



California ISO

TECHNICAL BULLETIN

Implementation of Hybrid Energy Storage Generating Facilities

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Revision History

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10/19/2016	1.0	Implementation of hybrid energy storage projects in CAISO market	M&ID

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1 Introduction

This technical bulletin focuses on generator interconnection requests involving existing or proposed generation (conventional or renewable) paired with energy storage. This technical bulletin refers to these as hybrid projects or hybrid generating facilities. This technical bulletin is intended to serve as a guide for some of the decisions that developers of such hybrid projects must consider as they progress through CAISO interconnection processes.

2 Background

Interest in energy storage is significant and continues to grow. Policy makers and regulators at both the state and federal level have taken a number of steps supporting the development of energy storage.¹ In California, expanding the use of energy storage is viewed as a means to optimize the use of wind and solar generation, assist in integrating increased amounts of renewable energy resources into the grid, and reduce greenhouse gases. Developers have responded to this growing interest by submitting a significant number of interconnection and modification requests to the CAISO for projects with energy storage.

In response to this policy support and developer interest, the CAISO is committed to enhancing the participation of energy storage in its markets and continuously works with stakeholders to identify potential policy and process changes that may be needed.

In 2013 the CAISO conducted an effort to clarify interconnection rules for energy storage. This effort concluded as a stakeholder initiative in 2014 and found that the CAISO's existing tariff provisions were sufficient to process interconnection requests, or modifications thereof, for

¹ Eligible energy storage projects include generating units participating in the CAISO market as participating generators, dynamic schedules and participating pseudo-ties.

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energy storage resources.² The November 2014 draft final proposal in the Energy Storage Interconnection initiative concluded that the CAISO's existing interconnection rules accommodate the interconnection of energy storage projects to the CAISO controlled grid that want to be treated as generators for both aspects of their operation (i.e., both charging and discharging).³ This means that an energy storage resource is a generator that produces positive generation during discharge mode and negative generation during charge mode. This is consistent with how energy storage participates in the CAISO wholesale markets under the non-generator resource ("NGR") model.

All energy storage projects participating in the CAISO markets, similar to all generating units, can operate only at the direction of the CAISO. For energy storage this means both charging from the CAISO controlled grid and discharging to the CAISO controlled grid are at the directions of the CAISO. If an energy storage facility wanted to charge from the grid at any time, not at the CAISO's direction, then it would be considered firm load and would need to obtain interconnection approval from the Participating Transmission Owner ("Participating TO") or Utility Distribution Company ("UDC"). Moreover, some energy storage projects that are paired with other generation technologies have the option of charging from the associated generator as well, outside of CAISO dispatch.

The energy storage interconnection initiative also identified non-interconnection related issues that should be addressed. To address these issues, the CAISO collaborated with the California Public Utilities Commission ("CPUC") and California Energy Commission ("CEC") to publish the California Energy Storage Roadmap in late 2014.⁴ The roadmap identified a broad array of challenges and barriers to energy storage and distributed energy resources ("DER"). The roadmap also identified actions to address these challenges, including several high priority action items assigned to the CAISO. To address these items the CAISO launched a new effort in

² Capitalized terms not otherwise defined herein have the meanings set forth in the CAISO tariff, and references to specific sections, articles, and appendices are references to sections, articles, and appendices in the current CAISO tariff and revised or proposed in this filing, unless otherwise indicated.

³ http://www.caiso.com/Documents/DraftFinalProposal_EnergyStorageInterconnection.pdf

⁴ <http://www.caiso.com/informed/Pages/CleanGrid/EnergyStorageRoadmap.aspx>

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2015 called the energy storage and distributed energy resources (“ESDER”) stakeholder initiative.⁵ The focus of ESDER is to identify and consider potential enhancements to existing requirements, rules, market products, and models for energy storage and DER market participation. ESDER Phase 1 is complete and proposed enhancements to benefit demand response enhancements and storage participating as NGR have been approved by FERC and implemented by the CAISO in 2016. ESDER Phase 2 is currently underway and is considering additional enhancements to benefit storage and DER.

3 Hybrid generation resources

As developer interest in energy storage has evolved, the CAISO has experienced an increasing number of inquiries from generation developers interested in pairing energy storage with either existing or proposed generation (conventional or renewable). For purposes of this technical bulletin such resources are referred to as “hybrid⁶” generation resources.

Developer inquiries have touched on many topics including the feasibility and implications of the various charging scenarios; charging from the grid, charging from the associated generator, or charging from both. Developers also have expressed concerns on the number of resource IDs required, metering and telemetry requirements, resource adequacy, ancillary services, and market modeling considerations.

Given the significant interest in hybrid energy storage resources and questions about how existing rules may apply, the CAISO has developed this technical bulletin to provide guidance on such issues. The CAISO hopes that this technical bulletin serves as a useful guide to the critical

⁵http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_AggregatedDistributedEnergyResources.aspx

⁶ Hybrid projects or hybrid generating facilities discussed in the sections below are understood to be a combination of multiple generation technologies, with at least one non-energy storage (renewable or conventional) and one energy storage technology based generating unit(s) combined into a single generating facility.

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decisions that such hybrid energy storage resources need to make as they progress through CAISO processes.⁷

In the following sections this technical bulletin addresses topic areas raised by developers through their inquiries, classified in terms of charging configurations. While the details are discussed in different sections in the technical bulletin, following is just an overview of potential scenarios:

1. Stand-alone energy storage(not discussed in the technical bulletin)
 - a. Storage is charged from the grid
2. Energy Storage combined with another generating unit (renewable or conventional)
 - a. Storage is charged from the grid
 - b. Storage is charged from the associated generating unit
 - c. Storage is charged both from the grid and from the associated generating unit

The CAISO also hopes to update this paper as stakeholder initiatives, CPUC proceeding, and FERC processes may result in changes for implementing energy storage resources.

4 Interconnection Considerations

Interconnection customers with generating facilities connected to the CAISO controlled grid or to the distribution grid may request to incorporate energy storage into an interconnection request or a project that has achieved its Commercial Operation Date (“COD”). Where the interconnection customer has not reached its COD, the CAISO would review its request under the Material Modification Assessment process (“MMA”). If the interconnection customer has achieved COD, the CAISO would review the request under the modification section of the Generator Interconnection Agreement (“GIA”⁸). Interconnection customers must provide the

⁷ This technical bulletin addresses hybrid projects where the generator and the energy storage unit participate in the CAISO markets. It does not address hybrid projects with storage or generation “behind-the-meter.”

⁸ More information on the modification review process for generating facilities in operation is available in the BPM for Generator Management at <http://www.caiso.com/rules/Pages/BusinessPracticeManuals/Default.aspx>

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proposed operating characteristics in the modification request. In particular, if the generating unit will be charged from the CAISO controlled grid at the CAISO's direction, the CAISO and Participating TO must study the "negative generation" (i.e., charging mode) for reliability impacts.⁹ Generating facilities connected at the distribution level will need to seek approval for such a modification from the Participating TO or UDC, as applicable.

Project Sizing and Interconnection Service Limits: If a hybrid generation facility would result in the installation of gross generation capacity in excess of the approved capacity allocated to the project in the GIA, the CAISO requires the interconnection customer to propose and install a generation limiting mechanism (e.g., an instantaneous control mechanism or tripping scheme) to limit the output of the hybrid generating facility, so that the total output of the hybrid generating facility cannot exceed the approved capacity at the point of interconnection.¹⁰

Interconnection customers should propose the generation limiting mechanism prior to the CAISO commencing study work on the modification request. Interconnection customers will be required to provide the generation limiting mechanism as a condition of the modification's approval. The mechanism will be captured in the GIA and is required to be in place before the project synchronizes to the grid.

5 Market Considerations

Ancillary Services: In accordance with Appendix K of the CAISO tariff, all hybrid projects, either defined as NGR or mixed fuel type generating facilities, will be eligible to participate in ancillary services market. Hybrid projects with separate resource IDs will be eligible to provide some ancillary services depending upon the individual generating unit. Specific rules for the various ancillary services are defined in Appendix K. Hybrid projects with a single resource ID will be eligible for applying to provide ancillary service as a single combined generating facility,

⁹ If the project desires charging at any time, not at the CAISO direction, then the project would require a firm load interconnection and would need to go through the Participating TO's process for load interconnection.

¹⁰ The CAISO and Participating TO must be able to rely on such a device working consistently. As such, the interconnection customer may not modify it.

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provided it complies with appropriate provisions of Appendix K. The generating facility will be tested for ancillary services after COD.

6 Market Modelling Considerations

6.1 Critical Decisions: VER, EIR and PIR Status

The discussion below pertains to only hybrid generating facilities combining energy storage with EIR generating units due to the extensive modelling impacts of such combinations. Pairings of energy storage with non-EIR units do not have similar market modelling and implementation impacts, as described in Section 6.2. In accordance with CAISO tariff Appendices A and Q, an Eligible Intermittent Resource (“EIR”) must be a Variable Energy Resource (“VER”).¹¹ Moreover, an EIR can receive certification to be a Participating Intermittent Resource (“PIR”). These designations are explained in greater detail in the BPM for Market Operations, but for this bulletin’s purposes it is important to note that EIRs and PIRs generally use forecasts in lieu of bids for dispatching purposes (PIRs may only use forecasting) due to their inability to store their “fuel” and their dynamic output. The use of forecasts allows both the CAISO and the resource to have its dispatching optimized in real-time depending on the resource’s conditions, namely, the weather. Accordingly, hybrid generating resources operating under a single resource ID or individual resource IDs can participate under the following options:

Single resource ID for energy storage unit and associated generating unit: The hybrid generating facility would continue to retain its VER status as defined in FERC Order 764, but would not be treated as an EIR and PIR in the master file or CAISO market settlement. This is because its operational characteristics and market behavior do not allow it to be treated as an

¹¹ The tariff defines an EIR as “A Variable Energy Resource that is a Generating Unit or Dynamic System Resource subject to a Participating Generator Agreement, Net Scheduled PGA, Dynamic Scheduling Agreement for Scheduling Coordinators, or Pseudo-Tie Participating Generator Agreement” while a VER is defined as “A device for the production of electricity that is characterized by an Energy source that: (1) is renewable; (2) cannot be stored by the facility owner or operator; and (3) has variability that is beyond the control of the facility owner or operator.”

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EIR or PIR under current market settlement rules and processes. Under this option, a hybrid generating facility cannot be certified with a PIR status because it cannot meet the forecasting data requirements necessary to produce market forecast data for the combined generating facility. This is because the CAISO cannot produce an accurate forecast based on the data provided. In other words, the CAISO forecasting would not be able to predict the MW output of a solar or wind generating unit due to the impact of the charging or discharging of the storage unit. Upon the loss of eligibility or current PIR status, CAISO forecasting would not provide a 15-minute market schedule for the resource. Therefore the resource's scheduling coordinator will need to schedule this resource by economically bidding or self-scheduling hourly output in the day-ahead market and bidding or adjusting schedules in the real-time market. Option 1, 2, and 3 below describe the different charging configurations and their impacts for single resource ID hybrid generating facilities.

Option 1 (charging from on-site generation only): If an energy storage unit is aggregating with and charging from an EIR generating unit, the EIR generating unit is no longer eligible to be an EIR and PIR and the storage device is not eligible to be a NGR, with the hybrid generating facility being modeled as a generator or a NGR, based on the modeling option selected by the customer and approved by CAISO.¹²

Option 2 (charging from grid only): If an energy storage unit is aggregating with an EIR generating unit and is charging only from the grid, the EIR generating unit is no longer eligible to be an EIR and PIR, with the hybrid generating facility being modeled as a NGR. This is because the hybrid generating facility now behaves as an energy storage device as a whole, charging and discharging into the CAISO grid as a single resource. The hybrid generating facility will be modeled and treated as NGR in the CAISO market.

Option 3 (charging from both on-site generation and grid): If an energy storage unit is aggregating with an EIR generating unit and is charging from the grid as well as charging from the associated EIR generating unit, the EIR generating unit is no longer eligible to be an EIR and PIR, with the aggregated resource being modeled as a NGR. This is

¹² The interconnection customer might be able to make this selection during the CAISO new resource implementation process, based on the specific characteristics of the project.

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because the hybrid generating facility now has the capability of behaving as an energy storage device as a whole, charging and discharging into the CAISO grid as a single resource. The hybrid generating facility will be modeled as a NGR in the CAISO market.

Projects operating under a single resource ID are treated like all generating resources that are not PIR. For example:

1. If a resource' metered output is different than its 5-minute dispatch this results in an uninstructed deviation, the energy is settled as uninstructed imbalance energy ("UIE") at the real time market price
 - a. A PIR certified resource has its forecast updated at 5-minute intervals while non-PIR certified resources do not, reducing the risk level for PIR certified resources that the energy will be classified as UIE versus instructed imbalance energy ("IIE").
2. UIE charge codes¹³ for conventional generation would apply, including the flexible ramp allocation charges due to uninstructed deviations.

Individual resource IDs for energy storage unit and associated generating unit (2+ resource IDs): Option 4 below summarizes the impact on modelling of the individual generating units based on charging options

Option 4 (charging from on-site generation, grid or both): If both the EIR generating unit and the energy storage device are under individual resource IDs, the EIR generating unit is able to retain its eligibility for PIR status, with the energy storage unit being treated as a NGR.

Examples describing modeling of the above selections in the master file have been detailed under Section 7.2

¹³ CAISO publishes a charge code matrix: <https://www.caiso.com/market/Pages/Settlements/Default.aspx>

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To summarize:

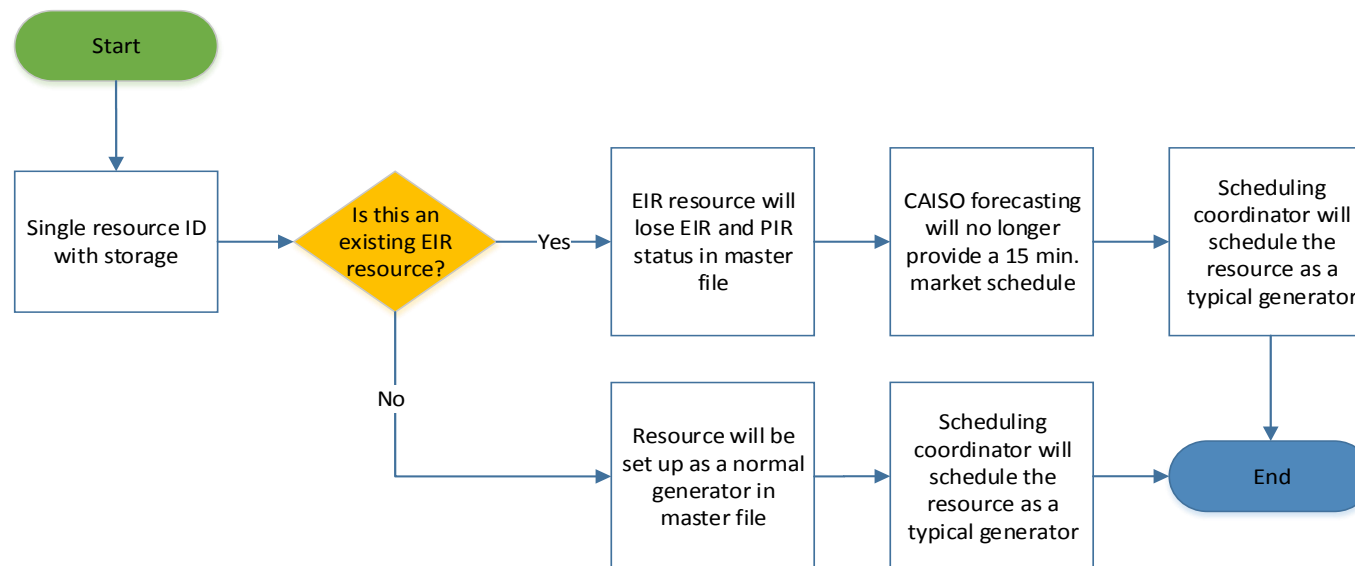
Hybrid generating facility						
Option selection	VER definition (FERC order 764)	VER treatment	EIR treatment	PIR eligibility	NGR treatment	Modelling in master file
Single resource ID						
Option 1 (on-site gen only)	Yes	No	No	No	Yes/No	Generator or NGR
Option 2 (from grid only)	Yes	No	No	No	Yes	NGR
Option 3 (both 1 & 2)	Yes	No	No	No	Yes	NGR
Multiple resource ID						
Option 4 (all charging options)	Yes	Yes	Yes	Yes	Yes	VER for wind/solar and NGR for energy storage

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6.2 Critical Decisions: Forecasting

An energy storage unit is not a VER. As such, if the generating unit was an EIR prior to the addition of the energy storage unit, it would no longer be eligible to be an EIR or PIR if both resources are operated under a single resource ID. Currently the CAISO does forecasting for PIRs only. The CAISO tariff does not have provisions or requirements in place to forecast for non-PIR resources and dispatch them based on that forecast. As described above, hybrid facilities that use separate resource IDs for the generating unit and the energy storage resource would not lose VER/EIR/PIR status for the generating unit.

Diagram 1 - EIR Status Diagram for Single Resource ID Hybrid Projects



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6.3 Critical Decisions: Resource Adequacy

The rules governing the Resource Adequacy (“RA”) programs operated by various Local Regulatory Authorities (“LRA”), including the CPUC, can be found on their respective websites. The CAISO uses RA to ensure that sufficient units bid into the day-ahead market to meet the forecasted demand and all applicable reliability criteria. Eligibility for RA needs to be verified by the interconnection customer with the appropriate LRA and its power purchase agreement counterparty, as specific requirements regarding the eligibility and treatment of energy storage may prohibit a hybrid fuel type resource ID and therefore the project would need two resource IDs.

7 Implementation of Decisions

Based on how the generating facility wants to operate, the implementation of operating a generating unit (conventional or renewable) combined with energy storage unit under a single or multiple resource ID(s) for participation in the CAISO market results in a mixed fuel type generating facility. The generating facility has three options for charging: A) charge from on-site generation; B) charge from the grid; and C) charge from on-site generation and the grid. The generating facility may want option C so that the energy storage unit can charge even if the on-site generating unit is not generating. The ramifications of electing to operate a mixed fuel-type generating facility under the three charging options are summarized in the following table and discussed in detail below:

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	Contracts	Master File	Metering	Telemetry
Two or more Resource IDs				
Charge from on-site generation	GIA, PGA, MSAISOME, PLA	Each resource identified; storage is NGR fuel=Other	Separate CAISO revenue meter for gen. and storage	Can share a RIG. Requires data points of both gen. and storage.
Charge from grid via bids and CAISO dispatch	GIA, PGA, PLA, MSAISOME	Each resource identified; storage is NGR fuel=Other	Separate CAISO revenue meter for gen. and storage	Can share a RIG. Requires data points of both gen. and storage.
Charge from both on-site generation and the grid via bids and CAISO dispatch	GIA, PGA, PLA, MSAISOME	Each resource identified; storage is NGR fuel=Other	Separate CAISO revenue meter for gen. and storage	Can share a RIG. Requires data points of both gen. and storage.
Single Resource IDs				
Charge from on-site generation	GIA, PGA, MSAISOME, PLA(for NGR)	Combined unit is modeled as a generating unit or NGR Fuel=Other	Single CAISO revenue settlement quality meter (net metered)	Single RIG. Combined unit output is the telemetry point

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	Contracts	Master File	Metering	Telemetry
Charge from grid via bids and CAISO dispatch	GIA, PGA, PLA, MSAISOME	Combined unit is modeled as a NGR Fuel=Other	Separate CAISO revenue meter for gen. and storage	Single RIG. Can share a RIG. Requires data points of both gen. and storage.
Charge from both on-site generation and grid via bids and CAISO dispatch	GIA, PGA, PLA, MSAISOME	Combined unit is modeled as a NGR Fuel=Other	Separate CAISO revenue meter for gen. and storage	Single RIG. Can share a RIG. Requires data points of both gen. and storage.

7.1 Contracts

Regardless of the number of resource IDs, the project’s GIA would need to include provisions to address both the non-energy storage generating unit and the energy storage unit. If the energy storage unit addition is a modification to an existing generating facility, then an amendment of the GIA will be required.

In addition, the project will be required to execute (or amend) a Participating Generator Agreement (“PGA”) for the entire project. The charging of the energy storage unit from on-site generation can be captured in the schedules for the PGA as a limitation on the generating capability of the on-site generating unit. In addition, the hybrid generating facility will require an instantaneous control mechanism or tripping scheme to ensure that the total output of the hybrid generating facility does not exceed the capacity approved in the interconnection study. The hybrid generating facility also will need to execute (or amend) a Meter Service Agreement for CAISO Metered Entities (“MSAISOME”). The MSAISOME allows the CAISO to directly poll the project’s settlement quality meter for settlement purposes. If the energy storage unit is charging from the CAISO grid either partially or all of the time, then a Participating Load Agreement (“PLA”) is required.

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7.2 Master File

The master file is a database containing specific information regarding generating units, loads and other resources that allows the market models to optimize the dispatch of the system at least cost. The master file contains unit specific information including Pmin, Pmax, ramp rate, fuel type, resource adequacy status and ancillary service capabilities (AGC, spin, non-spin), use limitations, start-up information, etc.

7.2.1 Single Resource ID Charging from On-Site Generating unit

If the hybrid generating facility charges the energy storage unit from the associated generating unit under a single resource ID, then the resource would be modeled as a generating facility or NGR with the fuel type in the CAISO master file as “Other.” This addition of energy storage is comparable to a modification in operating characteristics of the generating facility thus requiring a change in the master file to reflect its new status. Below are some examples of the master file changes that would be made for a single resource ID where the energy storage unit is charged by the other generating unit.

Example - 1: A natural gas generating unit that is modeled as a fuel type of “GAS,” when the storage generating unit is added then the fuel type will be changed to “Other.”

Example-2: A wind generating unit that is modeled as a fuel type of “WIND,” when the energy storage generating unit is added then the fuel type will be changed to “Other.”

Exemple-3: A solar generating unit that is modeled as a fuel type of “SOLR,” when the energy storage generating unit is added then the fuel type will be changed to “Other.”

7.2.2 Single Resource ID Charging from Grid

If the hybrid generating facility charges the energy storage unit from the grid with a single resource ID, then the resource will be modeled as a NGR with the fuel type in the CAISO master file as “Other.” This addition is comparable to a modification in operating characteristics of the generating facility, thus requiring a change in the master file to reflect its new status. Below are some examples of the master file changes that would be made for a single resource ID where the energy storage unit is charged from the grid.

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Example - 1: A natural gas generating unit that is modeled as a fuel type of “GAS,” when the energy storage generating unit is added then the generating facility will be modeled as a NGR and fuel type will be changed to “Other.”

Example-2: A wind generating unit that is modeled as a fuel type of “WIND,” when the energy storage generating unit is added then the generating facility will be modeled as a NGR and the fuel type will be changed to “Other.”

Exemple-3: A solar generating unit that is modeled as a fuel type of “SOLR,” when the energy storage generating unit is added then the generating facility will be modeled as a NGR and the fuel type will be changed to “Other.”

7.2.3 Single Resource ID Charging from Grid and On-Site Generating Unit

If the hybrid generating facility charges the energy storage unit from the grid and on-site generation with a single resource ID, then the resource will be modeled as a NGR with the fuel type in the CAISO master file as “Other.” Impacts will be the same as under Section 7.2.2

7.2.4 Two or More Resource ID with All Charging Options

If the hybrid generating facility charges the energy storage unit from the generating unit or the grid with separate resource IDs, then the original generating unit will be modeled with its original fuel type and the energy storage unit will be modeled as an NGR with the fuel type in the CAISO master file set as “Other.” This addition is comparable to a modification in operating characteristics of the generating facility thus requiring a change in the master file to reflect its new status. Below are some examples of the master file changes that would be made for a hybrid generating facility using separate resource ID(s) for addition of energy storage units.

Example - 1: A natural gas generating unit that is modeled as a fuel type of “GAS,” when the energy storage generating unit is added to the generating facility, the gas unit will have a separate resource ID with the fuel type of “GAS” and the energy storage unit will have its own resource ID and be modeled as an NGR with fuel type of “Other.”

Example-2: A wind generating unit that is modeled as a fuel type of “WIND,” when the energy storage generating unit is added to the generating facility, the wind unit will

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have a separate resource ID with the fuel type “WIND” and the energy storage unit will have its own resource ID and be modeled as an NGR with the fuel type of “Other.”

Exemple-3: A solar generating unit that is modeled as a fuel type of “SOLR”, when the energy storage generating unit is added to the generating facility, the solar unit will have a separate resource ID with the fuel type “SOLR” and the energy storage unit will have its own resource ID and be modeled as an NGR with the fuel type of “Other”.

7.3 Metering, Telemetry and Settlement

The generating facility can be connected at either the CAISO controlled grid voltage level or a Participating TO transmission or distribution voltage level. The metering and telemetry requirements are slightly different depending upon the connection. In general, a meter is needed for each resource ID, and, depending upon where the meter is connected, the meter will need to be compensated for losses to the point of interconnection with the CAISO controlled grid. Telemetry for the single resource ID charging from the on-site generating unit can be the net output of the generating unit and will not likely require modification if the unit is already existing. However additional telemetry data will be needed for a single resource ID charging from the CAISO grid or generating facilities with two or more resource IDs.

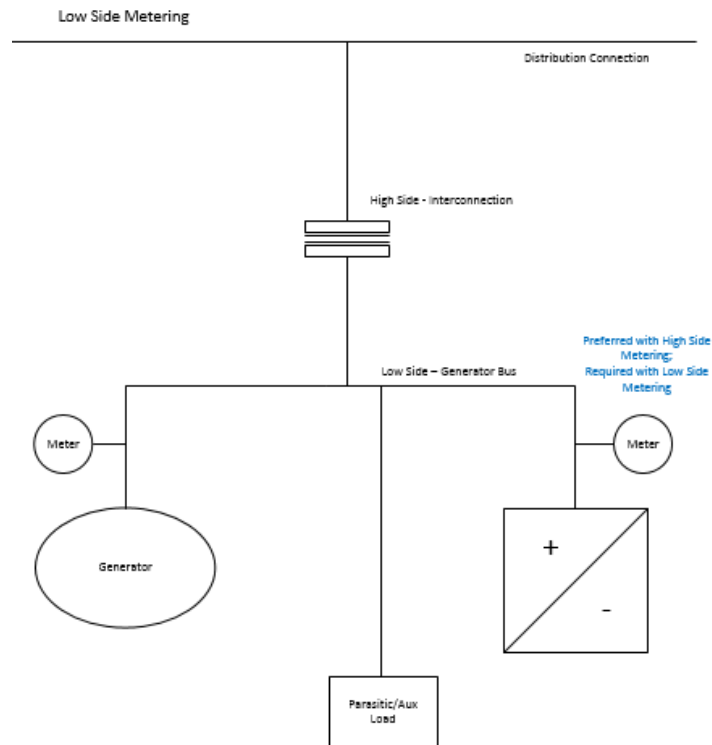
In addition, if the sum of the energy storage unit capability to discharge and the associated generating unit ability to generate is greater than the approved interconnection capacity amount, a tripping scheme is required to disconnect the generating facility from the grid. If the generating facility is a single resource ID that has elected to charge the energy storage unit from the on-site generating unit and in the event that negative generation occurs (e.g. the generating facility is pulling power from the grid), a tripping scheme is required to disconnect the generating facility from the grid. If the generating facility trips due to one of these reasons, the re-connection of the generating facility will be done in coordination with the CAISO and the applicable Participating TO.

There are a number of metering configurations that are available to the generating facility for both distribution connected and CAISO controlled grid connected generating facilities.

If the meters are connected on the low side of the transformer (Diagram 2), the meter data will be compensated to the point of delivery to the CAISO controlled grid.

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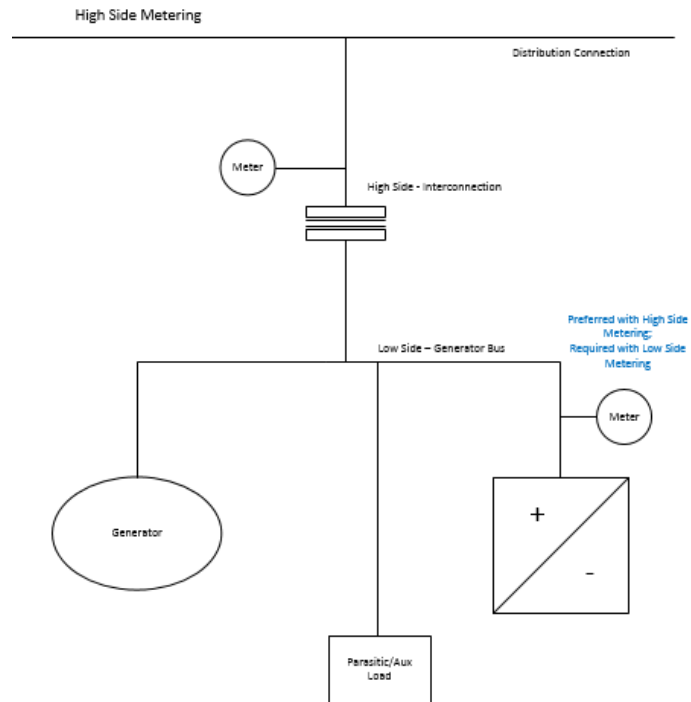
Diagram 2 – Metering layout for Distribution Connected Generating Facilities



If the distribution connected meter is on the high side of the distribution connected transformer (Diagram 3), then that meter will be used as the total output meter and compensated for losses to the CAISO controlled grid point of delivery and the meter on the energy storage unit will be used to monitor the charging and discharging of the energy storage unit.

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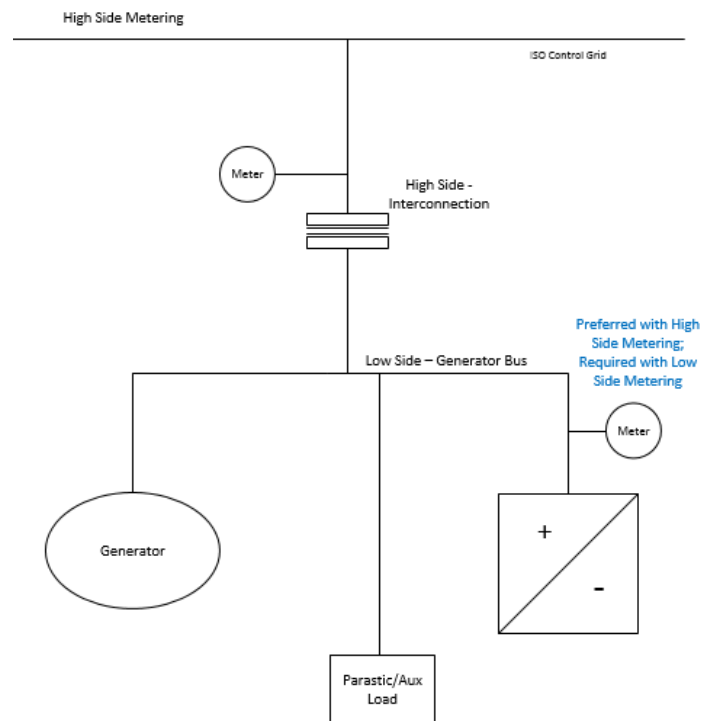
Diagram 3 – Metering layout for Distribution Connected Generating Facilities



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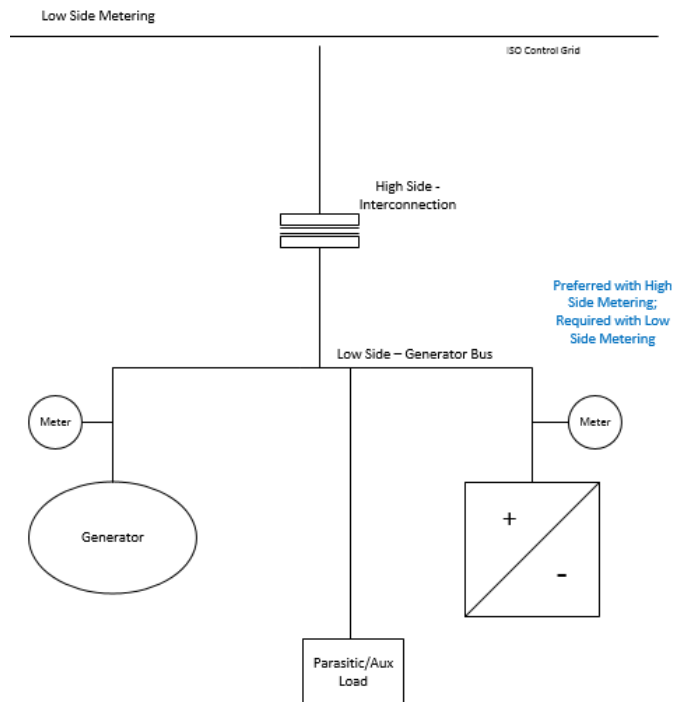
Similar to distribution connected generating facilities, the metering layout is the same for CAISO controlled grid connected generating facilities (Diagram 4 and 5), but is not required to be compensated for losses to the CAISO controlled grid at the point of delivery, because the generating facility is connected at that level.

Diagram 4 - Metering layout for CAISO Controlled Grid Connected Generating Facilities



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Diagram 5 - Metering layout for CAISO Controlled Grid Connected Generating Facilities



7.3.1 Single Resource ID Charging from On-Site Generating unit

With a single-resource ID hybrid generating facility where the energy storage unit only charges from its own on-site generating unit, the CAISO would only see the output of the combined generating facility. As such, the energy storage unit would not be separately subject to CAISO dispatch instructions for charging or discharging purposes. All settlements for the hybrid

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project will be at the point of delivery, based on the metered output to the CAISO controlled grid as adjusted for losses, at five-minute intervals.^{14,15,16}

Distribution Connected Storage: Metering on the high side of the step-up transformer can be done by a single CAISO revenue meter. If the generating facility is participating in the market, the real time telemetry would be required for the combined generating facility, through a Remote Intelligent Gateway (“RIG”) or Dispersive Technology and Distributed Network Protocol version 3 (“DTDNP3”) device to the CAISO Energy Management System (“EMS”), which is outlined in the BPM for Direct Telemetry.¹⁷

CAISO Connected Storage: Similar to distribution connected facilities, metering on the high side of the step-up transformer can be done by a single CAISO revenue meter. If the generating facility is participating in the market, real-time telemetry would be required for the combined generating facility through a RIG or DTDNP3 device to the CAISO EMS, as outlined in the BPM for Direct Telemetry.

7.3.2 Single Resource ID Charging from Grid

With a single resource ID for the combined generating facility, each generating unit will be required to be separately metered and telemetered. Even with a single resource ID, for grid reliability the CAISO will need to know the status of the energy storage unit separately from the generating unit. However, the CAISO would still issue dispatch instructions to the single resource ID. Thus the energy storage unit would not be separately subject to CAISO dispatch instructions for charging or discharging purposes. All settlements for the project will be at the

¹⁴ Detailed information on market charge codes is available at <http://www.caiso.com/Documents/ISOMarketChargeCodesMatrix.xls>

¹⁵ CAISO tariff Section 10.1.3 explains permitted netting which would be applicable to this scenario

¹⁶ Please refer Diagrams 2,3,4 and 5

¹⁷ <https://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Direct%20Telemetry>

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point of delivery, based on the metered output to the CAISO controlled grid as adjusted for losses, at five-minute intervals.¹⁸

Distribution Connected Storage: Metering on the high side of the step-up transformer will need to be augmented by another CAISO revenue meter for the energy storage unit. If the generating facility is participating in the market the real time telemetry would be required for the combined Generating Unit, with telemetered data of both storage and the on-site generating unit, through a RIG or DTDNP3 to the CAISO EMS which is outlined in the BPM for Direct Telemetry.

If the onsite generating unit metering is positioned at the low side of the step-up transformer, it will need an additional low-side meter for the energy storage unit. Low side metering of each generating unit will need to be compensated with the step-up transformer losses. The project would require real time telemetry to the CAISO EMS for the combined generating facility, with telemetered points for each generating unit, through a RIG or DTDNP3 device outlined in the BPM for Direct Telemetry.

CAISO Connected Storage: Metering on the high side of the step-up transformer will need to be augmented by another CAISO revenue meter for the energy storage unit. If the generating facility is participating in the market, the real time telemetry would be required for the combined generating facility, with telemetered points for each generating unit, through a RIG or DTDNP3 device to the CAISO EMS, which is outlined in the BPM for Direct Telemetry.

If the onsite generating unit metering is positioned at the low side of the step-up transformer, it will need an additional low-side meter for the energy storage unit. Low side metering of each generating unit will need to be compensated with the step-up transformer losses. The project would require real time telemetry to the CAISO EMS for the combined generating facility, with telemetered points for each generating unit, through a RIG or DTDNP3 device outlined in the BPM for Direct Telemetry.

¹⁸ Please refer Diagrams 2 and 3

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7.3.3 Two or More Resource IDs with All Charging Options

With two or more resource IDs for the combined generating facility, each generating unit will be separately metered and telemetered. The CAISO would issue separate dispatch instructions to each resource ID. All settlements for the project will be at the point of delivery, based on the metered output to the CAISO controlled grid as adjusted for losses, at five-minute intervals¹⁹

For hybrid generating facilities that have: 1) separate resource ID for the energy storage unit and 2) energy storage unit charges from the associated generating unit, i.e. does not charge from the grid based on CAISO dispatch instructions, the following settlement process applies during the charging period:

1. The associated generating unit will be metered and settled in the CAISO market based on its gross output, not the net delivery to the grid after accounting for energy flow to the energy storage unit
2. The energy storage unit will be metered and settled in the CAISO market for the energy flow into the energy storage unit
3. Since the charging of the energy storage unit will be outside CAISO dispatch, it will be settled as per market rules applying to UIE. UIE is the billing determinant for certain cost allocations, such as the flexible ramping product.

Distribution Connected Storage: Metering on the high side of the step-up transformer will need to be augmented by another CAISO revenue meter for the energy storage unit. If the generating facility is participating in the market, the real time telemetry would be required for the combined generating facility, with telemetered points for each generating unit through a RIG or DTDNP3 device to the CAISO EMS which is outlined in the BPM for Direct Telemetry.

If the onsite generating unit metering is positioned at the low side of the step-up transformer, it will need an additional low-side meter for the energy storage unit. Low side metering of each generating unit will need to be compensated with the step-up transformer losses. The project would require real time telemetry to the CAISO EMS for the combined

¹⁹ Please refer Diagrams 2,3,4, and 5

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generating facility, with separate telemetered points for each generating unit through a RIG or DTDNP3 device outlined in the BPM for Direct Telemetry.

CAISO Connected Storage: Metering on the high side of the step-up transformer will need to be augmented by another CAISO revenue meter for the energy storage unit. If the generating facility is participating in the market, the real time telemetry would be required for the combined generating facility, with telemetered points for each generating unit through a RIG or DTDNP3 device to the CAISO EMS which is outlined in the BPM for Direct Telemetry.

If the onsite generating unit metering is positioned at the low side of the step-up transformer, it will need an additional low-side meter for the energy storage unit. Low side metering of each generating unit will need to be compensated with the step-up transformer losses. The project would require real time telemetry to the CAISO EMS for the combined generating facility, with telemetered points for each generating unit through a RIG or DTDNP3 device outlined in the BPM for Direct Telemetry.