California Independent
System Operator Corporation

Discussion Paper

Modeling and Pricing Integrated Balancing Authority Areas Under the California ISO's Market Redesign and Technology Upgrade Program

Introduction and Summary

The California Independent System Operator Corporation's ("CAISO") Market Redesign and Technology Upgrade ("MRTU") program encompasses a comprehensive overhaul of the CAISO's electricity markets that will address the structural flaws in the CAISO's current markets. In particular, MRTU will both enhance reliability and increase the efficient utilization of the transmission system through development and application of a detailed and accurate Full Network Model or "FNM" of the CAISO Controlled Grid.[1] Application of the FNM to manage congestion and establish Locational Marginal Prices or "LMPs" will enable the CAISO to align price signals with the CAISO's operating requirements. As part of its larger effort to improve its ability to reliably manage congestion on the transmission system, the CAISO has identified appropriate improvements to how it models and prices transactions to and from Integrated Balancing Authority Areas ("IBAAs").[2] These improvements will further enhance the CAISO's overall congestion management solutions.

IBAAs are those Balancing Authority Areas or systems that are not part of the CAISO Balancing Authority Area but are closely interconnected/integrated with the CAISO's system through multiple free-flowing AC interconnections with the CAISO Balancing Authority Area. Power flows on an IBAA's system can result in parallel flows and otherwise more complex interactions with the CAISO system. This discussion paper summarizes and discusses certain options considered by the CAISO regarding the modeling and pricing of IBAAs and the CAISO's preferred approach. An additional Discussion Paper: *MRTU Release 1 Implementation of Preferred Integrated Balancing Authority Area Modeling and Pricing Options*, posted on the same day discusses the MRTU Release 1 implementation of the preferred modeling and pricing options discussed herein. It is important to emphasize that while the CAISO proposes to

[1] Appendix 1 includes a glossary of certain terms used in this paper which is based on the CAISO Tariff definitions.

[2] These were previously referred to Embedded Control Areas and Adjacent Control Areas (ECAs/ACAs). The CAISO does not believe it is necessary to distinguish between ECAs and ACAs as these categories were created to represent those outside control areas whose flows are more integrated with the CAISO Balancing Authority Area. The CAISO is also in the process of transitioning its tariff terminology references to control areas to the NERC Functional Terminology of Balancing Authority Areas.

accurately model and price its interactions with IBAAs, the CAISO is not proposing in any way to *manage* congestion in, or reveal *prices* internal to, the IBAAs.

By more accurately modeling the transmission networks of the IBAAs, as well as representing the physical load and generation patterns on the IBAA systems, the CAISO is able to more effectively manage Congestion on its own system. As discussed below, the CAISO proposes to represent and model the transmission system of the IBAAs but will not enforce the related constraints for purposes of managing congestion on the CAISO system. Initially, the CAISO contemplated requesting each IBAA to provide not only information regarding imports/exports to/from the CAISO system, but also resource-specific information regarding how the IBAA intends to satisfy its base-load requirements and the operating characteristics of the physical resources located within the IBAA.[3] After further consideration and pursuant to discussions with certain IBAAs whose systems are highly integrated with the CAISO's, however, the CAISO has determined accurate Congestion Management solutions can be achieved without this detailed information and data.

For these reasons, for Release 1 of MRTU, the CAISO is intending to implement an approach that minimizes the information needed from IBAAs but still achieves the accurate Congestion Management solutions, as intended by, and reflected in the MRTU Tariff. For Release 1, the CAISO proposes to continue to use the existing intertie Scheduling Points at the CAISO's Balancing Authority Area boundaries with the IBAAs. In order to more accurately model and capture the effect of power flows internal to the IBAAs' systems on the CAISO Controlled Grid, the CAISO will utilize a network model to represent flows within the IBAA, add market resources to the model of the IBAA, and map the intertie Schedules to individual or aggregate System Resources distributed within the affected IBAA's transmission system. The CAISO will use actual distribution factors to accurately attribute schedules submitted at the intertie points between the CAISO and the IBAA to resources within the IBAA system. While the CAISO has the actual distribution factor information necessary to proceed with implementation of its preferred approach, the CAISO is willing to confer with the IBAAs regarding the selection of alternative appropriate distribution factors. In order to accurately manage congestion on the CAISO Controlled Grid the CAISO will continue to enforce transmission limits on transmission facilities within the CAISO system as well as on the interties to the IBAAs. While the CAISO will have a detailed representation of the internal IBAA systems, the CAISO will *not* enforce any constraints within the IBAA systems for purposes of managing congestion on the CAISO Controlled Grid. This approach will enable the CAISO to achieve a high degree of accuracy regarding the impact on the CASIO Controlled Grid from actual flows within the IBAA and schedules between the IBAA and the CAISO.[4] In addition, the CAISO's will model losses internal to the IBAA so that the CAISO's power flow solution remains valid, but will exclude losses in the IBAA from affecting the CAISO's market prices. Thus, the CAISO's market

[3] The CAISO will consider implementing this capability if other Balancing Authority Areas become interested in doing so.

[4] This assumes that sufficient data is available to the CAISO's market systems from the State Estimator. If this assumption is not valid, the CAISO will use other functionality of its market systems to estimate the real-time distribution of flows within the IBAA from flows at the boundary of the CAISO and the IBAA.

prices will reflect only those constraints/conditions within the CAISO Balancing Authority Area.

Background

The CAISO's MRTU program is a comprehensive effort to address the structural flaws in the CAISO's current electricity markets. Among others, these flaws include a Congestion Management system that has led to excessive Intra-Zonal (i.e., un-attributed) Congestion costs, inefficient use of the CAISO Controlled Grid, and a market structure that has provided opportunities for manipulation and failed to ensure that the resources necessary for reliability are made available to the CAISO to serve real-time load. The MRTU market design addresses these flaws through a comprehensive overhaul of the electricity markets administered by the CAISO and the adoption of a new Full Network Model (FNM) that will accurately reflect the operational realities of the CAISO Balancing Authority Area. The primary objectives of the MRTU project are to ensure reliability and efficient market operation by: (1) performing effective Congestion Management in the CAISO's Day-Ahead Market (DAM) by enforcing all transmission constraints, so as to establish feasible forward Schedules; (2) re-establishing a Day-Ahead Market for Energy; (3) automating Real-Time Dispatch so as to balance the system and manage Congestion in an optimal manner with minimal need for manual intervention; and (4) ensuring consistency across market time frames (Day-Ahead through Real-Time) in the allocation of transmission resources to grid users and in the pricing of transmission service and Energy. These objectives of reliability and efficient market operation require that physical flows within the CAISO Control Area are modeled accurately.

The design of MRTU recognizes that the CAISO Balancing Authority Area is interconnected with several other Balancing Authority Areas in the Western Electricity Coordinating Council (WECC) interconnected system. Traditional methods of managing interactions between Balancing Authority Areas consist of managing contractual deliveries at intertie Scheduling Points between Balancing Authority Areas. In some cases, the differences between contractual deliveries and physical flows are of a limited size, which the CAISO's operators can manage in Real-Time. As a result, certain Balancing Authority Areas, such as the Bonneville Power Administration (Bonneville) Balancing Authority Area and the Nevada Power Company Balancing Authority Area, are not currently modeled in the Full Network Model. The CAISO's interconnections with these entities are instead modeled as radial interties to external network buses or Scheduling Points. These buses are referred to as Scheduling Points because that is where Import and Export Bids and Schedules from/to the Balancing Authority Areas are deemed to originate. More specifically, Import Bids are represented in the CAISO Markets as Bids from System Resources (logical generating units) connected at the relevant Scheduling Points. The external network beyond the Scheduling Points is ignored in the FNM.

This radial model of Balancing Authority Areas does not account for the loop flow effect of CAISO Import/Export Bids and Self-Schedules in resolving Congestion within the CAISO Balancing Authority Area, as well as the loop flow effect of external Energy

transactions among the interconnected Balancing Authority Areas in the WECC. Loop flow effect cannot be accounted for currently in the Day-Ahead Market as designed because external Balancing Authority Area transactions are not known in time (or at all) in order to be incorporated in the CAISO Markets.[5] The radial Balancing Authority Area model also does not allow for contingency analysis in the nearby external network that may have an impact on the simultaneous transfer capability on the interconnections with external Balancing Authority Areas, or within the CAISO Balancing Authority Area. To a certain degree, this impact is captured by Nomograms and dynamic Operating Transfer Capability (OTC) limits on the radial interties, which are determined by offline power system analysis studies using the entire WECC interconnected network model. Despite these limitations the radial model is satisfactory for determining the impact of flows internal to, and between, these external Balancing Authority Areas and the CAISO's system. The CAISO, does however, believe there are additional improvements that can and should be made to managing congestion across Balancing Authority Area boundaries. The CAISO proposes a staged implementation to address these issues with neighboring Balancing Authority Areas. In addition, the CAISO intends to further pursue these improvements through the efforts currently underway to improve inter-regional scheduling coordination throughout the WECC.

In order to prioritize the CAISO's overall plan to secure these improvements, the CAISO is currently focusing on those IBAAs whose networks are more closely integrated with the CAISO's. At present, the CAISO has identified the combined Sacramento Municipal Utility District (SMUD)/Western Area Power Administration (WAPA)/Modesto Irrigation District (MID) Balancing Authority Area and Turlock Irrigation District Balancing Authority Area as high-priority areas. The CAISO believes that, for purposes of MRTU Release 1, a more accurate representation of the impact of physical flows on these systems on the CAISO Controlled Grid is necessary in order for the CAISO to achieve accurate Congestion Management solutions and achieve its objective of maintaining reliability and achieving efficient market operation. With respect to these entities, assuming that their contractual deliveries to and from the CAISO Balancing Authority Area are actually located at Scheduling Points at the Balancing Authority Area boundary provides a less accurate forward-market Congestion Management result. The CAISO's ability to model and manage congestion on its system is enhanced more significantly by modeling conditions within these IBAAs in the FNM. The transmission networks of these entities are embedded in and/or run parallel to major parts of the CAISO network, and thus have a more significant impact than other IBAAs on the operation of the CAISO Balancing Authority Area.[6] Furthermore, accurate contingency analysis requires an accurate model for the IBAAs. For these reasons, the CAISO has proposed in its February 9, 2006 tariff filing that IBAAs (referred to at that time as Embedded Control

[5] In the Real-Time Market, the CAISO's State Estimator determines flows throughout the WECC, including loop flow in the CAISO's interties. For radial interties, the MRTU Real-Time Market software includes injections at the CAISO boundary to reflect the impact of loop flow. By modeling the IBAA network in the CAISO's FNM, and using the CAISO's State Estimator solution for that network in the Real-Time Market (using estimates of IBAA flows based on flows at the CAISO boundary, if needed), there is no need to perform loop flow compensation on interties with IBAAs, as is the case with radial interties. The effect of loop flow from external Balancing Authority Areas through the IBAA network is reflected in the power flow solution in the CAISO's market software.

Areas and Adjacent Control Areas (ECAs/ACAs)) will be modeled more accurately in the FNM. Because identified improvements in the way that IBAAs are modeled and treated by the CAISO depend on the IBAA's identification of its resources and schedules, as anticipated in the FERC's September 21, 2006 MRTU Order, the CAISO has endeavored over the past several months to coordinate with certain high-impact IBAA entities to develop procedures for sharing scheduling and other information to better model the IBAAs in the CAISO's systems and market application.[7] This paper discusses the alternatives considered with such parties and the development of the current treatment as described above and more fully below.

Discussion

The following discussion describes the options regarding the modeling and treatment of IBAAs that the CAISO is able to support (from a software perspective) in MRTU Release 1, and outlines certain implementation issues.

IBAA Modeling and Pricing Options for MRTU Release 1

In order for MRTU to proceed toward implementation, the CAISO has included software specifications for alternative methods for modeling and pricing IBAAs in the MRTU market. Such alternative methods are necessary as the CAISO will be required to model and price a variety of IBAAs, each of which may have unique modeling issues. As such, the CAISO has determined that it is appropriate to stage the implementation of its recommended IBAA modeling and pricing approach. Therefore, the CAISO has sought to include flexible solutions in its MRTU software functionality for this purpose. The following discussion is a presentation of modeling and pricing options that the CAISO is able to support (from a software perspective) in MRTU. The CAISO has and will continue to work with the individual IBAAs to determine the best alternative for the specific circumstances at hand until such time as the CAISO is able to transition all IBAAs to the CAISO's preferred, and a common, modeling and pricing regime.

Modeling /Representation Options

For the reasons discussed in the previous section, the CAISO's fundamental objective is to accurately represent the impact of each IBAA's physical load and generation on the CAISO's system. Two general options for achieving improved modeling and system detail include:

[7] Additional market software functions that are essential for the functioning of IBAAs, that are also used in modeling of External Balancing Authority Areas that are not ECAs IBAAs, are support for (a) Wheeling transactions and (b) "Pseudo Ties", which are generating units (or loads) that are physically interconnected to the electric grid of one Control Area but are under the control of another Control Area for purposes of determining Area Control Error (ACE). These market design elements will be described in other documents, and their details are not in the scope of this document.

Modeling Option 1: Map intertie Schedules to individual or aggregate System Resources distributed within the IBAA transmission system. Under this approach, the CAISO's intertie Scheduling Points would continue to be at the Balancing Authority Area boundary, but would be mapped to points within the IBAA for the purpose of analyzing congestion impacts on the CAISO grid. The location of these points would be determined by each IBAA's network topology in relation to the CAISO. By using intertie Schedules at the same Scheduling Points as in the pre-MRTU market, *Option 1* minimizes the details required for implementation.

Modeling Option 2: Schedule IBAA interchanges as generation and load, at their physical location within the IBAA area. The CAISO's Point of Receipt would be able to reflect the actual location of the physical resources (although, as discussed below, the CAISO's prices would be based on the value of the resources to the CAISO in terms of affecting congestion and losses within the CAISO Balancing Authority Area). This Option 2 requires more input data from the IBAA than Option 1, but could provide more accuracy because it would fully reflect the flows on the IBAA system, as well as the operating characteristics of the physical resources within the IBAA.

Both Modeling Options 1 and 2 can use the same FNM for the IBAA area that is used in the CAISO's State Estimator.[8] The CAISO will maintain Operating Transfer Capabilities (OTCs) for interties and transmission interfaces to IBAAs, as agreed to with the IBAA operator. As noted above, flow based network constraints within the IBAA would not be enforced in either option.[9] However, the CAISO and the IBAA would enforce the interface constraints at the border of the IBAA and the CAISO. In addition, network outage and maintenance information will be maintained, as available, for IBAA network elements and for IBAA -to- IBAA interties. Under either option, schedules could represent aggregated resources in the IBAAs. The Energy associated with imports to the CAISO (in Option 1) or from aggregated generation (in Option 2) will be distributed within the IBAA using distribution factors. Similarly, the Energy associated with exports from the CAISO (in Option 1) or to aggregated load resources (in Option 2) will be distributed within the IBAA using a second set of distribution factors. Furthermore, IBAAs may bid System Resources into the CAISO Markets at the IBAA's Scheduling Points on interties with other external Balancing Authority Areas.

---

[8] Alternatively, Modeling Option 1 can be configured to estimate the location of sources within the IBAA based on flows at the boundary between the CAISO and the IBAA. Also, Modeling Option 1 can allow the use of an alternative network model, such as a model derived from grid planning network models.

[9] Constraints within the IBAA could be enforced upon mutual agreement between the CAISO and the IBAA, to reflect operational concerns.

Modeling Option 1 maintains scheduling flexibility by allowing multiple Scheduling Coordinators (SCs) to schedule interchange between the CAISO and the IBAA, but its transparency in the market depends on how prices are determined for settlement. For the Day Ahead Market, Option 1 relies on a limited amount of data that originates outside the CAISO, which can be obtained from WECC base case power flow models. In the Real-Time Market, Option 1 allows a high degree of accuracy through use of the CAISO's State Estimator to match actual flows within the IBAA and on the IBAA's boundary with the CAISO, or alternatively can estimate flows within the IBAA based on flows at the CAISO boundary.

Modeling Option 2 is an enhanced approach that has been implemented in the MRTU software but would require detailed coordination and exchange of information between Balancing Authority Areas. Option 2 would provide better opportunities for improvements to Congestion Management in both the Day-Ahead and Real-Time Markets by establishing prices at the actual resource locations and based on each resource's specific characteristics, thus potentially resulting in a high degree of consistency between dispatch and prices. To validate the expected benefits of this approach, the CAISO has compared (a) aggregated resource-specific telemetry of the actual generation in each portion of the SMUD/Western/MID and TID areas, with (b) the distribution of total generation in each area using GDFs that were calculated for each hour of the day (without distinguishing weekdays from weekends). The generation profile produced by the GDFs compares well with the actual output of generation.

As noted earlier, despite these tangible benefits, Modeling Option 2 requires the provision of detailed and potentially sensitive information. Option 2 would also require arrangements (e.g., Inter-SC Trades) to be developed between the CAISO and the IBAA to allow Scheduling Coordinators (SCs) other than a generation owner to schedule a resource into the CAISO markets so that the CAISO's market structure would not limit access to the IBAA's transmission network.[10] The IBAAs currently identified have not expressed a willingness to participate in Modeling Option 2 because of the necessary exchange of potentially sensitive data that would be required to support Option 2. The CAISO believes that it can still achieve a robust and accurate Congestion Management solution under Option 1, assuming reasonably accurate inputs are available. Therefore, at this time, the CAISO does not intend to pursue Option 2. In cases where a generation owner chooses to designate a specific resource for participation in the CAISO Markets, Option 1 allows the resource to be either a Dynamic Resource-Specific System Resource or a Non-Dynamic Resource-Specific System Resource. Therefore, from a modeling/representation standpoint, the CAISO believes that Modeling Option 1 is the simpler approach, and recommends its use at least at the outset of MRTU Release 1.

Pricing and Settlement Options

The success of any Congestion Management enhancements regarding the modeling and pricing of IBAAs requires a high degree of consistency between dispatch and the

[10] Appendix 4 describes further details of Option 2, as a foundation for its possible future implementation through agreements between the CAISO and other Balancing Authority Areas.

pricing used for settlement. Under Modeling Option 1 above, the CAISO has considered the following price/settlement options with the individual IBAA:[11]

Pricing Option 1	Establish an intertie-specific LMP;
Pricing Option 2	Establish a single aggregated (hub) price for each IBAA as a whole; or
Pricing Option 3	Establish multiple aggregated/hub prices for subsystems within each IBAA.

Under Pricing Option 1, the CAISO would establish specific LMPs at each of the existing IBAA-CAISO tie-points. These LMPs would reflect both transfer capability limits at the tie-point as well as impact of internal flows within the IBAA system on the CAISO system, as represented and modeled using appropriate Generation Distribution Factors (GDFs) and Load Distribution Factors (LDFs). Option 1 would establish different LMPs at each of the different tie-points. While Option 1 is appealing in that it attempts to establish different LMPs at each tie-point, the price differences may be somewhat illusory in that they may be more reflective of *schedule* differences at each tie/scheduling point as opposed to price differences based on the physical attributes of the resources themselves. Moreover, IBAAs may experience differences between the tie-point and the bid price of an individual resource, thus exposing the IBAA to a potential under-recovery of costs.

Under Pricing Option 2, using the same underlying modeling methodology, a single "hub" price could be established for an entire IBAA. For example, with respect to the SMUD/Western/MID IBAA, a single hub price could be created for the entire SMUD/Western/MID system. TID would have its own separate hub price because it is a different Balancing Authority Area. Benefits from this approach include simplicity and that it avoids potential incentive problems associated with establishing different tie-point prices that are more an outcome of scheduling practices than resource or location-specific factors. However, other issues would arise because Option 2 would mask differences in the impact of resources in the SMUD, Western, and MID subsystems on congestion within the CAISO. Pricing the entire SMUD IBAA would indicate that the CAISO is indifferent as to where supply comes from in the SMUD IBAA, and would prevent the CAISO from indicating that it has locational needs for Congestion Management. Without any ability to indicate which resources within the larger SMUD IBAA would help to relieve congestion within the CAISO, the CAISO's software could dispatch the single combined SMUD IBAA resource based on an assumed distribution that would help to relieve the CAISO's congestion, while the delivered MW would actually make the CAISO's congestion worse. The CAISO would pay an average price even for delivery from resources within the SMUD IBAA that have low effectiveness in meeting the CAISO's system needs. Using a single SMUD IBAA hub could invite misuse of the intended resources, if (for example) the TID hub price turns out to be higher than the single SMUD IBAA price, and a marketer or other entity arranges for the use of transmission in the SMUD and TID IBAAs such that it would schedule its exports

[11] Modeling Option 2 produces prices at each IBAA resource's actual location.

from the CAISO at the SMUD IBAA Scheduling Points, while it schedules its imports to the CAISO at the TID Scheduling Points. It would be difficult to devise and enforce rules in the CAISO Markets to prevent this misuse of the intended resources. Also, it could not be presumed that a single resource aggregation for the SMUD IBAA would remain meaningful, since resources (or aggregations of resources) that have high value in the CAISO Markets could become resource-specific System Resources that would no longer be part of the single hub aggregation.

Under Pricing Option 3, again using the same underlying modeling methodology, multiple "hub" prices would be established for specific areas within each IBAA. For example, with respect to the SMUD IBAA, separate hubs could be created for SMUD, Western, MID, and/or regions within each area. This approach retains Option 2's benefits of simplicity and avoiding potential incentive problems associated with establishing different tie-point prices, while minimizing the problems identified above concerning Option 2. Pricing Option 3, however, would require greater detail in the specification of resources, to adequately define aggregations within an IBAA. Further discussion of implementation details is provided in Appendix 3. For these reasons, the CAISO prefers Pricing Option 3.

To illustrate the differences between the three alternative pricing options, the following table compares LMPs at hubs representing the location of physical resources and at several points on the CAISO boundary with the SMUD and TID Balancing Authority Areas. The "base scenario" is a subset of preliminary results for a LMP Study case that uses the proposed IBAA model, for Hour 16 of June 30, 2005. In the base scenario, congestion is present for the following network constraints:

- Blythe branch group
- California-Oregon Intertie (COI) branch group
- Mead branch group
- Pacific DC ("NOB") branch group
- Palo Verde branch group
- Parker-Gene branch group
- Southern California Import Transmission nomogram (SCIT)
- Sierra generation limit A

To show the impact of congestion east of the Bay Area, a second scenario creates congestion on a corridor (branch group) constraint from Tesla to Pittsburg. A third scenario creates congestion on the 230 kV line from Table Mt. to Rio Oso, which is part of a nomogram constraint that is north of the Bay Area. LMP differences between these scenarios reflect only the value of resources to the CAISO, since network constraints within the SMUD and TID Balancing Authority Areas are not enforced and losses within the SMUD and TID Balancing Authority Areas are not included in the CAISO's LMPs. The resulting LMPs are as follows:[12]

[12] Buses 37012 LAKE and 37016 RNCHSECO are Scheduling Points for the SMUD hub. Buses 37545 COTWDWAP, 30035 TRACY, and 37585 TRCY PMP are Scheduling Points for the WAPA hub. Buses 30670 WESTLEY and 38230 STANDFRD are Scheduling Points for the MID hub. Buses 30670 WESTLEY and 38432 OAKDLTID are Scheduling Points for the TID hub. The hub prices presented in this table are weighted averages of the LMPs at System Resource locations that are

	Base Scenario ($/MWh)	Congestion on Tesla to Pittsburg Corridor ($/MWh)	Congestion on Table Mt. to Rio Oso 230 kV ($/MWh)
SMUD Hub	98.45	98.18	111.64
WAPA Gen Hub	90.73	93.55	85.45
WAPA Load Hub	94.88	95.55	96.63
MID Hub	97.01	96.66	98.37
TID Hub	97.28	97.16	98.28
Roseville Hub	99.17	99.12	109.05
Single SMUD/ WAPA/ MID/ Roseville Hub	97.47	97.47	105.60
CAISO's NP15 EZGen Hub	93.18	105.29	94.65
37012 LAKE 230 kV	98.68	98.48	114.58
37016 RNCHSECO 230 kV	98.21	97.94	112.97
37545 COTWDWAP 230 kV	89.66	92.85	82.36
30035 TRACY 500 kV	93.46	94.19	88.39
37585 TRCY PMP 230 kV	94.05	91.56	92.47
30670 WESTLEY 230 kV	95.51	94.91	95.89
38230 STANDFRD 115 kV	98.64	98.12	104.88
38432 OAKDLTID 115 kV	98.92	102.65	99.14

The results show a shortcoming of the option of pricing at the CAISO boundary (Pricing Option 1), in that Bids from IBAA resources would be dispatched based on their value to the CAISO at their physical locations (represented by the "hub" prices) but would be settled at different prices for different boundary points where they would be scheduled. For schedules at some boundary points, settlements would not pay the value of the resources in any scenario, such as at Cottonwood (bus 37545 COTWDWAP): in the base scenario, the CAISO would dispatch WAPA generation at the value of its physical "hub" source, at $90.73/MWh, but the import to the CAISO at Cottonwood would be paid only $89.66/MWh. In some cases, prices paid at the boundary point are higher in some scenarios and lower in others, which would create a risk for the owner of a resource in the IBAA as to whether it would be paid its bid price. For example, in the base scenario, imports of WAPA generation at the 230 kV Tracy bus (bus 37585 TRCY PMP) would be dispatched at the WAPA hub's value to the CAISO of $90.73/MWh and settled at the higher price of $94.05 at the Tracy bus, whereas congestion at Tesla to Pittsburg would cause the Tracy price to be lower than at the WAPA hub ($91.56 vs. $93.55/MWh,

used to represent the supply (import to CAISO) and demand (export from CAISO Balancing Authority Area) of these IBAAs. Because the Scheduling Points at the IBAAs' boundaries with the CAISO are sometimes a significant distance from the System Resources that represent he underlying supply and demand, the weighted average price of the System Resources is not necessarily related to LMPs at the IBAA boundary. For example, in the base scenario, the SMUD Hub is the weighted average of prices at Lake, Rancho Seco, Elverta ($98.58/MWh), and Hurley (98.54/MWh), not simply the average of the CAISO boundary points at Lake and Rancho Seco. For simplicity, the Single Hub price presented here is a load-weighted average of the sub-system hub prices.

respectively). When a market participant bids into the CAISO market, it will not know where the CAISO will experience congestion, and thus it would be uncertain whether it will actually receive its Bid price in its settlements.

To ensure that the CAISO's settlements correctly pay the value of the Bids that are dispatched, and to avoid imposing risk of unpredictable settlements on market participants, the CAISO has concluded that settlements using the hub prices would be more appropriate than using prices at the CAISO boundary.

Appendix 1

Comparison Actual Versus Estimated Power Flows Using Alternative Scheduling Methodologies

---

To demonstrate the benefits of improved modeling of interactions between Balancing Authority Areas, this Appendix first compares scheduled and actual flows on the CAISO's interties with the SMUD and TID Balancing Authority Areas, as an example of areas that are closely interconnected with the CAISO. This comparison shows that the improved modeling tools discussed in this White paper provide more a accurate reflection of on actual physical flows and would allow CAISO to more fine tune its Congestion Management.[13] The conclusion is that in order to improve Congestion Management of flows from interties with SMUD and TID Balancing Authority Areas it would be more advantageous for the CAISO to exchange scheduling information with SMUD and TID that more accurately represent the physical delivery points into the SMUD and TID Balancing Authority Areas.

More accurate Congestion Management would require the inclusion of flows on individual intertie lines, but for simplicity of presentation, this paper aggregates interties and resources (generation and load) into three broad portions of the SMUD and TID Balancing Authority Areas, which consist of the following:

- Northern Scheduling Points and Resources:
    - Scheduling Points at Cottonwood: CTNWDW_2_CTTNWD and CTNWDW_2_RNDMTN [14]
    - Generation near Cottonwood: Shasta, Carr, Keswick, Spring Creek, Trinity, and Whiskey [15]
    - Loads of the City of Redding and other nearby cities that are served by Western transmission.

---

[13] The CAISO also examined an alternative method that would combine contractual deliveries at each Scheduling Point with Real-Time data on Demand in the SMUD and TID Balancing Authority Areas, which shows similar opportunities for enhancements.

[14] This paper examines internal SMUD and TID resources, and treats imports at Captain Jack as being in an "external' non-ACA Control Area. The Captain Jack to Olinda intertie into SMUD is closely connected to the Malin to Round Mountain intertie into the CAISO Control Area, and imports on either of these interties would flow through both the CAISO and SMUD Balancing Authority Areas.

[15] This paper does not include the Sutter power plant as a resource because Sutter is a "Pseudo Tie" generator under the Control Area jurisdiction of the CAISO. Sutter is located between the Cottonwood area and the Sacramento metropolitan area, and flow from its output would be distributed among the three groups of interties examined in this paper. Also, telemetry is not available for generation in the City of Redding, so Redding's generation could not be included in this analysis.

- Sacramento Metropolitan Area and SMUD's Upper American River Project:[16]
    - Scheduling Points for the RNCHLAKE _BG (Rancho Seco & Lake) branch group: RANCHO_2_BELOTA and LAKE_2_GOLDHL
    - Generation in or near the Sacramento metropolitan area (Campbell, McClellan, Proctor & Gamble, Carson Ice, U.C. Davis Medical Center, Folsom, Nimbus, and Roseville) and Upper American River Project (Camino, Jaybird, Jones Fork, Loon Lake, Robbs Peak, Union Valley, and White Rock)
    - Loads in the SMUD and Roseville service areas

- Southern Scheduling Points and Resources:
    - Scheduling Points south of Sacramento, including Western interties, MID, and TID: TRCYPP_2_TESLA, LLNL_1_TESLA, WESTLY_2_TESLA, STNDFD_1_STNCSF, TRACY5_5_PGAE, OAKTID_1_OAKCSF, and WESTLY_2_LOSBNS [17]
    - Generation in the MID and TID areas: Cottle, Don Pedro, Hershey, McClure, New Hogan, Woodland, Almond, Dawson, Lagrange, and Walnut
    - Loads in the MID and TID service areas.

Using final Hour-Ahead intertie Schedules from the CAISO Energy market, and actual intertie flows obtained from the CAISO's telemetry archives, Figures 1, 2, and 3 compare totals of scheduled net import to the CAISO Balancing Authority Area from the SMUD and TID Balancing Authority Areas to totals of physical intertie flows for these three aggregated areas. The data examined in this paper is for the week containing July 24, 2006, which is the date of record peak Demand for the CAISO Balancing Authority Area. Similar trends would be found for many time periods that could be selected for presentation. This particular week was selected for presentation because operating conditions during this week were critical due to high Demand, and accurate data for scheduling under these conditions is critical for maintenance of system reliability.

[16] SMUD's Cosumnes Power Plant began operations later in 2006, so its generation is not included in this analysis. Also, the aggregations of generation data used in these analyses do not indicate the resource aggregations that the CAISO would propose to implement in MRTU for the SMUD and TID Balancing Authority Areas. The actual aggregations for MRTU implementation will be developed through discussion with the IBAA Control Area operators.

[17] Data on flows also include the intertie at Herdlyn, although this is not currently enforced as an intertie branch group.

Figure 1
Import to CAISO at Cottonwood

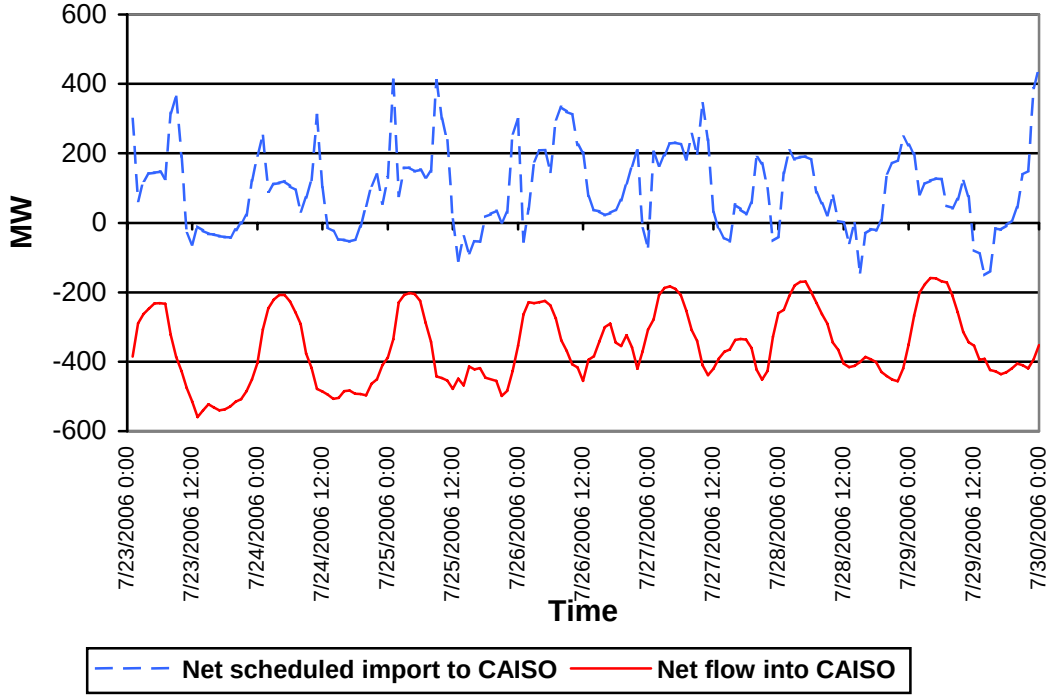


Figure 2
Import to CAISO at Rancho Seco & Lake

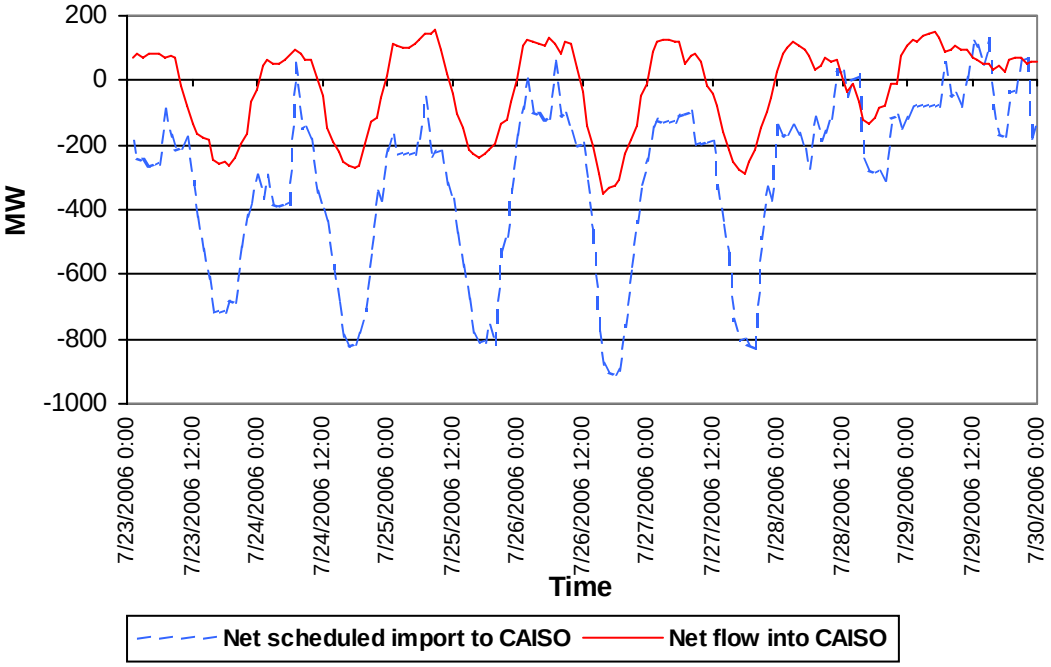
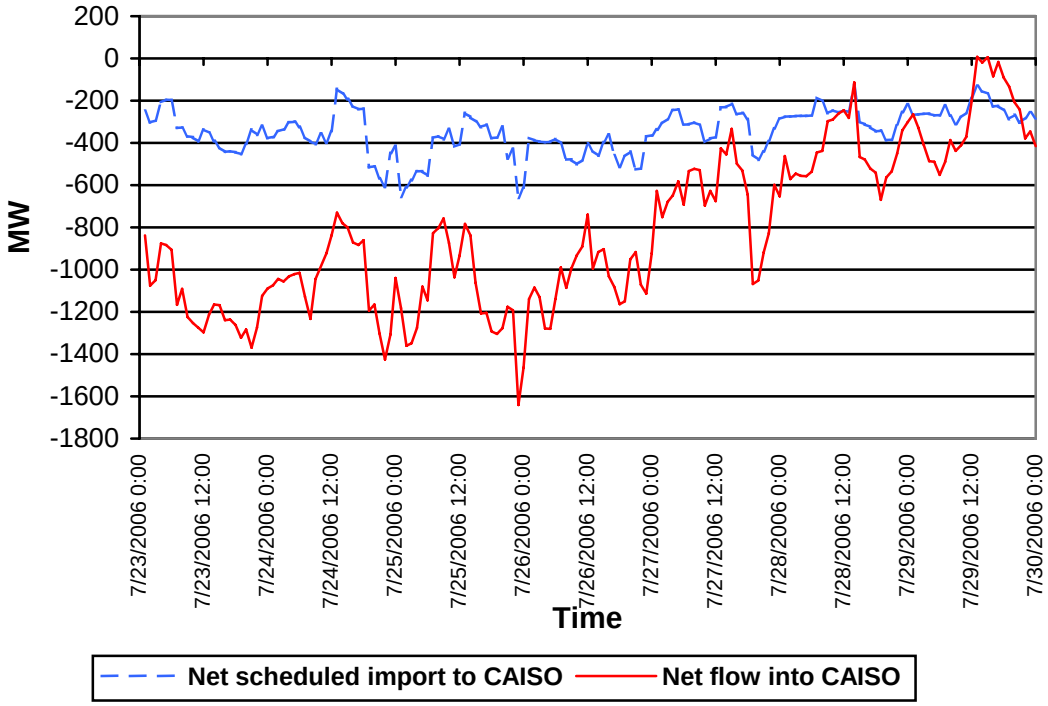


Figure 3
Import to CAISO at Southern SMUD&TID Points



Figures 1 to 3 demonstrate that there are large differences between the contractual use of transmission and physical flows in each of the three regions. In a majority of hours of this week, net imports to the CAISO were scheduled on the two intertie lines from Cottonwood (from Western's Cottonwood substation to PG&E's substations at Cottonwood and Round Mountain), but the actual flow was from the CAISO to Cottonwood. The difference between contractual Schedules and physical flows averaged 454 MW, and reached as high as 853 MW using hourly data. Exports of up to several hundred MW from the CAISO Balancing Authority Area to SMUD's Sacramento metropolitan area were scheduled in most hours of the week, but the typical daily pattern was net flows into the CAISO Balancing Authority Area in night and morning hours, and net flows out of the CAISO Balancing Authority Area to the SMUD Balancing Authority Area in afternoon and evening hours. The difference averaged 240 MW and reached as high as 554 MW. For the southern interties to the Western, MID, and TID networks, scheduled exports from the CAISO Balancing Authority Area averaged 345 MW, while actual flows out of the CAISO Balancing Authority Area averaged 817 MW, with the maximum difference reaching 1035 MW. Since the CAISO needs to manage network constraints for north-to-south flows through the Sacramento Valley, and has critical network constraints near Stockton (near MID and TID, and near the Tesla and Tracy substations where major CAISO Balancing Authority Area and Western transmission lines connect), these differences suggest CAISO's congestion management would be enhanced by the use of alternative methods to model actual physical injections or withdrawals of Energy from the transmission network.

Appendix 2

Additional Implementation Detail For Preferred Modeling Option 1

Figure 7 shows a broad overview of the CAISO's proposed approach to modeling IBAAs. The CAISO will predefine Resource Identifiers (Resource IDs) to Scheduling Points and supporting System Resources that the CAISO will model at major junctions within the IBAA near IBAA generation and/or load. In the Day-Ahead Market, the CAISO will use the Resource IDs' mapping of intertie Scheduling Points to System Resources, to place injections in the network. This allows the CAISO to approximate the flows at the IBAA boundary and within the CAISO that will result from the actual IBAA generation and load in real-time for purposes of Congestion Management. Multiple Resource IDs may exist in the CAISO Markets at each intertie Scheduling Point, and each will be mapped to a predefined set of System Resources. The predefined aggregation of System Resources that is mapped for some Resource IDs at any Scheduling Point can differ from the System Resources that are mapped for other Resource IDs at the same Scheduling Point, as illustrated at "Tie 1." At "Tie 1," some Resource IDs are predefined as originating from generation within the IBAA, while other Resource IDs represent wheeling transactions to or from the CAISO that use the IBAA's transmission service. In this case, the CAISO's price for the different Resource IDs could be different, to reflect the value to the CAISO of injections at their own aggregations of System Resources. The same aggregation of System Resources can be mapped from multiple Scheduling Points, as illustrated for "Tie 1" and "Tie 3." In this case, the value to the CAISO system due to injections from the aggregation of System Resources would be the same, regardless of which intertie Scheduling Point is used, and the CAISO's price would be the same. The CAISO will be trying, when predefining the mapping of System Resources to Resource IDs, to establish mappings that ensure realistic identification of the physical injections that support their Schedules.

In addition to the CAISO's use of System Resources at major junctions within the IBAA to represent physical generation and load, the CAISO will consider requests to establish Dynamic or Non-Dynamic Resource-Specific System Resources within the IBAA.[18] Among the requirements for establishing a Resource-Specific System Resource is the provision of telemetry that will allow the CAISO to validate the resource's compliance with Schedules in the CAISO Markets. If capacity in the IBAA is specifically established as a Resource-Specific System Resource, the CAISO will not include the capacity in an aggregation that represents non-resource-specific capacity.

If sufficient data is available to the CAISO's market systems in the Real-Time Market, the CAISO's State Estimator will provide the true location of injections in the IBAA, for

[18] See Appendix 1 for definitions of these specific terms. Generation could be either dynamically or non-dynamically scheduled, but load would be limited to non-dynamic scheduling in MRTU Release 1.

accurate Congestion Management.[19] The assignments of market Schedules to the designated System Resources will remain as they were predefined, but the market software will calculate "compensating injections" so that there is no double-counting of injections from the System Resources and the actual physical resources (generation and load) in the IBAA.[20] In each run of the Real-Time Market, the CAISO's Dispatch changes the injection at the System Resources' locations, but in future intervals the change in Dispatch will appear at actual physical resources as measured by the CAISO's State Estimator, or at locations that represent the physical resources.

As noted above, the CAISO will enforce thermal constraints on Energy flow on individual intertie branches between the CAISO Control Area and the IBAA. The CAISO will also enforce capacity constraints in the CAISO Markets on branch groups and Nomograms that are necessary for the reliable operation of the CAISO Control Area and CAISO Controlled Grid, as well as constraints that the CAISO and IBAA mutually agree to enforce. Each IBAA is responsible for congestion management within its network. Consequently, all network branches within IBAA networks, and the IBAA -to- IBAA interties, would be added to the CAISO's "exception list," which identifies network constraints that will not be enforced in the CAISO Markets. Therefore, the LMPs in the CAISO market will reflect conditions in the CAISO Balancing Authority Area, but will not reflect the impact of congestion within IBAA networks or on IBAA -to- IBAA interties.

Although network constraints within IBAA networks would not be enforced, any constraint violations will be reported by the CAISO's market applications. If overloads are observed in the Day-Ahead Market within IBAA networks or at their boundaries, the CAISO may communicate such events to the relevant IBAA operator and coordinate with the IBAA operator concerning any manual re-dispatch that is necessary in real-time. If the IBAA operator is unable to resolve these overloads in real-time, independent of the CAISO, the CAISO will issue Exceptional Dispatches to resources within the CAISO Balancing Authority Area to resolve them. The use of Exceptional Dispatches assures that the associated re-dispatch will not directly affect the CAISO's

---

[19] Alternatively, the CAISO's software will estimate flows within the IBAA based on flows at the CAISO boundary.

[20] This uses the same mechanism that exists at radial interties to external Balancing Authority Areas, for modeling of loop flow in the Real-Time Market. If market Schedules at a radial intertie were 100 MW but the observed flow is 110 MW, a "compensating injection" of 10 MW is placed into the Network Applications portion of the market software to recognize that there is 10 MW of loop flow across that intertie. If market Schedules at the radial intertie were 100 MW but the observed flow is 0 MW, there is –100 MW of loop flow, and the compensating injection is –100 MW. The same principle applies for the System Resources within the IBAA, which are placed at major junctions that are near generation and/or load but not at the same bus as the actual generation or load. If the State Estimator solution is used to place generation and load at their actual locations, then the actual injection at the bus where the System Resources are located is 0 MW. Thus, at the start of a Real-Time Market solution, the "compensating injection" has the same absolute value as the market Schedule, but has the opposite sign: if the market Schedule is for 100 MW of generation, the compensating injection places 100 MW of load at the same bus. (If the location of actual generation and load must be estimated from flows at the CAISO boundary, then the modeled injection at the System Resource's bus might not be zero, but the same methodology still applies.) For future intervals of the same run of the Real-Time Market, the compensating injection stays constant, and changes in Dispatch of the System Resource produce a non-zero net injection from the System Resource.

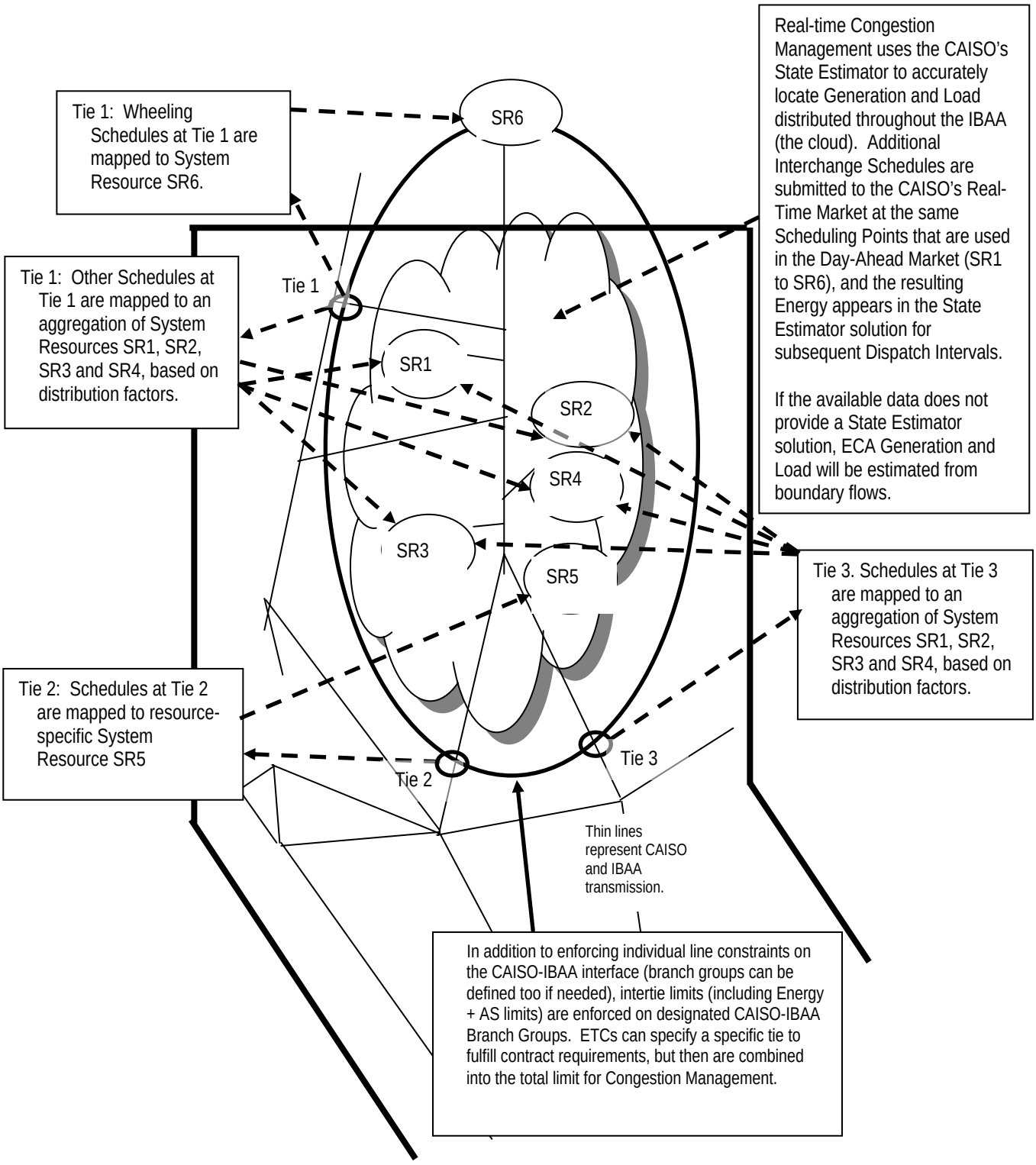
LMPs. The CAISO and the IBAA operators will need to develop specific procedures to determine how constraints within IBAA networks and their boundaries will be handled. The CAISO will work with the IBAA operators to develop operating procedures to resolve these network constraints.

Another type of constraint, which is part of modeling all interchange with other Balancing Authority Areas, is known as an "intertie" constraint that is associated with a branch group at the CAISO boundary, or in some cases with a set of branch groups or Balancing Authority Area boundaries. The "intertie" constraint limits the simultaneous scheduling of Energy and Ancillary Services, through assigning each Resource ID to one specific "intertie" constraint. The sum of all net import Energy Schedules into the CAISO, plus import Schedules for upward Ancillary Services (i.e., Regulation Up, Spinning Reserve, and Non-Spinning Reserve), for Resource IDs that are mapped to each "intertie" constraint must be within the designated import scheduling capacity. Similarly, all net export Energy Schedules out of the CAISO, plus import Schedules for downward Ancillary Services (i.e., Regulation Down) for Resource IDs that are mapped to each "intertie" constraint must be within the designated export scheduling capacity. The designated import or export scheduling capacity will generally equal the associated branch group rating. In MRTU's initial implementation, the CAISO anticipates that an "intertie" constraint will be established for each branch group at an IBAA boundary, which will apply to all Resource IDs that are established at Scheduling Points associated with that branch group.

In addition, IBAAs are responsible for losses within their networks. The CAISO proposes to schedule and dispatch Bids for IBAA System Resources as if there were no losses within the IBAA network, and to use the scheduled or dispatched MW as the basis for expected net interchange between the CAISO Balancing Authority Area and the IBAA. Although transmission losses within IBAAs, and on interties between IBAAs, will be fully accounted for in power flow calculations, their marginal impact will be ignored in the loss penalty factor calculations for setting the CAISO's LMPs. This is done because each IBAA is responsible for the transmission losses within the corresponding IBAA networks. The marginal impact of transmission losses will be ignored in the LMP calculations by zeroing the partial derivative contributions to the loss penalty factors from network branches within the IBAA networks and from the IBAA interties. This will only affect marginal loss rates and does not alter in any way the transmission losses within the IBAA networks, which are accurately represented in the optimal Schedule and Dispatch by the full AC power flow solution in the market optimization.

Settlement of inadvertent interchange (deviations between actual and scheduled interchange) would occur as it does currently.

Figure 7: Concepts for Scheduling Intertie Resources in Embedded and Adjacent Control Areas (Modeling Option 1)



Appendix 3

Alterative Enhanced Functionality for Integrated Balancing Authority Area Market and Network Models (Modeling Option 2)

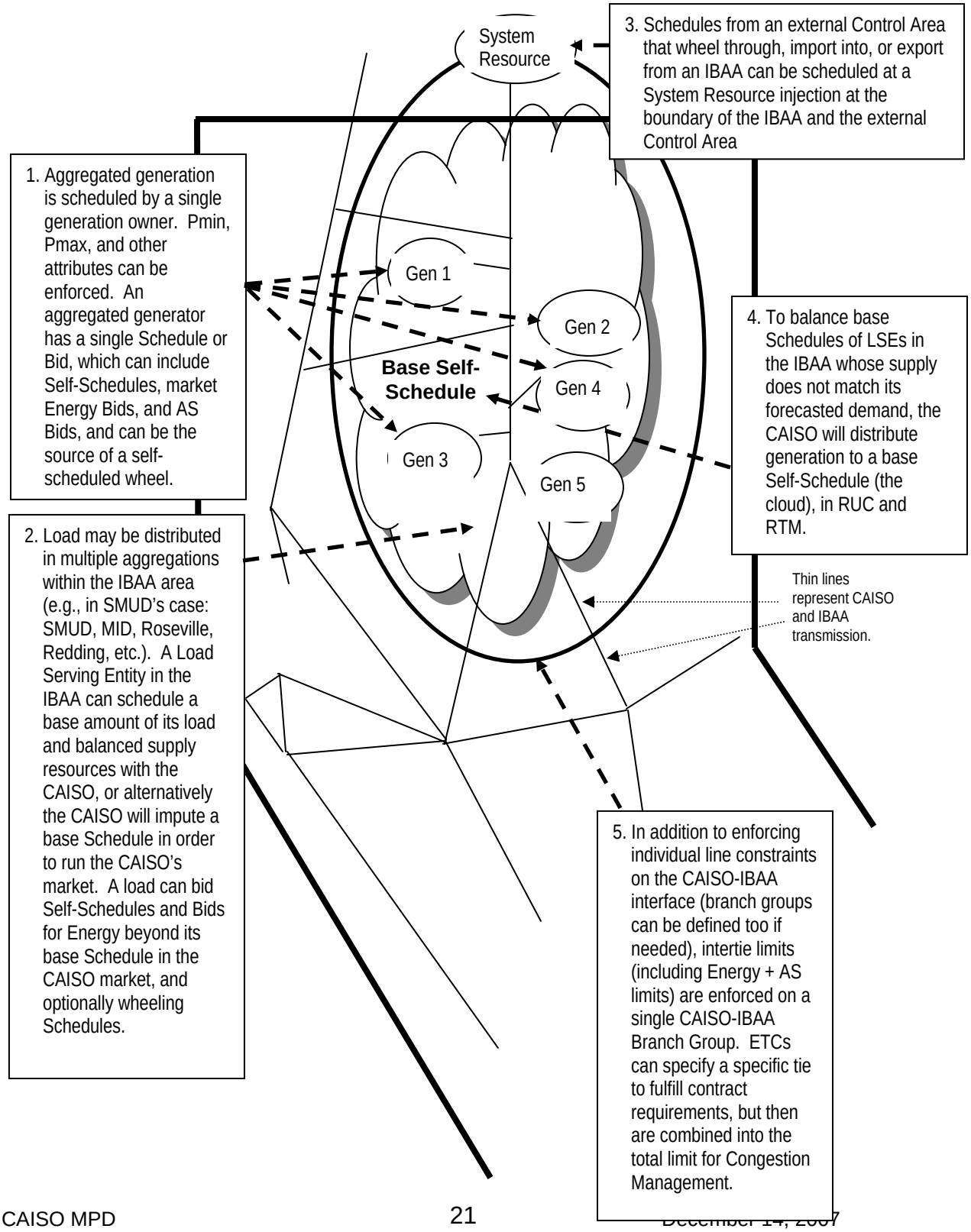
As described in the main text, Modeling Option 1 is the simpler approach of the two general approaches, and is being used in MRTU Release 1. Modeling Option 1 provides the additional benefits of more accurate modeling of flows to and from IBAAs but minimizes the details required for implementation, and maintains scheduling flexibility by allowing multiple SCs to schedule interchange between the CAISO and the IBAA, without requiring commercial details between Balancing Authority Areas. For the Day Ahead market, Modeling Option 1 relies on a limited amount of data that originates outside the CAISO, which can be obtained from WECC base case power flow models. In the Real-Time Market, Modeling Option 1 allows a high degree of accuracy by estimating actual flows within the IBAA and on the IBAA's boundary with the CAISO.

Modeling Option 2 is an enhanced approach the capability of which has been included in the MRTU software but requires detailed coordination between Balancing Authority Areas, and thus can be implemented in the future, after MRTU Release 1. Option 2 can achieve accurate congestion management in both the Day-Ahead and Real-Time Markets by reflecting the actual resource locations and resource characteristics, and produces consistency between dispatch and prices, because resources are settled at the same price where the resource is dispatched.

Figure 8 provides a broad overview of Option 2, for comparison with Figure 7. The following points are elaborated in captions in Figure 8:

1) IBAA Generation would be scheduled in the CAISO Markets similar to Generation in the CAISO Balancing Authority Area, with IBAA-specific features that are described below.
2) IBAA Load may be represented using multiple aggregations to distinguish Load Serving Entities within the IBAA area.
3) Schedules with external Balancing Authority Areas can be represented at the boundary of an IBAA. (If the external Balancing Authority Area were also modeled as an IBAA, the software would consider them together as an "IBAA Set".)
4) A "base schedule" may be established for generation and load within the IBAA, which will not be adjusted by the CAISO's software.
5) Intertie network constraints would be enforced, as well as branch group and nomogram limits that the CAISO enforces for reliable grid operations.

Figure 8: Concepts for Scheduling Physical Resources in Embedded and Adjacent Balancing Authority Areas (Modeling Option 2)



Modeling Option 2 would allow IBAA resources to bid into the CAISO Markets as System Resources similar to resources within the CAISO Balancing Authority Area.[21] This provides flexibility in scheduling of the IBAA's generation, since an IBAA generating resource's Bid can include any or all of the following:

a) a base Self-Schedule,

b) a number of Self-Schedules with Transmission Ownership Right (TOR) scheduling priority,

c) a number of Self-Schedules with Existing Transmission Contract (ETC) scheduling priority,

d) a price-taker Self-Schedule,

e) an Energy Bid,

f) a Regulation Up and/or Down Bid (if certified and dynamically scheduled),

g) a Spinning Reserve Bid (if certified), and

h) a Non-Spinning Reserve Bid (if certified).

A Bid for Demand in an IBAA may include any or all of the following:

a) a base Self-Schedule;

b) a number of TOR Self-Schedules;

c) a number of ETC Self-Schedules;

d) a price-taker Self-Schedule; and

e) an Energy Bid.

The networks of IBAAs must be modeled accurately in the CAISO's FNM. All generation and load nodes in an IBAA would be specified as Pricing Nodes for LMP calculation. Additionally, IBAA scheduling points with other external Balancing Authority Areas, and the Scheduling Points at the IBAA end of CAISO-IBAA interties, would also be specified as Pricing Nodes. The CAISO may define multiple load aggregations for a given IBAA. The CAISO may designate additional Pricing Nodes as needed for LMP calculation.

Generation within each IBAA would be registered in the CAISO's Master File as market resources, because Bids may be submitted for them as System Resources. Like Generation within the CAISO Balancing Authority Area, their registration can include all necessary operational and cost information if they are to be bid as Non-Dynamic or Dynamic Resource-Specific System Resources, including Minimum Operating Limit and maximum capacity (PMax) as well as the generation type (hydro, thermal, etc.). Start-

[21] The CAISO's ex-post Instructed Imbalance Energy accounting for IBAA generation bid as Non-Dynamic Resource-Specific System Resources will be similar to other System Resources, i.e., no Ramping or Residual Imbalance Energy. This requirement is driven by the CAISO's interchange transaction scheduling system, which only supports hourly Energy accounting for Non-Dynamic System Resources.

Up Time and Start-Up Cost, Minimum Load Cost, Minimum Run/Down Times, Ramp Rates, Forbidden Operating Regions, and all other relevant information can also be included. The Dispatch Instructions for Non-Dynamic or Dynamic Resource-Specific System Resources in an IBAA, and the associated intertie Scheduling Points, are sent via the CAISO's Automated Dispatch System (ADS) and to the CAISO's interchange tracking system, which processes the confirmation of Schedules.

This capability requires that a single Scheduling Coordinator (SC), and one Bid per IBAA generation resource, needs to be established for a generation resource, similar to resources within the CAISO Balancing Authority Area. However, transactions through other SCs can be supported by using Inter-SC Trades. Bid data submitted by Market Participants representing resources in IBAAs will receive the same protection of confidentiality as other Bid data submitted by CAISO Market Participants. Market data developed by the CAISO as part of its FNM is released only as its Congestion Revenue Rights FNM, which is a monthly publication subject to non-disclosure agreements and contains data for representative conditions, not Real-Time operational data. The CAISO's own use of data is for operational and reliability purposes, since the CAISO is a Balancing Authority Area operator, operates its markets as a part of Balancing Authority Area operations, and is not a Market Participant in its markets.

More detailed attributes of Option 2 are as follows. The IBAA resources would bid into the CAISO Markets as System Resources similarly to resources within the CAISO Balancing Authority Area, but with the following exceptions:

1) The CAISO would establish appropriate generation and load aggregations within IBAAs, and mechanisms for maintaining the required Generation and Load Distribution Factors (GDFs and LDFs) for these aggregations, through collaboration with the IBAA Balancing Authority Area operators. By default, the CAISO can develop the required data as it maintains GDFs and LDFs for resources within the CAISO.

2) The CAISO would maintain LDFs for IBAA areas in its LDF library, separately from LDFs for the CAISO Balancing Authority Area. The LDFs for IBAAs would not be included in the set of system LDFs that is used for distributing non-Participating Load throughout the CAISO Balancing Authority Area, and the CAISO Forecast of CAISO Demand does not include IBAA demand. IBAA LDFs can be based on historical information obtained from the CAISO State Estimator.

3) The CAISO would maintain GDFs in its GDF library for aggregated generation in IBAAs. These GDFs can be based on historical information obtained from the CAISO State Estimator, and be used in power flow calculations if GDFs are not submitted to the CAISO for a Non-Dynamic or Dynamic Resource-Specific System Resource that consists of aggregated generation. GDFs for base schedules would also be maintained in the GDF library for all generation in each IBAA. The base GDFs would also be based on historical information obtained from the CAISO State Estimator, and be used for base Self-Schedule adjustments in Market Power Mitigation and Reliability Requirement Determination (MPM-RRD), Residual Unit Commitment (RUC), and the Real-Time Market (RTM).

4) To achieve the most accurate Congestion Management, IBAAs should specify "base" Self-Schedules, which inform the CAISO about (a) the amount of Demand that the IBAA plans to serve using generation within the IBAA, or from interties between an IBAA and external Balancing Authority Areas, and (b) the distribution of the supply that matches that demand. The base schedules in the DAM identify Energy transactions that are external to the CAISO Balancing Authority Area and the CAISO Energy market. These transactions include Energy generated by IBAA generation, and Energy imported or exported between an IBAA and other external Balancing Authority Areas, to meet IBAA demand. All Self-Schedules for a given IBAA must be balanced, to result in a zero net interchange for the CAISO Balancing Authority Area. IBAAs that have direct interconnections between them, without going through the CAISO or other external Balancing Authority Areas, can be treated as an "IBAA set", and all Self-Schedules for IBAA sets must also be balanced. Because Energy from Self-Schedules is produced and consumed outside the CAISO Balancing Authority Area, it does not include Energy from Bids into the CAISO Energy market and it would not receive a CAISO Settlement. If the base schedules are not balanced when they are submitted to the CAISO, the CAISO would need to adjust them pro rata, in the CAISO's "Scheduling Infrastructure and Business Rules" (SIBR) software. [22]

5) Base schedules have the highest scheduling priority, so that they would never be adjusted in the CAISO Energy market.

6) Base schedules from IBAA generation and interties to other external Balancing Authority Areas can be revised in the RTM, similarly to other Self-Schedules. RTM base schedules would not be checked for balancing in SIBR since the CAISO does not receive non-Participating Load Bids. Any RTM base Self-Schedule balancing would take place in the RTM applications instead.

7) If an IBAA does not submit a base Self-Schedule, the CAISO would assume the base Self-Schedule equals zero in DAM. In RTM, including HASP, the CAISO proposes to use the actual IBAA demand and generation as determined by the CAISO's State Estimator.

8) When the CAISO runs its Residual Unit Commitment (RUC) process after DAM Schedules are established, available IBAA resources may be presumed to operate at levels greater than their base schedules, as needed to meet any unscheduled, forecasted demand in each IBAA. [23] The base Self-Schedule adjustment would be based on the relevant base GDFs for each IBAA, re-normalized to account for derates and any units hitting capacity limits during the adjustment process.

---

[22] After submission of DAM Bids is closed, any base schedules that remain unbalanced would be balanced by pro rata adjustments, first on the base schedules from generation until they hit the resources' minimum or maximum capacity limits (at which point the GDFs are re-scaled among the generators that remain dispatchable), and then on the base schedules for demand, followed by the Self-Schedules of ACA exports, if necessary. The affected Scheduling Coordinators will be notified of their adjusted base schedules.

[23] The CAISO's "Automated Load Forecast System" (ALFS) will be configured to produce Demand Forecasts for IBAA areas.

9) IBAA resources under Resource Adequacy (RA) requirements through contracts with CAISO Load Serving Entities must participate in RUC, at least for their RA RUC obligation. For IBAA resources, the RA RUC obligation is assumed to be net of any base Self-Schedule, including any adjustments to it. RUC Capacity that is scheduled to meet the CAISO Forecast of CAISO Demand would be constrained by the same limits that otherwise apply in CAISO Markets.

10) IBAA resources may submit Energy Self-Schedules and Bids into the CAISO Energy market as System Resources, similar to resources within the CAISO Balancing Authority Area, for capacity remaining above the base Self-Schedule. IBAA generation may submit three-part Bids as Non-Dynamic or Dynamic Resource-Specific System Resources.[24] Bids for IBAA resources as Non-Dynamic or Dynamic Resource-Specific System Resources would be subject to the same content, validation, and processing rules as for resources within the CAISO Balancing Authority Area, with some additional rules applying to base schedules and their adjustment. The Energy scheduled or dispatched from IBAA resources as Non-Dynamic or Dynamic Resource-Specific System Resources, in excess of any base schedules, would be considered to flow on interties between the CAISO and the IBAA, and would be settled at the LMP resulting from the CAISO's Energy market for the resource's Location. For aggregated resources, this would be an aggregate LMP. This is no different than the Energy from resources within the CAISO Balancing Authority Area, but for IBAA resources, this Energy is an incremental addition to the base Self-Schedule, if any.

11) Intertie Block Bids for Energy or other services would be supported for IBAAs, for System Resources in external Balancing Authority Areas in the DAM, but Intertie Block Bids would not be supported for IBAA generation that is bid as Non-Dynamic or Dynamic Resource-Specific System Resources. Instead, the CAISO would respect minimum up and down time constraints for IBAA generation that is bid as Non-Dynamic or Dynamic Resource-Specific System Resources, if these constraints are specified for the resource.

12) Bids for Non-Dynamic or Dynamic Resource-Specific System Resources in IBAAs would be allowed to set the LMP and may be subject to Market Power Mitigation – Reliability Requirement Determination (MPM-RRD), as indicated by the relevant indicators in the Master File. [25]

13) IBAA resources may bid Ancillary Services into the CAISO Markets as Non-Dynamic or Dynamic Resource-Specific System Resources, or as System Resources in external Balancing Authority Areas, for capacity remaining above

---

[24] IBAA generation can be hourly pre-dispatched in HASP or dynamically dispatched in the Real-Time Market (RTM) as Non-Dynamic or Dynamic System Resources, according to their hourly pre-dispatch indicator. The terms "Dynamic Resource-Specific System Resource" and "Non-Dynamic Resource-Specific System Resource", as used in this white paper, are intended to have the meaning defined in the CAISO Tariff for MRTU, as provided in Appendix 1.

[25] The CAISO currently does not anticipate applying MPM-RRD to imports from IBAAs, but will have the capability to apply MPM-RRD if required for imports in the future.

the base Self-Schedule, if certified, but like other System Resources, they may not self-provide Ancillary Services in the CAISO Markets.

14) An IBAA resource Bid as a System Resource would specify an intertie Scheduling Point, which is the Location at the IBAA end of a CAISO-IBAA intertie that would be used in the NERC tag for the resulting Schedule. The intertie Scheduling Point is used in NERC tags, but not in market optimization. The NERC tag would be an hourly value, which may vary during the day.

15) IBAA resources bid as System Resources, and in general any resource, may be specified as the source or sink of a source-to-sink Wheeling Bid. In this case, the incremental Schedule of the IBAA System Resource above the base Self-Schedule, if any, would be kept in balance with the matching Schedule on the other side of the Wheeling transaction. Further details of Wheeling will be described in other documents.

16) IBAA resources are treated as all other resources in CAISO Settlements, with the difference that there is no Settlement for the Energy (or other cost allocation, such as the Grid Management Charge or transmission Access Charge) that corresponds to base schedules. If meter data for schedules and dispatch of IBAA resources is not available, the corresponding Schedules from the intertie transaction scheduling system would be used instead for Settlement. Real-Time deviations from the base Self-Schedule would be accounted separately through inadvertent flow Settlement, and not be subject to Real-Time deviation Settlement in the CAISO Markets, since these deviations meet IBAA load deviations in real time. IBAA resources bid as Non-Dynamic or Dynamic Resource-Specific System Resources are eligible for Bid Cost Recovery. Energy from IBAA generation bid as Non-Dynamic or Dynamic Resource-Specific System Resources would be considered unit-contingent import for AS Obligation calculations, i.e., the same as Generation internal to the CAISO Control Area.