Opinion on
Intertie Deviation Settlements

by

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I. Introduction and Summary

A. Background

Unlike transactions that are contained within the footprint of an Independent System Operator (ISO), transactions that cross the boundaries between an ISO and another balancing area must be coordinated with the other balancing area in accord with regional transaction scheduling requirements. One example is the California experience with imports and exports to neighboring control areas, known as intertie transactions. These transactions are economically evaluated by the ISO in its market processes, but must also comply with regional intertie scheduling rules. Several times in the last decade, the California ISO has been unable to rely upon the delivery of intertie transactions that are scheduled in its market processes, because these transactions fail to flow during the operating hour for which they were scheduled. The uncertainty created by these failures raises the cost of meeting ISO load and can adversely impact reliability. These market and reliability issues relating to the delivery of scheduled intertie transactions have again become significant during 2017 and 2018.

A key distinction between intra-ISO transactions and those with neighboring control areas is the timing of scheduling and of settlement of "day-of" transactions. Because supply conditions and transmission availability outside of the CAISO can change after the CAISO day-ahead market is run, and some intertie transactions are only offered as hourly transactions, the CAISO runs an Hour-Ahead Scheduling Process (HASP) to coordinate the scheduling of hourly intertie transactions (including those that cleared in the IFM) ahead of real-time. Importantly, HASP determines schedules for hourly intertie transactions but does not set a financially binding commitment for those schedules. Instead these intertie transactions are settled along with other "day-of" transactions in the CAISO fifteen-minute market (FMM) and real-time dispatch (RTD).

This settlement design means that, unlike an intertie transaction that clears in the day-ahead IFM, a firm who is scheduled to import power in HASP but does not tag and deliver the power in FMM will not face an imbalance settlement, absent explicit rules that impose charges. In order to discourage arbitrary non-delivery, the CAISO has implemented a specific penalty for non-delivery of hourly transactions. This penalty, the Intertie Decline Charge, was intended to penalize importers and exporters for submitting transaction that they did not intend to deliver, while

trying to avoid punishing importers for intertie transactions that did not flow due to circumstances beyond their control, in particular the curtailment of non-CAISO transmission capacity needed for the transaction. However, the rules for applying the penalty, which include averaging of shortfalls across periods and a 10% threshold for applying the penalty, have proven to be very weak and ineffective in incenting performance. The weakness of the penalty allows intertie suppliers to economically benefit from non-delivery even when delivery is within the ability of the seller.[1]

The CAISO is experiencing adverse market and reliability impacts from large megawatt amounts of hourly intertie transactions that have been scheduled in HASP, but do not flow in real-time. The uncertainty surrounding intertie deliveries impose additional market and ratepayer costs because of the actions ISO operators take when they are unable to rely upon scheduled intertie transactions in real-time.

There are a number of potential motives for these high levels of non-delivery that we discuss later in this opinion. Some of these non-deliveries might reflect an economic decision of the supplier or buyer not to deliver the power, rather than being the consequence of external factors such as transmission system curtailments. For example, low FMM and real-time prices at the same time that the CAISO is purchasing power out-of-market at high prices may be contributing to the problem of non-deliveries by causing market participants to not deliver hourly transactions that cleared in HASP when they observe that FMM and RTD prices are extremely low as the *t*-20 tagging deadline approaches. It is likely that most or all of these motives account for some instances of non-delivery, but it is not clear which of these motives are the dominant causes of non-deliveries. Moreover, it is possible that there are other important causes that we have not yet identified.

Situations in which large megawatt quantities of scheduled intertie transactions do not flow in real-time create reliability risks for the CAISO, particularly if they happen on high-load days, as occurred on September 1 and 2, 2017. These adverse reliability impacts may be unavoidable if the non-deliveries are due to transmission system curtailments, but could very well be avoided if the reason for the non-delivery is within the control of intertie seller. Delivery failures also appear to be contributing to real-time outcomes in which CAISO operators schedule large amounts of imports out-of-market using exceptional dispatch, apparently sometimes at high prices, while FMM and real-time prices are low. These outcomes can contribute to large uplift costs and can lead to the high levels of non-deliveries that cause the operators to exceptionally dispatch imports.

In response to these concerns, the CAISO is now proposing to substantially revise its regime for penalizing the non-delivery of imports or exports. The changes will make distinctions between delivery failures that are caused by system conditions beyond the control of the importer/exporter and others that the importer/exporter can presumably control. The changes will sharpen the consequences of non-deliveries that are not deemed to be due to system conditions.

[1] We focus in this opinion on the market and reliability impacts of the failure of intertie suppliers to deliver imports, but there is a converse, but less serious, problem of export transactions that are scheduled but do not flow. The proposed penalties would apply to non-delivery of both imports and exports.

In this way, the changes are intended to greatly reduce the profitability of non-delivery when it is undertaken for economic reasons.

B. Summary

As we discuss below, while the current penalty regime has some clear flaws, we are somewhat surprised by the inability of market prices to at least partially deter non-delivery. The fact that real-time prices often do not increase as a result of the impact of the non-delivery of imports raises some questions about the impact of the proposed changes and could also be a sign of other issues with price formation in the day-of markets that may be worth addressing regardless of their impact on import non-delivery.

In this opinion we first (Section II) discuss the charges that are applied to the non-delivery of intertie transactions, and consider why they may not be effective in incenting the delivery of scheduled interchange in real-time. These charges include the failure charge that is applied specifically to hourly transactions, the operational adjustment charge that can be applied to both hourly and FMM transactions that are not delivered, and the settlement of real-time imbalances that is applied to IFM transactions that are not delivered in real-time

Then, in Section III, we discuss a number of factors that may contribute to the high level of non-delivery of hourly transactions in real-time. Three of these factors have been identified by the ISO, and we suggest a number of others that could also be responsible for a material portion of non-deliveries. Understanding the likely reasons for the high level of non-deliveries is important both to assessing the degree to which the proposed charges are likely to be effective in reducing the high level of non-delivery of intertie transactions as well as to assessing what other changes in intertie scheduling behavior may follow implementation of the proposed charges. These factors and possible reasons for non-delivery include the following:

1. Energy cannot be delivered due to a generation forced outage
2. Scheduled Energy is not delivered because seller elects to deliver the energy elsewhere.
3. Speculative energy supply bid into the IFM or HASP is not delivered because the seller is unable to buy power to meet its delivery obligation.
4. FMM prices that are expected to be much lower than HASP prices (which can lead to factor 2 and may be related to factor 11)
5. Operational Adjustment Charge implementation
6. Reduced deliveries from intermittent resources
7. Day-Ahead Market arbitrage
8. The seller delivers less than the HASP schedule so that the scheduling limit will not bind in the FMM, raising FMM prices.
9. Raise FMM prices by reducing supply
10. The under- or over-delivered amounts are a result of EIM participation
11. The power is not delivered to cover the HASP schedule because the seller instead delivered the energy to the CAISO as exceptional dispatch transactions.
12. The use of the CAISO system by other balancing areas for load balancing

We discuss each of these factors and possible reasons in some detail, and for several of them, we draw a few conclusions about whether higher penalties for non-delivery would effectively address the issue. Unfortunately, there is little information available to allow us to assess which of

these are the most important reasons for the current high level of non-deliveries, which in turn makes it difficult for us to assess how effective the proposed charges will be, or what other impacts they may have.

In Section IV, we briefly summarize the four core elements of the changes proposed by the ISO and how they generally correspond to the various possible reasons for the high level of non-deliveries. Then in Section V, we briefly summarize responses that other ISOs have made to the problem of non-delivery. There, we conclude that their institutional arrangements are sufficiently different from the CAISO's situation that there are few relevant lessons in their experience. Finally, in Section VI, we comment on the effectiveness of the changes proposed by the ISO and on their potential secondary impacts. These comments are limited to a discussion of potential impacts because of the lack of information on what factors actually important reasons for non-delivery.

In summary, because the reasons behind the failures to deliver have not been fully established, we cannot conclude that the proposed changes would, in isolation, eliminate or even substantially reduce the amount of intertie transaction non-delivery. For the same reason, we cannot assess the likelihood of specific negative unintended consequences from the implementation of these changes. On the one hand, these changes might cause fewer day-ahead market transactions to be offered economically in the HASP and less real-time supply overall to be offered in HASP. On the other hand, these changes might incent more participation in the FMM by both day-ahead market and real-time transactions.

Despite these uncertainties, we believe that the implementation of stronger incentives for the delivery of scheduled intertie transactions is desirable, and, on balance, we recommend the adoption of the proposed changes. However, we are unable to confidently state these changes will eliminate the problem of non-delivery. This proceeding has highlighted pricing outcomes that are potentially concerning, particularly a pattern of very low FMM and RTD prices during what the ISO describes as stressed system conditions. We recommend that the CAISO continue to investigate the causes of these pricing patterns as further changes may be necessary to fully correct the problems that motivated this initiative.

II. Delivery Incentives Provided by the Current Design

This section reviews the delivery incentives provide by the current market design and explains our understanding of why these incentives have not been effective, to the extent we can identify the reasons for their ineffectiveness.

A. Failure charge

One of the primary tools intended to discourage non-delivery of intertie transactions under the current ISO market design is a penalty called the failure charge. The failure charge is discussed in detail in the ISO's draft final proposal. It is intended to be applied to hourly transactions that are scheduled in HASP but do not flow in real-time. This penalty has been ineffective in incenting import suppliers to deliver energy for the reasons explained by the ISO in the draft final proposal.

Two key limitations of the current failure charge design are the averaging of non-delivery levels over a month and the application of a 10% threshold below which now penalty is applied. In other words, no penalty is imposed for non-delivery unless more than 10% of the intertie energy scheduled by a particular intertie trader is not delivered during the month.[2] The ISO showed in its draft final proposal that the 10% threshold has the practical effect that the penalty is almost never applied, even when there are substantial levels of non-deliveries impacting ISO markets.[3] The extreme rarity with which any penalty would be applied means that the failure charge will be completely ineffective at incenting delivery performance. The level of non-delivery that the ISO has experienced shows that the failure charge does not deter intertie traders from non-delivery when they expect non-delivery to be more profitable, nor does it appear to deter them from scheduling imports they may or may not be able to deliver, nor does it incent them to take steps to reduce the potential for unintended failures to deliver.[4]

While the ISO focuses in its draft final proposal on the lack of effective performance incentives provided by the failure charge, there are two other elements of the CAISO market design that penalize non-delivery, these are the operational adjustment charge and the charges for deviations between day-ahead and real-time schedules, which we discuss next.

B. Operational Adjustment Charge

The operational adjustment charge is a form of imbalance payment applied to the difference between the FMM schedule and the RTD schedule. Its level is equal to the difference between the FMM price and RTD price. The operational adjustment charge is not explicitly a penalty for not delivering imports that are scheduled in HASP, but it should have this effect if it operates as intended. In essence, the importer whose hour-ahead transaction is scheduled in HASP, and then in the FMM for the first two FMM intervals of the hour, but then does not deliver power in real-time is treated, at least for these two FMM intervals, as selling power at the FMM price and buying it back at the RTD price. This "charge" can therefore be a payment to an import supplier that failed to deliver if the RTD price turns out to be lower than the FMM price. Below we first describe the operational adjustment charge, then explain why it should tend to deter non-delivery of hourly transactions. We then discuss possible reasons why it apparently has been ineffective in deterring non-delivery in practice.

1. Charge Design

To better describe the workings of the operational adjustment charge, it is useful to summarize the timing of the various day-of market processes. The HASP process initializes at *t*-67.5 before

[2] There is an additional floor that no penalty will be imposed if the total megawatts that are not delivered over the month is less than 300 megawatt hours, see California ISO, Intertie Deviation Settlement, Draft Final Proposal, December 12, 2018, p.14.

[3] See California ISO, Intertie Deviation Settlement, Draft Final Proposal, December 12, 2018, particularly Figures 8, 9 10 and 11, pp. 31-32.

[4] Even unintended failures can adversely impact CAISO reliability. An effective penalty structure would incent market participants to take actions such as internal training programs and procedures to ensure that scheduled transactions flow with high probability without applying charges that reduce participation in the market.

the actual hour to which it applies, with the HASP schedules typically posted around t-60, and definitely prior to *t-45*. In other words, the HASP bid submission process closes 75 minutes before the hour it is scheduling for. The real-time pre-dispatch run in which FMM prices are set initializes 37.5 minutes before the start of the first fifteen minutes of the hour to which it is applied. Therefore both HASP and market prices have been set for the first 15 minutes of an hour by 37.5 minutes before that hour. The second set of FMM prices are determined in the FMM run that initializes 15 minutes later, i.e., 22.5 minutes before the start of the hour. However, under current rules, the final commitment from importers to identify and deliver power by providing an energy and transmission E-Tag – a process known as "tagging" – is not due until 20 minutes before the hour in question. The transmission tag cannot be provided for an import transaction until transmission has been purchased from the generation source to the ISO intertie delivery point. The presence of the tag therefore assures the ISO that transmission is available for the transaction and has been paid for.

In the case of hourly HASP transactions, the operational adjustment charge (or credit) would therefore be applied during the first six 5-minute RTD intervals (2 FMM intervals) of the hour if an hourly HASP transaction is not delivered due to the failure to tag the transaction by *t*-20, resulting in the FMM and RTD schedules for the transaction to differ. The transaction would have an FMM schedule, and be included in FMM supply for the first two 15 minute intervals of the hour, because the delivery failure would not be known to the ISO until the transaction was not tagged at *t*-20. This would be after the binding FMM run for the first three RTD intervals would have initialized at *t*-37.5, and after the binding FMM run for the 2nd set of three RTD intervals would have initialized at *t*-22.5.

2. Charge Impact

If an hourly transaction is scheduled in HASP but is not delivered in real-time, the scheduled intertie imports would have been included in the calculation of the FMM prices covering the first two FMM intervals of the hour. However, the scheduled imports would not be reflected in RTD supply or prices for the corresponding first six RTD intervals of the hour when the power did not flow due to the lack of an E-Tag. The RTD price should therefore, other things equal, be higher than the FMM price. Simply put, the decreased level of import supply in RTD (compared to the FMM when an import transaction is not delivered) should be raising RTD prices relative to FMM prices, at least weakly. While there would be some intervals in which other factors would reduce the RTD price below the FMM price, there would also be some intervals in which other factors would magnify the price impact of the reduced import supply, so on average the operation adjustment should impose a positive charge on undelivered import transactions. In other words, we would expect the difference between the RTD price and the FMM price would be positive due to the impact of the failure to deliver the power. Hence, we would expect that the operational adjustment charge would impose a potentially significant cost on import suppliers who fail to deliver scheduled power during tight market conditions, as the failure to deliver power should on average materially raise the RTD price above the FMM price when supply is tight.[5]

[5] Note that an operational adjustment charge defined in this manner is *not* the same as the market-wide impact of the price increase (which is a negative pecuniary externality upon buyers in RTD and a positive pecuniary externality upon sellers). The former penalty would be the price change times the quantity of undelivered energy, while the market-wide impact on consumers is the price change times the quantity cleared in RTD. However, it can be argued to be proportional to the market inefficiency resulting from non-delivery, since the so-called welfare triangle (dead-

The logic is directly analogous to an internal resource with a day-ahead schedule who fails to supply energy during tight conditions. The failure to supply energy should raise prices in real-time, creating a potentially significant loss to the resource that fails to deliver power. While this charge is only be applied to under deliveries of HASP schedules during the first 6 RTD intervals of the hour (when intertie schedules that were not delivered would be included in FMM supply but not in RTD supply), it should impose a significant penalty on the supplier that fails to deliver power when non-delivery materially impacts RTD prices. Hence, one would expect that, barring other factors, this should discourage non-performance in real-time.

3. Charge Effectiveness

The ISO has not compiled data on the magnitude of the operational adjustment charges but the significant problems with ISO has encountered with non-delivery of intertie imports strongly suggests that these charges have not been effective at incenting delivery by intertie suppliers. It is not clear why this has been the case, however. The apparent lack of impact of the operational adjustment charge, and the lack of understanding why this is the case, contributes to our uncertainty regarding what is causing the non-delivery of imports and how effective the proposed charges will be in correcting the current problems.

The operational adjustment charge will not have much effect on incenting performance if the FMM price is very similar to the RTD price or even higher than the RTD price in the first two intervals of the hour when HASP transaction delivery failures occur. One possible explanation is that non-delivery has not been correlated with large FMM – RTD price differences. This should not generally be the case. As explained above, with all other things being equal, there will be less supply available in RTD than in these FMM intervals when such delivery failures occur. While we have not undertaken a systematic review of the price differences during hours impacted by delivery failures, we nonetheless have observed a number of circumstances in which there were large transaction failures yet the RTD price did not materially exceed the FMM price.

One circumstance in which the operational adjustment charge would not penalize a failure to deliver power, despite there being less supply available to meet load in RTD than in the FMM is when FMM prices are extremely high and close to the price set by the power balance violation penalty price in RTD. In this circumstance, the lack of scarcity pricing in RTD causes the RTD price to be roughly capped by the power balance violation price, so both the FMM and RTD prices would be around $1000, even though there is less supply available in RTD and therefore its supply imbalance is more extreme. This would have been the case during hours 19 and 20 on August 28, 2017 when prices were close to $1000 in both RTD and FMM during these hours impacted by the non-delivery of imports.

However, there are many other hours in which there were large amounts of imports scheduled as hourly HASP transactions that were not delivered in real-time and in which the FMM prices are far below the power balance violation price. In these hours a reduction in supply would have been expected to at least somewhat raise RTD prices relative to FMM prices. Surprisingly, in

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weight loss) caused by a price deviation from marginal cost is proportional to the price change times the quantity change (more precisely, it can be approximated as one-half that product).

many of those hours, RTD prices were not obviously increased. For example, there were several hundred megawatts of non-deliveries of imports during hour 16 on September 1, 2017, but the highest RTD price during the first 6 intervals of the hour was only $44.19, while the lowest FMM price was $49.73. During the first 6 intervals of hour 18 when more than a thousand megawatts of hourly imports were not delivered, the RTD price ranged from $7.69 to $28 while the FMM prices were $19.96 and $28.91. Finally, during the first 6 RTD intervals of hour 20 on September 2, another hour when over a thousand megawatts of hourly imports were not delivered, the highest RTD price was $36.16 while the lowest FMM price was $38.01 and the highest $168.32.

It is possible that non-deliveries had no material impact because FMM prices were so low and supply apparently so plentiful in most of those hours. However, it is unclear to us why FMM prices were so low during periods in which we understand the CAISO was making out-of-market purchases, nor do we understand why the failure to deliver 500-1000 megawatts of power would have no material impact on RTD prices.

Possible factors that could be reducing or eliminating the increase in RTD prices relative to FMM prices include:

i) systematically lower load conformance adjustments in RTD than in FMM relative to the differences in the net load forecast;
ii) application of the load bias limiter in real-time;[6]
iii) the continued ineffective implementation of the flexi-ramp product in RTD;[7] and
iv) out-of-market purchases that are not be reflected in FMM prices but are reflected in RTD prices.

In the data we have reviewed, as illustrated in the examples from September 1 and 2 2017, we rarely see increases in RTD prices when there are large amounts of imports not delivered. Instead, what we observe in most of these hours is that prices are very low in both FMM and RTD. It is not clear what accounts for this circumstance in which both FMM and RTD prices are extremely low, despite challenging operational conditions that lead to large out-of-market purchases through exceptional dispatch.[8] There appears to be a frequent pattern during the September heatwave that the megawatts of hourly HASP transactions that were not delivered, and hence included in FMM supply but not in RTD supply, was either very similar to or less than the amount of out-of-market operator purchases. If these operator purchases were made in the period after t-37.5 and hence were not reflected in FMM schedules, but were reflected in RTD

[6] It is our understanding that the load conformance limiter was relatively ineffective in depressing real-time price during the last few years because of demand response offered at high prices that would set prices close to the power balance penalty price when there were power balance violations and the load conformance limiter was applied to reduce real-time prices.

[7] The shadow price of the flexiramp product was consistently 0 in RTD through 2017 and this continued through November 2018. The shadow price was also very often 0 in the FMM, but not as consistently as in RTD.

[8] It is our understanding based on data provided by the CAISO that over 700 MW of power was purchased out-of-market during hours 16, 17 and 18 on Sept 1 and during hours 18 and 19 on Sept 2, while more than 1000 megawatts was purchased in out-of-market transactions during hours 19 and 20 on Sept 1 and during hours 20 and 21 on Sept 2.

schedules, their magnitude may have offset the non-delivered HASP transactions in both FMM and RTD, leading to no material net price impact on RTD. We do not know, however, when these transactions were entered into or which ones were included in FMM supply over the first half of the hour and which were not included.

Whatever the cause, the persistently low RTD prices mean that, at least during the fall 2017 heat wave hours, there were generally small or zero differences between FMM and RTD prices when delivery failures occurred, so any operational adjustment charges would be low. Since the penalties imposed by the proposed CAISO design would also be based upon FMM and RTD prices, it is important to understand why FMM and RTD prices have been low even when the failure on intertie suppliers to deliver power has required substantial out-of-market purchases. If this pattern of low prices during hours when large amounts of power are not delivered continues, it will likely impact the effectiveness of the proposed changes.

We have discussed the implementation of the operational adjustment with the CAISO, we have not been able to either verify that it is performing as intended nor identified specific implementation issue. We have a general concern with how exceptionally dispatched out-of-market purchases are accounted for, and how they are accounted for in the calculation of the operational adjustment charge is one of the elements that should be reviewed. In our view, total deliveries in RTD should be compared to the sum of the hourly HASP schedules and the exceptionally dispatched amounts.

C. Real-time Imbalance Settlements

A final charge that may be imposed on intertie transactions that are scheduled in HASP but not delivered in real-time is the imbalance settlement imposed on day-ahead import transactions. Deviations between day-ahead market schedules and real-time deliveries will be settled at either FMM or RTD prices, depending on when the resulting imbalance is accounted for. The settlement of these deviations could impose a material loss on the seller if the day-ahead market price was low and the real-time price high. However, this charge will not deter non-delivery if FMM prices are low. These charges should have provided a strong incentive for the delivery of day-ahead market schedules on August 28 during the fall 2017 heat wave since FMM and RTD prices were very high during hours 18, 19 and 20. The failure to deliver transactions scheduled in the day-ahead market would have resulted in imbalance charges of around $1000 a megawatt hour, so there should have been a strong incentive to deliver import transactions that had been scheduled in the day-ahead market.

Conversely, these imbalance charges would not have incented delivery during most of the hours of the fall 2017 heatwave because as noted above, FMM prices and RTD prices were typically very low on other days, particularly on September 1 and 2. It is important that the ISO be able to rely on the real-time delivery of transactions scheduled in the day-ahead market if the supply is needed and the two-settlement system is intended to provide appropriate incentives for delivery. However, the premise of the two-settlement system is that real-time prices will be high when power is needed. If real-time prices are low at times when the CAISO needs power, the two-settlement system will not be effective in incenting performance.

It is not known whether any of the transactions that did not flow during the fall 2017 heatwave were day-ahead market transactions. More generally, it is not clear if substantial losses are being incurred by import suppliers due to non-delivery of day-ahead market schedules. To the extent that the transactions that are not being delivered in real-time are transactions that were scheduled in the IFM, the ineffectiveness of the current real-time deviation charges in incenting performance suggests that the additional charges proposed by the ISO also may not be fully effective in correcting incentives. On the other hand, if few if any of the transactions that were not delivered had been scheduled in the day-ahead market, that would be more encouraging regarding the effectiveness of the proposed changes.

III. Potential Reasons for Non-Delivery of Hourly HASP Transactions

It is desirable to understand the most important factors leading to the majority of non-deliveries when evaluating potential market changes. This would enable us to assess two impacts: whether the changes proposed by the ISO are likely to be sufficient to incent more consistent delivery of intertie transactions or instead have little impact, and also to assess whether the changes might have other impacts that might exacerbate the ISO's import supply problem in some ways.

We have identified a number of potential motives for these high levels of non-delivery. It is likely that most or all of these motives account for some instances of non-delivery but it is not clear from the data available to us which of these motives are the most important causes of non-deliveries. All we have been able to conclude from a review of non-delivery during the heatwave period studied by the ISO is that there must be multiple factors contributing to non-deliveries because of the diverse conditions over the hours in which substantial amounts of scheduled imports were not delivered. Moreover, it is possible that there are other significant causes that we have not yet identified.

The CAISO has noted three reasons other than transmission curtailments for scheduled intertie transactions not flowing in real time. We review these reasons below and also discuss nine other potential motivations for these delivery failures.[9]

1. *Energy cannot be delivered due to a generation forced outage*

The CAISO states that this reason for non-delivery is "completely beyond the control of the scheduling coordinator."[10] However, this is only the case if the outage occurs so close to real time that replacement supply cannot be purchased. Otherwise, the failure to deliver reflects an economic choice not to buy power from another source to replace the curtailed transaction. Such a decision not to buy replacement power may be more likely when market conditions are tight or if California FMM prices are low. A more effective penalty for non-delivery would decrease the economic attractiveness of doing so.

2. *Scheduled Energy is not delivered because seller elects to deliver the energy elsewhere.*

[9]See California ISO, Intertie Deviation Settlement, Draft Final Proposal, December 12, 2018, p. 28.

[10]Ibid.

Non-delivery could be simply a result of prices rising at locations outside the Energy Imbalance Market (EIM) after the transaction is offered in the HASP, with the seller taking advantage of the free option that the ISO has given it to delay tagging the transaction until *t*-20 to be able to shift its supply into another market. It should be noted that this motivation is closely related to the 4th motivation, below. The seller may choose to sell the power elsewhere when it anticipates the FMM clearing at prices far lower than its HASP offer and below prices offered by buyers outside the EIM.

However, if the seller sees these high prices outside the EIM prior to *t*-80 or so, it should be entering into the other transaction prior to offering supply in the HASP. Hence, the behavior leading to non-delivery should be expected to be motivated by changes in prices outside the CAISO between the time supply is offered in the HASP and the time that transactions are tagged. It is a little surprising that market conditions would be changing so much in this period to result in large amounts of power not being delivered to the CAISO, on multiple interties, hour after hour. Is it possible that buyers are waiting until they see if their purchases clear in HASP, then offering higher prices in the bilateral market because there are few consequences to a failure to deliver power to the CAISO, i.e., to letting this free option expire?

A related question is whether large conformance adjustments by the CAISO operators on particular days are driving HASP clearing prices above regional bilateral prices so that more imports (and fewer exports) clear in HASP than is normally the case. This would lead to more activity in bilateral markets after HASP clears on these days.

3. *Speculative energy supply bid into the IFM or HASP is not delivered because the seller is unable to buy power to meet its delivery obligation.*

During hours 19 and 20 on August 28 when there were large non-delivery amounts, the HASP load conformance was 1700 MW, the load conformance in FMM was also 1700 MW, and FMM prices were close to $1000. It could be that the market was so tight that this supply was not available even at prices near $1000, but the CAISO was able to buy exceptional dispatch energy at some of the same locations at which the energy was not delivered.

This reason for non-deliveries is potentially related to the 2nd reason above as it could reflect suppliers offering supply in HASP so they can deliver it if FMM prices are favorable and they can locate supply, but would not deliver it power if they cannot buy power in bilateral transactions at a price consistent with FMM prices. Again, the ISO is giving suppliers in HASP a free option to deliver, and it should not be surprising that it is more profitable to not exercise that option in some cases.

If these non-deliveries are occurring because there is actually no supply available outside the EIM, then the CAISO is more likely to be unable to buy the power from other sources in any case. However, it is hard to reconcile a prospective condition of low supply availability with the low CAISO FMM prices during many of the hours with large non-deliveries during the fall 2017 heatwave. On September 2, the FMM cleared at $44 or less in all 4 intervals of hour 18, at $40 or less in 3 intervals of hour 19, at $80 in the other, and at prices ranging from $38 to $168 in hour 20. On September 1, FMM prices were less than $62 in all intervals of hour 16, no higher

than $40 in three intervals of hour 17 and $128 in the other, and less than $37 in all 4 intervals of hour 18. Only in two FMM intervals each in hours 19 and 20 did prices rise above $225, to above $600 in two intervals of hour 19 and between $300 and $400 for 2 intervals of hour 20. These prices do not suggest EIM market conditions in which supply could not be purchased to cover deliveries to the CAISO.

Another consideration relating to the impact of non-deliveries is that if market participants were submitting speculative transactions in HASP with only a small potential for delivery, and were waiting until *t*-20 to tag the amount of energy they were able to deliver, it then appears likely that they would incur significant penalties under the operational adjustment charge that would have been applied during the first 2 FMM intervals of the hour. If intertie transactions are being submitted on a speculative basis despite the application of the operational adjustment charge, this suggests that either there are either large benefits to submitting such speculative transactions or that the operational adjustment charge is not having the intended effect.

Hence, while the three above considerations that the CAISO has identified likely account for some of the non-deliveries the CAISO has experienced, there are a number of other causes for these non-deliveries that should be considered, which we discuss below.

4. *Low expected FMM prices*

Because hourly intertie transactions are cleared in the HASP but settled at FMM prices, there is a potential for the FMM price to be much lower than the HASP price. If this is the case, the intertie seller may use its ability to delay tagging the intertie transaction to deliver less than the hourly HASP schedule or even deliver no power at all because sometime after HASP executes, the seller revises its expectations of FMM prices to levels that are materially less than HASP prices and the seller would incur significant losses delivering power at the expected FMM prices. Presently, a HASP seller essentially has a free option to not deliver transactions scheduled in HASP if the FMM prices observed between *t*-75 and *t*-20 suggest that delivery will not be profitable.

As noted above, this is similar to the 2nd motive above (which is that the sellers shift the energy to another more profitable market), except that under this motive the intertie supplier may not sell the power at all when it does not deliver the power because it expects the price in the CAISO market to be less than cost of fuel or less than the opportunity cost of its water.

Review of HASP and FMM data provided to the MSC during the September 2017 heatwave indicates that this motive for the non-deliveries would be consistent with the pricing patterns during many of the hours on September 1 and 2 when there were large non-deliveries. This motive would be consistent with the observation that the undelivered transactions are hourly HASP transactions that cleared at high HASP prices but were not delivered when FMM prices were much lower as *t*-20 approached. For example, on hours 17 and 18 on September 1, an hour when there were substantial non-deliveries at NOB/Sylmar, HASP prices were much higher than FMM prices. In hour 18 the HASP prices ranged from $201 to $954, averaging slightly over $600 and the FMM prices ranged from $19.96 to $37.49, averaging slightly over $27. The difference in hour 17 was smaller but still material with HASP prices averaging $138 and FMM prices averaging $57.Similarly, on September 2 at NOB/Sylmar, the HASP price averaged $138 in hour 18 while the FMM price was only $30, the HASP price averaged $423 in hour 19, but averaged

slightly than $47 in FMM, and the HASP price averaged $318 in hour 20, but only around $84 in FMM.

The differences in prices were not as extreme at Malin but were still material. On September 1 in hour 18 the HASP price averaged $201 and the FMM price averaged $21. On September 2 the HASP price averaged $113 in hour 18 and the FMM price $32; the HASP price averaged $185 in hour 19 and $41 in FMM, and the HASP price averaged $142 in hour 20 and $63 in FMM. The non-deliveries were not nearly as large at Malin as at Sylmar on these days. This may have been because there were no extremely high HASP prices at Malin that would have cleared high cost offers that would in turn have had a large incentive to not deliver when FMM prices were far lower.

There were many other non-deliveries at MEAD on September 1 and 2. The pattern is a little more complex but also suggests that power cleared in HASP at high prices is not delivered when FMM prices are much lower at *t*-20. On September 1 there were substantial under-deliveries during hours 18 and 19, then very few in hours 20 and 21. The average HASP price in hour 17 was $33 but was - $41.5 in FMM. The FMM prices for the 2nd 15-minute period in hour 17 were below - $230, and were only single digit positive for the 3rd FMM interval. RTD prices were also negative for the first 5 RTD intervals of hour 17 and positive but less than $20 for intervals 6-9. It is not surprising that intertie suppliers might have decided not to deliver power at Mead at *t*-20. FMM prices then spiked to average $717 in hour 19, and Mead non-deliveries were only 144MW in hour 20 and nearly zero in hour 21. The non-deliveries at Mead on September 2 are even more difficult to analyze because HASP prices at Mead were substantially negative in hours 17 through 20 so only price taking transactions could have cleared in HASP. However, FMM prices were at least slightly positive in hours 17 through 19 so it is not clear why any power cleared in HASP at negative prices would not have been delivered when FMM prices were at least slightly positive.

It appears likely to us that a portion of the non-deliveries on these days were a result of market participants observing large differences between HASP and FMM prices and making reduced deliveries when current FMM and RTD prices were very low relative to the HASP price at which their transaction had cleared.[11] One reason for the large differences between HASP and FMM prices may have been out-of-market exceptional dispatches of intertie energy that were not modeled in HASP but flowed in FMM. This could signal a counter-productive self-perpetuating cycle. If the operators were concerned about the level of imports that were not being delivered and acquire energy after the HASP cleared, this would result in high HASP prices and low FMM prices. The HASP-FMM price spread would then cause intertie sellers to reduce the energy delivered on their tags, and these non-deliveries would in turn incent the operators to schedule more out-of-market exceptional dispatch transactions, repeating the cycle.

[11] Other sources of information would be the advisory dispatch instructions for future RTD intervals that would be observed by scheduling coordinators for internal CAISO generation. The RTD prices for the next hour, would not reflect non-deliveries of HASP transactions until the reduced E-Tag was submitted at *t*-20. It is also unclear at what point in time the advisory RTD prices would reflect the impact of out-of-market purchases that would be flowing in the next hour. Another source of information about next hour prices that might incent non-delivery of hourly HASP transactions would be out-of-market purchases by the CAISO. The entities making these out-of-market sales would know that the CAISO was entering into transactions that would likely reduce FMM prices below HASP prices which might incent them to non-deliver HASP schedules in expectation of low real-time prices.

As discussed further under item 11 below, much of the relationship between HASP and FMM prices over the September 2017 heat wave appears to be explained by the level of operator out-of-market purchases. On August 28 when operator purchases tended to be somewhat less than the amount of power scheduled in hourly HASP transactions that was not delivered, FMM prices were generally very high and in line with HASP prices. On September 1 and 2, however, the level of out-of-market purchases typically tended to materially exceed the amount of non-deliveries, which would account for much lower FMM prices. It is not clear to us from the analysis we have been able to carry out whether the price formation issues that need to be addressed go deeper than the impact of the out-of-market exceptional dispatches.

We have not been able to examine exactly which out-of-market purchases were included in HASP or exactly in which FMM run they were reflected in FMM supply but the general magnitude of the out-of-market purchases appears to be roughly consistent with the observed prices. One might conjecture that HASP prices were also inflated because the load conformance in HASP was being greatly inflated in order to schedule extra imports. While this may be the case, the load conformance adjustments appear to be is just as inflated or even more inflated in FMM, so this factor would not account for the difference between the HASP and FMM prices. For example, in hour 18 on September 1, the load conformance adjustment was 1600 MW in HASP, and likewise 1600 MW in the first 3 FMM intervals, rising to 1800 MW in the 4th. In hour 19 on September 2, the load conformance adjustment was 2000 MW in HASP, and 2300 MW in the first FMM interval and 2500 MW in the remaining intervals.

Similarly, one might conjecture that HASP does not account for the EIM supply that could be dispatched in FMM, but it is our understanding that while the EIM dispatch occurs in FMM, the supply offers are included in the HASP evaluation as well as in FMM.[12] Hence we suggest that the ISO needs to focus on the impact of out-of-market purchases, and the way, and when, they are accounted for in the CAISO market and settlements systems, in order to improve price formation and elicit improved delivery of intertie transactions in combination with the proposed penalties.[13]

There are also less simple potential explanations for the large differences between HASP and FMM prices, such as differences in congestion patterns between the HASP and FMM. There was congestion across California on these days, with varying prices at the different ties. As a result, differences in congestion in HASP and FMM could have resulted in different patterns of high and low prices at particular locations, such as Sylmar. These differences in congestion patterns could have arisen from transmission derates occurring after HASP ran, or from differences in the load distribution factors used in HASP and FMM, or perhaps from other factors.

[12] Differences between HASP, FMM and RTD prices could also be impacted by differences in the actual CAISO and EIM load forecasts (before the conformance adjustments) and perhaps differences in load conformance adjustments in the EIM between HASP and FMM.

[13] There are some pricing anomalies that we have not been able to account for in examining the data on out-of-market purchases, such as why FMM prices are not much lower than RTD prices for the first two FMM intervals of each hour if these FMM runs include both the HASP transactions and the out-of-market purchases.

The proposed charge for non-deliveries would tend to push market participant decision making in a direction which would help end the cycle of non-deliveries and operator out-of-market purchases. The charge would do so by incenting the delivery of transactions scheduled in HASP, which would in return reduce the need for operators to enter into out-of-market purchases that would not be accounted for in HASP. There are two caveats to this virtuous cycle which need to be considered, however. First, the non-delivery charge being considered will not be effective in incenting delivery when there are huge discrepancies between HASP prices and FMM prices. During hour 18 at Sylmar on September 1, the HASP price was a little over $600 and the FMM price around $27. 75% of the FMM price would have been a little over $20. Paying a $20 penalty to avoid a loss of several hundred dollars would be an easy decision. Thus, we need to anticipate that this penalty is not going to solve non-delivery issues that are due to such huge discrepancies between HASP and FMM prices.

Second, the ability of market participants to reduce the E-Tag on cleared HASP transactions at *t*-20 if FMM prices appear to be wildly out of line with their HASP offer price and supply costs is a safety valve that allows them to offer supply in HASP, while reducing the potential for huge losses from dramatically lower FMM prices. If this safety valve were eliminated by non-delivery penalties but the potential for the large price differences remained, the response of some or perhaps many suppliers might be to offer much less supply in HASP. To put this in reliability terms, one can ask the question "What is worse than having only ½ of the 1000 megawatts cleared in HASP show up in real time?" and the answer is "Only having 100 megawatts offered in HASP." If a material portion of non-deliveries are a result of price formation issues in CAISO markets that will continue to exist, such as the risk of out-of-market purchases that will depress FMM prices far below HASP clearing prices, the penalties could reduce deliveries as well as non-deliveries. This outcome could force CAISO operators into more out-of-market purchases rather than eliminating the need for them.

A final consideration relating to these price formation issues is that intertie suppliers could avoid these price risks by scheduling imports in the FMM rather than in hourly HASP transactions. Therefore, in order to correct these non-delivery issues, it is important to understand why these intertie suppliers are offering supply in the form of hourly transactions in HASP, and incurring these price risks (which are only reduced but not eliminated by waiting until *t*-20 to tag transactions), rather avoiding all of the price risk by offering supply in the FMM. If intertie suppliers are scheduling transactions in HASP rather than FMM to avoid minor costs, the penalty might shift supply from hourly HASP transactions to the FMM without reducing the supply available to the CAISO too much. However, this might not be the case. The cost of buying transmission for supply that might or might not be dispatched in FMM may be too high to justify buying transmission in order to submit bids in the FMM and the supply that is no longer offered in HASP may simply be unavailable to the CAISO except in the day-ahead market or through exceptional dispatch transactions. Moreover, we need to be conscious that element 1 of the proposed changes discussed in Section IV below might by itself have such an effect, because it will require suppliers to buy transmission by *t*-40 for their HASP transactions.

However, it is clear that this motivation does not account for all of the instances of substantial non-delivery. For instance, it should be noted that during hours 19 and 20 on August 28 when large amounts of scheduled imports were not delivered, FMM prices were close to $1000 in hours 19 and 20, and had been around $1000 during much of hour 18. Thus, it seems unlikely

that power would have been sold elsewhere in order to receive a higher price, and market participants should have been sufficiently confident of receiving a high price for the power scheduled in HASP so that they would be motivated to deliver in real-time. Therefore, we conclude that these price formation issues should not have been a factor leading to such substantial non-deliveries in these hours.

5. *Operational Adjustment Charge implementation*

We explained in Section II.B above that transactions that were scheduled in HASP, and included in the FMM at *t*-37.5, and at *t*-22.5 because they had not been declined, would receive an FMM schedule for the first two intervals of the operating hour. If the power did not flow during these intervals, as would be the case if no E-Tag was submitted, the seller would incur an operational adjustment charge equal to the difference between the FMM price and the RTD price. If the FMM price was moderate but the RTD price was materially higher than the FMM price due to the supply available in FMM but not in RTD, the seller would incur a large loss for its failure to deliver.

As discussed at length in Section II.B, the failure of this penalty to deter non-delivery of hourly HASP transactions raises the question of why this has been the case. There are at least two aspects to this question. First, it is not clear why RTD prices have not been materially higher than FMM prices during the first 6 RTD intervals of the hour when material amounts of hourly HASP transactions are not tagged, are included in FMM, but do not flow and are not included in RTD supply. RTD prices that are lower than FMM prices when these transactions do not flow indicate that the supply that was not delivered was unneeded. This may in part be the case because of other actions the ISO operators take when intertie transactions are not tagged at *t*-20 that are also not reflected in FMM prices. But it is difficult to understand why there would be no apparent increase in RTD prices relative to FMM prices, when large amounts of power that were included in supply in FMM are undelivered and are therefore not included in RTD supply.

Second, as discussed above, it is not clear how the charge has been calculated during some of the conditions the prevailed during the September heat wave, and changes may be appropriate in elements such as how deliveries for out-of-market transactions are accounted for.

Both of these considerations are relevant to assessing the likely effectiveness of the changes proposed by the ISO.

6. *Reduced deliveries from intermittent resources*

It is possible that deliveries could be less than the HASP schedule because the intertie transaction is supported by the output of an intermittent resource whose forecast output is lower at *t*-20 than projected in HASP or in FMM. We understand that it is anticipated that intermittent resources would schedule their output in FMM, rather than as hourly HASP bids, and that under-deliveries of FMM schedules are not included in the under-delivery data compiled by the CAISO. We also understand that in practice some intermittent resources output is being scheduled using HASP

transactions, rather than FMM transactions but the ISO believes that these transactions do not account for a material portion of the hourly HASP transactions that are only partly delivered. [14]

The role of intermittent resource output variations has not been discussed in CAISO proposals or in the stakeholder process until now, but is raised in Section 7.2 of the Draft Final Proposal as an apparently important issue. However, no data is available from the ISO on how much of the power that was not delivered was sourced from intermittent resources and we understand that information would be difficult to compile.

If power is not delivered because of variations in intermittent resource output, those variations will continue to exist following implementation of the proposed charge. While the charge might shift the transaction scheduling from hourly HASP transactions to FMM transactions, the power still would not be delivered when intermittent output falls. However, it does not appear likely to us that variations in intermittent resource output would account for the high levels of intertie deviations that were observed specifically in the evening ramp hours during the fall 2017 heatwave, although they could account for a portion of the overall level of under delivered import energy. It is somewhat important to understand the extent to which under-deliveries of energy scheduled in HASP or FMM are associated with intermittent resources and what factors if any might be increasing the magnitude of the under-deliveries in assessing the impact of the proposed changes.[15]

7. *Day-Ahead Market arbitrage*

It is striking that on the high load days in Fall 2017 studied by the CAISO and reviewed in the Draft Final Proposal, energy prices were high in these hours in the day-ahead market and low in FMM. The submission of virtual supply offers would therefore have been highly profitable in the DA market, and the scheduling of imports in that market that were not delivered in real-time would also have been profitable. This behavior—in which import supply was offered in the day-ahead market, available to flow in real-time, but would not flow if real-time prices were low—would be efficient if FMM prices reflected the actual cost of meeting load, i.e., if the cost of meeting load was actually very low.

As discussed in Section II.B, the delivery incentives provide by the two-settlement system depend on real-time prices accurately reflecting the need for power. If day-ahead prices are high

[14] It is possible that some suppliers may choose to schedule intermittent output in HASP so they can defer purchasing transmission until they have a better estimate of their likely real-time output.

[15] If EIM entities are using EIM prices to charge for balancing area imbalances, one might conjecture that there are more reductions in intermittent resource transaction quantities in FMM during the evening peak hours on high priced days because the sellers were trying to avoid high imbalance charges in the source balancing authority (BAA) if its output was less than its E-Tag. However, it does not appear to us that this would be the case because if the seller delivered the power to the CAISO it would receive the EIM FMM price, which should generally offset an imbalance charge based on the EIM RTD price (unless the RTD price in the EIM BAA was consistently higher than the FMM price). Indeed, we would expect the EIM FMM price to be lower than the CAISO FMM price by the amount of the GHG charge.

Conversely, if the intermittent resource producer could sell its output in the EIM BAA at the EIM price if it did not flow to the CAISO there would be less cost to having positive imbalances. Once again, it appears that the CAISO FMM charge and the EIM imbalance charge based on the EIM RTD price should generally offset and favor delivery of expected real-time output to the CAISO.

and real-time prices are low, it is efficient for high cost supply to be offered in the day-ahead market but not flow in real-time. With low FMM and RTD prices in most of the fall 2017 heat-wave hours that experienced a large amount of non-deliveries, particularly on September 1 and 2, the two-settlement system would not have incented delivery of day-ahead market schedules. There is a need for real-time prices to send an efficient signal for the delivery of day-ahead market commitments in real-time that is independent of the non-delivery issues.

However, if day-ahead market transactions do not flow in real-time because real-time prices are low, those low prices should not result in non-delivery of hourly transactions that have cleared in HASP. This is because if the day-ahead transactions do not clear in HASP because prices are low, the ISO would not expect those transactions to be delivered in the FMM and there would no non-delivery concern. Hence, if transactions that cleared in the day-ahead market are among those that are not delivered in real-time, there must be some consideration in addition to the response of import suppliers to low real-time prices that is causing those transactions to be cleared in HASP, but not flow in real-time.

The California ISO has not yet been able to assemble data on the degree which these non-deliveries involved transactions scheduled in the day-ahead market, so the importance of understanding the potential incentives is not clear. One possibility is that the non-delivery of day-ahead market transactions is occurring when FMM prices are expected to be low, as under item 4 above, but the seller is concerned with its financial exposure if market conditions change after HASP clears so that actual FMM prices are much higher than HASP prices when its transaction did not clear in HASP. This risk provides the following incentive to importers with day-ahead market schedules that they expect to be profitable to buy out of in real-time: the incentive would be to bid so that their transactions clear in HASP, even at low HASP prices, and then defer their decision of whether to deliver power until *t*-20. This strategy would allow an importer to wait until very close to real-time to make a final decision whether it will deliver power to cover its day-ahead market schedule. This option would reduce the risk to the import seller of having to buy out of its day-ahead market schedule at a higher than expected FMM price, and would thereby shift onto the ISO the uncertainty of whether day-ahead market transactions that cleared in HASP would actually be delivered in real-time.

It is our understanding, however, that if no E-Tags were submitted prior to publication of HASP results, the settlement of these day-ahead market transactions would have been subject to the HASP reversal rule, which would settle the undelivered day-ahead market transaction at the day-ahead market price, rather than the FMM price.[16] It is also our understanding that any day-ahead market transactions for which no tag was submitted would have been subject to the HASP reversal rule and therefore would not have benefitted from the difference between day-ahead market and real-time prices.

If this understanding is correct, and if we are correct that the partial deliveries on September 1 and 2 were associated with both transmission and energy tags submitted at *t*-20, then it does not appear to us that the desire to wait until *t*-20 to decide on whether the delivery of power would be economic would have been a motive for these delivery failures. The other implication of the application of the HASP reversal rule is that there should have been a strong incentive for these

[16] The HASP reversal rule would effectively eliminate the arbitrage profits if it were applied.

intertie suppliers with day-ahead market schedules to deliver the scheduled power in FMM, as they would not have simply earned the relatively low FMM price by delivering the power, but by avoiding the HASP reversal rule they would have earned the much higher day-ahead market prices.

However, we understand that it is also possible for a market participant to meet the requirements of the HASP reversal rule by tagging the transactions prior to the HASP run, showing the transaction has purchased transmission, then void the tag prior to *t*-20 so that the HASP reversal does not apply, the transaction does not flow, and the seller can buy out of its day-ahead market schedule at the low FMM and RTD prices.

It is difficult to assess the importance of these considerations in incenting non-deliveries and how the proposed penalties would likely change behavior for three reasons. 1) We do not know how many of the transactions that did not flow had day-ahead market schedules. 2) Neither do we know whether the transactions with day-ahead market schedules that did not flow bought transmission prior to HASP so that they were not subject to the HASP reversal rule or whether the transactions were in fact subject to the HASP reversal rule. 3) Finally, we do not know whether the transactions cleared at HASP prices that were materially above FMM prices or whether the offers cleared in HASP because the transactions were offered at prices that were economic at both HASP and FMM clearing prices.

8. *The seller delivers less than the HASP schedule so that the scheduling limit will not bind in the FMM, raising FMM prices.*

By reducing the supply offered so the intertie scheduling limit does not bind, an intertie seller will realize a higher price for its imports and an intertie buyer will pay a lower price for exports. This motive is potentially relevant when the HASP price is reduced due to import congestion, which we understand would be known to intertie sellers when submitting e-tags at t-20. Since we understand that the FMM is typically very thin, HASP congestion is likely to disappear or be materially reduced if real-time (FMM) flows are reduced below the HASP schedule.

This motive would be important to consider if the either of the two following situations apply to HASP transactions that are undelivered:

i. Those transactions do not have day-ahead market schedules; or
ii. There is material congestion in the HASP.

While day-ahead transactions might be more likely to flow because they are not exposed to real-time congestion, they also might be more likely to flow because they are financially binding.

This incentive appears more likely to result in small amounts of partial non-deliveries on each intertie, rather than to incent large amounts of power not being delivered. Whether this incentive is important could be indicated by partial schedules with small under-deliveries relative to the amount delivered. The incentive would also tend to motivate a partial decline prior to the binding FMM run; this would eliminate congestion throughout the hour. Meanwhile, the CAISO data mostly shows failures to tag that would only impact the last two FMM intervals of the hour. Between these considerations and the congestion data we have examined, this incentive does not appear to be a material issue on most of the ties.

Because the benefits of eliminating HASP congestion charges on all of the megawatts delivered could be large relative to a penalty applied to undeliverable megawatts, it could be difficult to deter these failures to deliver if liquidity in the FMM market is low. With the increasing importance of EIM scheduling and greater use of intertie capacity in the FMM, this incentive should be of diminishing importance. However, it could be a consideration on ties that are and remain outside the EIM.

9. *Raise FMM prices*

The seller delivers less energy than its transmission reservation in order to exercise market power. It could do this by driving up real-time (FMM and RTD) prices by reducing its energy delivery while its transmission reservation blocks use of this transmission by other sellers. In this circumstance, it is possible that the penalty for non-delivery of a few megawatts would be compensated by an increase in the price of many other megawatts. This incentive could account for large amounts of phantom transactions being scheduled in order to produce a larger market price impact when they were not delivered. However, this incentive would not be applicable to DAM transactions that do not flow as they would already have locked in the price they would receive for the import. It would also not be applicable to deliveries on uncongested interfaces, as additional transmission would have been available.

This raises the question of whether the sellers that do not deliver power have significant sales that settle at FMM and RTD prices that would benefit from the higher prices.

The low prices on September 1 and 2 are hard to reconcile with this motivation, however. It is possible that the sellers did not anticipate that the CAISO would buy large amounts of imports out-of-market, depressing FMM and real-time prices and that non-delivery of power has raised prices on other days.

10. *The under- or over-delivered amounts are a result of EIM participation*

If a material proportion of the over- or under-delivered transactions source or sink in EIM BAAs, the CAISO should evaluate whether these over- or under-deliveries are related to EIM rules.

It does not appear that the resource sufficiency rules would incent an EIM entity to schedule exports to the CAISO in HASP that would not flow in real-time because the HASP exports to the CAISO would be included in the EIM entity's base schedule and would count against the EIM entity in the resource sufficiency test. However, there might be an incentive to schedule HASP imports from the CAISO as they would also be included in the base schedule and count for resource sufficiency. However, our understanding is that the amounts of exports that do not flow have not been large and this is not the problem that concerns the CAISO.

We understand that at least some of the import transactions that were not delivered during the heatwave were not sourced within an EIM entity so could not have been related to interactions with EIM market rules, but we are not able to determine whether other transactions might have been related to such interactions.

11. *The power is not delivered to cover the HASP schedule because the seller instead delivered the energy to the CAISO as exceptional dispatch transactions.*

On August 28, September 1 and 2, 2017, it appears to us, based on data the CAISO has provided, that exceptional dispatch energy was delivered to the CAISO at the same locations where hourly HASP schedules failed to flow. Indeed, it appears to us from the data we have reviewed for the September 2017 heat wave that there is a fairly close relationship between the megawatts of non-deliveries on each tie and the level of out-of-market operator purchases. [17] We understand that the CAISO made some of these emergency energy purchases earlier in the day. Hence, it is possible that the sellers who failed to deliver energy cleared in HASP, did so because they had instead sold this energy to the CAISO through exceptional dispatch transactions.

An incentive to sell power to the CAISO through exceptional dispatch transactions rather than delivering power scheduled in HASP may exist if the CAISO offers to pay higher prices for exceptional dispatch energy than the seller expected to receive in real-time. On September 1 and 2, a sale to the CAISO through exceptional dispatch at a fixed price or a bid or better price would have avoided the price risk of HASP transactions, even if there were no price premium to the exceptional dispatch transaction. If exceptional dispatch prices are higher on average, there would an even stronger incentive to sell through exceptional dispatch transactions. However, this incentive would not explain why the sellers would have offered the supply in HASP if the supply had already been sold to the CAISO through exceptional dispatch transactions.

Unfortunately, clarifying the potential effect of this incentive is not possible at this time because the timing of the exceptional dispatch purchases is unclear. If the exceptional dispatch energy is purchased after HASP offers are submitted, sellers may be opting to deliver power at the exceptional dispatch price rather than risk being paid a lower FMM price for energy cleared in FMM. The large gap between HASP prices and the generally very low FMM prices during the hours in which the ISO was purchasing power out-of-market using exceptional dispatch on September 1 and 2 would tend to incent sellers to make such a choice. If the delivery reductions of the partial deliveries were of roughly the same magnitude of the amount of power sold to the CAISO through out-of-market transactions, it would suggest that such a substitution was taking place. On the other hand, given the large discrepancies between HASP clearing prices and FMM prices in many of the hours with large non-deliveries, the sellers might not have delivered the power even had there been no out-of-market exceptional dispatch transaction. In addition, as noted in the discussion of price formation under item 4 above, the mere fact that the seller learns that the ISO is making out-of-market purchases may deter the seller from delivering high cost power to cover hourly HASP schedules as the seller may anticipate that ISO out-of-market purchases will result in FMM settlement prices that are materially below HASP clearing prices.

Similarly, even if the hourly HASP transactions had cleared in the day-ahead market as well as in HASP, an intertie supplier could choose to sell the power to the ISO at a high price in an exceptional dispatch transaction, then not deliver power sold in the day-ahead market, expecting to be able to buy out of its day-ahead market obligation at a much lower price in the FMM than it would be paid for the out-of-market transaction.

[17] In addition, in reviewing non-delivery data during another heat wave in which there were no out-of-market purchases we also observed a very low level of non-delivery of hourly HASP transactions.

However, prices were not low in FMM during hours ending 19 and 20 on August 28, hours when there were some non-deliveries, so we do not believe price formation issues contributed to those non-deliveries. On the other hand, although there is some overlap on this day between the set of ties at which there were exceptionally dispatched import purchases and those with non-deliveries, there are both many fewer out-of-market purchases and fewer non-deliveries, so the degree of overlap is much less apparent than on September 1 and 2.

We have only examined the pattern of out-of-market purchases over this one heat wave, but if there is in general a substantial overlap between (i) power that is scheduled in HASP but not delivered and (ii) exceptional dispatch purchases by the ISO, the effectiveness of the proposed charges for improving delivery will depend at least in part on elements of the exceptional dispatch purchase process that we have not analyzed. These include the prices that are being paid for this exceptionally dispatched energy.

To the extent that non-deliveries are influenced by a crowding out, or even substitution with exceptionally dispatched energy over the same interties, other changes may be necessary. For example, there might need to be changes in the settlement rules applied to market participants who have sold energy both in HASP and through exceptional dispatch transactions. These changes could include counting real-time deliveries first against HASP schedules and only paying exceptional dispatch prices for deliveries in excess of the HASP schedule. However, such a change will not only incent sellers to deliver HASP schedules, but it could also have the negative effect of incenting them to only sell out-of-market power at even higher prices if the current price formation issues continue.

12. *The use of the CAISO system by other balancing areas for load balancing*

Some of the data we have examined reveals patterns that could be consistent with some Balancing Area Authorities (BAA) who have limited balancing resources within their own area using the CAISO HASP for the purpose of balancing their net interchange and internal load. It appears to us that a balancing area operator could clear an export schedule in HASP if it thinks it may be long for the hour, then adjust the tag downwards at *t*-20 based on its expected balancing area load at that point in time, selling less into the CAISO if its load is expected to be higher. The balancing area operator would have an incentive to overschedule exports in HASP in this situation so that it could cover its load if load was higher than expected as *t* approached, while selling power up its full HASP schedule if its load was low. Similarly, if a Balancing area operator expected to be short, it could schedule an import from the CAISO in HASP that was larger than needed, then reduce the amount of the import at *t*-20 if it did not need the power.

This method of using the CAISO for balancing through HASP transactions could be more attractive to BAAs than participating in the FMM, because by using HASP they would not have to wait until *t*-22.5 to put in the reduced E-Tag prior to *t*-20. They could instead put the reduced tag in at *t*-25 or *t*-30, or whenever it was convenient. The purchase of transmission could also be deferred until close to *t*-20. We do not believe that this incentive accounts for a material portion of the large non-deliveries in high load hours, but it may be contributing to the problem and contributing to operator uncertainty. The proposed changes appear likely to be somewhat effective in deterring this behavior, or at least charging for the use of the CAISO for balancing and the costs

imposed on the CAISO if the behavior continues.

IV. Proposed Changes

The CAISO proposes four key changes:[18]

1. Require intertie traders to submit transmission tag by t-40 and accept dispatch in the automated dispatch system (ADS) by t-45.

The CAISO will use the transmission tag to limit the amount of the intertie transaction that can be cleared in the FMM run for the next hour that initializes at *t*-37.5. The CAISO will also limit the amount of an hourly transaction that can clear in FMM based on the ADS instruction.[19]

This provision will require the seller to purchase transmission by *t*-40. The seller is less likely to incur this cost if it does not expect to deliver the power in real-time. Hence, for hourly schedules, the "fifteen-minute market binding award will equal the lower of the HASP schedule, HASP accepted award (ADS accepted value) or E-Tag Transmission profile."[20]

2. HASP non-delivery penalty

The CAISO will impose a non-delivery penalty on hourly transactions equal to 50% of the higher of FMM or RTD price on the difference between the HASP schedule and the energy E-Tag, unless the difference is due to a transmission curtailment. The choice of any particular percentage is difficult to justify given the lack of understanding we have of the reasons for non-delivery. The design of the charge to be based on the higher of the FMM or RTD price, rather than on the difference between the FMM and HASP prices or the difference between the RTD and FMM prices ensures that a penalty will be applied even when there is no apparent market impact from the non-delivery. We understand the ISO motivation for this design, but this design choice is a telling commentary on the severity of the underlying price formation problem that may be the root cause of non-delivery.

This penalty will be applied for all megawatts that are not delivered for reasons other than transmission curtailment. There will be no 10% threshold.[21] Finally, the minimum per megawatt hour penalty will be $10 even if the energy price is negative.

3. Additional ADS penalty

There will be a 50% adder to the non-delivery penalty (i.e. an additional 25% of the higher of the FMM or RTD price) if the hourly HASP transaction is accepted in ADS but not delivered.[22]

[18] California ISO, Intertie Deviation Settlement, Draft Final Proposal, Dec 12, 2018, Section 7, pp. 37-54.

[19] Ibid.

[20] Ibid., pp. 39, 45

[21] CAISO, p. 43

[22] CAISO p. 40

Since intertie dispatch instructions must be accepted in ADS prior to *t*-45, the non-delivery charge will be 50% of the RTD or FMM price if the CAISO is notified at *t*-40 or *t*-45, and 75% of the price if the CAISO does not find out until the energy tag is submitted at *t*-20.

4. FMM deviations

Differences between the FMM schedule and the energy E-Tag from 15 minutes transactions (or between the FMM schedule and the amount of transmission e-tag if it is lower than the amount of the energy e tag) will be settled as real-time deviations. Hence the importer will be charged the difference between the FMM price and the RTD price for the amount that is dispatched in FMM but not delivered (the energy tag is less than the FMM award).

V. Experience at Other ISOs

The CAISO is not the only ISO that faces challenges with variations in expected intertie deliveries. The New York ISO and Ontario IESO, which, like the CAISO economically schedule interchange transactions, both impose charges on intertie transactions that do not flow. The New York ISO in 2000 imposed a charge equal to the difference between the price in the scheduling process and the real-time price on transactions that do not flow for reasons that are within control of the intertie supplier in response to the relatively frequent scheduling of transactions that were apparently intended not to flow in real-time.[23] This charge appeared to be extremely effective in immediately putting an end to this behavior, presumably because price formation in the NYISO exposed the seller to very high charges for such a failure to deliver during tight supply conditions.

MISO and PJM have historically not used an economic process to schedule interchange, instead allowing market participants to submit price-taking transactions. This design led to continuing operational challenges for both ISOs because of the large and often unpredictable changes in net interchange. The management of these swings led the MISO in particular to implement a headroom constraint in its forward unit commitment processes to enable it to manage the swings in interchange, and also led to the imposition of restrictions on the timing for schedule changes.

In the last few years, NYISO and ISO New England, NYISO and PJM, and PJM and MISO have shifted to coordinated interchange scheduling processes between the source and sink ISOs. This greatly reduces the potential for unexpected changes in interchange supply or demand.[24] This approach is not an option for the CAISO because it does not adjoin other ISOs with whom it could jointly schedule interchange. However, as the EIM expands, more and more of the flows between the CAISO and adjacent BAAs should be coordinated by the CAISO in FMM.[25]

[23] The IESO also has charges but they are particularly complex because of its current non-locational pricing design.

[24] The economic efficiency of the scheduling processes is still a challenge, but the ISOs are much less likely to be impacted by large unexpected swings in interchange.

[25] EIM expansion will make it increasingly important for the ISO to account for the incentives created by settlements in both the ISO and EIM markets and the interaction between them.

VI. Effectiveness of Proposed Changes

The imposition of the proposed charges for non-delivery is a step in the right direction and should contribute to improved delivery performance for hourly intertie transactions. However, the amount of improvement we can expect from these changes depends to an uncertain degree upon 1) what is motivating these under-deliveries and 2) how CAISO actions change when these charges have been implemented. We do not have a completely clear picture of the characteristics of the transactions that are not delivered in real-time nor of the factors that might be motivating the non-deliveries.

Our uncertainty as to the most important factors motivating these non-deliveries makes it impossible for us to be confident in any assessment of what other changes in intertie scheduling behavior might accompany these changes. While the ISO needs reasonable assurance that hourly transactions scheduled in HASP will flow in real-time, and these changes should shift behavior in the right direction, we need to consider what other changes in behavior these changes might elicit, which will depend in part of which factors are most important in leading to non-deliveries.

One factor that will limit the impact of these charges in motivating changes in behavior is the price formation issues that were discussed extensively in Section III. Both FMM and RTD prices have often been very low during some hours coinciding with large non-deliveries. If these price formation issues are not effectively addressed, the imposition of the proposed penalties may indeed tend to somewhat reduce the level of non-deliveries, but the impact might be relatively small if FMM and RTD prices both continue to be low during these hours and HASP prices high. A $10 per MWh penalty will not effectively deter behavior that avoids a $200 per MWh loss.

Similarly, if transactions scheduled in the day-ahead market are being cleared in HASP, then not delivered in real-time when prices are low, the penalties may not have a large impact on this behavior as the non-delivery penalty would be low and the profits from buying out of the day-ahead market schedule large. However, if risks avoided by waiting until *t*-20 to tag transactions are not large the penalty might shift behavior towards more delivery.

If the non-delivery is occurring because the power that would have covered HASP schedules is being sold to the CAISO in out-of-market exceptional dispatch transactions at high prices with any operational adjustment charges or deviations from the day-ahead schedule settled at low prices, the proposed market changes may not alter this pattern of behavior. This is particularly so if the out-of-market purchases are at high prices and the penalties based on low real-time prices.

The requirement to buy and tag transmission by *t*-40 in order to be included in the FMM run should provide the CAISO with more notice that hourly transactions cleared in HASP are not going to flow. This will enable the CAISO to balance supply in the FMM run initializing at *t*-37.5, so non-deliveries will be reflected in FMM runs for entire hour. On the other hand, the need to buy transmission by *t*-40 and to incur penalties if the power is not delivered, even when FMM prices are very low, may reduce supply offers in HASP and raise the price which the remaining intertie supply is offered. Moreover, we do not know to what extent the power that is

not being delivered under the current rules has purchased transmission in order to avoid triggering the HASP reversal rules.

If CAISO operators expect less supply to be available in HASP after these changes are implemented, this could lead to larger, not smaller out-of-market purchases earlier in the day. It is essential that the higher charges not simply displace HASP supply but allow the CAISO to clear supply that will be delivered instead of offers that will not be delivered. The likelihood of this outcome will depend upon the cause of the non-deliveries which is unclear at present.

Another possible impact is that the need to buy transmission for hourly HASP transactions by *t*-40 and the higher penalties for failing to deliver energy cleared in HASP will tip behavior towards greater participation in FMM. However, this outcome is uncertain, and depends both on the factors motivating the non-delivery of hourly transactions and the factors hindering participation in the FMM.

If participation in FMM is uneconomic for many suppliers because they cannot buy power on a 15-minute basis or due to the cost of buying transmission for an hour for power that might flow for only 15 minutes, then the charges may not elicit much increase in FMM participation.

It is possible that the need to decide at *t*-40 whether to deliver power or incur an additional 25% penalty may cause more sellers to tag transmission and deliver power scheduled in HASP because they will have less insight into FMM prices during the next hour. But this impact of the penalty may be small relative to the loss from delivering power if FMM prices continue to be low in real-time relative to HASP prices even when the CAISO is buying power at high prices through exceptional dispatch.

If non-delivery is occurring because suppliers are submitting speculative offers in HASP, then attempting to buy power if the offer clears in HASP and not delivering or only partly delivering if they find it impossible to buy power at a profitable price, we anticipate that the imposition of even moderate penalties, such as $10 per megawatt hour should tend to reduce the level of speculative offers at the margin. This is because a smaller penalty should be sufficient to deter speculative offers with low probability of being profitably delivered. However, it is not clear if speculative offers account for much if any of the non-delivery.

Because we do not clearly understand what has caused some of these large non-deliveries, there may be other consequences from implementing these penalties that we have not clearly identified.

Overall, we support these changes because the ISO needs to provide incentives for intertie traders to deliver the power that is scheduled in HASP, and the present arrangements manifestly fail to do this. It appears likely to us, however, that many HASP transactions are currently undelivered because of deeper price formation issues in CAISO markets. If the proposed penalties are implemented without taking steps to address the underlying price formation issues that contributing incenting non-delivery, we are concerned that the changes may be ineffective in materially increasing the degree to which CAISO operators can count on transactions cleared in HASP being delivered. Furthermore, the charges may reduce the real-time supply offered in the HASP. If

this is the case, the changes could result in a greater, not reduced, need to rely on out-of-market transactions to meet variations in real-time load.

We also have a concern that a material portion of the non-deliveries of HASP schedules on days with exceptional dispatches is in fact "delivered," but in the form of more lucrative out-of-market purchases rather than HASP schedules. We do not think the proposed penalty charges will be effective in addressing this without accompanying changes to the way that exceptional dispatch imports are scheduled and settled.

Thus, although on balance we support the changes that have been proposed as being useful to correct today's lack of penalties for non-deliverability, we are unable to confidently state these changes will eliminate problem of non-delivery. This proceeding has highlighted pricing out-comes that are potentially concerning, particularly a pattern of very low FMM and RTD prices during what the ISO describes as stressed system conditions. We recommend that the CAISO continue to investigate the causes of these pricing patterns as further changes may be necessary to fully correct the problems that motivated this initiative.