Energy Storage Interconnection

Issue Paper & Straw Proposal

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1 Introduction

The ISO is committed to helping facilitate the development of energy storage and is actively working to identify policy and process changes needed to address the interconnection challenges faced by storage developers. The ISO recognizes that the unique characteristics of energy storage – its ability to behave as either a generator or a negative-generator (i.e., load) and its potential to quickly switch between these two modes – may not, in certain respects, align well with the ISO's interconnection process, which was designed to accommodate requests to connect generation (but not load) to the ISO controlled grid. Thus, the purposes of this initiative are to identify where the current rules either do not sufficiently address or conflict with the needs of storage projects, and propose solutions to address those needs. Although the primary focus of this initiative is to identify and obtain FERC approval for any needed tariff changes prior to the opening of the April 2015 window for the submission of new interconnection requests, this paper also describes how the ISO is currently working with interconnection customers who have submitted storage projects into the Cluster 7 window in April 2014.

Policy makers and regulators, at both the state and federal level, have recently expressed interest in, and support for, energy storage. In 2010, California Assembly Bill 2514[1] found that expanding the use of energy storage systems could optimize the use of wind and solar generation, assist in integrating increased amounts of renewable energy resources into the grid, and reduce emissions of greenhouse gases. This bill required the California Public Utilities Commission (CPUC) to determine targets for energy storage procurement to be achieved by each load-serving entity. In 2013, pursuant to this bill, the CPUC adopted an energy storage procurement framework and established a target of 1,325 MW of energy storage to be procured by Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), and San Diego Gas and Electric Company (SDG&E) by 2020, with installations required no later than the end of 2024.[2]

[1] California Assembly Bill 2514 was approved by the Governor on September 29, 2010.

[2] CPUC Decision 13-10-040 issued on October 7, 2013.

Also in 2013, the Federal Energy Regulatory Commission (FERC) issued Order 792 wherein FERC made the determination to revise the definition of a Small Generating Facility in the *pro forma* Small Generator Interconnection Procedures (SGIP) and Small Generator Interconnection Agreement (SGIA) to explicitly include storage devices.[3] FERC revised the definition of Small Generating Facility in Attachment 1 to the SGIP and Attachment 1 to the SGIA as follows: "The Interconnection Customer's device for the production and/or storage for later injection of electricity identified in the Interconnection Request, but shall not include the Interconnection Customer's Interconnection Facilities."[4]

The CPUC order establishing procurement targets for energy storage had the effect of triggering a significant amount of energy storage interconnection requests in the ISO's Cluster 7 application window that closed on April 30, 2014. In total, the ISO received interconnection requests for approximately 1,669 MW of stand-alone battery storage, 44 MW of other stand-alone storage, approximately 255 MW of battery storage combined with generation, and a 90 MW combined PV/battery storage project.[5] In total, this represents over 2,000 MW of energy storage. An additional amount of interconnection requests for energy storage were submitted through the distribution interconnection processes of the participating transmission owners. Of these latter requests, those requesting full or partial capacity deliverability status will be studied for deliverability purposes in the ISO's interconnection study process pursuant to the Generator Interconnection and Deliverability Allocation Procedures (GIDAP).

Existing GIDAP rules will apply to the Cluster 7 interconnection requests. Given that the interconnection study process for these projects is currently underway, there is insufficient time to identify, seek approval, and implement changes to the GIDAP tariff for Cluster 7. The ISO is working with the Cluster 7 interconnection customers and the participating transmission owners to identify opportunities to streamline the process under the existing rules where possible and has developed an approach described in section 4 of this paper. This effort will be used to inform the design of changes for future clusters. Conflicts with existing tariff rules that are identified through this effort with the Cluster 7 projects will be addressed through this initiative, although depending on the timeframe needed to develop proposed solutions, resolution of these conflicts may not occur in time to directly benefit Cluster 7 projects.

Beyond Cluster 7, the ISO anticipates that it will receive further requests to interconnect energy storage projects one year from now in the Cluster 8 application window that will close on April 30,

[3] 145 FERC ¶ 61,159.

[4] FERC Order 792, paragraphs 227, 228.

[5] The ISO generator interconnection queue as of June 20, 2014 (in both spreadsheet and PDF formats) can be found at: http://www.caiso.com/participate/Pages/Generation/Default.aspx

2015. Through this initiative, it may be possible to identify improvements that could be implemented prior to the Cluster 8 window so that those improvements can be applied to projects in that cluster. The ISO intends to work towards that goal.

In summary, the focus of this initiative will have both a short-term dimension (i.e., addressing immediate issues related to Cluster 7) and a long-term dimension (i.e., resolving issues for Cluster 8 and beyond).

2 Stakeholder process

The ISO launched the energy storage interconnection initiative in late March 2014 in anticipation of receiving interconnection requests for energy storage in the Cluster 7 application window (i.e., the window that would close April 30, 2014). This initiative provides a forum for issue identification and solution development related to energy storage interconnection requests to the ISO controlled grid.

The ISO held a stakeholder web conference on April 7 to discuss existing processes available for the interconnection of energy storage facilities to the ISO controlled grid. Following this initial web conference, stakeholders were invited to submit written comments by April 14 on issues of immediate concern – i.e., those related to interconnection request applications planned to be in Cluster 7. Stakeholders were also invited to raise issues of a policy nature and these are discussed in section 3 of this paper.

In response to issues of more immediate concern raised by stakeholders, the ISO posted supplemental information on the ISO website on April 22.[6] This document clarified the technical data necessary to ensure that the ISO studies Cluster 7 energy storage projects appropriately. The document also clarified that the ISO will use information from the discharge cycle in the deliverability assessment for Cluster 7 – i.e., the ISO will use the four-hour discharge capacity, which is at most the total storage capacity in MWh divided by four.

In this initiative, the ISO will continue to address issues pertaining to how to accommodate Cluster 7 energy storage interconnection requests under existing GIDAP rules while simultaneously considering and proposing modifications to the GIDAP to be applied to Cluster 8 and beyond. At this point the ISO expects to present proposals for modifying GIDAP rules to the ISO Board of Governors for approval in November of this year.

The following table summarizes the stakeholder process schedule for the energy storage interconnection initiative.

[6] http://www.caiso.com/Documents/EnergyStorageProjects-SupplementalInformation.pdf

Stakeholder process schedule		
Step	**Date**	**Activity**
Issue identification / collection	April 7	Stakeholder web conference
	April 14	Stakeholder comments due
Issue paper / straw proposal	June 24	Post issue paper / straw proposal
	July 1	Stakeholder web conference
	July 15	Stakeholder comments due
Revised straw proposal	August 5	Post revised straw proposal
	August 12	Stakeholder meeting or web conference
	August 26	Stakeholder comments due
Draft final proposal	September 16	Post draft final proposal
	September 23	Stakeholder meeting or web conference
	October 7	Stakeholder comments due
Board approval	November 13-14	ISO Board meeting

3 Issues raised by stakeholders

Following the April 7 stakeholder web conference that served to kick-off this initiative, the ISO invited stakeholders to submit written comments by April 14. The ISO requested that stakeholders provide comments in two subject areas: (1) issues of more immediate concern relating to the submission of interconnection requests in the Cluster 7 application window and (2) policy issues relating to interconnection of energy storage to the ISO controlled grid that may require comprehensive examination through this initiative.

As previously discussed, in response to issues of more immediate concern the ISO posted supplemental information for energy storage projects on the ISO website on April 22.[7] The purpose was to provide clarification on the technical data being requested of energy storage developers. The ISO published this information prior to the close of the interconnection request application window (i.e., April 30) so that it could be considered by energy storage developers who were intending to submit interconnection requests.

In response to the ISO's request for comments on policy issues that should to be addressed, stakeholders raised a broad spectrum of energy storage-related policy issues in their written comments, some of which are interconnection related (i.e., issues that would seem to fit within the

[7] http://www.caiso.com/Documents/EnergyStorageProjects-SupplementalInformation.pdf

scope of this initiative), and some that are not. These are discussed in more detail below in sections 3.1 and 3.2, respectively.

Because only a portion of this broad spectrum of energy storage issues will be addressed in this interconnection initiative, the need for a more comprehensive energy storage roadmap was identified. Accordingly, the ISO is partnering with the CPUC and California Energy Commission (CEC) to develop and produce such a roadmap. The purpose of the roadmap is threefold: (1) identify the broad spectrum of issues related to energy storage, (2) clarify where (i.e., the venue) and how these issues will be addressed, and (3) identify the priority of these issues. The roadmap document is targeted to be published by the end of 2014. Near term steps include outreach to stakeholders to gather input about issues and a public workshop being planned for late summer.

3.1 Issues in scope for this initiative

Based on a review of the stakeholder comments received, the ISO has identified the following topics as in scope for this initiative. Stakeholders are asked to comment on this scope. Stakeholders are further asked to provide comments on each in-scope topic in detail. The ISO will use this feedback to develop proposals in a subsequent paper.

Interconnection study process – Stakeholders have inquired whether the current GIDAP interconnection study process can accommodate all aspects of energy storage (i.e., both the charging and discharging cycles) or whether the interconnection studies for energy storage projects will be bifurcated between the ISO's GIDAP (for the discharging cycle) and the PTOs' load interconnection processes (for the charging cycle). Many stakeholders believe that any such bifurcation would be inefficient, should be avoided, and that the interconnection study process should be consolidated under the GIDAP wherein all interconnection studies are performed pursuant to a single interconnection request by the ISO or by the PTOs at the direction of the ISO. Stakeholders also raised questions about whether the methodologies used in interconnection studies align with the many possible configurations and use cases for energy storage. A related topic is consideration of energy storage in optimizing the system (e.g., the potential for energy storage to increase the utilization of generation and transmission assets). Another issue is the question of cost responsibility for network upgrades triggered by energy storage charging cycles. All of these issues are within the scope of this initiative. Stakeholders are invited to comment on these topics.

Modification request process – Stakeholders see the modification request process under GIDAP as providing a potential means to add energy storage to a generator project already going through the interconnection process. This initiative will examine whether any changes to this process are needed to achieve this potential. Stakeholders also raise the possibility that energy storage interconnection customers may desire to modify their project during the interconnection process based on information they acquire through participation in utility procurement processes (e.g.,

following the Phase I interconnection study results meeting). Although these rules are addressed in the GIDAP tariff and BPM and the Queue Management BPM, this initiative will examine whether any changes are needed. Stakeholders are asked to comment on this topic.

Independent Study Process behind-the-meter (ISP-BTM) expansion process[8] – Stakeholders have expressed interest in using the ISP-BTM expansion process to add storage to existing generation projects. Clarifications to this process within the independent study process and its impact on net qualifying capacity were recently examined in the Interconnection Process Enhancements (IPE) initiative.[9] Proposed improvements developed through the IPE initiative included (1) removing the requirement for a separate expansion breaker, (2) adding a requirement for an automatic tripping scheme, and (3) adding a requirement for separate metering and a separate resource ID to retain the full capacity deliverability status of the original facility. These proposed improvements were approved by the ISO Board of Governors at its May meeting[10] and development of the associated tariff amendments is underway. However, late in the IPE initiative, some stakeholders raised the issue that ISP-BTM capacity expansion should be allowed through the material modification process. In response, ISO management indicated that under existing rules the ISO will accept requests for project modifications entailing the addition of energy storage to generation projects and make a determination for materiality on a case-by-case basis. This will allow the ISO to gain experience in performing material modification assessments on projects seeking to incorporate energy storage and guide future enhancements to the material modification assessment process. The energy storage interconnection initiative will consider whether further improvements to the ISP-BTM expansion process are needed to facilitate energy storage. Stakeholders are invited to comment on this topic.

Deliverability study methodology – In general, stakeholders question how well the current interconnection study methodologies align with the likely use cases for energy storage. Specifically, stakeholders suggest that while many storage projects may request full or partial capacity deliverability status so that the procuring utility can count it for resource adequacy purposes, the conventional approach of studying its four-hour capacity at summer on-peak conditions may not align with the use case for a storage project that may actually be discharging during the ramp-in rather than during the peak. Under such a use case, the approach of studying its four-hour capacity may drive the need for additional network upgrades that may only be used

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[8] This is an ISO process pursuant to ISO Tariff Appendix DD section 4 that relates to transmission level interconnections under the independent study process. This is not to be confused with interconnections behind the end-use customer meter on a utility distribution system.

[9] The draft final proposal may be found at: http://www.caiso.com/Documents/DraftFinalProposal-Topics_4-5-13-InterconnectionProcessEnhancements.pdf

[10] The material presented to the ISO Board of Governors at its May meeting may be found at: http://www.caiso.com/Pages/documentsbygroup.aspx?GroupID=44BA3E30-7815-4F7F-9F58-9DD956C3E442

during resource shortage conditions, and for some storage projects, may not identify upgrades that are needed during ramping conditions. Thus, stakeholders have expressed interest in exploring whether deliverability studies should be performed any differently given the existing resource adequacy rules and how deliverability studies for energy storage should be performed if resource adequacy rules are assumed to change.

Another issue of interest to stakeholders is how energy only and full capacity deliverability status may impact an energy storage facility's effective flexible capacity. Although this issue may overlap with topics under consideration in the ISO's reliability services initiative (RSI), the interconnection study methodology aspects are within the scope of this initiative.

Finally, there is the question of what "deliverability" means with respect to charging energy storage projects for later discharge. This issue is about the ability of a storage project at a particular location on the grid to charge during a particular time when it is needed for system, local, or flexibility needs. What this means in the interconnection process context and how such studies should be performed are within the scope of this initiative.

Stakeholders are invited to comment on these deliverability study methodology topics.

New or streamlined agreements – Although the ISO does not view this as a stand-alone issue in itself, the ISO does acknowledge that in our efforts to improve the process for the interconnection of energy storage, potential opportunities to streamline existing interconnection-related agreements, or perhaps the potential to develop new agreements, may be identified. The ISO is interested in stakeholders' views on this topic.

3.2 Issues not in scope

The following issues are ones the ISO does not view as in scope for this initiative. As previously mentioned, however, the intent is for the more comprehensive energy storage roadmap to clarify where these issues are being/will be addressed and the priority.

Rate treatment for energy storage charging – Specifically, the question of whether the purchase of charging energy should be considered a wholesale or retail transaction. Some stakeholders view this topic as the primary unresolved issue confronting energy storage development. In the context of Cluster 7 storage interconnection requests, for the simplest cases of stand-alone storage projects or storage paired with generation projects that participate in the ISO markets, the ISO's view is that charging energy is electric energy temporarily stored for later resale and is not end use consumption. Thus, the ISO views the purchase of charging energy for such purpose as a wholesale function. (See Section 4 below for further discussion.) Beyond these most basic scenarios, however, the ISO does not intend to address issues surrounding the rate treatment for energy storage charging cycle in this initiative. Many factors may ultimately play a role in this issue such as participation in ISO markets, at what level an energy storage project is connected (e.g.,

connected to the transmission grid vs. the distribution system, connected behind the customer meter), and how an energy storage project is configured (e.g., standalone, combined with generation and/or load). Rate treatment for energy storage charging is not a topic within the scope of this initiative.

Energy storage as a non-transmission alternative – Stakeholders have expressed interest in giving energy storage consideration as a non-transmission alternative. A more specific area of interest to stakeholders is consideration of a study approach that considers storage as a non-transmission alternative during those periods when it is out of market. That is, stakeholders are interested in whether the ISO could restrict its studies of energy storage as a non-transmission alternative to those periods when the resource is out of market. Another area of interest to stakeholders is whether the annual transmission planning process could quantify the values or benefits that energy storage could provide to the system and to ratepayers. These are issues more relevant in the context of the annual transmission planning process than interconnection process issues and thus are not within the scope of this initiative.

Metering/telemetry rules – Stakeholders point out that energy storage may develop under many different configurations each with potentially unique metering and telemetry needs. Stakeholders desire clarity on the metering and telemetry requirements for a particular configuration. Storage resources are able to interconnect using existing ISO metering and telemetry requirements found in ISO Business Practice Manuals.[11] New options for resource data aggregation and meter data concentration are being considered in an existing stakeholder initiative for expanding metering and telemetry options; however, the scope of this existing initiative may not cover the unique configurations being considered for storage implementation. The ISO is actively working to determine how to fully address these needs outside of the present energy storage interconnection initiative.

Market design – Stakeholders have expressed interest in exploring the possibility of other compensation mechanisms for energy storage and whether new market products will be developed. One such issue previously discussed is how energy only and full or partial capacity deliverability status may impact an energy storage facility's effective flexible capacity. Because this issue has a tie-in to interconnection study methodologies, this aspect has been included within the scope of this initiative; however, other market design issues are not within the scope of this interconnection initiative.

[11] The Metering BPM can be found at: http://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Metering.

The Direct Telemetry BPM can be found at:
http://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Direct%20Telemetry.

4 Applying the GIDAP to Cluster 7 energy storage projects

New interconnection requests to the ISO grid are governed by the Generator Interconnection and Deliverability Allocation Procedures (GIDAP) approved by FERC in 2012. The GIDAP rules are contained in ISO Tariff Appendix DD.

As discussed earlier, stakeholders support consolidating the interconnection process for grid-connected storage under the GIDAP in order to avoid the inefficiencies of a bifurcated process that separates a storage facility into generation and load. The ISO intends to work with stakeholders through this initiative to achieve this consolidation goal. However, for the present, the existing GIDAP tariff (i.e., without the benefit of tariff changes) will be applied for energy storage projects in Cluster 7. Energy storage related interconnection and study issues will be dealt with under the existing tariff structure to the fullest extent possible.

The ISO's view is that the existing GIDAP rules can accommodate Cluster 7 storage projects (either stand-alone or integrated with other generation) and proposes to apply existing GIDAP rules to Cluster 7 storage projects that want to be treated as generators for both aspects of their operation – that is, as a generation project that produces positive output during its discharge cycle and negative output during its charging cycle – insofar as studying the reliable interconnection of such projects to the ISO controlled grid. In addition, interconnection of a storage project as a generator, for purposes of being studied under the existing GIDAP, means that both the charging and discharging cycles of the facility will be subject to the requirement that the facility respond to ISO dispatch instructions including curtailment instructions to manage congestion or other operational issues on the system. In other words, the facility will be subject to ISO dispatch instructions in both charging and discharging modes, which could curtail operation during either mode. This includes installation of the requisite metering and telemetry. As explained below, however, the existing GIDAP provisions will not be utilized to assess requests by storage projects to obtain a higher level of service for their charging functions (i.e., comparable to firm load service).

Requisite metering and telemetry are based on the number of transformers interconnecting the project. If there is only one transformer and a separate meter and resource ID are needed for both on-site generation and storage, then low side metering is allowed provided that (1) the IC requests and receives an exemption from the ISO, and (2) the losses between the low side meter and the high side of the transformer are static.[12]

[12] "Static" means that the losses are always assumed to be constant or fixed percentage at a specific calculated amount. Static losses assume maximum generation with maximum transformer losses. This is in contrast to dynamic loss calculations where losses vary and are calculated based on actual generation levels. A separate meter and resource ID are needed in order to calculate a qualifying capacity for each generation type for resource adequacy purposes.

Reliability studies (as defined in the GIDAP) performed by the PTOs under ISO direction will consider both the discharging and charging cycles and will be based on the maximum net discharging output in MW and maximum charging demand in MW, respectively. The reliability studies will provide information regarding potential congestion; potential overload issues will be identified as well as some level of information as to how these issues would impact the dispatch through congestion management. The studies are intended to include the charging mode under off-peak load hours and partial peak load hours and these studies will identify constraints under the assumed conditions. Although these "charging mode" results will not indicate the precise hours associated with these constraints, the intent is to provide information to the interconnection customer about potential operational limitations as stakeholders have indicated that such information would be useful. However, any impact analysis of charging limitations as part of the reliability studies can only be considered informational. Due to the large number of factors that can affect actual system performance, these studies cannot be considered definitive.

Deliverability studies performed by the ISO will consider only the discharge cycle of the facility, as deliverability is a specific measure applicable to the state's resource adequacy program. For generator projects requesting full or partial capacity deliverability status, the maximum positive output tested for deliverability is the four-hour capacity. If the four-hour capacity is not provided in the interconnection request, ISO will calculate it as the total storage capability in MWh divided by four.

The Phase I results will only include network upgrade requirements for discharging the storage project. ISO interconnection studies will not identify or determine network upgrades that may be necessary to allow a storage facility to have complete flexibility to charge at any time of the day it may desire regardless of system conditions.

The ISO's view is that the GIDAP does not apply to the situation where an interconnection customer wants the flexibility to charge at any time, e.g. to receive service on par with treatment provided to firm end-use customer load. To ensure that such charging energy can be delivered to the storage facility on demand may require network upgrades in addition to those needed to accommodate the discharge functions. However, this level of service for drawing power from the grid is not afforded through the GIDAP study process and cost responsibility framework for upgrades, which relates to wholesale output responding to market dispatch. Thus, the ISO does not believe that the current GIDAP provisions can apply to such load-driven upgrades to support unrestricted charging.

The ISO proposes that if an interconnection customer wants the flexibility to charge at any time, comparable to firm load service with low risk of being subject to possible curtailment during charging mode, then the customer must seek such service from the appropriate PTO through means other than the GIDAP. For example, the interconnection customer could work directly with the appropriate PTO to request that its charging function be treated as firm load – either retail

industrial load or wholesale load, depending on the regulatory determination as to whether such load is retail or wholesale in nature.[13] In the case of firm retail load service, the PTO's existing rules for determining cost responsibility for any identified upgrades needed to connect retail load would apply. However, the ISO understands that the charging service would then be in its entirety under retail terms. On the other hand, if a storage project's charging function is determined to be wholesale load, the PTO's existing rules for determining cost responsibility for any identified upgrades needed to connect wholesale load would apply. Another possible approach would entail the interconnection customer working with the PTO (and ISO) to identify any upgrades needed that could be funded through a "merchant" model in which the interconnection customer would fund the upgrades without reimbursement. Under all of these approaches, any agreements needed to address study scope and study costs would be a matter between the interconnection customer and the PTO.

Another approach suggested by some stakeholders would involve the PTO including the unrestricted charging load in its retail load forecast as part of its grid expansion planning process. As the ISO understands this approach, the PTO could present to the ISO a set of upgrades needed to accommodate growth in its retail load, and the PTO would request that the ISO approve these upgrades within the context of the ISO annual transmission planning process and allow the upgrade costs to be recovered through the transmission access charge (TAC). The ISO opposes this approach for a several reasons. First, as previously stated in this paper, the ISO believes that the procurement of electric energy to charge an energy storage facility participating in ISO markets is a sale for resale and therefore a wholesale rather than retail transaction. Second, the load forecast used in the ISO's annual transmission planning process is that approved by the California Energy Commission through its Integrated Energy Policy Report process and reflects only retail load growth. Third, to include such charging load in a retail load forecast would be inconsistent with the interconnection customer seeking access to wholesale rates to charge its facility. Lastly, such an approach could incent the perverse outcome of identifying and approving TAC-funded upgrades to support unrestricted charging. Such an outcome contradicts the potential for energy storage to increase generation and transmission utilization and reduce the need for additional transmission upgrades. The ISO believes that such a contradictory outcome should be avoided, and is thus opposed to this suggested approach.

The ISO invites stakeholders to comment on its proposed approach for the application of existing GIDAP rules to energy storage projects in Cluster 7, as discussed in this section. As the ISO continues to work with the Cluster 7 interconnection customers and the participating transmission owners to refine this proposed approach, the ISO will use this stakeholder initiative to discuss the issues and challenges encountered, identify where there may be conflicts with existing tariff rules,

[13] The ISO's view is that for stand-alone storage or storage integrated with other generation, energy purchased to charge such projects would constitute sales for resale, and therefore should be treated as wholesale in nature.

and work with stakeholders to develop proposed solutions. Again, the objective is to use this Cluster 7 effort to inform the design of proposed improvements that could be implemented prior to the Cluster 8 window so that those improvements can be applied to projects in that cluster.

5 A framework for differentiating between energy storage configurations

The ISO proposes to use a framework of potential interconnection configurations to identify and organize issues faced by energy storage in the interconnection process. In developing proposed improvements to the ISO interconnection process to address these issues, the ISO believes it is important to take into consideration the many possible energy storage configurations that have been described by stakeholders to date, identify where unique issues may exist for a particular configuration, and develop proposed solutions for each. In this paper, the ISO proposes such a framework for stakeholder consideration. For purposes of this discussion, the ISO uses the term "configuration" to mean a physical configuration from an interconnection perspective.[14]

Consistent with the three "use-case buckets" discussed in the CPUC decision establishing energy storage procurement targets, the ISO has organized the various interconnection configurations into three categories based on the interconnection level (i.e., ISO controlled grid, distribution, or customer sited).

As a common feature, all of these configurations assume participation in ISO markets (i.e., configurations not involving participation in ISO markets are not in scope for this initiative).

The ISO invites stakeholders to comment on whether this framework is complete (or whether it is too expansive and unmanageable for purposes of this interconnection initiative), those configurations/sub-configurations of most interest to stakeholders, and those most relevant to this interconnection initiative. In other words, for purposes of this initiative the ISO is interested in only focusing on those configurations that enable a useful examination of the highest priority energy storage interconnection issues. The ISO will use stakeholder input to prioritize which configurations and sub-configurations will be addressed in this initiative. For those configurations of most interest, the ISO requests that stakeholders submit energy storage interconnection issues or challenges associated with each configuration of interest (e.g., where the current interconnection rules either fail to address or conflict with the needs of storage projects). Based on

[14] A storage developer could configure its projects in a particular way with the intention of providing a variety of benefits, services, or uses. The combination of a particular configuration and the specific services that it intends to provide would represent a "use case."

stakeholder feedback, those configurations that are either deemed not relevant to this initiative or should be deferred will be excluded from the scope of this initiative.[15]

The three categories and their associated configurations are outlined below.

ISO grid connected storage – This category is defined as storage requesting interconnection to the ISO controlled grid and is the only category interconnecting under the GIDAP. The ISO has identified three configurations that may be relevant under this category: stand-alone storage; storage paired with on-site generation; and, storage that is paired with on-site load. These are described briefly below.

- Stand-alone storage. Charges only from the ISO controlled grid (presumably at wholesale rates) and discharges only to the ISO controlled grid. The facility responds to ISO dispatch instructions.
- Storage paired with on-site generation. The facility responds to ISO dispatch instructions. Three sub-configurations:
    - Charges only from the ISO controlled grid.
    - Charges only from the on-site generation.
    - Capable of charging from both the ISO controlled grid and from the on-site generation.
- Storage paired with on-site load. Charges directly from the ISO controlled grid. Two sub-configurations:
    - Discharges only to the on-site load that is not auxiliary load.
    - Capable of discharging to both the load and to the ISO controlled grid.

Distribution connected storage – This category is defined as storage facilities that will participate in ISO markets and that are requesting interconnection to a utility distribution system by participating in the distribution company's wholesale distribution access tariff (WDAT) process. Storage facilities in this category requesting either full or partial capacity deliverability status (i.e., for the discharging or positive output of the facility) will be studied and allocated deliverability according to GIDAP rules.

The ISO has identified three configurations that may be relevant under this category: stand-alone storage; storage paired with on-site generation; and, storage paired with on-site load. These are described briefly below.

- Stand-alone storage. Charges only from the utility distribution system and discharges only to the utility distribution system. The facility responds to ISO dispatch instructions.

[15] The energy storage roadmap effort will also use a configuration approach and will seek to identify a broader range of energy storage issues beyond interconnection.

- Storage paired with on-site generation. The facility responds to ISO dispatch instructions. Three sub-configurations:
    - Charges only from the utility distribution system.
    - Charges only from the on-site generation.
    - Capability to charge from the grid and from the on-site generation.
- Storage paired with on-site wholesale load. Charges directly from the utility distribution system. Two sub-configurations:
    - Discharges only to the on-site wholesale load.
    - Capable of discharging to the on-site wholesale load and to the utility distribution system.

Customer sited storage – This category is defined as storage resources connected behind the end-use customer meter that request interconnection under a utility's WDAT or the CPUC's Rule 21. The ISO is initially including this category because storage interconnected at this level may want to participate in ISO markets—either individually or aggregated with other customer sited storage. However, it may turn out that the issues raised by this category are too significant in number and complexity to fit within the scope of this interconnection initiative and may need to be deferred to the energy storage roadmap. The ISO is interested in stakeholder feedback on this category and its potential configurations and the relevancy of including it in this interconnection initiative at this time. For example, from an interconnection issues perspective, do stakeholders view an examination of the two previous categories as a higher priority in this initiative than this third category?

The ISO has identified three configurations that may be relevant under this category: stand-alone storage, storage paired with load, and storage aggregated across multiple sites. These are described briefly below.

- Stand-alone storage. Charges only from the utility distribution system and discharges only to the utility distribution system. The storage facility responds to ISO dispatch instructions.[16]
- Storage paired with load. Charges directly from the utility distribution system (i.e., charging energy is supplied in the same manner as the energy used to serve the load) and discharges either to the load or to the utility distribution system. The storage facility responds to ISO dispatch instructions.
- Storage aggregated across multiple sites. This could be stand-alone or paired with load, or some combination of the two. Charges only from the utility distribution system and

[16] Although the ISO is including this configuration for purposes of discussion, the ISO does not see, in the abstract, how such projects would qualify for a Rule 21 interconnection given what appear to be purely wholesale functions.

discharges either to the load or the utility distribution system. The aggregated storage facilities respond to ISO dispatch instructions.

Again, the ISO invites stakeholders to comment on this proposed framework of three categories and associated configurations, and suggest energy storage interconnection issues or challenges associated with each configuration of interest (e.g., where the current interconnection rules either fail to address or conflict with the needs of storage projects). The ISO will use this feedback to inform the design of proposed improvements in the next paper.