Ancillary Services Overview

California ISO Ancillary Services Market

Introduction

This section presents an overview of the California ISO Ancillary Services (A/S) market with explanations of some of the design features used in the A/S markets and settlement process. This section is intended to give the settlement analyst and energy scheduler a basic understanding of the A/S design features and to describe how the settlement charges are derived. The actual settlement equations and components for the specific charge types are included in the following ISO Settlement Guide sections. Some of the key principals of the A/S market (self-provision, on demand obligation and SC to SC transactions) are discussed in detail in this section.

A/S procurement ensures the ISO has adequate reserve generation capacity to maintain the electric system reliability, and system frequency, by matching generation and load at all times under both normal and abnormal conditions. California is the first restructured electric marketplace to obtain A/S through a competitive bidding process. This Market based process demonstrates that system reliability can be maintained by relying on open markets for these essential services.

Four unbundled primary A/S (regulation, spinning reserves, non-spinning reserves, and replacement reserves) are procured by the ISO, daily in day–ahead and hour-ahead forward markets or auctions. The remaining two unbundled services voltage support and black start are arranged on a long-term basis. The four primary A/S are priced at separate market prices rather than combined into a single. The four primary A/S are defined as follows:

**Regulation:** Generation that is on-line, and synchronized with the ISO controlled grid so that the energy generated can be increased or decreased instantly through automatic generation control (AGC), directly by the ISO EMS. Regulation is used to maintain continuous balancing of resources and load within the ISO-controlled grid, as well as maintains frequency during normal operating conditions.

**Spinning Reserves:** Generation that is already on-line, or "spinning", with additional capacity that is capable of ramping over a specified range within 10 minutes and running for at least two hours.

**Non-spinning Reserves:** Generation that is available but not on-line, that is capable of being synchronized and ramping to a specified level within 10 minutes, and then capable of producing dispatched energy for at least two hours.

**Replacement Reserves:** Generation that is capable of starting up if not already operating, synchronized with the ISO controlled grid and ramping to a specified load within one hour, and running for at least two hours.

The two remaining A/S (voltage support and black start) are procured primarily through the Reliability Must Run (RMR) contracts. The ISO is responsible for conducting a competitive market of the four primary A/S on behalf of the market participants (the Scheduling Coordinators). SCs can either self-provide their pro rata share of the total ISO grid operating reserve, replacement reserve and regulation...
requirements or have the ISO arrange it for them in a competitive manner. The ISO determines the appropriate amount of required A/S using load forecast and Preferred Schedule information, to assure compliance with WSCC minimum operating reliability criteria (MORC). Each SC is responsible for a pro rata share or A/S obligation based upon its metered load and exports, consistent with the ISO Tariff. The ISO procures the required A/S on behalf of Market Participants, which do not self provide these services through a competitive bidding process, from generators or importers of A/S.

A/S self provided schedules and Market bids can only be submitted to the ISO through SCs. This forward Market auction process takes place after the time when Preferred Schedules and A/S bids are submitted to the ISO. The ISO purchases A/S during the day-ahead forward Market, and again during each of 24 hour-ahead forward Markets to account for any changes in load and generation schedules.

The ISO uses A/S resources, in conjunction with supplemental energy resources, as sources of balancing energy, to be dispatched in real time. Proxy energy bids associated with A/S capacity and supplemental energy bids are compared in the Real Time ISO imbalance energy Market. In real time, the ISO dispatches these sources of balancing energy on an economic basis, economic dispatch.

Bids or offers to sell/ supply any or all four reserve A/S are submitted simultaneously, after the corresponding California Power Exchange commodity energy market is cleared and unit level energy schedules are known. All A/S bids consist of a capacity component and an energy component. If a generating plant (unit) is awarded capacity in one market, any bids from the unit to supply A/S in subsequent markets are adjusted to account for any capacity previously purchased from that specific unit.

The ISO procures the four primary A/S through a system-wide auction, whenever the forward market energy schedules (day-ahead or hour-ahead) can be accommodated without the need for inter-zonal congestion management and rescheduling. Suppliers of each service are all paid the system-wide market-clearing capacity price (MCP) for that specific service. If inter-zonal congestion exists, the requirements for each service are established on a zonal basis, and the procurement is carried out separately in each zone, resulting in different zonal market clearing prices.

**Ancillary Services Redesign**

In July 1998, the ISO embarked on a comprehensive market redesign process, which culminated in filings to FERC in March and April 1999. In the course of this process, the ISO developed a number of market redesign elements which, when implemented during the summer of 1999, result in fundamental improvements in the functioning of the A/S markets. The major elements of the A/S redesign are:

- A/S cost allocation based on metered demand, rather than on scheduled demand.

- Elimination of payments for A/S capacity and imbalance energy, when the capacity sold to provide reserves is unavailable in real time to respond to ISO dispatch instructions.

- Implementation of procedure to facilitate inter-SC trades of A/S.

- Separate markets for upward and downward Regulation reserves, to allow different market clearing prices for each service.

- Implementation of a modified Deviation Replacement Reserves cost allocation mechanism to discourage un instructed deviations from schedules. Deviation Replacement Reserve costs are first assessed to market participants on the basis of the volume of under-scheduled load or over-scheduled generation. Second, the cost of any residual Replacement Reserves, purchased by the ISO for System reliability, is allocated to all SC’s with load, on a pro-rata basis. Procurement of lower-priced, higher-
quality ancillary services to substitute for higher-priced, lower-quality services, while still meeting it’s the Control Area’s total reliability requirements. This is referred to as the "Rational Buyer" protocol.

Definitions and Concepts

Prior to a discussion of the A/S design elements and the settlement process the following terms are of particular importance:

"A/S Requirement" for a SC is determined by applying theWSCC reserve criteria to the SC’s demand portfolio. For operating reserves (spin and non-spin), this amount is equal to 5% of Demand served by hydroelectric, 7% of Demand served by non-hydro, plus 100% of Interruptible Imports and on-demand obligations (exports of A/S), further adjusted by any inter-SC A/S transactions. At least 50% of the operating reserve requirement must be met by spinning reserve and the remaining portion can be met by non-spinning reserve. Regulation reserve obligation varies by trade hour, typically between 5-12% of load, as determined by the ISO to meet hourly energy balancing requirements.

"A/S Obligation" is the SC share of the A/S that ISO procured to meet the markets need. The ISO procures A/S in the forward markets to meet WSCC reliability criteria, less any self-provision of a specific A/S by SC’s. The ISO exercise operating discretion to procure the appropriate amount of any specific A/S, based upon SC scheduled load, ISO forecasted load and system conditions. The values of a SC's requirement and obligation are closely related, but must be clearly distinguished.

"Demand" is defined, for the purpose of operating reserves, as consisting of a SC’s metered load and firm intertie exports. Demand, as used in the settlement of Regulation and Replacement Reserves, is defined as metered load. "Metered Load" consists of an SC’s metered load and, exclusive of any inter-tie export schedules. "Metered Demand" is comprised of a SC’s metered load and firm intertie export schedules that are used in real time. Metered demand excludes any dynamic interchange export and obligation due to inter-SC energy transactions. Metered demand is used in computations involving Spin and Non-Spin reserves.

A "Region" may consist of one or more adjacent congestion zones. The ISO system may contain one or more regions. The regions do not overlap and each congestion zone must be completely contained in one region. The region configuration is dynamically identified for each trading hour and for each market (DA and HA) for the purpose of A/S procurement. The MCP for the A/S may differ from one region to another.

Allocation Using Metered Consumption – The cost of Regulation and Replacement Reserves procured on behalf of the Market, is allocated using the SC’s metered load. The cost of Spin and Non-spinning reserve capacity (operating reserves) is allocated in proportion to the SC's metered demand. DA and HA A/S costs are allocated separately through a DA charge and HA charge, specific to each A/S. The DA charge recovers the A/S procurement costs from the DA market, whereas the HA charge recovers the A/S procurement costs from the HA markets. Self Provision – A SC’s reserve obligation is reduced by the amount of the reserve that is being self-provided. The SC’s final energy schedule is used to determine both their A/S obligation. When a SC changes their energy schedule, in the HA markets from the amounts that were scheduled in the DA market, the ISO may also have to adjust its HA procurement accordingly.
As a result, a SC’s final obligation is determined by the DA schedules unless altered in the HA Markets. A SC’s selling position or buying position is altered automatically by their final schedules:

- **Buy back provision for self-provision**: When a SC reduces their self-provision in the HA Markets, they may do so by buying back the reduction, at the HA price. This buy back provision is described later in this section.

- **Impose limits on HA increase to self-provision**: When the market's total HA increment in self-provision exceeds ISO's incremental need, portions of the SC's self provision may become unqualified. This is further explained below.

- **SC’s use their self-provision to reduce their allocated A/S obligation**: Excess self-provision refers to the amount that the SC has in excess of their allocated obligation. The qualified portion can be used to reduce the SC’s obligation and if the qualified self-provision creates an excess for the SC, the SC will receive credit for the excess at the normal user rates for the subject service. Portions of the SC's self provision may become unqualified. Unqualified self provision cannot be used to reduce the SC's reserve obligation and does not generate any credit for the SC. Unqualified excess occurs when the total increase of self-provision in the HA market exceeds ISO's incremental needs. The SC's whose increase in self-provision exceeds their own incremental needs, will have a prorata portion of their self-provision disqualified.

**Inter-SC Transactions of A/S** - This functionality allows SCs to trade their A/S obligations. These transactions are considered during the allocation of A/S costs. In the Settlement System, A/S acquired through inter-SC trades are used to reduce the buyer's A/S obligation. A/S sold through inter-SC trades are used to increase the seller's obligation. If the amount brought is larger than the buyer's need, their obligation will become negative. The SC will receive a credit for negative A/S obligation. This is applicable to all services, however, only one trade per service per zone per hour can be made. A counterpart trade must exist and be opposite in sign.

**Procurement of A/S** - The ISO procures A/S based on the ISO's demand forecast, rather than the SC's energy schedules. Settlements of ISO A/S procurement are based on the final accepted bids using the MCP. Therefore, the "due SC" A/S settlement calculations did not change in the A/S redesign implementation.

**Buy Back Provision for Bid in A/S** - The buy back provision allows SCs who have over-sold A/S in the DA market to buy back that A/S capacity at the HA MCP. Settlement of A/S based on metered demand has no apparent implication for the by back of A/S. The HA user rates for Regulation, Spinning reserve, Non-spinning reserve, and Replacement reserve capacity are calculated based on the net payments for each service (i.e. total payments net of amounts payable by SCs who have bought back capacity that was sold to the ISO in the DA market).

**Buy Back Provision for Self Provision** - SC’s may attempt to turn their DA self provision into HA bid when the HA MCP is higher than the DA MCP. In doing so, SC’s receive the higher HA MCP while the corresponding increase in A/S obligation is settled at a lower rate (weighted average of the DA and HA MCPs). To curb the potential gaming scenarios, when a SC reduces their self-provision in the HA market, they need to do so by buying back the reduced amount at the HA MCP. This buy back amount is added back to the SC's HA self provision and thus their effective HA self provision will remain at the DA level and their net A/S obligation will not be increased as a result. For the purpose of receiving credit for excess provision, the buy back amount will be considered as being provided by another source.

Buy back of self-provision is settled on a zonal basis instead of a resource basis. This will allow the SC to substitute one A/S resource with another in the same zone without a buy back.
Sell Back Provision - The sell back provision allows SCs who have over-scheduled in the DA market to sell that A/S capacity back to the ISO. The sell-back provision is rendered moot due to the billing based on metered demand, since the DA schedule carries no A/S purchase obligation. With no obligation arising in the DA market, there is nothing to sell back in the HA market.

Settlements Protocols for Buy Back of Self Provision

SC's who reduce their DA self provision in the HA market can only do so by buying back the reduced amount from the ISO at the HA MCP. This buy back amount will be added back to the SC's HA self provision and be used to reduce the SC's net A/S obligations. While buy back of bid in A/S is settled on a resource basis, buy back of a self-provision is settled on a zonal basis. Thus, buy back takes place only if the SC's total self-provision (for a given A/S type) in a given zone is reduced.

Thus, the calculation of a buy back quantity is as follows:

\[
\text{Quantity} = \text{DA Self Provision} - \text{HA Self Provision}
\]

\[
\text{SelfProvideBuyBackHAMW}_{jzt} = \max(0, \text{PhysicalSchedSelfProvideDAMW}_{jzt} - \text{PhysicalSchedSelfProvideHAMW}_{jzt})
\]

where:

\(\text{SelfProvideBuyBackHAMW}_{jzt}\) is the MW amount of A/S that SC \(j\) needs to buy back in zone \(z\) and time interval \(t\);

\(\text{PhysicalSchedSelfProvideDAMW}_{jzt}\) is the MW amount of A/S self provision as indicated in SC \(j\)'s DA schedules for zone \(z\) and time interval \(t\);

\(\text{PhysicalSchedSelfProvideHAMW}_{jzt}\) is the MW amount of A/S self provision as indicated in SC \(j\)'s HA schedules for zone \(z\) and time interval \(t\);

The calculation of the buy back cost is as follows:

\[
\text{Cost} = \text{Quantity} \times \text{HA MCP}
\]

\[
\text{SelfProvideBuyBackHASS}_{jzt} = \text{ASMcpHAS}/\text{MW} \cdot hr_{ct} \times \text{SelfProvideBuyBackHAMW}_{jzt}
\]

\[
\text{SchedSelfProvideHAMW}_{jzt} = \max(\text{PhysicalSchedSelfProvideDAMW}_{jzt}, \text{PhysicalSchedSelfProvideHAMW}_{jzt})
\]

where:

\(\text{SelfProvideBuyBackHASS}_{jzt}\) is the dollar amount that SC \(j\) pays for the buy back of reduced self provision in zone \(z\) and time interval \(t\);

\(\text{ASMcpHAS}/\text{MW} . hr_{ct}\) is the MCP of the subject A/S in zone \(t\) and time interval \(t\), and
SchedSelfProvideHAMW_{zt} is the MW amount of A/S self provision that SC is considered to have in his HA portfolio for zone z and time interval t. Buy back amount is included in this quantity.

NOTE: When the market's total HA increment in self-provision exceeds ISO's incremental need, portions of the SC's self provision may become unqualified.

With this introduction and overview to the A/S market and how A/S costs are allocated the following sections will discuss in detail the cost allocation of Regulation, Spinning and Non-Spinning Reserves. Replacement Reserves, Voltage Support and Black Start are discussed later in this Settlements Guide.

**A/S Settlement Charges**

Ancillary Services settlement charges account for two principal elements related to the reliable and secure operation of the California ISO (ISO) grid. The first element is the percentage of generation capacity that must remain available to replace energy resources in the event a contingency occurs. The second element involves the needed responses to real-time increases and decreases in electric demand.

The A/S charges reimburse the ISO for the costs of purchasing A/S in the Day-Ahead and Hour Ahead Markets. Additionally, the A/S charges provide for: 1) payments to SCs for providing the capacity in the Day-Ahead and Hour- Ahead Markets, and 2) payments to SCs for the dispatch of Supplemental Energy in the Real-Time Market.

There are five types of A/S charges that may appear on the Settlement Statement. These charges are covered in the following Settlements Guide sections:

**Automatic Generation Control**

- Day Ahead Automatic Generation Control Regulation Up due SC (charges # 0005)
- Hour Ahead Automatic Generation Control Regulation Up due SC (charge #0055)
- Automatic Generation Control Regulation Up due ISO (charge #0115)
- Day Ahead Automatic Generation Control Regulation Down due SC (charge #0006)
- Hour Ahead Automatic Generation Control Regulation Down due SC (charge #0056)
- Automatic Generation Control Regulation Down due ISO (charge #0116)

**Spinning and Non-Spinning Reserve**

- Day Ahead Spinning Reserve due SC (charges # 0001)
- Hour Ahead Spinning Reserve due SC (charge #0051)
- Spinning Reserve due ISO (charge #0111)
- Day Ahead Non-Spinning due SC (charge # 0002)
- Hour Ahead Non-Spinning due SC (charge # 0052)
- Non-Spinning Reserve due ISO (charge #0112)

**Replacement Reserve**

- Day Ahead Replacement Reserve due SC (charges # 0004)
- Hour Ahead Replacement Reserve due SC (charge #0054)
- Replacement Reserve due ISO (charge #0114)

The remaining two unbundled services voltage support and black start are arranged on a long-term basis.

- Black Start Energy due ISO (charge # 1353)
• Black Start Energy due SC (charge # 1001)
• Reactive Power due ISO (charge # 1302)
• Reactive Power due SC (charge # 0302)