California Independent
System Operator Corporation

# Draft Straw Proposal

# Post-Release 1 MRTU Functionality for Demand Response


## Summary

The California Independent System Operator (CAISO) has set a goal of supporting resources that add to California's electric capacity through managing system demand. This document is an initial version of CAISO proposals to enhance the functionality for demand resources that will be in the current release (Release 1) of its Market Redesign and Technology Upgrade (MRTU) program. This Straw Proposal provides details about the enhanced functionality being planned for Post Release 1 MRTU where the goal is to provide demand resources with full comparable functionality as that of generation. This design provides considerable flexibility for demand resources, allowing Participating Loads to (1) bid in CAISO Markets as simply as submitting an Energy Bid, or (2) provide operating characteristics including but not limited to Minimum Load Reduction (minimum MW of demand response), Minimum and Maximum Load Reduction Time, and Minimum Load Reduction Cost in addition to the Energy Bid, or (3) additionally provide capacity as Non-Spinning Reserve. This document is part of a stakeholder process that will specify the core set of software requirements that will be implemented in the CAISO's next phase of demand response.


## Introduction

In an Issue Paper on "Post-Release 1 MRTU Functionality for Demand Response", published on June 26, 2007 (see http://www.caiso.com/1c08/1c0810a2e527b0.pdf) and presented at a demand response working group meeting on that date, the CAISO described the vision for Participating Load functionality that was in the CAISO's original Market Design 2002 ("MD02") filings, but that needed to be deferred until after the initial implementation of Market Redesign and Technology Upgrade ("MRTU"). The reader is encouraged to review the Issue Paper for the background that it provides. Feedback from stakeholders at that meeting indicated that there is interest in proceeding to develop the Participating Load functionality following the concepts that were described. Consequently, the CAISO has documented its proposed functionality in this Draft Straw Proposal, including an appendix titled "Development of Software Requirements for Participating Load (Post-Release 1)". The CAISO's intent is that the final version of this appendix will become part of the Software Requirements Specification that guides the implementation of the Participating Load functionality.

The original MD02 conceptual design included a comprehensive Participating Load model, which included voluntary three-part bids similar to generators' start-up/ minimum-load cost/ multi-segment Energy Bid, RUC participation, Load aggregation, participation in multiple markets (Day-Ahead and Real-Time), eligibility to provide Non-Spinning Reserve, run-time constraints, etc. The original design included options for scheduling at local or aggregated

levels, but the overall MRTU design changed to scheduling of Load at highly aggregated levels, although Dispatch of Participating Load is needed at specific physical locations in the CAISO's transmission network. If the two principles of (1) overall scheduling of Load at a highly aggregated level and (2) dispatching at specific physical locations were simply combined in a way that would first schedule Load at a highly aggregated level and then re-dispatch it at its specific physical location, an opportunity for abusing the market design would be created through scheduling of fictitious Load that is then "curtailed" at a higher price, back to its actual level. This difference meant that the full Participating Load model could not be adapted in time for implementation in MRTU Release 1, and interim solutions needed to be implemented in MRTU Release 1, as described in the June 26 Issue Paper. However, the original Participating Load model was partially developed during MRTU Release 1's implementation, and it appears that it can be restored as a market enhancement after Release 1.

The scope of this document does not include the functionality for pumped storage hydro generation, which is already addressed in MRTU Release 1.

## Principles for Participating Load Functionality

A guiding principle for this Draft Straw Proposal is that as a full dispatchable demand resource model, the Participating Load model should provide flexibility. As the minimum participation, the only required Bid component is an Energy Bid. The ability to provide only the simple Bid structure represented by the Energy Bid can be considered as "Participating Load Lite", i.e. a way of participating that does not require elaborate content of Bids, while also providing additional bidding options within the same program design when Participating Loads have needs for added functionality. The Energy Bid may have up to 10 segments, but a Bid may include fewer segments. In addition, a Participating Load may participate in the Residual Unit Commitment (RUC) process if it submits a RUC Availability Bid.[1] As indicated in the June 26 Issue Paper, Participating Loads may schedule using custom load aggregations, generally within boundaries such as the "sub-LAPs" used in parts of the current Congestion Revenue Right allocation process. This level of aggregation ensures that the CAISO can rely on scheduling and dispatching Participating Load demand resources to manage congestion. Along with ensuring Real-Time reliability of the network, this can help to ensure the feasibility of scheduling Load using the Default Load Aggregation Points (LAPs). If there are insufficient Bids available for Congestion Management of local network constraints, reductions of Load throughout a Default LAP may be necessary, and the result would be high LMPs in constrained locations since a large amount of Load must be rescheduled to relieve a constraint by a small amount. Having Participating Load Bids available at the local level reduces the risk of this outcome.

The example in Figure A illustrates how Participating Load would function with only an Energy Bid curve. In this example, the Participating Load has submitted an Energy Bid with four segments. Following the definition of Base Load in the MRTU Release 1 tariff ("the maximum consumption of a Participating Load as bid in the CAISO Markets by Scheduling Coordinators"), the highest MW level of the Energy Bid is labeled as the "Base Load". The lowest MW level of the Energy Bid is labeled as the "Minimum Load", and in this case (since there is only an Energy

[1] Participation in RUC is required for Resource Adequacy (RA) Resources. A RUC Availability Bid of $0/MWh is currently used for RA Resources, and the CAISO expects this to continue in Release 1A. The CAISO intends to insert adjustments to the CAISO Forecast of CAISO Demand (CFCD) when Load Serving Entities (LSEs) inform the CAISO that they are implementing Day-Ahead demand response programs that are not bid into the CAISO Markets as Participating Load. The CFCD is the basis for the CAISO's capacity reservation in RUC. The CAISO anticipates that this will continue in Release 1A.

Bid, and no optional Bid components have been used), the Minimum Load is a Self-Schedule like a non-Participating Load's Bid could include. The Participating Load's Schedule would be determined economically within its Bid range, i.e., between its Minimum Load and Base Load. In this example, the fourth Bid segment's price is less than the market clearing price at its location, so its Schedule is at the break between its third and fourth Bid segment. This is shown as a reduction ("Load Curtailment") from its Base Load.

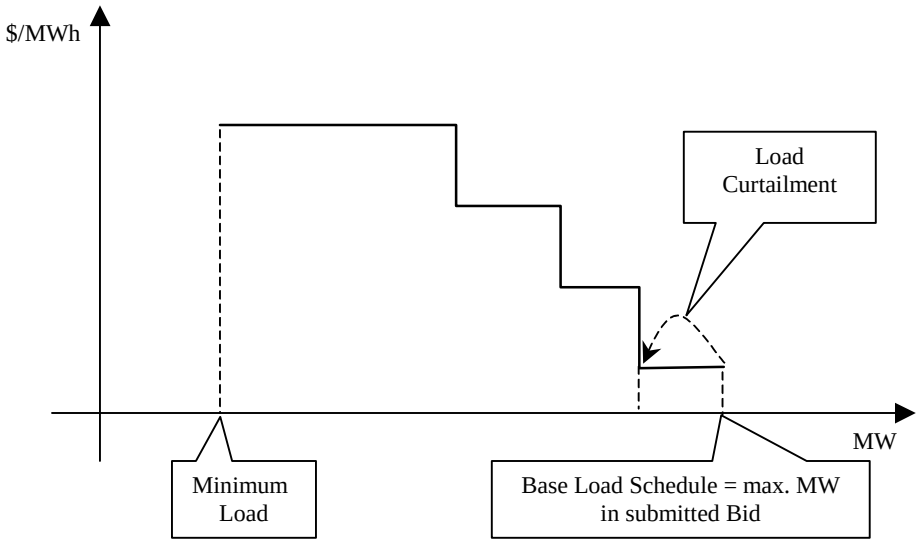


Figure A: Participating Load Energy Bid

The Participating Load model includes the ability to provide Non-Spinning Reserve as well as to participate in the Energy market and RUC procurement. The eligible amount of Non-Spinning Reserve capacity is the Load reduction that can be delivered within 10 minutes, and requires certification by the CAISO to ensure compliance with established technical standards. Ancillary Services such as Non-Spinning Reserve can be simultaneously self-provided for part of the resource's capacity, and bid for any remaining capacity using a single segment for the quantity and price of offered capacity. The RUC Availability Bid indicates the quantity and price of capacity that is offered to meet the CAISO's RUC Requirement. A RUC Award does not alter the Participating Load's Day-Ahead Schedule, but obligates the bidder to offer the RUC capacity for Dispatch in the Real-Time Market.

In addition, the Participating Load model several optional Bid components that may be used by Participating Loads to guide how their capacity is dispatched in the CAISO Markets, but that are not required. These are listed in the following table:

| Comparison of Dispatchable Demand Resource Bid Components with Generation Resource | |
|---|---|
| **Dispatchable Demand Resource** | **Generator Resource** |
| Base Load Schedule | Base Load |
| Minimum Load Reduction | Minimum generator output |
| Minimum Load | Maximum generator output |
| Load Reduction Initiation Time | Start-up time |
| Minimum Load Reduction Time | Minimum up time |
| Maximum Load Reduction Time | Maximum daily energy limit |
| Minimum & Maximum Daily Energy Limit | Maximum daily energy limit |
| Load Drop Rate | Ramp up rate |
| Load Pickup Rate | Ramp down rate |
| Load Reduction Initiation Cost | Start-up cost |
| Minimum Load Reduction Cost | Minimum load cost |

The availability of these Bid components provides Participating Loads with essentially the same flexibility that generators have in the CAISO Markets to ensure that the CAISO's Dispatch recognizes limitations in their availability. In addition to the Minimum Load's relevance even if only the Energy Bid is submitted, the Bid components that are pertinent to all Participating Loads are the Load Drop Rate and Load Pickup Rate, which indicate how fast the Participating Load can respond to the CAISO's Dispatch. The remaining optional Bid components are meaningful if a Participating Load has a minimum amount of load, which is the "Minimum Load Reduction" that must be dispatched if any Load Curtailment is used; these are: Base Load Schedule, Minimum Load Reduction, Load Reduction Initiation Time, Minimum & Maximum Load Reduction Time, Minimum & Maximum Daily Energy Limit, Load Reduction Initiation Cost, and Minimum Load Reduction Cost.

The role of these optional Bid components can be seen by comparing Figure B, "Generator Bid", with Figure C, "Participating Load Bid with Minimum Load Reduction". The generator's output is variable within the range of its Energy Bid, but cannot operate below its "Gen Minimum Output". To reach its minimum output, the generator may incur start-up costs. To operate at its minimum output level, it may incur average costs that are higher than the incremental cost at points within its first Bid segment. The generator may have operating limits including how fast it can start, how long it must run once it starts, and how much Energy it can produce in a given day. The CAISO's market optimization will take these costs and operating limits into account in determining the optimum Schedules for this and other supply resources. Similarly, the operation of the Participating Load shown in Figure C is variable within the range of its Energy Bid, but if it reduces its Demand below its Base Load, it must reduce by at least its Minimum Load Reduction. It may incur a minimum cost for starting each Load Curtailment, or an hourly cost for its minimum Load Curtailment that exceeds the price at which it can offer additional reductions in Demand. The Participating Load may have operating limits including how fast it can initiate its Load Curtailment, a minimum amount of time that it must remain off-line once it starts a Load Curtailment, a maximum duration of a Load Curtailment, or minimum or maximum amounts of Energy reduction during Load Curtailments. The attributes that the CAISO proposes to include as Bid components are listed in the table above, which the CAISO believes to form a very flexible array of options for managing demand resources.

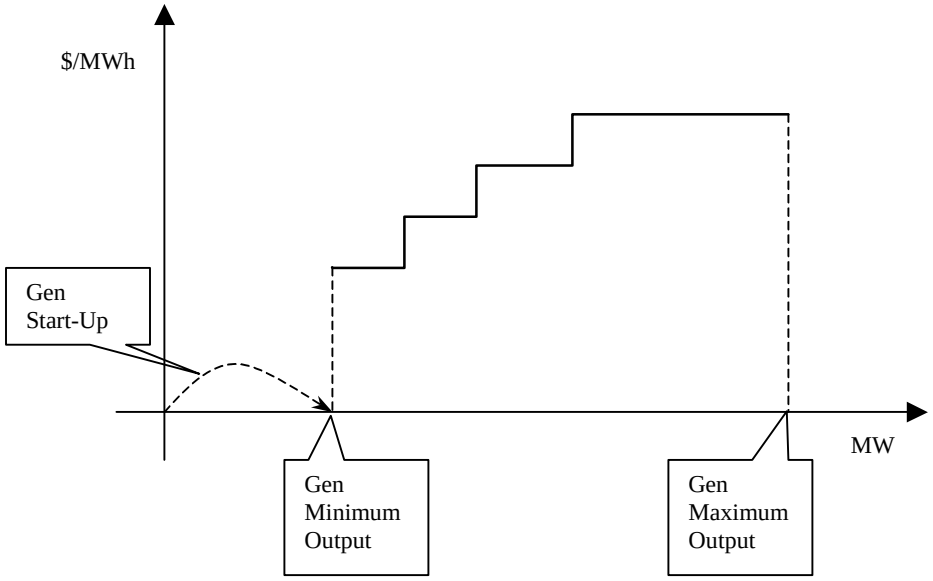


Figure B: Generator Bid

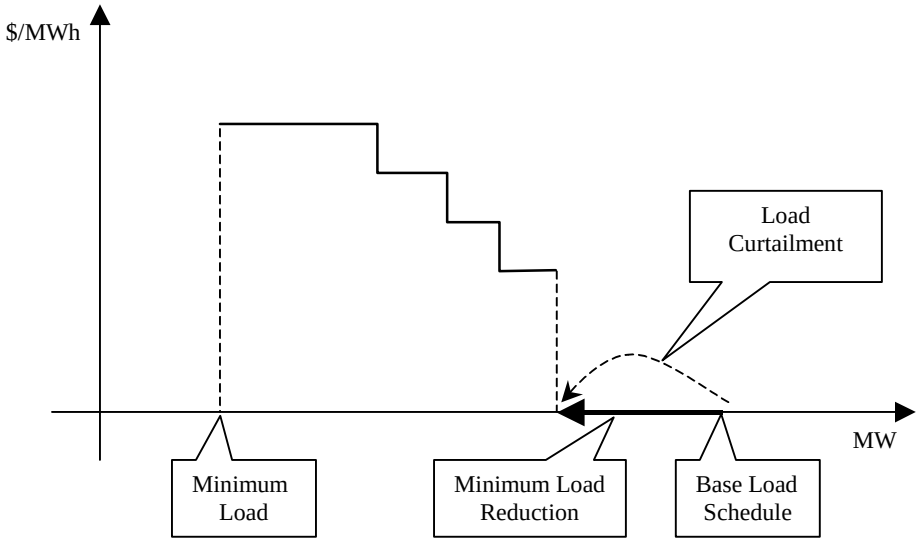


Figure C: Participating Load Bid with Minimum Load Reduction

In releasing this Draft Straw Proposal for review in a working group setting, the CAISO is interested in inputs as to whether additional Bid components are needed for Participating Load functionality soon after implementation of MRTU Release 1. This Draft Straw Proposal has limited its optional Bid components to ones that are in the vendor's design that was partially implemented during MRTU Release 1, and currently excludes two optional Bid components that the CAISO has previously discussed but are not documented in the vendor's existing design:

- Minimum Base Load Time (minimum time after load restoration, before the next Load reduction – equivalent to Minimum Down Time for generators), and
- Maximum number of daily load curtailments (equivalent to Maximum Daily Starts for generators)

The CAISO can consider adding these items to its post-Release 1 design, but doing so will require explanations by stakeholders as to why they are needed. The CAISO will also be interested in stakeholder input that identifies other optional Bid components that are needed soon after MRTU Release 1, which again should include explanations as to why they are needed.

The CAISO also sees the development of this Straw Proposal as an opportunity to identify potential future enhancements to its Participating Load functionality. Examples of potential future enhancements include:

- It is possible that the Real-Time Market's clearing price may understate the value of ramping capacity, as short price spikes have occurred in the pre-MRTU market when economic resources cannot ramp quickly enough to meet changes in system Demand, or as sustained ramping periods have produced capacity shortages. Some demand resources can be among the sources of ramping capacity.
- Current Ancillary Service products (which provide 10-minute availability) may not be the best match for local supply scarcity (which requires availability in 20- to 30-minutes, or more).
- Participating Load may be able to provide Spinning Reserve or Regulation, but the technical requirements and conformance to WECC Minimum Operating Reliability Criteria (MORC) for doing so would require further development.

The CAISO invites input as to whether these or other longer-term enhancements should become part of the Participating Load model. The CAISO will need to understand how any suggested enhancements fit into its overall market development strategy, which is managed through a process known as the "Market Initiatives Roadmap". Once potential future enhancements are identified, they can be placed in the Roadmap process for prioritization among the CAISO's other initiatives.

## Next Steps

The CAISO's publication of its June 26 Issue Paper and this Draft Straw Proposal are the beginning of a process that will result in implementing improvements to the Participating Load functionality of MRTU Release 1. The CAISO's proposed schedule for moving toward implementation steps is as follows:

- CAISO issues Draft Straw Proposal: 9/25/07
- Working Group comments requested by: 10/3/07
- Working Group meeting (coordinated with Release 1 working group): 10/16/07
- CAISO revises Draft Straw Proposal: 10/23/07
- Working Group comments requested by: 10/30/07
- CAISO issues Straw Proposal to stakeholders: 11/6/07
- Stakeholder meeting/conference call: Mid-November
- Working Group input on Business Practice Manual and User Guide begins: December 2007

Through this process, both conceptual and implementation issues will be identified and explored. Among these is the need for bidding activity rules or other market power mitigation requirements, including but not limited to:

- Whether any controls must be established on what amount of Base Load can be scheduled.
- Whether Minimum Load (which is not included as a price-sensitive portion of the Energy Bid) should be settled at the locational LMP of the Participating Load or at the Default LAP like a non-Participating Load. The current MRTU tariff provides that the entire Demand of a Participating Load resource is settled at the locational LMP.
- Whether rules need to be established for Bid Cost Recovery to ensure that action by the Load was actually necessary to reduce its Demand. That is, there may be opportunities for Participating Loads to structure their Bids to be eligible for Bid Cost Recovery when their resulting Schedule is where they normally would be operating, with no actual demand response being necessary. It may be necessary to make Bid Cost Recovery subject to a validation of verifiable costs.
- Whether there is a need for scheduling Participating Loads in the Hour Ahead Scheduling Process (HASP). The CAISO's current proposal has concluded that the bidding options that are described in this paper already exceed any benefit that would be available in HASP, including Bid Cost Recovery and the opportunities for Participating Loads to specify a Load Reduction Initiation Time that can exceed the 45-minute notice that is provided in HASP, and to specify a Minimum Load Reduction Time that can exceed the one-hour duration that is provided in HASP.
- Whether there are any interactions between Convergence Bidding and Participating Load, and the role of demand response in Scarcity Pricing.

# Appendix

# Development of Software Requirements for Participating Load (Post-Release 1)

## 1 Introduction

This document describes enhancements to functionality in Release 1 of the CAISO's Market Redesign and Technology Upgrade (MRTU) for Load resources that wish to actively participate in the CAISO Markets. These resources are known as "Participating Loads", and participate in the CAISO Markets through tariff provisions including the following definitions:

> **Participating Load**: An entity, including an entity with Pumping Load, providing Curtailable Demand, which has undertaken in writing by execution of a Participating Load Agreement to comply with all applicable provisions of the CAISO Tariff, as they may be amended from time to time.
>
> **Curtailable Demand**: Demand from a Participating Load or Aggregated Participating Load that can be curtailed at the direction of the CAISO in the Real-Time Dispatch of the CAISO Controlled Grid. Scheduling Coordinators with Curtailable Demand may offer it to the CAISO to meet Non-Spinning Reserve or Imbalance Energy.
>
> **Custom Load Aggregation Point (Custom LAP):** An aggregation of Load PNodes created by the CAISO based on a set of custom LDFs submitted by a Scheduling Coordinator, at which such Scheduling Coordinator may submit a single Bid and settle Demand consistent with the CAISO Tariff rules, and for which the Scheduling Coordinator is required to submit to the CAISO Meter Data for the nodal Load represented in such aggregation.

MRTU Release 1 includes limited functionality for Participating Loads, and the CAISO intends to expand this functionality in a later release. In addition to participation in the Day Ahead Market (DAM) providing opportunities for response by Participating Loads to the CAISO's needs for capacity that might not be available in the Real-Time Market (RTM), and because the CAISO intends to procure 100% of its Ancillary Service capacity (e.g., Non-Spinning Reserve) in DAM, the functionality described herein will be available in both DAM and RTM. For other types of resources, participation in DAM and RTM involve separate bidding and scheduling processes in most ways – differences involve aspects such as bidding activity rules, and scheduling priority in RTM for schedules that have been established in DAM. Similarly, the functionality described in this document is intended to apply to both DAM and RTM, except where specific differences are noted.

The scope of this document does not include the functionality for pumped storage hydro generation, for which MRTU Release 1 provides at least some functionality.

## 2 Load Aggregation

### 2.1 General Requirements

The MRTU market design aggregates Loads using Standard/Default Load Aggregations and Custom Load Aggregation Points (Custom LAPs). The CAISO will determine criteria for the designation of Custom LAPs. For scheduling and settlement, SCs may schedule Participating Load using a Custom LAP or at a nodal level if they are registered to schedule at the nodal level. The load that is scheduled at an aggregated level will be distributed to nodes according to relevant Load Distribution Factors (LDFs). The LDFs for the Custom LAPs for aggregated Participating Load are fixed (i.e., not variable) during the optimization. The IFM/RUC application shall provide final DA and RT schedules at each bus and at the same aggregation level that SCs specified when they submitted their schedules.

### 2.2 LMPs for Aggregated Participating Load

A Participating Load aggregation is treated as an aggregate control in the optimization, with a fixed distribution to the underlying nodes using the relevant Custom LDFs. For Participating Load, the Locational Marginal Prices (LMPs) calculated at Aggregated Pricing Nodes (APNodes) are aggregated, weighted-average of the LMPs at the Pricing Nodes (PNodes) that make up the APNodes, weighted by the same LDFs that are used to distribute the aggregated Participating Load Bid to nodes during the optimization.

Custom Load Aggregations that represent Participating Loads are excluded from the calculation of the aggregated LMPs for Default Load Aggregation Points. While LDFs for Default LAPs' Load are determined based on historical State Estimator data, LDFs for Custom LAPs are established by the CAISO using data provided by the Scheduling Coordinator. A question to be resolved is whether Scheduling Coordinators should be able to update the LDFs for Custom LAPs through their Bid submissions, or remain as Master File data as in MRTU Release 1. Similarly, the frequency of updates of the static LDFs in the Master File based on nodal Meter Data, and requirements for hourly submission of nodal Meter Data for Settlement, need to be established.

## 3 Bids Usage and Treatment in IFM/RUC Application

### 3.1 Bids for Participating Loads

Bids for Participating Loads provide for participation in CAISO Markets beyond that of non-Participating Loads. Non-Participating Loads can submit a monotonically decreasing staircase curve having up to 10 segments defined by MW load levels and prices. This Bid curve applies to scheduling at a Default LAP. There are no inter-temporal constraints in the Bid for a non-Participating Load (i.e., it is not a three-part bid).

Participating Load shall be modeled at a specified node or Custom Load Aggregation. The Participating Load functionality supports a variety of Bid components in order to provide Scheduling Coordinators with flexible options for structuring Demand Response programs, including a three-part bid and certified operating limits, ramp up/down rates, and inter-temporal constraints, as detailed further below. A Participating Load may also provide Non-Spinning Reserve with a capacity and energy bid up to a certified capacity, and may offer capacity for Residual Unit Commitment (RUC).

Figure 1 shows an example of a Participating Load Energy Bid.

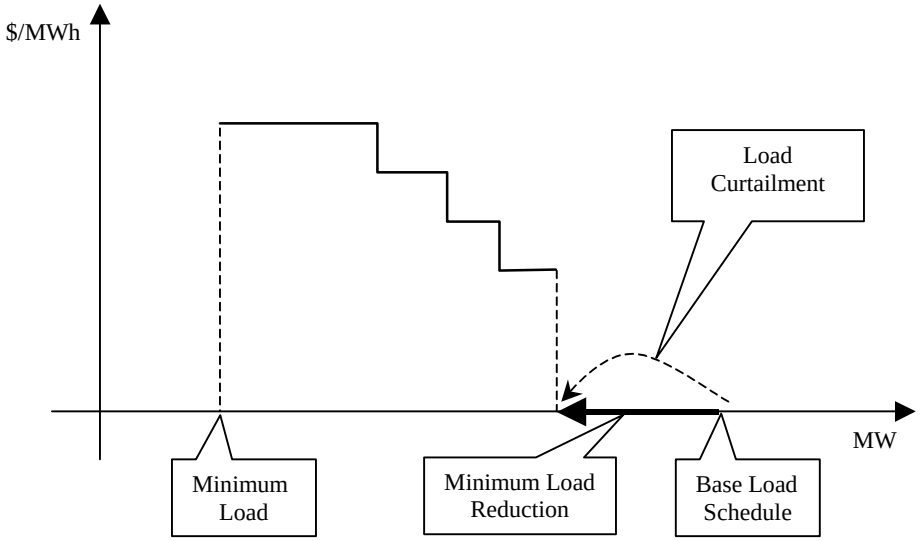


***Figure 1.*** *Participating Load Energy Bid*

The Energy Bid Curve is required, but use of the other Bid components is optional. The three-part bid includes the following:

- Load Energy Bid curve (required, allows multiple segments) [2]
- Load Reduction Initiation Cost (optional)
- Minimum Load Reduction Cost (optional)

A RUC Availability Bid is optional, but may be required if a Demand Resource is a Resource Adequacy Resource:

- RUC Availability Bid

The Participating Load model data provides the following additional Bid components, [3] which are included in submitted Bids only at the option of the Participating Load. Default values will be used if specific values are not submitted in the Bid for a Participating Load. [4]

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2 The energy bid that is submitted by the SC has up to ten segments. But SIBR may add up to ten additional segments from the proxy bid curve. Therefore the energy bid that is passed to the IFM from SIBR may have up to 20 segments. In addition, the IFM application may add additional segments to represent various self-scheduling priorities.

3 This list of Bid components is based on design documents that have previously been discussed with the CAISO's vendor. Other potential Bid components that the CAISO has considered are (1) Minimum Base Load Time (minimum time after load restoration, before another Load reduction is dispatched), and (2) Maximum Number of Daily Load Curtailments. Stakeholders who believe that these Bid components are required in the CAISO's implementation should explain in comments on this draft document why they believe these are necessary.

4 The default values are:

- Base Load Schedule: maximum MW in Energy Bid
- Load Reduction Initiation Time: zero
- Minimum Load Reduction Time: zero
- Maximum Load Reduction Time: unlimited (i.e., a large number)
- Load Drop Rate: unlimited (i.e., a large number)

- Base Load Schedule (see discussion below)
- Load Reduction Initiation Time (the time required to initiate Load reduction – single segment)
- Minimum Load Reduction Time (the minimum time required to operate at reduced load after load reduction initiation)
- Maximum Load Reduction Time (the maximum time required to operate at reduced load after load reduction initiation)
- Load Drop Rate (the ramp rate for load drop)
- Load Pickup Rate (the ramp rate for load pickup)
- Minimum and Maximum Daily Energy Limits (limits on daily energy from load reduction, if a Curtailable Demand Bid is dispatched)
- Maximum Non-Spinning Reserve Capacity (MW and price for load reduction within 10 minutes, for qualified resources) [5]

A Participating Load may specify a "Base Load" as part of its Bid. [6] The specification of a Base Load causes the Bid to be treated differently in the optimization if the Base Load exceeds the maximum MW of Load that is stated in its Energy Bid. The two options are:

1. If the Participating Load designates a Base Load that is higher than the maximum MW of Load that is stated in its Energy Bid, then the difference between (a) its designated Base Load, and (b) the maximum MW of Load that is stated in its Energy Bid, defines a "Minimum Load Reduction". That is, the CAISO's optimization may set the Schedule for the Participating Load either (a) at the designated Base Load or (b) within the range of the Energy Bid, but the CAISO's optimization shall not schedule the Participating Load within the range defined as the Minimum Load Reduction. So that the CAISO's optimization considers a meaningful decision between these two points, the Base Load is considered to be a Self-Schedule by the Participating Load if the Minimum Load Reduction is greater than zero (i.e., if the Base Load is higher than the maximum MW of Load that is stated in its Energy Bid). The CAISO's optimization then determines whether to accept the Participating Load's Bid to reduce its Demand below its Base Load.
   If a Participating Load's Bid includes a Minimum Load Reduction, then its Bid may also include (a) a Load Reduction Initiation Cost (which is a fixed cost for reducing Load below the Base Load, regardless of the duration of reduction below the Base Load), and/or (b) a Minimum Load Reduction Cost (which is an hourly cost of reducing Load below the Base Load). The Load Reduction Initiation Cost and Minimum Load Reduction Cost will affect the CAISO optimization's determination of whether (a) the Participating Load's optimal

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- Load Pickup Rate: unlimited (i.e., a large number)
- Minimum and Maximum Daily Energy Limits: minimum = zero, maximum = unlimited (i.e., a large number)
- Maximum Non-Spinning Reserve Capacity: zero

[5] Ancillary Services may be simultaneously self-provided for part of the resource's capacity, and bid for remaining capacity. If a Participating Load's Non-Spinning Reserve capacity Bid is accepted in DAM, then its Energy Bid range in RTM must be at least as much as the awarded Non-Spinning Reserve.

[6] The MRTU Release 1 tariff defines "Base Load" as "the maximum consumption of a Participating Load as bid in the CAISO Markets by Scheduling Coordinators."

schedule remains at its Base Load (i.e., the combination of Energy Bid, Load Reduction Initiation Cost, and Minimum Load Reduction Cost does not make it economic to reduce the Participating Load's Schedule below the Base Load, which is its Self-Schedule if its Curtailable Demand Bid is not accepted), or (b) its Curtailable Demand Bid is accepted and it is scheduled at a lower MW level within the range of the Energy Bid.

2. If the Participating Load's Bid does not designate a Base Load, or the designated Base Load does not exceed the maximum MW of Load that is stated in its Energy Bid, it is considered to be able to provide Demand Response over the entire range of its Energy Bid, and its Base Load is treated as the maximum MW of Load that is stated in its Energy Bid. [7] In this case, the minimum MW of Load in its Energy Bid (i.e., the start of its first submitted Bid segment) constitutes the Participating Load's Self-Schedule. This Self-Schedule up to the start of the first energy bid point is a "price taker", i.e., it is charged the relevant aggregate LMP regardless of its dispatched level up to the self-scheduled MW, as is any non-Participating Load. In the CAISO's optimization, scheduling of the self-scheduled MW is implemented for Congestion Management by inserting "uneconomic" Bid segments between zero MW and the self-scheduled MW, based on artificial prices ("penalty prices", in optimization terms) that reflect various scheduling priorities, such as TOR and ETC schedules, etc. – the same as is the case for non-Participating Load. [8]

For Generating Units, a resource's minimum load ("Pmin") is registered in the CAISO's Master File, and changes to the resource's minimum load due to derates are reported in SLIC or the Siemens Outage Scheduler. For a Participating Load, the Minimum Load Reduction is submitted implicitly with the energy bid, as the difference between Base Load and the last (highest) MW Energy Bid quantity. Thus, there is no need for updates to be received from SLIC or the Siemens Outage Scheduler.

### 3.2 RUC Participation

By submitting a RUC Availability Bid, a Participating Load indicates the quantity (MW) and price ($/MWh) at which it offers to sell capacity for the specified interval of time to meet the CAISO's Residual Unit Commitment requirement. The CAISO's acceptance of a RUC Availability Bid does not alter the Participating Load's Day-Ahead Schedule, but obligates the bidder to offer the RUC capacity for dispatch in RTM. A RUC participation flag that is contained in its Bid submitted to the IFM controls participation of each Participating Load in RUC. For Load resources, only Participating Loads can participate

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7 If the Base Load does not exceed the maximum MW of Load that is stated in its Energy Bid, its Minimum Load Reduction equals zero. If a Participating Load's Bid states a Load Reduction Initiation Cost and/or Minimum Load Reduction Cost but does not have a Minimum Load Reduction greater than zero, then the Load Reduction Initiation Cost and/or Minimum Load Reduction Cost will be ignored.

8 If the Base Load exceeds the maximum MW of Load that is stated in its Energy Bid, and therefore its Base Load is its Self-Schedule, the CAISO's optimization shall also insert "uneconomic" Bid segments for Congestion Management between zero MW and the lowest MW level in the Energy Bid curve. However, the Base Load constitutes the "price taker" Self-Schedule if the optimization does not accept the Curtailable Demand Bid.

in RUC. [9] The RUC participation flag has the same values that are defined for generators.

### 3.3 Market Power Mitigation

The CAISO will determine Market Power Mitigation requirements once the general design of the Participating Load functionality is established, through consultation with its Department of Market Monitoring. This may include bidding activity rules or other requirements.

## 4 Modeling of Participating Load Resources in Optimization

This section builds on the previous sections by describing the Participating Load model's formulation in optimization terms, as part of implementing the business requirements stated above.[10] The functionality described herein anticipates the use of an explicit Participating Load Resource model with a three-part bid as follows:

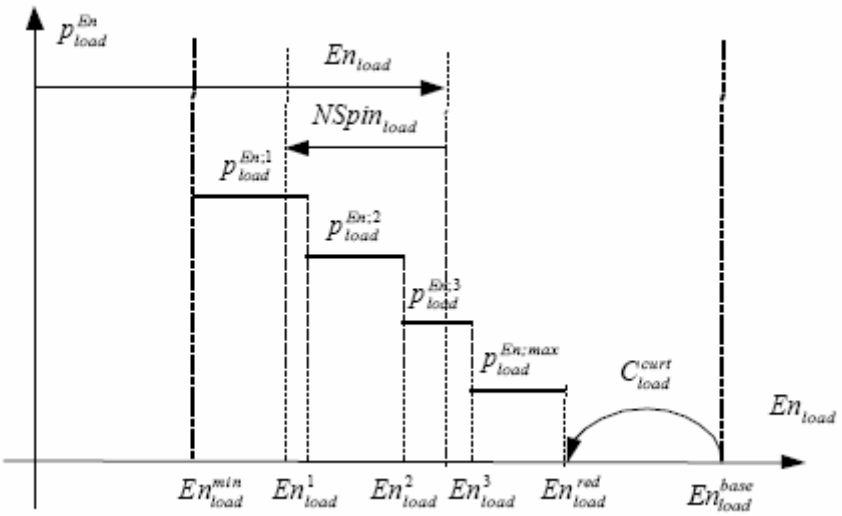


*Figure 2. Participating Load Resource model*

The contribution of a dispatched Participating Load Resource at time period *t* in the objective function of the DAM and RTM is as follows:

$$C_{load}^{curt} + C_{load}^{\min} - C_{load}^{En}(En_{load}^{t}) + C_{load}^{NSpin}(NSpin_{load}^{t}) \quad (1)$$

Where:

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9 In cases where Load-Serving Entities have Demand Response programs that utilize the CAISO's non-Participating Load functionality, the CAISO may adjust the RUC procurement target using he same mechanisms that are being defined and used prior to implementation of the expanded functionality described herein.

10 The latest description of the Participating Load functionality for MRTU Release 1 was stated in the CAISO's Software Requirements Specification Addendum for the Real Time Market, version 1.2, and has been adapted for the current document. The CAISO will be discussing the software specifications with its vendor to determine the additional features that can be readily implemented.

| | |
|---|---|
| $En_{load}$ | is the dispatch (DOT); |
| $En_{load}^{base}$ | is the Base Load; |
| $En_{load}^{red}$ | is the dispatch at Minimum Load Reduction; |
| $En_{load}^{\min}$ | is the minimum dispatch; |
| $En_{load}^{i}$ | for *i*=1,2,…,*n*; define the segments of the energy bid; |
| $p_{load}^{En;i}$ | for *i*=1,2,…,*n*; are the prices of the energy bid segments; |
| $C_{load}^{En}\left(En_{load}\right)$ | is the energy bid (the incremental cost as a function of dispatch); |
| $NSpin_{load}$ | is the Non-Spinning Reserve Award; |
| $C_{load}^{curt}$ | is the Load Reduction Initiation Cost (the cost to initiate load reduction); |
| $C_{load}^{\min}$ | is the Minimum Load Reduction Cost (the cost/hr to operate at reduced load); and |
| $C_{load}^{NSpin}$ | is the Non-Spinning Reserve Bid Price. |

The following inter-temporal constraints apply to Participating Load Resources:

a) Load Reduction Initiation Time (the time required to initiate load reduction);

b) Minimum Load Reduction Time (the minimum time required to operate at reduced load after load reduction initiation);

c) Maximum Load Reduction Time (the maximum time required to operate at reduced load after load reduction initiation);

d) Load Drop Rate (the ramp rate for load drop);

e) Load Pickup Rate (the ramp rate for load pickup);

f) Minimum and Maximum Daily Energy Limits (limits on daily energy from load reduction).

Participating Loads will not contribute reactive power capacity for voltage regulation.

## 5 Settlement Principles

The basic principle for financial Settlements for this Participating Load model is that DAM and RTM establish scheduled levels of operation, which creates a financially binding Day-Ahead Schedule for purchases at the CAISO's Day-Ahead LMPs, and that the final Settlement in RTM will be based on the difference between Settlement Quality Meter Data and the Day-Ahead Schedule, priced at Real-Time LMPs. The benefit of being a Participating Load rather than a non-Participating Load is the ability to offer Bids in RTM that will receive Dispatches from the CAISO that indicate opportunities to be paid at least the Bid price for Load reductions as well as to buy additional Energy at no more

than the Bid price, to respond to locational prices for Energy purchases in DAM as well as RTM, and (if qualified) to earn capacity payments for Non-Spinning Reserve.

In addition, to the extent that a Participating Load includes a Load Reduction Initiation Cost and/or hourly Minimum Load Reduction Cost in its Bid, it will be assured that its market revenues for Load reductions in DAM or RTM will be at least as much as these Bid components. The principles for Bid cost recovery will be the same as for other resources, as described in the CAISO Tariff.

## 6 Changes from Software Requirements Specification for MRTU Release 1

An implementation of the Participating Load model was included in MRTU Release 1 and was partly implemented, but as other aspects of the MRTU Release 1 design evolved, not all market design features of the Participating Load model could be conformed to the overall design within the required timeframe. The latest description of the Participating Load functionality for MRTU Release 1 was stated in the Software Requirements Specification Addendum for the Real Time Market, version 1.2, and has been adapted for the current document.

In the original design, a Participating Load was required to self-schedule a “Base Load” in the IFM in order to provide Demand Response and/or Non-Spinning Reserve. The “Base Load” Self Schedule would be a price taker, i.e., it would be charged the relevant aggregate LMP, like any non-Participating Load. Using the “Base Load” as its initial schedule, Demand Response would be provided using a three-part Bid and certified operating limits, ramp up/down rates, and inter-temporal constraints. When the Participating Load would be dispatched (curtailed) from its Base Load, it would be paid the LMP for the Load reduction at its specific location, in addition to being charged for its Base Load at the Default LAP price. The Participating Load would be eligible for recovering its Load Reduction Initiation Cost and its hourly Minimum Load Reduction Cost through Bid cost recovery. The original design’s difference in Settlement between the Base Load and reductions from the Base Load led to requirements (1) for the Participating Load to qualify for locational pricing of its demand response by registering a minimum value for its Minimum Load Reduction in the CAISO’s Master File, (2) for SIBR to validate that the Participating Load’s Base Load exceeds the highest Energy Bid quantity by no less than the registered Minimum Load Reduction, and (3) for the optimization process to check whether a derate had increased the Minimum Load Reduction below the last energy bid quantity, and potentially delete the overlapping portion of the energy bid for the duration of the derate. Non-Spinning Reserve would optionally be provided with a capacity and Energy Bid up to a certified capacity, subject to Demand Response plus Non-Spinning Reserve not exceeding the Base Load schedule.

The revised design requirements described in this document are very similar to the original design requirements. One difference is that the Base Load will now be settled at the same locational price as reductions from the Base Load. As a result, there is no need to limit to a Master File value, or validate the Minimum Load Reduction against a Master File value, and the implementation is simplified. This also results in a more flexible design from the perspective of the Participating Load, which can determine whether its own business needs justify defining a Minimum Load Reduction.

The original design would have also required validation that the Base Load could be scheduled as a Self-Schedule as part of the Default LAP, separately from the

determination of whether Load reductions should be dispatched at the locational price, whereas the current design allows the use of a single Energy Bid. The current design sets the self-scheduled quantity differently depending on whether the Participating Load's Bid includes a Minimum Load Reduction, but this is more a matter of semantics than of constructing the bid curve in the optimization process. By avoiding the requirement for each Participating Load to have a Minimum Load Reduction greater than zero, the current design may improve the performance of the optimization process.

The original design also contains references to a separate hour-ahead market and to binding scheduling and dispatch in the Hour-Ahead Scheduling Process, which are no longer part of the MRTU design.

Although it appears that the current design simplifies the implementation, whether these changes do facilitate the implementation of the Participating Load model will need to be determined through consultation with the vendor while the design is being completed.