2.3 CAISO Markets

This subsection presents a high level description of the Day-Ahead and Real-Time Markets. Market bidding timelines and primary activities are also discussed. Refer to Exhibit 2-1.[1]

[1] Trading Day-1 refers to the time when the Extra Long Commitment takes place, which happens after the Day Ahead market is complete, from Trading Day-1 1000 to 1300. The 'extremely long unit commitment' process takes place at 1500, and is still part of the Trading Day-1 process even though it applies to the subsequent day. Please see section 6.8 for further detail.

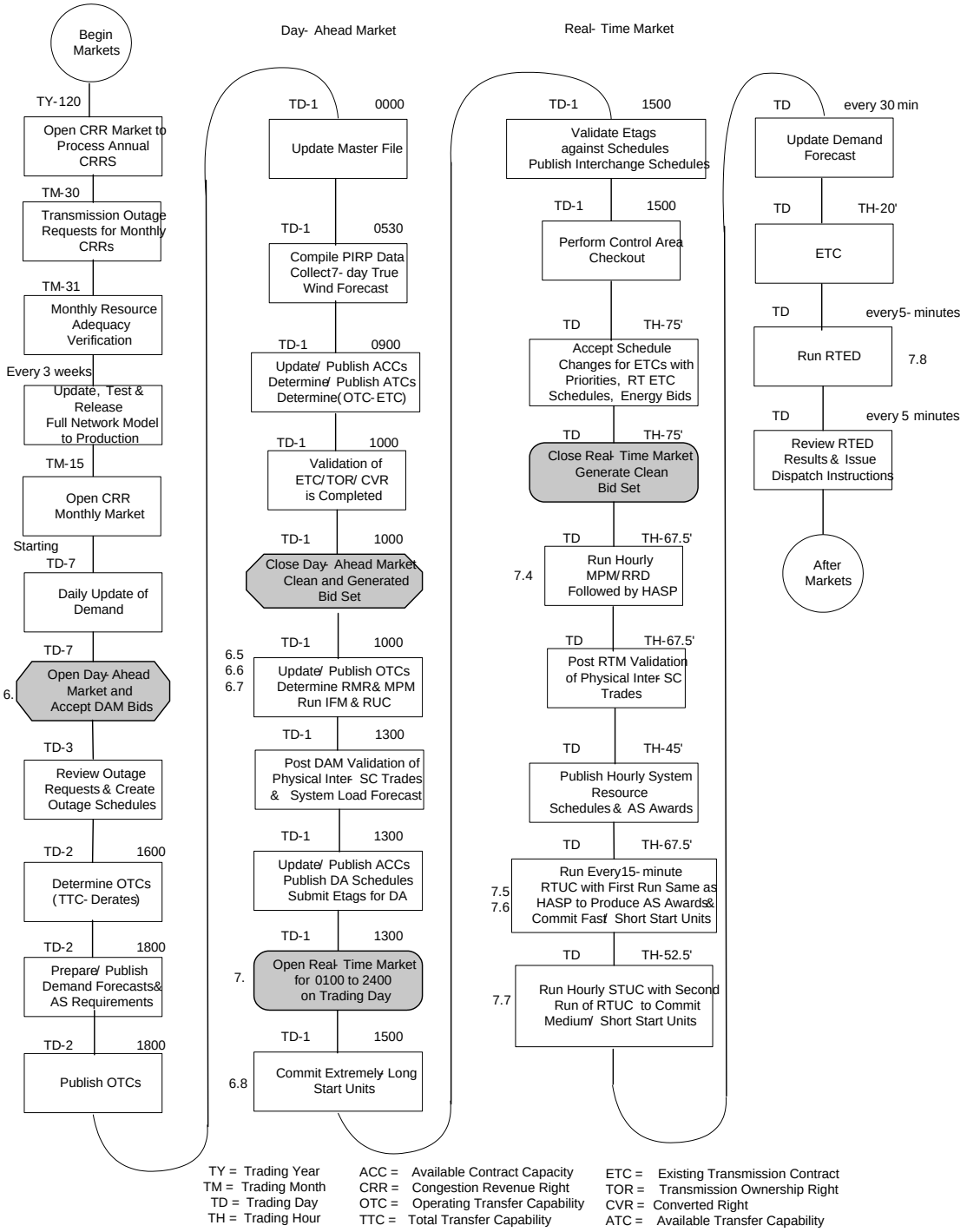

Exhibit Error! No text of specified style in document.**-1: CAISO Markets – Overview Timeline**

The manual ELC process is in addition to the RUC process and is conducted as part of the Day Ahead Operating Procedures and considers Bids submitted in the DAM for the operations two days out. Any commitment outside this time frame of an ELC resource would be an Exceptional Dispatch. ~~commitments for the two days out.~~

2.3.1.3 Residual Unit Commitment

Residual Unit Commitment is a reliability function for committing resources and procuring RUC Capacity not scheduled in the IFM (as physical Energy or AS capacity.) RUC Capacity is procured in order to meet the difference between the CAISO Forecast of CAISO Demand (CFCD) (including locational differences and adjustments) and the Demand scheduled in the IFM, for each Trading Hour of the Trading Day. In addition, RUC anticipates supply and demand over a longer look-ahead time period (default to 72 hours but can be up to 168 hours, compared to 24 hours in the IFM). This allows RUC issue advisory commitment instructions for Extremely Long-Start Resources which may not be considered in the IFM due to their long start-up times. These advisory instructions are considered as part of the ELS commitment process described in Section 6.8 below. In order to reduce cycling of resources through the transition from one day to another, RUC looks-ahead beyond the binding 24 hour period as it procures capacity and make commitment decisions for the applicable binding time horizon, taking into account expected needs in the forward days beyond the 24 hour time period. Refer to Section 6.7, Residual Unit Commitment. The CAISO, however, runs the RUC process for every Trading Day regardless of the difference between the CFCD and the Scheduled Demand in the IFM. The objective of the RUC is to ensure sufficient physical capacity is available and committed at least cost to meet the adjusted CAISO Forecast of CAISO Demand for each hour of the next Trading Day, subject to transmission and resource operating constraints. RUC achieves this objective by minimizing the total of Start-Up Costs, Minimum Load Costs and incremental availability costs (i.e., RUC Availability Bids). As a result, it is possible that when RUC runs RUC may procure Capacity and possibly commit resources even though the CAISO Forecast of CAISO Demand prior to the taking into account the locational differences and adjustments, is equal or less than the Scheduled Demand of the SCs resulting from the IFM. This can happen because the locational quantity of load scheduled in the IFM may be different than the locational quantity of load after distributing the adjusted CAISO Forecast of CASIO Demand in RUC. In addition, RUC may need to commit resources to the extent virtual supply displaces physical supply in the IFM.

Resources receive a binding Start-Up Instruction from RUC (if committed by RUC), only if they must receive start up instruction in DAM to meet requirements in RTM. Other resource commitment decisions are determined optimally in the RTM.

2.3.1.4 Extremely Long-Start Commitment

The commitment of resources that require a Start-Up Time of greater than 18 hours or notification earlier than the publication of the DAM is considered both in the RUC (explained in the previous section) and in the Extremely Long-Start Resource

commitment process. Extremely Long-–Start resources receive advisory startup-up instructions through the RUC process. Such start-up instructions are confirmed and made binding and communicated manually by CAISO operators. Refer to Section 6.8, Extremely Long-Start Resource commitment, for the details of this process.

6.4.7 Resource Commitment

The commitment of resources by the Day-Ahead and Real-Time applications is shown in Exhibit 6-2.

Exhibit Error! No text of specified style in document.**-2: Generating Unit Commitment Selection by Application**

Attribute	Fast Start	Short-Start	Medium Start	Long-Start	Extremely Long-Start
Start Up Time	less than or equal to 10 minutes	less than 2 hours	between 2 & 5 hours	between 5 & 18 hours	greater than 18 hours
Cycle Time		less than or equal to 270 mins	less than or equal to 270 mins		
Day-Ahead Applications					
IFM	Commit	Commit	Commit	Commit	No Commit
RUC	Advisory	Advisory	Advisory	Commit	~~No~~ Advisory Commit
ELC[2]	Advisory	Advisory	Advisory	Advisory	Commit
Real-Time Applications					
RTUC	Commit/ Advisory	Commit/ Advisory	No Commit	No Commit	No Commit
STUC	Commit/ Advisory	Commit/ Advisory	Commit	No Commit	No Commit

[2] Extremely Long-- Start Commitment Process

6.7 Residual Unit Commitment

As described above, the IFM clears the market based on the Self-Schedules and Economic Demand Bids of the SCs, and as a result it may clear at an overall level that is significantly lower than the CAISO Forecast of CAISO Demand for the next day. The purpose of the RUC process is to assess the resulting gap between the IFM Scheduled Load and the CAISO Forecast of CAISO Demand, and to ensure that sufficient capacity is committed or otherwise be available for Dispatch in Real-Time in order to meet the Demand Forecast for each Trading Hour of the Trading Day.

To achieve this objective, the RUC process may commit and issue Start-Up Instructions to resources that are not committed at all in the IFM, as well as identify additional unloaded capacity from resources that are committed and scheduled in the IFM and designate this capacity as needed for Real-Time Dispatch in particular Trading Hours of the Trading Day.

While RUC only procures capacity for the 24 hours of the next day, RUC's time horizon is configurable from 24 hours up to 168 hours, unlike the 24 hour time horizon in IFM. This longer time horizon allows RUC to consider capacity needs in beyond the first day, which enables RUC to procure capacity in a manner that may reduce unit cycling over the midnight hours. For example, if RUC needs additional capacity near the end of the trading day RUC may procure that capacity from a Long Start Unit if it foresees a need for that unit in the following day, and it would be more economic to keep the unit on-line than start it up the following day. In addition, the longer time horizon will allows the RUC process to consider the economic commitment of Extremely Long-Start Resources which have a startup time of greater than 18 hours and which generally cannot be considered in the normal IFM function. For these resources RUC may issue advisory start-up instructions for commitments which occur beyond the first 24 hours if the unit's start-up time would prevent the commitment to be feasible in a subsequent run. These advisory ELS commitment instructions are confirmed and made binding by the CAISO operators in the ELS commitment process. Within the RUC's time horizon, resource's commitment cost and bids will be considered in the entire corresponding time frame.

The ability to look beyond the twenty-four hour time period may be deactivated in order to address system and processing requirements. In which case, RUC will not issue any advisory commitments to ELS Resources and all ELS resources are committed by the CAISO operator through its processes, as necessary.

To perform this function, the RUC utilizes the same SCUC optimization and FNM that the IFM uses, but instead of using Demand Bids, it distributes the CAISO Forecast of CAISO Demand (here after CFCD) over the CNodes of the FNM using the system Load Distribution Factors (LDFs). It then treats all IFM resource (Generation, import and

export) Schedules at a high scheduling priority so they are not re-optimized in RUC unless uneconomic adjustments are necessary. The RUC determines any incremental unit commitments and procures capacity from RUC Availability Bids to meet the RUC procurement target. Capacity selected in this process is then expected to be bid in and be made available to the RTM.

In performing this optimization, RUC ignores submitted Energy Bids and uses RUC Availability Bids instead, with the provision that such Bids must be zero for all capacity that has been designated Resource Adequacy Capacity. RUC also considers Start-Up and Minimum Load Costs for optimal commitment of units to meet the RUC procurement target for resources not committed in the IFM. Based on these Bids the RUC process calculates, in addition to the new Unit Commitment and dispatch process, RUC prices at each PNode. The RUC process thus designates RUC Capacity on a locational basis, in the sense that it identifies such capacity by determining a feasible Dispatch of that capacity to meet the RUC procurement target. The following summarizes the RUC processes described in this section:

- RUC Objective
- RUC Inputs
- RUC procurement target
- Distribution of CFCD on Full Network Model
- Day-Ahead Schedules for Supply
- RUC Availability Bids
- RUC Operational Constraints
- RUC Execution
- RUC Outputs

6.7.1 RUC Objective

The objective of the RUC optimization is to minimize the incremental Start-Up, Minimum Load and incremental RUC Availability Bids in order to ensure sufficient resources are committed and/or capacity is available to meet the adjusted CFCD for each hour over 24 hours of the next Operating Day, where:

- Incremental availability costs are represented by the RUC Availability Bids. RUC Availability Bids associated with capacity from resources that are under a contractual obligation to offer capacity such as Resource Adequacy Capacity resources are $0/MWh. RUC Availability Payments are paid to capacity eligible to receive such payments, per hour per MW of capacity identified in RUC above the greater of the resource's Day-Ahead Schedule, Day-Ahead RMR Schedule, RUC RA obligation or a resource's Minimum Load. RUC Availability Bids are processed as follows:

- For the first 24 hours of the optimization, RUC uses Availability Bids which are applicable for the Trade Date.

- For the forward trading days beyond the first trade day, for non Extremely ~~a~~ Long--Start resources, the CAISO will select~~s~~ a date from the historic seven days, up to and including the Trade Date, based on which date most closely matches the period. Energy bids and energy self schedules will be selected from that date and applied to the second 24 hour period.

- However, Energy Bids for ELS resources are copied from the Trade Date to the forward trade days, in order to preserve the bidding intention of the ELS resources.

- For the first 24 hours of the optimization, Day-Ahead Schedules and Ancillary Service Awards as a result of the IFM are maintained in determining the incremental quantity of RUC Capacity necessary to meet the adjusted CFCD.

- For the second and third 24 hours of the optimization, self schedules from the selected dates are used as a proxy for the Day-Ahead schedules. Also for the second and third 24 hours, an adjustment is made to the CFCD to account for Ancillary Service awards that would have been made in the second and third 24 hour periods.

6.7.2 RUC Inputs

This section identifies those inputs that are particularly specific to RUC. Inputs that are common to all the DAM functions are identified in earlier sections of this BPM.

6.7.2.1 RUC Inputs Common to MPM/IFM

- System Load Distribution Factors, same as in MPM, (see Section 3.1.4, Load Distribution Factors)

- Generation Distribution Factors (see Section 3.1.2, Generation Distribution Factors)

- Transmission Constraints

- Generation Outages (see *BPM for Outage Management*)

- Daily total Energy Limits (applies to both Minimum Load and RUC Capacity)

6.7.2.2 Differences between first 24 hours and forward trade hours of the optimization

RUC data inputs for the 72 hour time horizon come from the following sources:

- Bids: As a proxy for the actual bids submitted for the Trade Date (first 24 hour period) bids, including RUC Availability Bids, Start-up Costs, and Minimum Load Costs, will be replicated from one of the last seven days, up to and including the Trade Date. The actual dates are chosen by the CAISO based on the closest match to the optimization period.

  In order to preserve the bidding intention of Extremely Long-Start Resources, energy bids and self schedules for the second and third 24 hour period for these resources will be replicated from the Trade Date. If this were not done, it would be possible that an Extremely Long-Start Resource would receive a binding commitment based on a bid from a prior day, when they did not submit a bid for the Trade Date.

- Master File Data: Data including Pmin, Pmax, resource type, etc. will be replicated from the Trade Date to the forward hours. All resources will assume the MF definitions effective on the first trade day.

- Forecasts: Forecast data, including load forecasts, outage forecasts, etc. will be based on the latest data available.

~~6.7.2.2~~6.7.2.3 RUC Zones

A RUC Zone is a designated area representing a collection of CNodes such as an IOU service area, UDC, MSS, Local Capacity Area. The CAISO may develop such collections of CNodes as sufficient historical CAISO Demand and relevant weather data becomes available to perform a Demand Forecast. RUC Zones are defined to allow CAISO Operators to adjust the CFCD on a local area basis as input to the RUC process, to ensure that the RUC process results in adequate local capacity procurement. The CFCD for a RUC Zone is produced by the CAISO's Demand Forecasting tools and is adjustable by CAISO Operators on a RUC zone basis.

The CAISO has defined the RUC Zones to be equivalent to the existing appropriate aggregation level of CAISO demand forecast systems. The mapping of RUC Zones to CNodes shall be static data, maintained in the CAISO Master File. The status of each RUC Zone shall remain active for as long as the CAISO's Automated Demand Forecast System (ALFS), or its successor, maintains such regional forecasting capabilities.

The CAISO will initially use three RUC Zones corresponding to three TAC areas. The number of RUC Zones may increase in the future in order to adjust the CFCD on a more granular basis. In the future, if the CAISO improves its demand forecasting capabilities to represent greater locational diversity, then the definitions of RUC Zones may be modified to reflect these changes. Such changes would be put before Market Participants for review and comment prior to implementation.

~~6.7.2.3~~6.7.2.4 CAISO Forecast of CAISO Demand (CFCD)

CFCD is determined by CAISO for each load forecast zone. A load forecast zone corresponds to defined areas representing UDC, MSS or Load serving boundary for which CAISO has sufficient historical CAISO Demand and relevant weather data to perform a Demand Forecast.

CAISO forecasts CAISO Demand for each hour of the next seven Operating Days for each load forecast zone utilizing neural-network forecasting software that is widely used in the utility industry. To forecast the weather, CAISO utilizes multiple weather forecasting data sources so as to reduce forecasting errors. CAISO continually monitors its weather forecasting and Load forecasting results to ensure the average forecast error is minimized.

~~6.7.2.4~~6.7.2.5 RUC Procurement Target

The RUC procurement target is based on the difference between CFCD and the IFM Scheduled Demand for each Trading Hour of the next Trading Day, and based on the CFCD for the following forward trade days.

The CFCD for each RUC Zone is distributed nodally over the Full Network Model (FNM). For the RUC process, the Day-Ahead Schedules for Supply resulting from the IFM (Self-Schedules for the following forward trade days) are modeled as Self-Schedules with high scheduling priority so that RUC identifies the incremental Supply needed to serve the difference between the Day-Ahead Schedule for Supply of Energy and the adjusted CFCD.

Once the initial RUC procurement target is calculated for each RUC zone, adjustments to these quantities may be made, on a RUC zone basis, according to the provisions described in the following sections. An example of such adjustment is Demand Response where if a SC informs CAISO about participation in Demand Response, CFCD is lowered accordingly which in effect reduces the RUC procurement target.

~~6.7.2.4.1~~6.7.2.5.1 RUC Zone Adjustment

In order to ensure sufficient capacity and resources are committed while at the same time reducing the possibility of over-procurement in RUC, CAISO may make the following adjustments to the hourly CFCD by RUC zone. After all the individual adjustments are determined as described below the CAISO adjusts the CFCD of each affected RUC zone, without making changes to the LDFs within that RUC Zone. The RUC Zone CFCD adjustment can be absolute or relative as follows:

$$CFCD_{RZ,hour,adj} = CFCD_{RZ,hour,orig} + \Delta CFCD_{RZ,hour,adj}$$

Or

$$CFCD_{RZ,hour,adj} = CFCD_{RZ,hour,orig} \; x \; \%CFCD_{RZ,hour,adj} / 100$$

Where:

- $\Delta CFCD_{RZ,hour,adj}$: The total quantity of CFCD adjustments in MW is based on the summation of the adjustment for: 1) Metered Subsystems that have opted-out or are Load Following MSS, 2) negative adjustments for Demand Response, 3) positive adjustments to CFCD for Eligible Intermittent Resources, 4) positive Demand adjustments to CFCD for forecasted net reductions in Self-Scheduled Supply (forecast reductions in Self-Scheduled Generation and imports) expected to be submitted in the Real-Time Market, and 5) any other CAISO Operator input. Criteria 1 through 4 describe the primary conditions under which the CAISO may change RUC procurement. However, as Balancing Authority Area Operator, the CAISO reserves the flexibility to adjust RUC procurement to address unforeseen circumstances that could affect reliability.

- $CFCD_{RZ,hour,orig}$: The original CFCD.

- $CFCD_{RZ,hour,adj}$: The adjusted CFCD used as the input for the RUC.

- $\%CFCD_{RZ,hour,adj}$: The adjustment as a percentage of the original CFCD.

The adjustments associated with Eligible Intermittent Resources and forecasted Self-Schedules to be submitted in the Real-Time Market can result in either positive Demand side adjustments or positive Supply side adjustments. Positive Demand side adjustments are reflected as adjustment to the CFCD and positive Supply side adjustments are represented as an adjustment to the expected output of individual resources or imports. Refer to CAISO Tariff Section 31.5.3.

~~6.7.2.4.2~~6.7.2.5.2 MSS Adjustment

This section is based on CAISO Tariff Section 31.5.2, Metered Subsystem RUC Obligation.

MSS Operators are permitted to make an annual election to opt-in or opt-out of RUC participation. Prior to the deadline for the annual CRR Allocation and Auction process, as specified in Section 36 of the CAISO Tariff, an MSS Operator must notify CAISO of its RUC participation option for the following CRR cycle:

CAISO Tariff Section 31.5.2.1, MSS Operator Opts-In to RUC Procurement states that:

- **Opt-in to RUC Procurement** – If the MSS Operator opts-in to the RUC procurement process, the SC for the MSS is treated like any other SC that Bids in the DAM with respect to RUC procurement by CAISO and allocation of RUC costs. CAISO considers the CAISO Demand Forecast of the MSS Demand in setting the RUC procurement target, and the SC for the MSS is responsible for any applicable allocation of costs related to the Bid Cost Recovery for RUC as provided in Section 11.8 of the CAISO Tariff.

CAISO Tariff Section 31.5.2.2, MSS Operator Opts-Out of RUC Procurement states that:

- **Opt-out of RUC Procurement** – If an MSS Operator opts-out of the RUC procurement process, CAISO does not consider the CAISO Demand Forecast of the MSS Demand in setting the RUC procurement target, and does not commit resources in RUC to serve the MSS Demand. The MSS Operator is responsible for meeting the Supply requirements for serving its Demand (i.e., "Load following") in accordance with this Section 31.5.2.2 of the CAISO Tariff, and it is exempt from the allocation of costs related to the Bid Cost Recovery for RUC as provided in Section 11.8 of the CAISO Tariff. The MSS that opts out of CAISO's RUC procurement has two options for meeting the Supply requirements for serving its Demand, which it can select on an hourly basis depending on how it Self-Schedules its Demand in the DAM. The two options are:

    - Based on CAISO Demand Forecast (see CAISO Tariff Section 31.5.2.2.1)
    - Not Based on CAISO Demand Forecast (see CAISO Tariff Section 31.5.2.2)

An MSS that has elected to opt-out of RUC, or has elected to Load follow and therefore has also elected to opt-out of RUC, is required to provide sufficient resources in the Day-Ahead Market, and in the case of a Load following MSS, follow its Load within a tolerance band. To reflect these options CAISO replaces the CFCD for such an MSS with the quantity of Demand Self-Scheduled by the MSS in the IFM. By doing so, CAISO prevents RUC from committing additional capacity or resources for any differences between the CFCD for the MSS and the MSS Self-Scheduled quantities in the IFM. MSS adjustment is defined as follows:

$$CFCD_{MSS,Opt\text{-}out,RUC} = DS_{MSS\_Opt\text{-}out,IFM}$$

Where:

- $CFCD_{MSS,Opt\text{-}out,RUC}$: The CFCD used for the RUC zone for an MSS that either elected to opt out of RUC or has opted out as a result of electing to Load follow its MSS Demand.

- $DS_{MSS\_Opt\text{-}out,IFM}$: The quantity of scheduled CAISO Demand associated with an MSS that either elected to opt out of RUC or has opted out as a result of electing to Load follow its MSS Demand.

~~6.7.2.4.3~~6.7.2.5.3 Demand Response Adjustment

There are two different categories of Demand Response: 1) Demand Response that is triggered by a staged emergency event and 2) Demand Response that is triggered by price or some other event that is known in advance. Only the Demand Response that is in category 2, that is certain of being curtailed, can be counted on as an adjustment to the RUC procurement target. If an SC informs CAISO prior to 1000 hours on the day prior to the Trading Day that Demand Response for the Trading Day can be exercised by CAISO, then the CFCD is reduced accordingly when running RUC. This communication may happen in the form of a data template (for e.g. .csv file) which includes SCID, Trade Date, Hour, RUC Zone and the available Demand Response for the applicable time period in MW.

~~6.7.2.4.4~~6.7.2.5.4 Eligible Intermittent Resource Adjustment

Eligible Intermittent Resources (EIRs) have the opportunity to bid or schedule in the Day-Ahead Market. Consequently, the ultimate quantity scheduled from EIRs may differ from the CAISO forecasted deliveries from the EIRs. CAISO may adjust the forecasted Demand either up or down for such differences by RUC zone for which the EIR resides. To the extent the scheduled quantity for an EIR in IFM is less then the quantity forecasted by CAISO, the CAISO makes a Supply side adjustment in RUC by using the CAISO forecasted quantity for the EIR as the expected delivered quantity. However, to the extent the scheduled quantity for an EIR in IFM is greater then the quantity forecasted by CAISO, CAISO makes a Demand side adjustment to the RUC zone Demand equal to the difference between the Day-Ahead Schedule and the CAISO forecasted quantity.

CAISO uses a neural-network forecasting service/software to forecast deliveries from EIRs based on the relevant forecasted weather parameters that affect the applicable EIR. CAISO monitors and tunes forecasting parameters on an ongoing basis to reduce intermittent forecasting error. EIR adjustment is defined as follows:

$$CFCD_{RZ,IRPAdj} = \max(0, \Sigma G_{RZ,IRP,IFM,Sch} - \Sigma G_{RZ,IRP,DAM,CAISOForecast})$$

Or

$$SA_{Gen,IRPAdj} = \max(0, \Sigma G_{RZ,IRP,DAM,CAISOForecast} - \Sigma G_{RZ,IRP,IFM,Sch})$$

Where:

- $CFCD_{RZ,IRPAdj}$: The quantity of adjusted CFCD by RUC zone as a result of differences in scheduled and forecasted quantities for EIR for Trading Hour.

- $SA_{Gen,IRPAdj}$: The quantity of Supply adjustment made to an intermittent resource when the Day-Ahead Schedule for the EIR is less then the CAISO forecast for delivery for the EIR.

- $\Sigma G_{RZ,IRP,IFM,Sch}$: The total quantity of scheduled EIR within RUC zone for a Trading Hour.

- $\Sigma G_{RZ,IRP,DAM,CAISOForecast}$: The total quantity of CAISO forecast EIR deliveries within RUC zone for a Trading Hour.

~~6.7.2.4.5~~6.7.2.5.5 Real-Time Expected Incremental Supply Self-Schedule Adjustment

In order to avoid over procurement of RUC, CAISO estimates the HASP Self-Schedules for resources that usually submit HASP Self-Schedules that are greater than their Day-Ahead Schedules. The estimation is performed using a similar-day approach.

The CAISO Operator can set the length of the Self-Schedule moving average window. Initially this moving average window is set by default to seven days; in which case the weekday estimate is based on the average of five most recent weekdays and the weekend estimate is based on the average of the two most recent weekend days. To the extent weather conditions differ significantly from the historical days, additional adjustment may be necessary, where the systematic approach does not yield Schedules consistent with expected weather or other system conditions. After determining the estimate of Real-Time Self-Schedules, CAISO adjusts the CFCD of a RUC zone based on the forecasted quantity changes in Supply as a result of Self-Schedules submitted in RTM. A similar day forecasting approach is used to forecast the Real-Time Self-Scheduled adjustment. This adjustment for forecasted Real-Time Self-Schedules could result in positive or negative adjustments.

- A **Demand** adjustment to CFCD occurs when there is a net forecast **decrease** in Real-Time Self-Schedule Supply relative to the Day-Ahead Schedule Supply.

- A **Supply** adjustment to the individual resources occurs when there is a net forecast **increase** in Real-Time Self-Schedule Supply relative to the Day-Ahead Schedule Supply of the individual resource

~~6.7.2.4.6~~6.7.2.5.6 Day-Ahead Ancillary Service Procurement Deficiency Adjustment

While CAISO intends to procure 100% of its forecasted Ancillary Service reserve requirement in the IFM based on the CFCD, CAISO reserves the ability to make adjustments to the CFCD used in RUC to ensure sufficient capacity is available or resources committed in cases that CAISO is unable to procure 100% of its forecasted reserve requirement in the IFM. While the CFCD used in RUC may be adjusted based on reserve procurement deficiencies, CAISO does not procure specific AS products in RUC, nor does the RUC optimization consider AS-related performance requirements of available capacity.

For example, it is not within RUC's objective to ensure that sufficient 10-minute service is available. However, to the extent RUC identifies capacity, such capacity is obligated to bid that capacity into the Real-Time Market as Energy and in so doing also allows CAISO to either dispatch Energy or acquire Operating Reserve from such capacity in the Real-Time Market to the extent such units qualify for the provision of such reserves.

~~6.7.2.4.7~~6.7.2.5.7 Operator Review & Adjustment

The CAISO Operator reviews the CFCD and all calculated adjustments. The CAISO Operator has the authority to accept, modify, or reject such adjustments. If the CAISO Operator determines it must modify or reject adjustments, the CAISO Operator logs sufficient information as to reason, Operating Hour, and specific modification(s) made to the calculated adjustments. Furthermore, such CAISO Operator adjustments are reviewed and approved by the CAISO Shift-Supervisor.

CAISO makes information regarding CAISO Operator adjustments available to Market Participants in a report. This information is described in more detail in the *BPM for Market Instruments, Sections 11 and 13.*

~~6.7.2.5~~6.7.2.6 Day-Ahead Schedules for Supply

Prior to determining the quantity of additional capacity that needs to be available, CAISO introduces and honors the resource commitments and associated Supply Schedules that have cleared the IFM. However, after potential RUC zone specific procurement target adjustments are factored into CFCD, the resulting distribution of Demand on individual CNodes for RUC may be different from that used in the IFM. Because of this, RUC Capacity may be procured from resources in a RUC zone where the CFCD had been increased relative to the IFM scheduled Demand, even when the total system wide Day-Ahead Schedules are equal to or greater than the total system wide RUC CFCD. As a result of this, IFM resource Schedules entered into the RUC optimization as high priority Self-Schedules (essentially fixed resources) may need to be reduced. For some

resources, this may result in a RUC Schedule that is lower than the Day-Ahead Schedule in order to satisfy the SCUC power balance constraint, which effectively means that the Day-Ahead Schedule of the resource was reduced to accommodate procurement of RUC Capacity from another resource. Note that this reduction of the Day-Ahead Schedule in RUC has no bearing on the settlement of the original Day-Ahead Schedule.

RMR Generation Schedules that have been determined in the pre-IFM, MPM-RRD process are also honored in the RUC process. Therefore, if an RMR resource dispatched to 200 MW in the pre-IFM, MPM-RRD process, but only clears the IFM at 100 MW, the RMR resource is scheduled at 200 MW as input to RUC.

Constrained Output Generators (COG) are dispatched to their constrained output level in RUC. Therefore, a COG resource that has a PMin=PMax=50 MW may be dispatched in IFM at 20 MW. In RUC, however, such a COG resource schedule of 50 MW is enforced as input to the RUC process.

Other supply, such as Existing Transmission Contracts (ETCs), Converted Rights (CVRs) or Transmission Ownership Rights (TORs) Self-Schedules are also honored at the Self-Scheduled levels established in the Day-Ahead Schedule through the IFM.

Wheeling transactions are not explicitly kept balanced in RUC because they are already protected by IFM self-schedule scheduling priority.

Forbidden Region constraint is not enforced in RUC because the RUC is procuring capacity not energy. This constraint is enforced in MPM/IFM.

Supply adjustments to Eligible Intermittent Resources and forecasted increased in RTM Self- Schedules may be made as described in Section 6.7.2.5.1~~6.7.2.4.1~~, RUC Zone Adjustment.

~~6.7.2.6~~6.7.2.7 RUC Availability Bids

Participation in RUC is validated by the RUC eligibility designation contained in the Master File. Generating Units (except for certain exempt Use Limited Resources), Dynamic System Resources and Resource-Specific System Resources are designated as eligible for RUC. Non-Resource-Specific, non-Dynamic System Resources are designated as NOT eligible for RUC. SCs may only submit RUC Availability Bids (above the Minimum Load) for which they show also submit an Energy Bid to participate in the IFM. Scheduling Coordinators may submit RUC Availability Bids on behalf of eligible capacity that is not subject to a RUC obligation. The CAISO will optimize all RA Capacity from Generating Units, Imports or System Resources at $0/MW per hour for

the full amount of RA Capacity for a given resource. SCs may submit non-zero RUC Availability Bids for the portion of a resource's capacity that is not RA Capacity.

A RUC Availability Bid is a ($/MW, MW) pair. The meaning of a RUC Availability Bid differs depending on whether the resource that submits the RUC Availability Bid has a Resource Adequacy obligation. If a resource does not have a RA obligation, the Scheduling Coordinator has the option of submitting a RUC Availability Bid pursuant to the rules in Section 30.5.2.7 of the CAISO tariff and Section 7.1 of the BPM for Market Instruments. If a resource has a RA obligation, a certain amount of capacity of this resource is registered with CAISO as RA Capacity. RA Capacity that is not a hydroelectric Generating Unit, Pumping Load or Non-Dispatchable Use-Limited Resource exempt from the RUC obligation pursuant to CAISO Tariff section 40.6.4.3.2, must also participate in both the IFM and the RUC processes. Moreover, the RA Capacity must participate in the RUC process with a $0/MW RUC Availability Bid for the entire RA Capacity. This $0/MW RUC Availability Bid is generated by the CAISO on behalf of resources with a RUC obligation.

An SC need not submit a RUC Availability Bid for a Generating Unit or System Resource for the portion of the resource capacity that is under RUC obligation. For these resources that are obligated to offer their RA Capacity to RUC pursuant to Section 40.6 of the Tariff, RUC will automatically insert a RUC Availability Bid for the applicable RA Capacity and that bid will be equal to $0/MWh. In the event that a Generating Unit or System Resource only has part of its capacity designated as RA Capacity, the SC may only submit a RUC Availability Bid for any non-RA Capacity for that resource. The RUC Availability bid used in RUC will be constructed as follows: from the higher of the Minimum Load or the IFM Schedule up to the RA Capacity minus any Regulation Up/ Spin/ Non-Spin awards, a $0/MWh bid is created for any unused portion of the resource's RA Capacity. Any submitted RUC Availability Bid is then put on top at the submitted price. For Use-Limited Resources that are not exempt from the RUC obligation, the ISO will create a RUC Availability Bid consistent with the resources' RA capacity offered into the Day-Ahead Market through their Bids.

As stated in CAISO Tariff Section 40.6.4.3.2 "Hydro and Non-Dispatchable Use Limited Resources", Hydro resources and Non-Dispatchable Use-Limited Resources are required to submit Self-Schedule or Bids in the Day-Ahead Market for their expected available Energy or their expected as-available Energy, as applicable, in the Day-Ahead Market and HASP. Hydro resources and Non-Dispatchable Use-Limited Resources are not subject to commitment in the RUC process.

The RUC bidding requirements applicable to RA Capacity are described in more detail in the BPM for Reliability Requirements.

The total amount of RUC Capacity (which considers both the RA Capacity plus the submitted RUC Availability Bid quantity for an RA resource) is limited by the upper operating limit minus the sum of Day-Ahead Schedule and the upward Ancillary Service Awards. In other words, the sum of the DAM Energy Schedule, the upward Ancillary Service Awards including Ancillary self-provisions, and the RUC Award is limited by the upper operating limit.

If a resource is determined to have an RMR requirement by the RRD and LMPM process (either by the CAISO Operator or the DAM software) for an hour in the Day-Ahead, and if any portion of the RMR requirement has not been cleared in the IFM by the Scheduled Demand, the entire amount of RMR requirement are represented as a RMR Self-Schedule in the RUC to avoid over-committing other resources.

While IFM honors multi-hour Intertie Block Bids when procuring Energy, post IFM processes (RUC, HASP, and RTM) are not designed to enforce multi-hour block constraints. Therefore, RUC evaluates all intertie RUC Availability and HASP evaluates System Resource Energy Bids on an hourly basis instead of a multi-hour block basis.

Exhibit 6-4 defines the RUC Capacity that is available on a Generator that has been scheduled by the IFM. This Generator is also providing AS.

Exhibit Error! No text of specified style in document.**-34: Capacity Available for RUC**

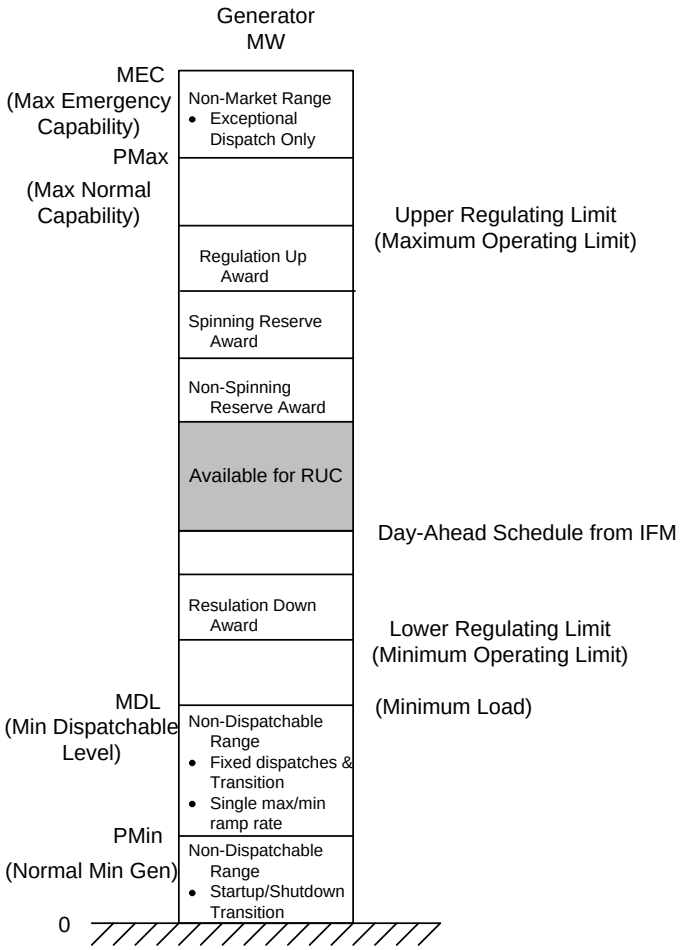

Exhibit 6-5 summarizes the characteristics of: Start-Up Costs, Minimum Load Costs as they apply in RUC, and the RUC Availability Bid for the various types of resources.

Exhibit Error! No text of specified style in document.**-45: RUC Start Up, Minimum Load, & Availability Bid Eligibility**

	Start-Up Costs	**Minimum Load Costs**	**RUC Availability Bid**
Participating Generator	Cost-Based Or Standing six-month Bid (CAISO Tariff: 30.4, 30.5.2.2)	Cost-Based Or Standing six-month Bid (CAISO Tariff: 30.4, 30.5.2.2)	RA Capacity = $0 Non RA Capacity is eligible to Bid (CAISO Tariff: 31.5.1.1, 31.5.1.2)
Constrained Output Generator (COG)	Cost-Based Or	Cost-Based Or	No RUC Availability Bid permissible; but

	Start-Up Costs	Minimum Load Costs	RUC Availability Bid
	Standing six-month Bid (CAISO Tariff: 30.4, 30.5.2.2)	Standing six-month Bid (CAISO Tariff: 30.4, 30.5.2.2)	accounted for in RUC based on Minimum Load cost bid (CAISO Tariff: 31.5.1.1)
Resource-Specific System Resource	Cost-Based Or Standing six-month Bid (CAISO Tariff: 30.4, 30.5.2.4)	Cost-Based Or Standing six-month Bid (CAISO Tariff: 30.4, 30.5.2.4)	RA Capacity = $0 Dynamic non-RA Capacity eligible to bid otherwise Other non-RA not eligible to bid into RUC (CAISO Tariff: 31.5.1.1)
Non-Resource-Specific System Resource	N/A (CAISO Tariff: 30.5.2.4)	N/A (CAISO Tariff: 30.5.2.4)	RA Capacity = $0 Dynamic non-RA Capacity eligible to bid otherwise Other non-RA not eligible to bid into RUC (CAISO Tariff: 31.5.1.1)
Participating Load (using Full Participating Load Model)	Not supported initially	Not supported initially	Not supported Initially
Participating (Pump) Load (using pumped-storage model)	N/A	N/A	N/A
Non-Participating Load	N/A	N/A	N/A

~~6.7.2.7~~6.7.2.8 RUC Operational Constraints

The RUC process has the ability to incorporate additional operational constraints using solution parameters that are set by a CAISO Operator. The following sections describe the criteria that are used for setting these constraint parameters. Although the CAISO Operator can set these constraint parameters, these parameters are not expected to change often after a period of initial implementation. After the initial implementation period, CAISO will post a notice to Market Participants when these parameters are to be changed.

~~6.7.2.7.1~~6.7.2.8.1 Capacity Constraints

The capacity constraints ensure that sufficient RUC Capacity is procured to meet the CFCD. This is accomplished by enforcing the Power balance between the total Supply (which includes IFM Energy Schedules, RMR Generation Schedules that result from MPM-RRD and RUC Capacity) and the total Demand (which includes IFM export Schedules and Demand Forecast.) The CFCD can be adjusted to increase the RUC target if there is AS Bid insufficiency in IFM, as described in Section 6.7.2.4~~6.7.2.3~~ above.

~~6.7.2.7.2~~6.7.2.8.2 Maximum Energy Constraint

In order to reduce the possibility that CAISO over-commits capacity in RUC when trying to meet the CFCD, RUC is capable of enforcing a constraint on the solution that would limit the total quantity of IFM Energy Schedules plus RUC Minimum Load Energy to be less then a percentage of the total CFCD.

$$\Sigma(\text{Pmin}) + \Sigma(\text{DA Imports}) - \Sigma(\text{DA Exports}) + \Sigma(\text{DA Gen}) <= \%E_{\text{RUC,Limiit}} \text{ x CFCD}$$

Where:

- Σ(PMin) : The total of all Minimum Load Energy committed in RUC for a Trading Hour
- Σ(DA Imports) : The total of DA Scheduled imports for a Trading Hour
- Σ (DA Exports) : The total of DA Scheduled exports for a Trading Hour
- Σ (DA Gen) : The total of DA Scheduled Generation Energy for a Trading Hour
- $\%E_{\text{RUC,Limiit}}$: The % Energy of CFCD Energy limitation.

This RUC Energy constraint is a soft-constraint and can be violated to obtain a solution. CAISO currently sets the RUC Energy Limit constraint to be between 95% and 100% of the CFCD.

Operational factors that are considered in setting this parameter are:

- Demand Forecast error
- Operational conditions such as Overgeneration
- Seasonal factors

~~6.7.2.7.3~~6.7.2.8.3 Short-Start Unit Capacity Constraint

This section is based on CAISO Tariff Section 31.5.4, RUC Procurement Constraints

In order to limit RUC from relying excessively on the capacity of Short-Start Units when making RUC decisions, CAISO may limit the percentage of total Short-Start Unit

capacity that is committed in RUC. Short-Start Units are limited based on the following equation:

$$\Sigma(CAP_{RUC,QS}) <= \%SS \times \Sigma(CAP_{Total,QS})$$

Where:

- $\Sigma(CAP_{RUC,QS})$: The total capacity of Short-Start Unit capacity committed in RUC
- %SS : The percentage of total Short-Start Unit capacity parameter
- $\Sigma(CAP_{Total,QS})$: The total Short-Start Unit capacity available in the CAISO.

The Short-Start Unit capacity percentage limit is set to 100% by default. However, CAISO Operators may set this parameter as low as 75%. Operational factors that are considered in setting the Short-Start Unit constraint parameter are:

- Historical confidence that a Short-Start Unit actually starts when needed. Short-Start Unit performance is assessed based on operational experience among the CAISO's operators, collectively for all Short-Start resources.
- The need to conserve the number of run-hours and the number of start-ups per year for critical loading periods
- Seasonal constraints such as Overgeneration[3]

All of these factors work in the same direction to reduce the capacity percentage limit below the default value of 100%.

6.7.3 RUC Execution

After completing the IFM and steps described above, CAISO executes the RUC process for the next Trading Day using the Security Constrained Unit Commitment (SCUC) algorithm. RUC simultaneously optimizes ~~24~~ between 24 and 168 hours with the objective to minimize the total Start-Up Costs, Minimum Load Costs, and incremental availability costs (i.e., RUC Availability Bid) while meeting the adjusted CFCD. Using the Full Network Model, RUC also ensures that transmission constraints are not violated.

The RUC process is run every day whether or not the Day-Ahead Schedule for Demand is greater than the CFCD. If no additional resource needs to be procured or no additional resources need to be committed, then RUC completes its execution without having to commit any additional resource capacity. However, it is possible that RUC needs to identify additional RUC Capacity or commit additional resources either because of insufficient Load being scheduled in the IFM or due to transmission constraints because of differences in the Location and quantity of Demand scheduled in the IFM and the CFCD.

[3] Over-generation tends to occur during off-peak hours, when the level of RUC procurement is low. This factor, therefore, should have only a small impact on Short Short-Start Unit procurement.

While RUC commits resource capacity from Long-Start and Short-Start Units to meet CFCD, RUC does not automatically de-commit resources in cases of Overgeneration conditions or in cases where the Day-Ahead Schedules exceed the CFCD. The RUC solution identifies to the CAISO Operator resources that may need to be considered for de-commitment. The CAISO Operator reviews and assesses the results prior to making any manual de-commitment decisions.

6.7.4 RUC Outputs

This section summarizes the results of the RUC process. Unless otherwise noted, only results from the first 24 hours are considered binding and published.

6.7.4.1 RUC Schedules

The total MW per hour amount of capacity committed by RUC including the MW per hour amounts committed in the Day-Ahead Schedule.

6.7.4.2 RUC Capacity and RUC Awards

RUC Capacity and RUC Awards are determined as follows:

- RUC Capacity is the positive difference between the RUC Schedule and the greater of the Day-Ahead Schedule or the Minimum Load of a resource.
- The portion of the capacity that corresponds to the Minimum Load is not considered RUC Capacity and it is not eligible for RUC Bid Cost compensation since the Minimum Load Energy is compensated at the Minimum Load Cost in Bid Cost Recovery. For Extremely Long-Start Resources committed in the following forward trade days of the time horizon, only capacity up to Minimum Load will be committed.
- The portion of the RUC Capacity from a RMR unit that is used in the RUC optimization to meet CFCD is not eligible for RUC Award since the capacity is already compensated through RMR Contract. The RMR requirements are re-evaluated in the Real-Time MPM/RRD.
- The portion of the RUC Capacity that corresponds to RA RUC obligation is also not eligible for RUC Award.
- Any RUC Capacity in excess of RMR Capacity or RA RUC obligation is considered a RUC Award eligible for RUC Payment.

CAISO only issues start-up instructions to Long-Start Units and Extremely Long-Start Resources that must be started sufficiently in advance of real time to meet Real-Time

Demand. For Extremely Long-Start Resources, advisory start-up instructions may be issued for start times up to the end of the time horizon. However, these instructions will only be binding after confirmed by the CAISO operator and if the resource's startup time prevents it's re-evaluation in the following day's IFM/RUC run. For other units, the CAISO re-evaluates their commitment decisions in STUC, HASP and RTUC. However, the RUC Schedule determined by RUC is made available to the relevant SCs even if a RUC Start-Up instruction is not issued in the DAM.

6.7.4.3 RUC Pricing

RUC Prices are calculated by the RUC optimization based on the RUC Availability Bids, as modified by CAISO's validation for Resource Adequacy requirements. A resource that receives a RUC instruction is compensated by the product of the RUC Award and the RUC Price of its Location. The determination of the RUC Price is similar to the determination of the Energy LMP; except that RUC Availability Bids are used for the RUC Price. The RUC Price has Energy, Loss, and Congestion components associated with it similar to LMPs that are produced in the IFM, however, the RUC Prices are not decomposed.

Note that OASIS reports RUC prices as RUC LMPs.

6.7.4.4 RUC Start-Up Instructions

RUC issues binding start-up instructions only to Long-Start Units. RUC also issues advisory start-up instructions for Extremely Long-Start Resources that are validated by the CAISO Operator through the Extremely Long--Start commitment process. For Short-Start Units, RUC evaluates the Start-Up Costs, but does not issue start-up instructions. For Short-Start Units, Start-Up Costs are eligible for Bid Cost Recovery only if the resource is actually started up as a result of a binding start-up instruction issued by RTUC.

Short-Start Units that are not under a contractual obligation to offer capacity (e.g., Resource Adequacy Capacity resources and Reliability Must Run resources that have been scheduled by an RMR Dispatch) are eligible to a RUC Award even though they are not issued a binding RUC Start-Up instruction in RUC.

If the CAISO does not issue a Start-Up instruction to such units in the Real-Time Market, such units are compensated for their RUC Award, but do not receive payment for RUC Start-Up Costs and Minimum Load Costs, as they were never started up. Short-Start Units that are under a contractual obligation to offer capacity are not eligible to RUC Availability Payments, but are compensated for Start-Up and Minimum Load Costs through Bid Cost Recovery if they receive a Start-Up instruction in the RTM and actually start up.

6.7.4.5 RUC Settlement

All RUC Awards are paid the RUC Price. RA and RMR units do not receive RUC Awards for their RA/RMR Capacity. The RUC cost allocation uses a two-tier Settlement approach.

- In the first tier, the Net RUC Bid Cost Uplift is allocated to positive Load deviations up to MW RUC Capacity per MW Load deviation basis.
- In the second tier, any remaining Net RUC Bid Cost Uplift is allocated pro rata to all Demand.

See the *BPM for Settlements & Billing* for details on Settlement. CAISO Tariff section 11.8.6.5 specifies the two allocation tiers for RUC.

6.8 Extremely Long-Start Commitment

Some Extremely Long-Start (ELS) Resources may need to receive Start-Up Instructions from CAISO before DAM results are available. According to the CAISO Tariff 27.4.1:

ELS Resources, for which commitment in the DAM does not provide sufficient time to Start-Up and be available to supply Energy during the next Trading Day will be committed manually by the CAISO Operators. Such manual commitment instructions are determined in combination with other operational expectations and reliability needs.

Extremely Long-Start Resources may be either physical resources with Start-Up Times greater than 18 hours or the contractual intertie resources that must receive commitment instructions by 0600 hours one-day ahead. Therefore, there is a need for a manual procedure to determine the commitment status of such resources two days in advance. This procedure is called the Extremely Long-start Commitment (ELC) process.

The ELC process is performed after the regular DAM processes are completed. The ELC process consists of the following steps:

1) The ELC process is initiated by the CAISO Operator.

2) If available, the CAISO Operator evaluates the non-binding advisory commitment issued by the RUC process for ELS resources. If the solution is appropriate and consistent with good utility practice, the CAISO Operator will manually communicate the instructions to the ELS resource.

   Otherwise, the CAISO operator will employ the following steps to commit ELS resources:

~~1)~~3) ELC process for Trading day ‘T+2’ occurs after the completion of the DAM for Trading day ‘T +1’

~~2)~~4) The CAISO will consider resources for ELS decision if the resource has submitted a DAM Energy bid for Trading day ‘T+1’. The CAISO Operator will evaluate all the ELS submitted bids to make a decision based on Start up Cost, Minimum Load Cost, power flow studies and Good Utility Practice.

~~3)~~5) Once the decision is made, the selected Extremely Long-Start Resources will receive start up instruction for Trading day ‘T+2’ by 1500 hours of Trading day ‘T’.

~~4)~~6) The CAISO Operator manually notifies (in the form of a phone call) the pre-committed ELS resources about their binding start up instructions as determined in the steps above.

~~5)~~7) The commitment instructions will not include schedules greater than the Minimum Load.

~~6)~~8) By 1000 hours of the Trading day ‘ T+1’, pre-commited ELS units are required to submit the same bid (Bid submitted for Trading day ’T+1’) to the CAISO for Trading day ‘T+2’. This is because the original bid was used for determination of ELS commitment.

~~7)~~9) Depending on system conditions and resource characteristics CAISO may make decisions more that Trading day ‘T+2’ days ahead.

The Master File has an ELS Resource flag that indicates that the resource is subject to the ELC procedure.

Commitments of ELS Resources outside of this manual ELS commitment process must be made through Exceptional Dispatches.

7.7 Short-Term Unit Commitment

This section is based on CAISO Tariff Section 34.4, Short-Term Unit Commitment.

At the top of each Trading Hour, immediately after the HASP is completed, CAISO performs an approximately five-hour STUC run using SCUC and the CAISO Forecast of CAISO Demand to commit Medium Start Units and Short-Start Units with Start-Up Times greater than the Time Horizon covered by the HASP.

The Time Horizon (see Exhibit 7-1) for the STUC optimization run extends three hours beyond the Trading Hour for which the HASP optimization was run, and replicates the Bids used in that Trading Hour for these additional hours.

CAISO ~~revises these~~ replicate~~d~~ Bids each time the hourly STUC is run, to utilize the most recently ~~submitted~~ available Bids. A Start-Up Instruction produced by STUC is considered binding if the resource could not achieve the target Start-Up Time (as determined in the current STUC run) in a subsequent RTUC run as a result of the Start-Up Time of the resource.