California ISO

Informational Posting:

Aggregate Capability Constraint

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1. Aggregate Capability Constraint

In the hybrid resources initiative, the ISO recognized an issue where co-located and hybrid resources could build generating capability in excess of approved interconnection limits, which can happen when resources are paired at a single generating facility behind a shared point of interconnection.[1] For example, solar and storage pair well and may be 'oversized' compared to interconnection limits, as storage is incentivized to charge while solar is generating and solar is usually partially or completely unavailable when storage discharges. These resource arrangements are a result of various commercial considerations and resource synergies that can better leverage and respond to market prices on the ISO grid.

The ISO has experience with multiple resources at the same generating facility behind a single point of interconnection. Traditionally, the ISO modeled these resources so that the aggregate maximum generating value, represented as PMAX in the Master File, is limited to the amount of the interconnection limit applied to the entire generating facility. For example, a 100 MW resource and a 50 MW resource operating behind a single 100 MW interconnection limit, might be modeled by the ISO as a resource with a 67 MW maximum generating capability (PMAX) and a second resource with a 33 MW maximum generating capability. Modeling resources this way ensures that aggregate dispatch instructions to both resources never exceed the 100 MW interconnection limit. This modelling approach limits the total amount of dispatch available from the resources. The ISO would like the ability to receive bids from all 100 MW from the first resource, when available, and all 50 MW from the second resource during the net load peak, for example, potentially enhancing efficiency of market outcomes. The aggregate capability constraint (ACC) is the market functionality that allows for this arrangement.

The aggregate capability constraint helps manage the interconnection limit when a resource, like a solar and storage resource, is interconnected with aggregate maximum generating capabilities greater than the interconnection limit. It serves as a limit to the total aggregate quantity of energy that may be dispatched from an underlying set of co-located resources. The aggregate capability constraint can be applied to multiple resources (i.e. more than two) at the same generating facility, and the ISO can apply multiple aggregate capability constraints to the same generating facility as well. The aggregate capability constraint does not allow for sub-constraints and may only be applied to sets of resources connected to a single point of interconnection as part of the same generating facility. The examples provided below illustrate the flexibility of how this constraint may be applied.

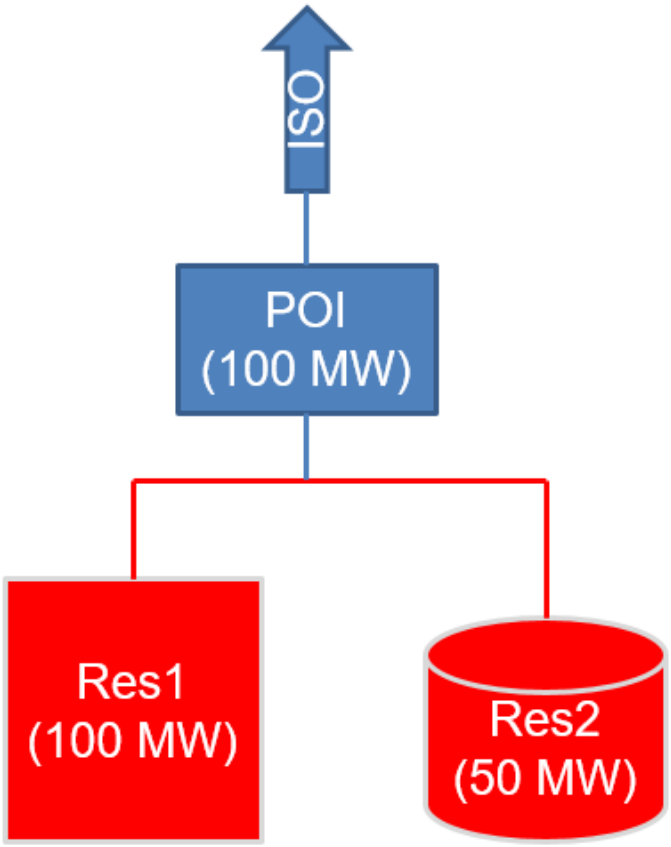
2. Examples

The ISO presents two examples that illustrate how the aggregate capability constraint is applied to co-located resources. The first example is relatively straightforward with two underlying resources, while the second example is more complex and shows two aggregate capability constraints that are each applied to a set of resources at a single point of interconnection.

[1] Hybrid resources initiative: https://stakeholdercenter.caiso.com/StakeholderInitiatives/Hybrid-resources.

In the first example, illustrated in Figure 1, there are 2 co-located resources: Resource 1 and Resource 2. We assume that resource 1 is a 100 MW resource and Resource 2 is a 50 MW resource. Both resources are part of the same generating facility and are limited to injecting no more than 100 MW into the ISO at their point of interconnection at any time. In this example, there is a physical limit reflected in the interconnection agreement, represented by the 100 MW interconnection limit.

Figure 1: Simple ACC application with 2 co-located resources

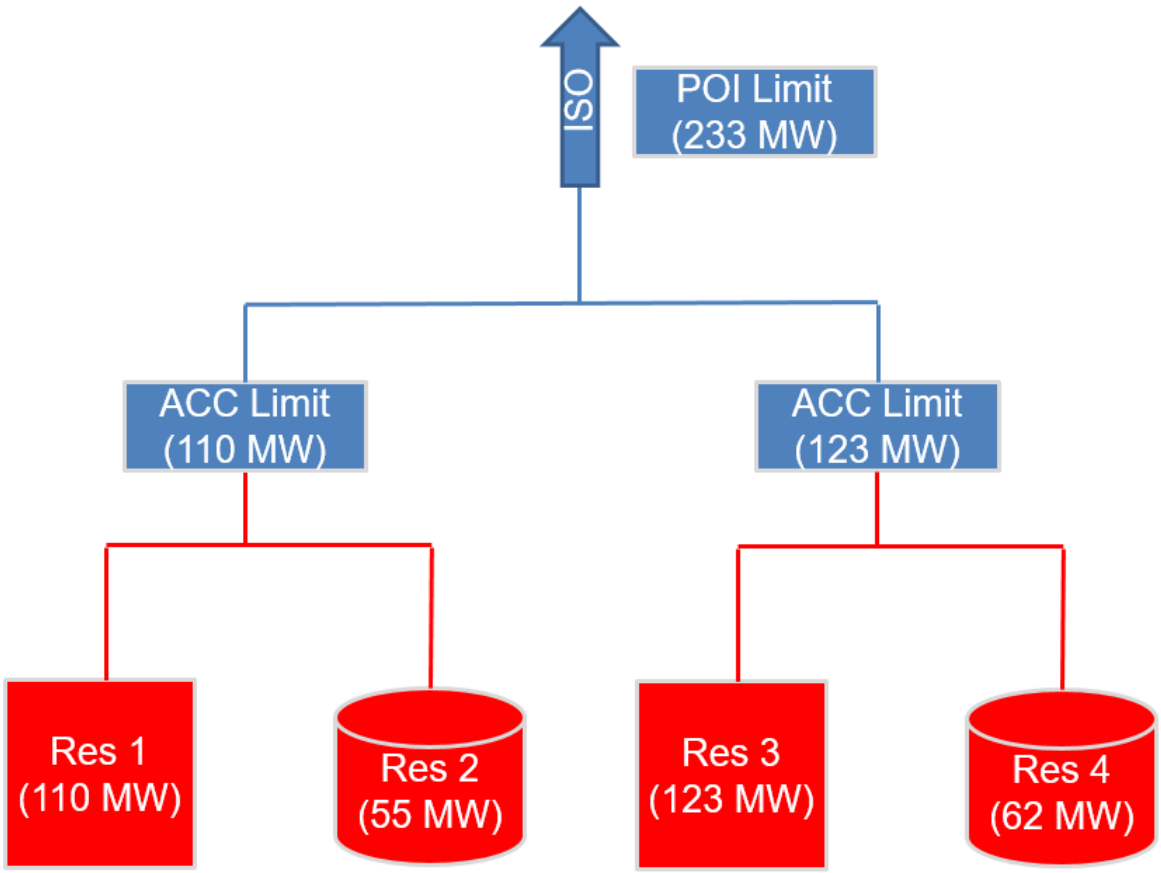


In this example, Resource 1 and Resource 2 are co-located with each other. Further, because the aggregate value of the maximum generation from these two resources exceeds the limit at the point of interconnection, the ISO will require application of the aggregate capability constraint to prevent the combined dispatch from these resources from ever exceeding the 100 MW interconnection limit.

In this example, the ISO is agnostic about the underlying technology for Resource 1 and Resource 2. Resource 1 could be a solar resource and Resource 2 could be a storage resource, which could reflect many of the resources that the ISO anticipates implementing in the market during the next few years. However, these resources could be any combination of hybrid, gas, renewable, hydro or storage generation.

The second example, illustrated in Figure 2, shows a more complex scenario with four resources and multiple underlying constraints applied to those resources. The ISO notes that this scenario is not covered by the current CAISO tariff, but this functionality can be allowed once tariff amendments and required implementation changes are in place.[2] The ISO understands that some facilities may be designed this way to accommodate underlying agreements with energy off-takers.

Figure 2 One facility with two off-takers and two aggregate capability constraints



This scenario reflects a situation where a single generating facility capable of maximum generation of 350 MW, but limited to only injecting 233 MW at the point of interconnection with multiple resources and multiple off-takers. In this example we assume two off-takers for the generating facility. In this example, Resource 1 and Resource 2 are capable of generating up to 110 MW and 55 MW, respectively, but the combined output of both are limited by their bi-lateral off-taker's contract to no more than 110 MW at any time. Further this limit is enforced at the facility level to ensure that Resource 1 and Resource 2 do not produce above this limit. Similarly, Resource 3 and Resource 4 are capable of generating up to 123 MW and 62 MW, and both are limited by their off-taker contracts of no more than 123 MW at any time. Again there is

[2] The ISO plans to file these tariff changes as a component of the other hybrid changes going to FERC for approval in Fall 2021.

an aggregate capability constraint enforced at the facility to prevent these resources from exceeding 123 MW of generation.

Limits on both sets of resources are enforced independently of each other and can be accommodated by the ISO, after tariff changes are implemented for fall of 2021. In this example, the ISO applies two aggregate capability constraints: the first on Resource 1 and Resource 2 for 110 MW, and the second on Resource 3 and Resource 4 at 123 MW. Both are enforced at the point of interconnection and applied to the relevant resources, while also accounting for the interconnection limit at the generating facility, i.e. 233MW. Again, the ISO is technology agnostic about the resources that the aggregate capability constraint is applied to, and these resources may be solar and storage but need not be.

The application of this aggregate capability constraint as described in this scenario is only meant for resources that are part of the same generating facility. The ISO will not consider imposing aggregate capability constraints to resources belonging to separate generating facilities (i.e. covered under separate generator interconnection agreements).

The ISO cautions against imposing these limits on resources too frequently. In the second example, if Resource 1 and Resource 2 bid into the market with very low prices and Resource 3 and Resource 4 bid at very high prices the aggregate capability constraint will limit how much generation the ISO may access from the low cost generation at Resource 1 and Resource 2. This constraint will be in place even though these resources may find it economic to generate and the ISO may receive cost savings from additional participation from these generators by replacing more expensive generation. At the same time, additional generation may be available, but uneconomic from Resource 3 and Resource 4.

3. Deliverability and Resource Adequacy

The ISO notes that with each additional constraint, aggregate capability constraint or otherwise, and each additional resource modeled will result in additional effort to solve the market. At some point it will not be technologically feasible to accommodate additional constraints and such arrangements. The ISO also notes that all constraints enforced result in less available capacity to the ISO to dispatch at any time. This reduces efficiency and increases prices, and may need to be reconsidered in the future.