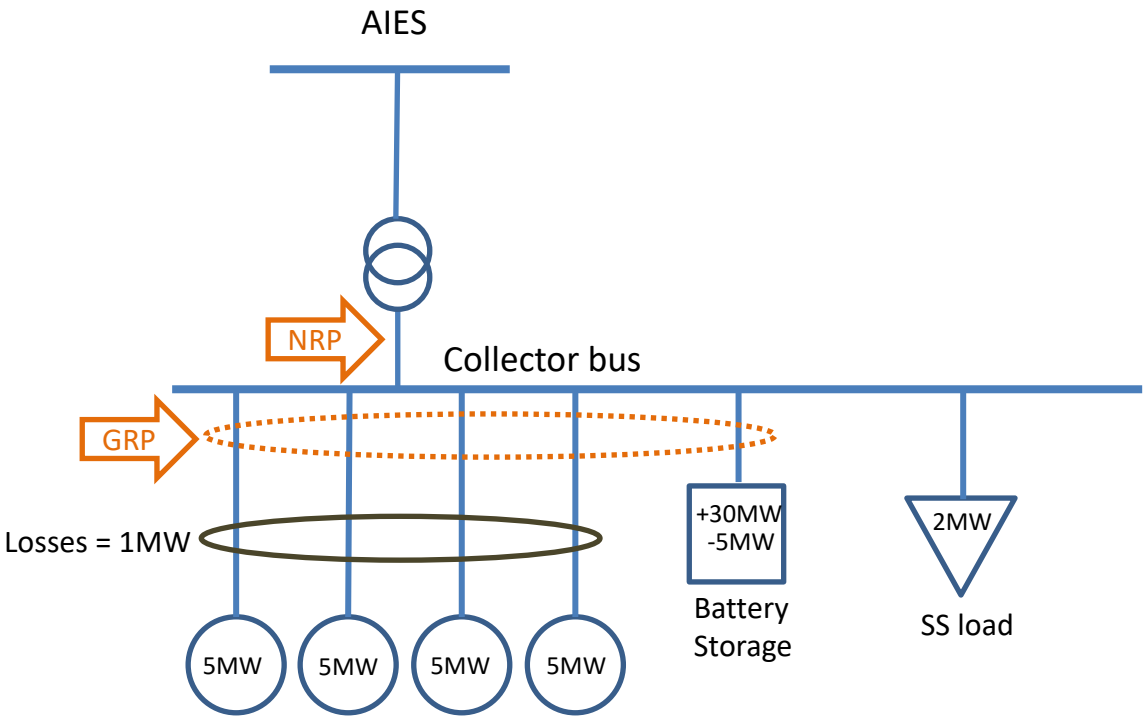
Wind Aggregated Facility



Aggregated Generators

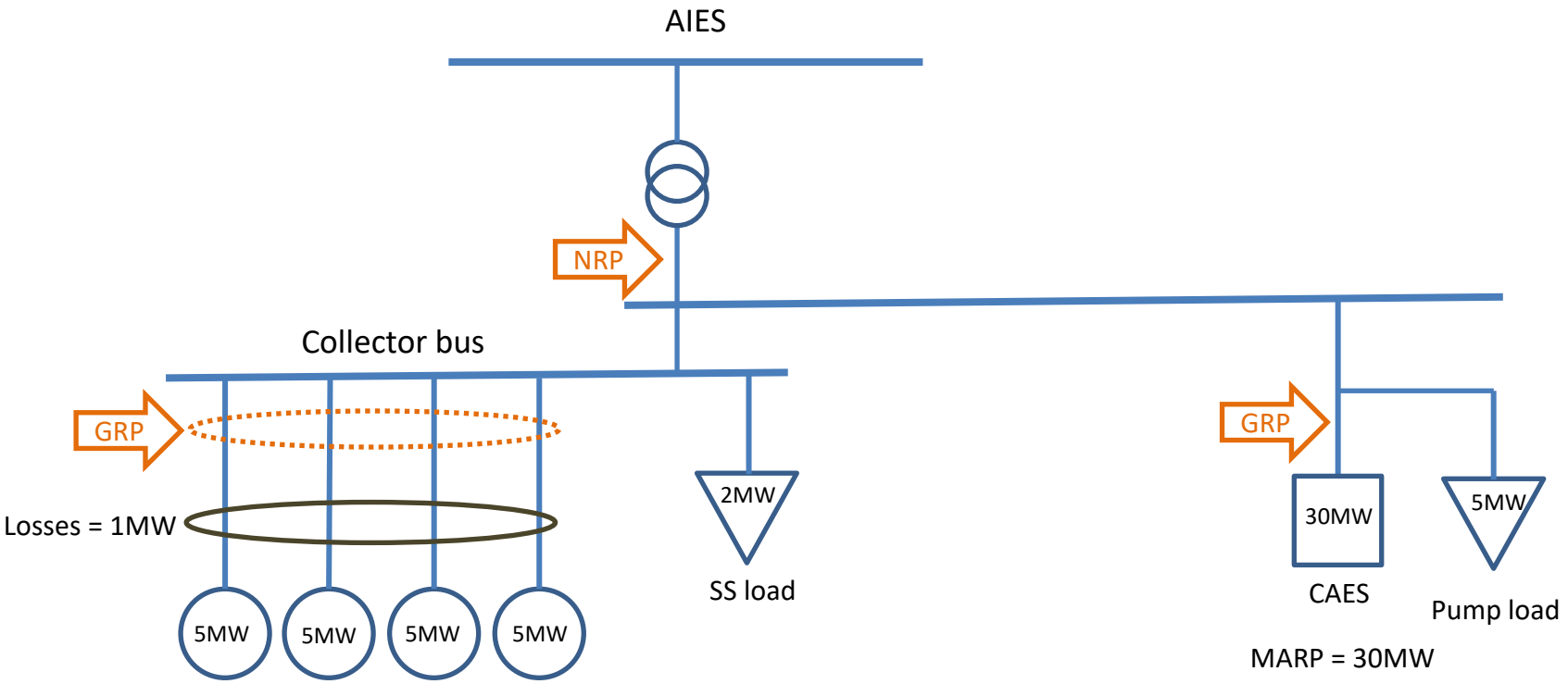
MARP = sum(gen nameplates) – losses = 20-1 = 19MW

Wind & Battery Aggregated Facility



MARP = sum(gen nameplates) + sum(batt nameplates discharging) – losses = 20 + 30 -1 = 49MW
MACP = sum(batt nameplates charging)

Wind Aggregated Facility co-located with Compressed Air Energy Storage



Aggregated Facility
MARP = sum(nameplates) – losses = 20-1 = 19MW

Power Measurement Terms - Discussion

Allowable Dispatch Variance

Stakeholder Feedback

- Clarify:
  - what “variable energy resource” is within the definition; and
  - what the proposed changes to the ADV definition are intended to achieve and impacts on real-time operations.

Proposed Definition of ADV

- Can’t fit on a single slide. ☺
  - Calls out the underlying technologies
- Alternatively, we can remove technology references from the definition and characterize pool assets as controllable and non-controllable to determine ADV:
  1) Controllable assets – Expected output is ± 5 or ±10 MW around the dispatch level, depending on size
  2) Non-controllable assets – Expected output is ± 5 or ±10 MW, where expected output is determined as the lesser of: (a) potential MW; or (b) dispatch level
  3) Combination controllable & non-controllable – A combination of 1) and 2) [see following example]

Examples of Dispatch Control

Dispatchable assets the AESO considers controllable:

- An asset made up of controllable Generating Unit(s) – i.e. thermal, hydro, biomass, nuclear
- An asset made up of only Energy Storage Resources (ESR)
- An asset made up of controllable Generating Unit(s) and ESRs
- An asset made up of price responsive load

will have an ADV of ± 5MW or ± 10 MW if the asset MC > 200 MW around the dispatch level

Dispatchable assets the AESO considers non-controllable:

- An asset made up of only variable energy resources – wind and/or solar, will have a ADV of ± 5 MW or ± 10 MW if the asset MC > 200 MW, based on of the lesser of the dispatch level or the potential MW.

Dispatchable assets the AESO considers partially controllable:

- An asset made up of controllable Generating Unit(s) and/or ESRs, and VERs has ADV based on VER block determination

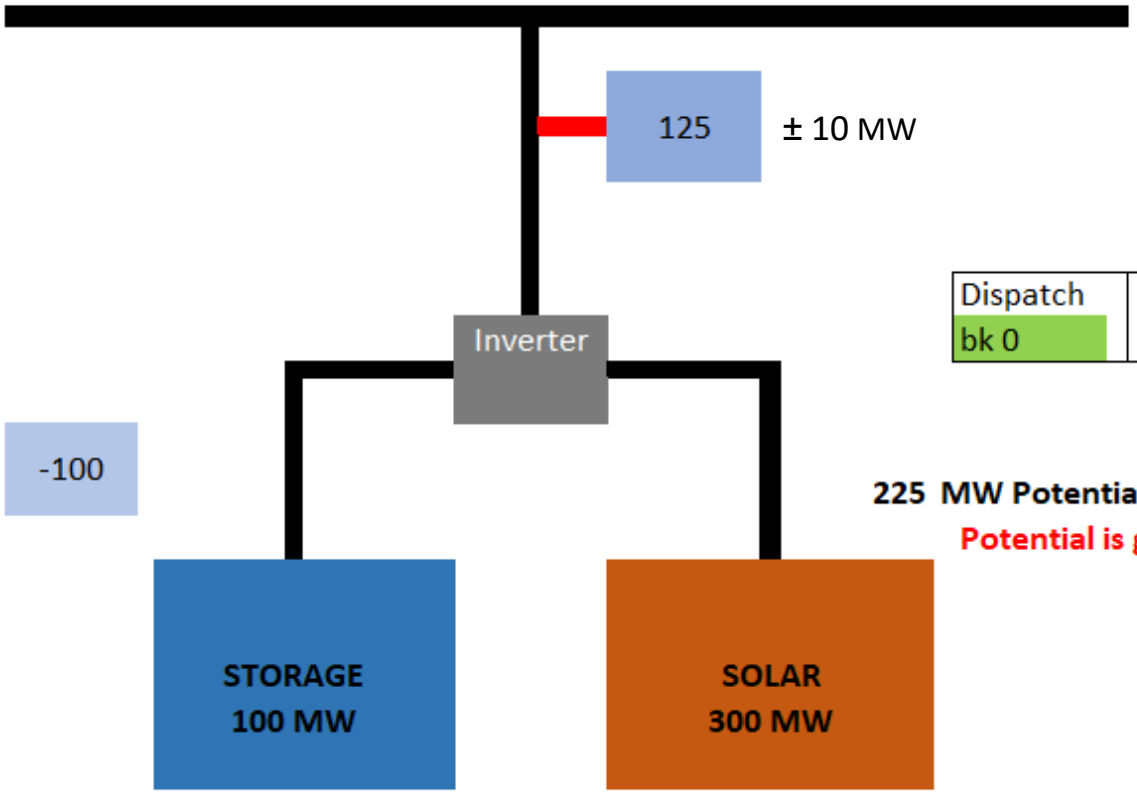
ADV Definition Discussion

Do you support adopting "controllable" and "non-controllable" terminology in the ADV definition?

Controllable & Non-controllable Combination Example

	set real-time potential (MW)			225	Expected
Block	$/MWh	MW	bk sz	VERb (MW)	NTG (MW)
bk 4	335	400	60	0	325
bk 3	224	340	30	0	265
bk 2	65	310	110	100	235
bk 1	35	200	75	75	200
bk 0	0	125	125	125	125
			size of VER:	**300**	
			actual storage size:	**100**	

Controllable & Non-controllable Combination Example - SMP is $12/MWh



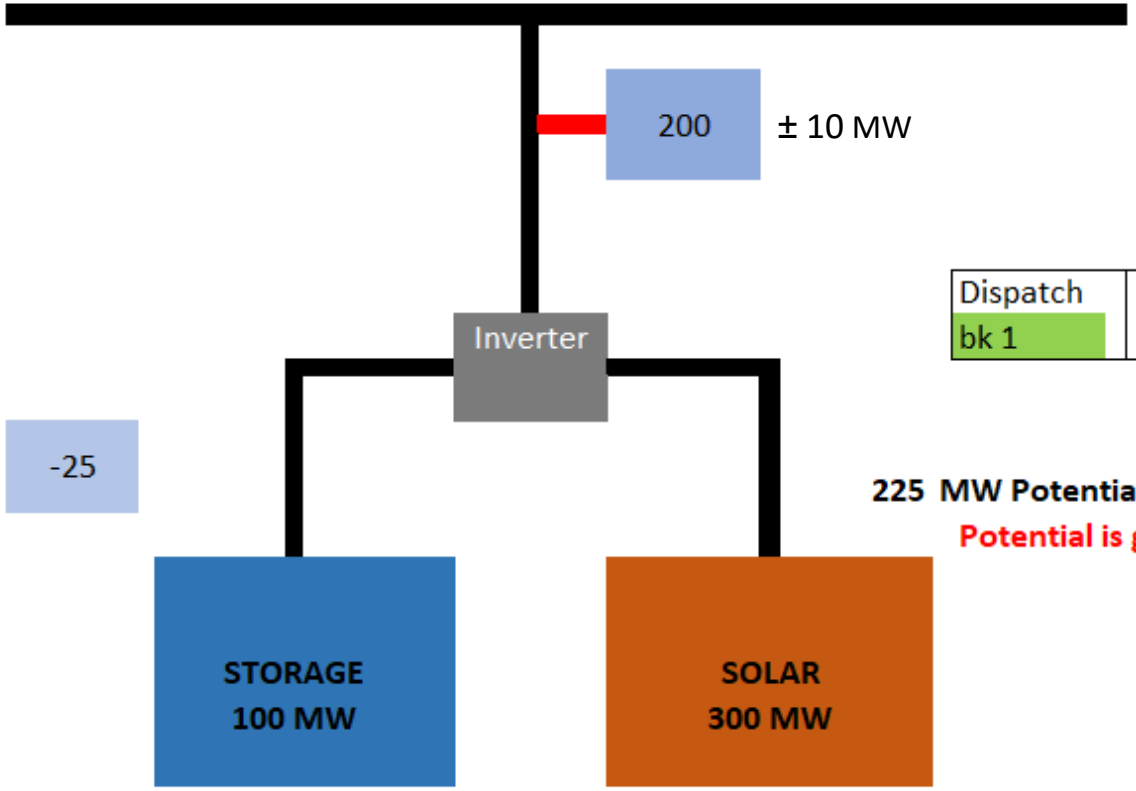
Dispatch	Block $	MW
bk 0	$ -	125

Dispatched inside VER block

225 MW Potential

Potential is greater than Dispatch level

Controllable & Non-controllable Combination Example - SMP is $36/MWh



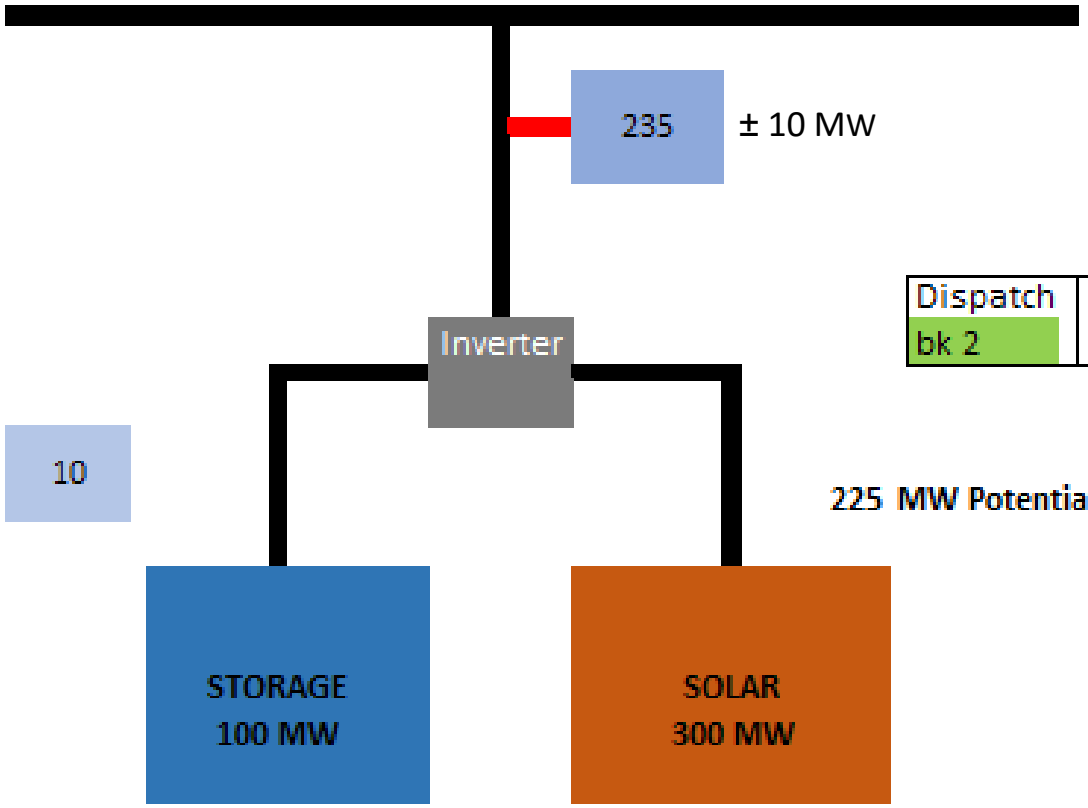
Dispatch	Block $	MW
bk 1	$ 35.00	200

Dispatched inside VER block

225 MW Potential

Potential is greater than Dispatch level

Controllable & Non-controllable Combination Example - SMP is $66/MWh



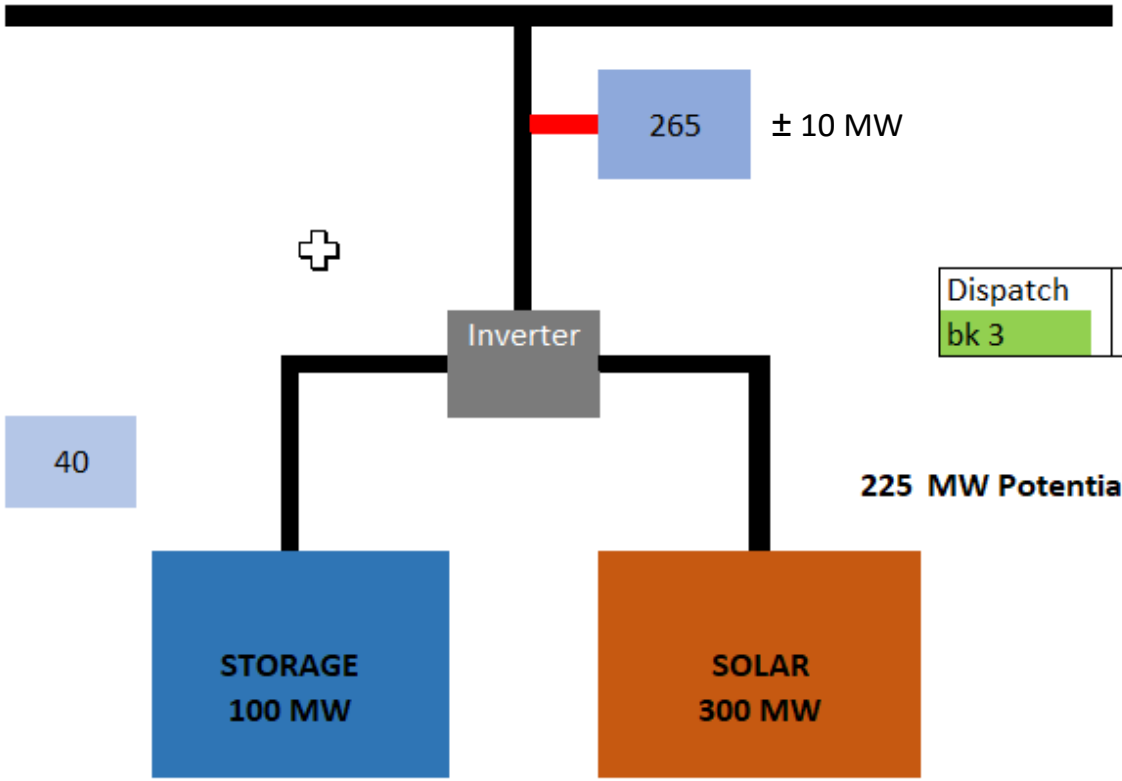
Dispatch	Block $	MW
bk 2	$ 65.00	310

Dispatched outside VER block

To determine the storage output requirements, subtract the in-merit block MW from the size of the solar resource (VER block):

i.e. 310 MW – 300 MW = 10 MW plus 225 MW potential = 235 MW

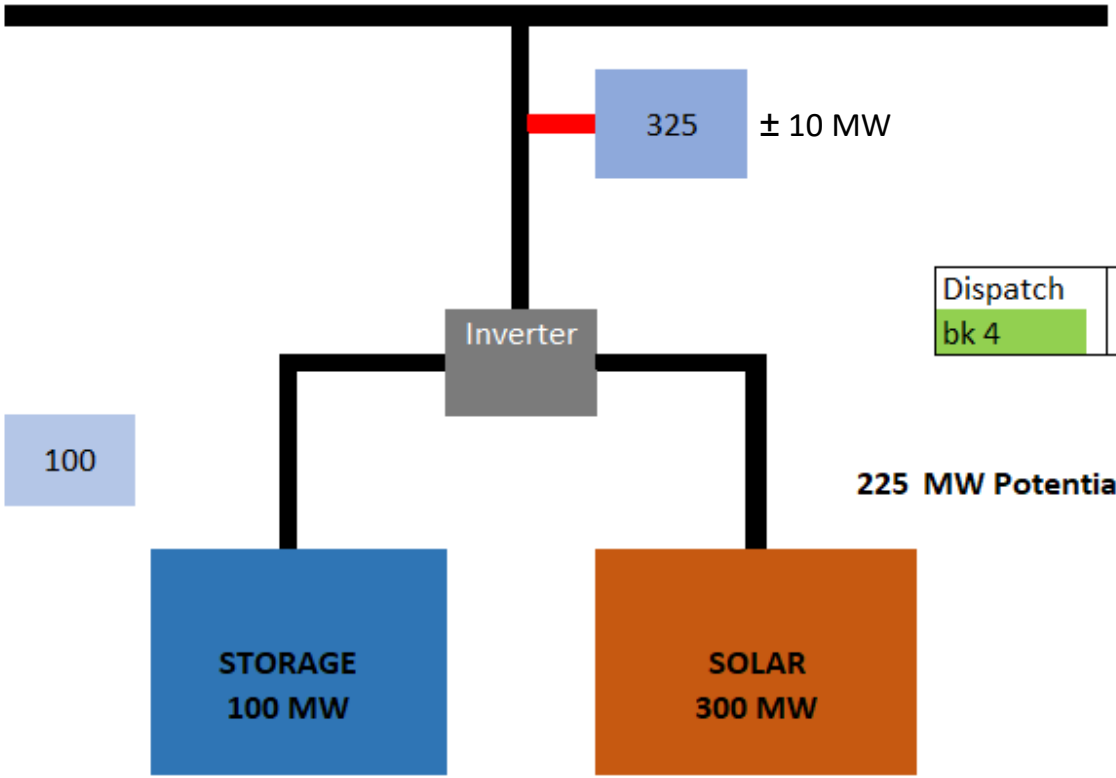
Controllable & Non-controllable Combination Example - SMP is $225/MWh



Dispatch	Block $	MW
bk 3	$224.00	340

Dispatched outside VER block

Controllable & Non-controllable Combination Example - SMP is $400/MWh



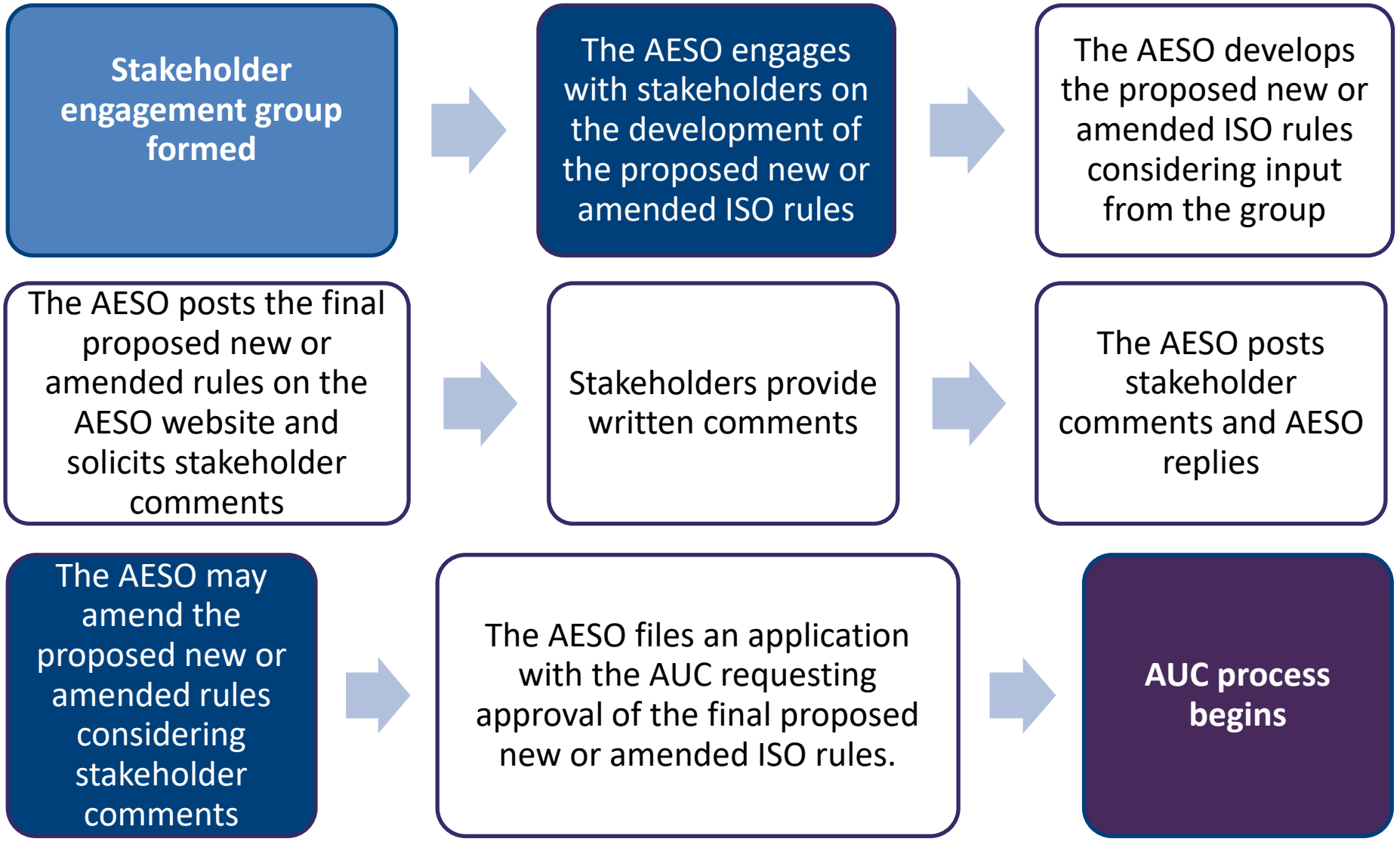
Dispatch	Block $	MW
bk 4	$335.00	400

Dispatched outside VER block

Questions, Thoughts, Comments

Next Steps

ISO Rule Development Process



Engagement Timeline

Dates	Consultation Step
September 13-16, 2022	Stakeholder Survey: (1) topics for Open Forum Q&A; (2) feedback on Session 1
September 26, 2022	Stakeholder Session 2: Open Forum Q&A
Mid-late October 2022	Final ES ISO Rule Amendments & session meeting minutes posted
Early-mid November 2022	Stakeholder comments on final proposed ES ISO Rule Amendments due
Late November – early December 2022	AESO responses to Stakeholder comments; ES ISO Rule Amendments finalized; AUC application filed

Thank you