Hybrid Resources
Second Revised Straw Proposal

Stakeholder Web Conference

Gabe Murtaugh

May 7, 2020

New online stakeholder commenting tool coming this Spring

- Ability to view all comments with a single click.
- Ability to filter comments by question or by entity.
- Login, add your comments directly into the template and submit.
  - You can save and return to your entry anytime during the open comment period.

NOTE

Submitting comments in the new tool will require a one-time registration.

Agenda

Time	Topic	
10:00-10:10AM	Welcome and introduction	Jimmy Bishara
10:10-10:20AM	Timeline and definitions	Gabe Murtaugh
10:20-11:00AM	Market interaction – Hybrid resources	Gabe Murtaugh
11:00-11:40AM	POI constraint – Co-located resources	Gabe Murtaugh
11:40-11:55AM	Metering	Gabe Murtaugh
11:55AM-12:15PM	Resource adequacy and must-offer obligations	Gabe Murtaugh
12:15-1:15PM	BREAK	All
1:15-2:55PM	Open discussion / Q&A	All
2:55-3:00PM	Next steps	Jimmy Bishara

Acronyms

ACC – Aggregate capability constraint
DA – Day-ahead
DMM – Department of market monitoring
NGR – Non-generator resource
POI – Point of interconnection
RA – Resource adequacy
RAAIM – Resource adequacy reliability incentive mechanism
RT – Real-time
SC – Scheduling coordinator
VER – Variable energy resource
WREGIS – Western renewable energy generating information system

TIMELINE AND DEFINITIONS

Timeline for hybrid policy

Date	Item
April 29	Post second RSP, Final for co-located resources
May 7	Public call for second RSP
May 29	Market Surveillance Committee meeting
July 22	**Board of Governors meeting for co-located**
July 29	Publish draft final proposal
Aug 11	Public call for draft final proposal
Oct 6	Publish final proposal
Oct 14	Call for final proposal
Nov 18	**Board of Governors meeting**
Fall 2020	Implementation of co-located constraint (Energy only)
Fall 2021	Remaining implementation for hybrid policy

Definitions

- Co-located Resources – Multiple Resource IDs behind a single point of interconnection
  - Each resource is modeled and submits bids to the ISO independently
  - ISO will model state of charge, VER forecasts, heat rates independently as appropriate
- Hybrid – Single Resource IDs, with multiple mixed-fuel components behind a single point of interconnection
  - ISO receives one bid curve from the hybrid resource which should include any internal optimization
  - Hybrid resource should always be able to respond to any dispatch instruction from the ISO

This initiative is bifurcated into two pieces: one with planned fall 2020 implementation and one in fall 2021

This serves as the **final proposal** for co-located resources and the POI constraint, planned for fall 2020

- Co-located resource constraint (Energy only)

Fall 2021 release will include full build-out for co-located resources and model for hybrid resources

- Hybrid resource definition established
- Hybrid definition will have access to ‘dynamic limit’ tool
- Hybrid bidding requirements and incentive mechanisms will be in place

MARKET INTERACTION – HYBRID RESOURCES

Hybrid resources will be subject to the same market principles as other resources

- Hybrid resources will bid a single bid curve into the DA and RT markets
  - Hybrid resources will be dispatched like other resources on the system
  - Bids can change from hour to hour, and may range from Pmin to Pmax
- Hybrid resources are required to respond to dispatch instructions from the ISO
- Hybrid resources are subject to uninstructed imbalance energy for any energy that is not delivered
- ISO will not maintain state of charge for hybrid resources
  - Hybrid resource are responsible for self-managing state of charge

- Co-located resources will bid consistent with current ISO rules for specific resource type
  - No change from existing treatment today

Hybrid resources will not be classified as variable energy resources

- Variable energy resources refer to wind and solar resources on the grid today
  - VERs produce when the sun/wind is available and may produce ‘at will’
- Hybrid resources will not have VER classification
  - Hybrid resources will be required to respond to ISO operating instructions
- Hybrid resources will use the NGR model
  - The ISO will not model state of charge for hybrid resources
  - Hybrids will be responsible for charging the resource as needed to meet bidding obligations and market opportunities
- ISO is not considering including variable energy or non-generator features for hybrids
  - May be technologically burdensome
- Feedback from developers suggests that allowing hybrids to ‘self manage’ state of charge may be ideal

The ISO needs to understand underlying variable components for all generation on the system

- Today the ISO collects a significant amount of data for forecasting output for variable energy resources
  - The ISO also provides forecasts (or allows variable energy resources to provide their own) for all variable energy resources on the system
- Hybrid resources will be required to provide information on underlying variable components for forecasting and grid reliability
  - Topographical Map
  - Site information sheet
  - Real-time meteorological station data
  - Real-time forecast and telemetry data
  - High-sustainable limit
- High-sustainable limit is a new measurement that is a real-time telemetered estimate of what a variable component is capable of producing
- Data will also be used for reporting WREGIS information

New tools will be required in order for hybrid resources to operate and perform in the market

- Hybrid resources will have many of the same challenges as existing resources
  - Variable generation capability for certain hybrid components
  - State of charge for storage components
- Dynamic limits will established for storage resources
  - Hybrid resources will have the ability to manage variable output through a ‘dynamic limit tool’
  - This tool will be based on similar technology that the ISO already uses for variable energy resources
- Dynamic limits will be submitted by the SC to the ISO
  - Data is provided for 5-minute intervals
  - Data for 3 hours of duration will be submitted
- No requirement to submit limits for all intervals

The dynamic limit tool will limit the generation range that the ISO could dispatch a hybrid resource to

- Example hybrid resource:
  - 100 MW Solar resource
  - +/-50 MW storage resource (4 hour storage → 200 MWh)
  - +100 MW of interconnection capacity for injections into the ISO grid
  - -50 MW of ability to withdraw from grid (charge hybrid component)
- This tool could may be useful when the hybrid owner is charging the storage component or if the storage resource is nearly discharged
  - Generation from the variable component of the hybrid resources may be driving potential output during these scenarios, as no or limited capability may be available from the storage component

The dynamic limit tool will limit the generation range that the ISO could dispatch a hybrid resource to

- Suppose the example resource:
  - Expected max solar generation of 80 MW over next hour
  - Plan to charge the resource at full 50 MW from solar
  - A corresponding outrage card would be entered for capacity from 30 MW to 100 MW, and from -50 MW to 0 MW

	11:00	11:05	11:10	11:15	…	13:55
Expected Solar Gen	73	70	78	75	…	
Energy available for Dispatch	73-50=23	70-50=20	78-50=28	75-50=25		
Economic Bid Curve	0-30 MW				…	
Upper Economic Limit	23	20	28	25	…	
Lower Economic Limit	-	-	-	-	…	

The dynamic limit tool will limit the generation range that the ISO could dispatch a hybrid resource to

- Resources may update outage cards each hour, or more frequently as hybrid operations changes
  - In the previous example hybrid resource may stop charging the storage component internally, or charge the storage component at a reduced rate in later intervals or hours
- The dynamic limits will include upper and lower limits
  - A hybrid resource may plan to partially charge a storage component from the onsite generation, and may be willing to charge the resource additionally from the grid, given the correct economic incentive
  - These limits only reduce the range of what the resource could be dispatched to
  - This will not update dollar values associated with bid curves, inclusive of multi-step curves (i.e. the curves will not be ‘shrunk’ to fit the limits)

POI CONSTRAINT – CO-LOCATED RESOURCES

The ISO is implementing changes to the co-located resources in fall 2020 and fall 2021

- The concept of co-located resources exists today
  - ΣPmax < POI MW limit for co-located resources
- This proposal includes a relaxation of this rule, and the use of an aggregate capability constraint
  - This constraint will prevent the combined energy from a resource from exceeding interconnection limits
  - Constraints will be enforced on upper and lower interconnection limits
  - Resources will generally be allowed to operate under the paradigms in place today
- The initial (fall 2020) implementation will only include a limit on energy dispatch from co-located resources
- Full release (fall 2021) will include energy and ancillary services limit for co-located resources

The aggregate capability constraint implemented in 2020 will limit the total amount of dispatch

$$MAX\left[0, \sum_{i \in S} (EN_i)\right] \leq UL$$

$$MIN\left[0, \sum_{i \in S} (EN_i)\right] \geq LL$$

Where:

i	Resource
S	Set of co-located resources
EN	Energy schedule
UL	Upper limit
LL	Lower limit

In fall 2021 the constraint will be expanded to include ancillary services

$$MAX\left[0, \sum_{i \in S}(EN_i + RU_i + SR_i + NR_i + FRU_i)\right] \leq UL$$

$$MIN\left[0, \sum_{i \in S}(EN_i + RD_i + FRD_i)\right] \geq LL$$

Where:

RU	Regulation up award
RD	Regulation down award
SR	Spinning reserve award
NR	Non-spinning reserve award
FRU	Flex ramp up award
FRD	Flex ramp down award

These constraints will limit the economic instructions sent to co-located resources to respect POI limits

- These constraints will prohibit resources from receiving a combined instruction exceeding interconnection limits
- This will be enforced similar to other constraints in the ISO market, where a shadow price will be associated with the formula when the inequality binds
  - The shadow price will not be applied to co-located resources
- Resources will be priced as if they were at the point of interconnection, rather than behind it
  - This will introduce inconsistencies between dispatch instructions and prices
  - When there are high resources may not be dispatched at their Pmax

The pricing inconsistencies for co-located resources is a concern for the ISO

- Resources could be receiving high prices but not be dispatched at Pmax
- This would be an incentive for resources to produce beyond instructions from the ISO dispatch
- ISO is proposing safeguards to ensure output is consistent with dispatch
  - All co-located resources will be required to follow dispatch instructions
  - Co-located resources that do not follow dispatch instructions may lose eligibility to use the aggregate capability constraint and would revert back to the current methodology where ΣPMax <= POI
  - Resources will continue to be required to have physical or electronic controls at interconnection to limit flows to contract levels
  - The shadow price will not be applied to co-located resources
- ISO exceptional dispatch tools do not include POI constraints
  - ISO is requiring that all co-located resources be operated by the same scheduling coordinator, so that exceptional dispatch instructions will never exceed POI constraints
- May update operating controls to accommodate this in the future

Additional control, beyond the ACC, may be needed to always observe the POI constraints

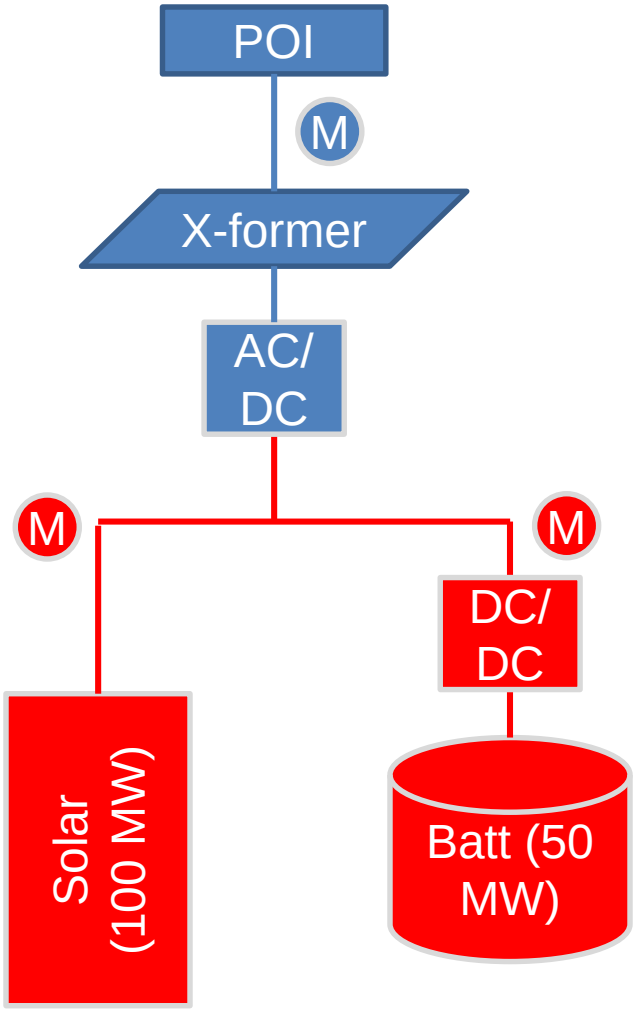
- Today, VER resources are allowed to produce ‘as capable’
  - VERs are required to follow operating instructions and negative supplemental dispatches
- This implies that aggregate output from co-located resources could exceed POI constraints
  - This is particularly true when the POI constraint is binding
- ISO continues to emphasize that generation should not ever exceed the point of interconnection limits
- One solution to this problem is to require that co-located variable energy resources never exceed their forecast
  - The ISO model uses forecast values as the expected energy produced by the variable energy resources
  - This assumption coupled with the constraint would preserve the POI limit
- Resources may want to produce ‘as capable’
  - This is existing functionality for variable energy resources
  - Co-located resources would need additional controls in place to assure that POI limits are not exceeded, so that co-located VERs producing above their forecast do not cause aggregate generation to exceed POI limits
  - The ISO is not planning to add additional controls or requirements at this time
- The POI constraint will also be enforced by a physical limiter or runback established/verified during the ISO interconnection process

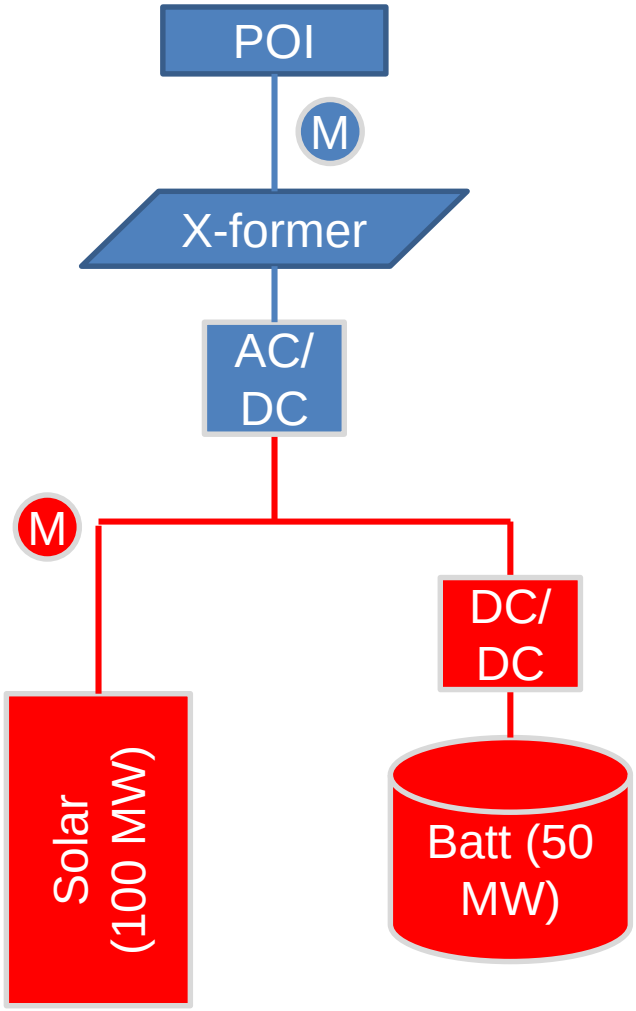
METERING

Each resource interconnecting to the ISO will go through the interconnection process with the ISO

- ISO ensures that metering is sufficient and that accurate information will be passed to the ISO
  - Hybrid resources will be required to provide meter quality data for energy injected onto the grid
  - Each co-located resource will be required to provide meter quality data for energy generated from each resource and aggregate energy injected onto the grid
  - All variable energy resources will be required to meter data for energy being generated for forecasting and renewable accounting purposes
- Each interconnected resource on the grid is unique. ISO staff will continue to work with interconnection customers to ensure that the metering solution is sufficient to meet metering requirements

Metering diagrams for co-located and hybrid resources





RESOURCE ADEQUACY & MUST OFFER OBLIGATIONS

Hybrid resources will have many of the same requirements as other existing RA resources today

- Counting rules for hybrid and co-located resources are being considered in the CPUC's RA track 2 proceeding
  - ISO provided comments and input in that discussion
- Hybrid and co-located resources will generally have a 24x7 must offer obligation in the market
  - Co-located resources will continue to have bidding requirements associated with their resource type
  - Hybrid resources will have dynamic limits to manage variable output
  - Hybrids may use outage cards to indicate on-site charging of storage resources, which will be done without ISO instruction
- Hybrid and co-located resources will be subject to RAAIM
  - RAAIM is assessed during availability assessment hours, and resources that are on outage during those times, will be subject to RAAIM penalties

ADDITIONAL NOTES

Each resource interconnecting to the ISO will go through the interconnection process with the ISO

- Prior to the introduction of hybrid resources, the ISO will require that NGRs with VER components report forecast data and high sustainable limits to the ISO
- The ISO does not foresee any new changes to settlement
  - Each co-located resource continues to be settled independently
  - Each hybrid resource continues will also be settled
- Market power concerns for hybrid resources will not be addressed in this proposal
  - ISO continues to work on a proposal for mitigation for storage, which could inform a proposal for hybrid mitigation
  - Acknowledgement that several thousand MW of hybrid resources will potentially have the ability to exert market power
  - ISO continues to retain authority to review generator information
  - DMM will continue to monitor for gaming or manipulative behavior

OPEN DISCUSSION / Q&A

NEXT STEPS

Next Steps

Milestone	Date
Second revised straw proposal posted	April 30, 2020
Stakeholder meeting	May 7, 2020
Stakeholder comments due	May 28, 2020

Written stakeholder comments on the paper and today's discussion are due by COB May 28 to initiativecomments@caiso.com.

All material for the Hybrid Resources initiative is available on the ISO website at: http://www.caiso.com/StakeholderProcesses/Hybrid-Resources.