CAISO CRR Credit Requirements

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I. OVERVIEW

CRRs are point-to-point financial instruments that hedge congestion charges on the California ISO transmission system. A CRR entitles and obligates the holder to be paid or to pay the difference between the congestion component of the LMP price in the day-ahead market at the sink and at the source of the CRR. Because CRR holders will be obligated to make payments to the CAISO covering hours in which the congestion component at the sink is lower, or more negative, than the congestion component at the source, CRR holdings can potentially give rise to payment obligations.

The CAISO faces two slightly different kinds of credit risk stemming from the CRR holdings of market participants. First, some CRR auction participants will likely buy CRRs that are negatively priced in the CRR auctions.[1] In essence, these auction participants are selling congestion management in the forward market, which is desirable from the standpoint of overall market performance. In the case of a generator, these counterflow CRR holdings may be hedged by the ability of the generator to offer its resource in the day-ahead market in which CRRs are settled. Absent credit requirements there would be a risk that the holder of such negatively priced CRRs would be unable to make payments when required, inflicting losses on the CAISO congestion rent account that would ultimately be borne by other market participants. In effect, if the holder of a counterflow CRR were to default, the counterflow CRR would be removed from the outstanding CRRs and the remaining CRRs would not satisfy the simultaneous feasibility test. This would create a potential for the CAISO CRR settlements as a whole to be revenue-inadequate.[2]

Second, there is a potential for CRR auction participants to buy CRRs at positive prices, i.e., CRRs that are expected at the time of the auction to entail payments from the CAISO congestion rent account to the CRR holder, but which turn out in practice, as a result of unexpected changes in market conditions, to require payments by the CRR holder to the CAISO congestion rent account. As in the first case, absent credit requirements there would be a risk that the CRR holder would be unable to make these payments when required, thus reducing the payments into the CAISO congestion rent account.[3]

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[1] I.e., the CRR buyer is paid to hold the CRR because the CRRs are expected to entail payments by the holder to the CAISO settlements rather than payments from the CAISO congestion rent account to the CRR holder.

[2] It is noteworthy that absent the counter flow (i.e., negatively priced) CRR, it is necessarily case that the remaining CRRs will not satisfy the simultaneous feasibility condition (i.e., it is not the case that they might not satisfy this test; they will not satisfy a simultaneous feasibility test). The price of the CRR in the auction would not be negative unless this was the case.

[3] There is a somewhat subtle distinction in this case, however, in that while the CAISO congestion rent account will necessarily have a lower balance by the amount of money which is not received due to the default, it is

The determination of the initial post-auction credit requirement, i.e., the credit that must be maintained once the auction results are known, is discussed in Section IV. The term "uncollateralized CRR payment" is used to refer to a situation in which the holder of a particular CRR would be required to make a payment to the CAISO in excess of the initial credit requirement for holding that CRR.

The simplest form of CAISO credit policy would address the first risk by requiring holders of negatively priced CRRs to maintain credit sufficient to pay back the price of the CRR in the auction (i.e., to cover the expected value of CRR payments). While such a CAISO credit policy would ensure the ability of CRR holders to cover their obligations if actual congestion levels equal those anticipated in auction prices, such a credit policy would not ensure that CRR holders would be able to cover their obligations in the event that actual congestion charges in the day-ahead market were higher than expected. Since one reason LSEs hold positively priced CRRs is to hedge them against the possibility that congestion charges in the day-ahead market may be higher than expected, the potential for the holders of negatively priced CRRs to be called upon to make payments in excess of the expected level is not remote and should be accounted for in the CAISO credit policy. Moreover, such a credit requirement would not entail any coverage for potential uncollateralized CRR payments by the holders of positively priced CRRs.

A more sophisticated credit requirement would require the holders of negatively priced CRRs to provide credit coverage in excess of the expected payments and also require credit coverage for some positively priced CRRs, ensuring that the probability of uncollateralized CRR payments does not exceed a threshold set by the CAISO, based on the observed volatility of CRR payments. While PJM and the NYISO have several years of historic CRR payments that can be analyzed in assessing the level of credit coverage required to provide the intended level of credit coverage given historic volatility, the CAISO has no such historic data on variations in overall congestion patterns.

Ideally, the credit requirements will be based on the probability of uncollateralized CRR payment obligations at the level of individual CRRs that are simple enough to be applied in a spreadsheet, depending only on the CRR auction price, and the month or season in the case of monthly or seasonal CRRs. Such a probabilistic standard would also permit the CAISO to take account of the value of high priced positively priced CRRs in determining credit requirements for market participants holding portfolios of CRRs. That is, if the payments to the holder of a positively priced CRR would exceed $1,000 with a 97% probability, this value could be used as an offset to the credit requirement for holding other negatively priced CRRs. The actual impact of such an offset would depend on the specific pattern of CRR portfolios held by market participants.

Section V discusses how the initial credit requirement might be adjusted over time as the CRR holder makes or receives payments. One approach would be to require that the entire

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quite possible, in fact likely, in the case of CRRs having positive values in the auction which turn to have negative values in the day-ahead market, that the remaining set of CRRs will still satisfy the simultaneous feasibility test, so the CAISO will still collect enough congestion rents to pay all CRR holders despite the default. Indeed, in the event of such a change in congestion patterns that causes CRRs with positive auction prices to have negative values in the day-ahead market, the CAISO might have a large surplus in its congestion rent account.

initial collateral requirement be maintained over the duration of the CRR. Such a credit policy tends to raise the effective credit requirement over time for negatively priced CRRs. Another approach would be to gradually reduce the credit coverage requirement over time.

II. COMPARISON TO CREDIT REQUIREMENTS OF OTHER ISOS

On a superficial level there is considerable variation across the RTOs in the credit requirement applied to the holding of both negatively priced and positively priced CRRs. Much of the apparent difference in credit policies, however, actually reflects differences in the timing of payments to and by CRR holders, rather than differences in coverage against default risk.

A critical first step in comparing credit policies across ISOs is, therefore, to identify the differences in CRR settlement timing.[4] The NYISO and MISO settle CRR purchases at the end of the auction, while PJM and ISO-NE settle the purchases over the term of the CRRs. Thus, buyers of counterflow CRRs in New York and MISO must meet credit requirements at the end of the auction but have also been paid for the counterflow CRR. In PJM and ISO-NE, no credit coverage may be required at the end of the auction, but the buyer of counterflow FTRs also has not been paid for holding the counterflow CRR. These differences are discussed in greater detail below.

Consider first positively priced CRRs. Current NYISO credit and settlement policies require a buyer to pay for the CRR at the end of the auction. In addition, the CRR holder must maintain credit coverage based on the CRR price. Under current PJM rules, on the other hand, a CRR holder does not pay for the CRR at the end of the auction. Instead, payments due to the CRR holder are offset against the auction price and the net difference settled. CRR buyers in PJM therefore need to provide financial assurance over the term of the CRR that they will be able to make this final payment. In calculating the credit coverage for this payment, however, PJM provides an offset to the CRR purchase price reflecting the likely payments to the CRR holder based on historic congestion patterns. Under ISO-New England credit and settlement rules payments for CRRs purchased in the auction are not made at the time of the auction, so the credit requirement provides assurance over the term of the CRR that the holder will be able to cover the price paid for the CRR in the auction. Unlike PJM, ISO-NE does not provide an offset for expected payments to the CRR holder.

To illustrate the differences, consider a CRR with a price of $1,000 in a monthly auction and historic payments of $990. In the NYISO, the CRR holder would have to pay $1,000 at the end of the auction and maintain credit coverage for an additional $1,000. In PJM, the CRR holder would not pay anything at the end of the auction. It would have to provide credit coverage for the $1,000 price of the CRR it purchased. This credit coverage would be reduced by 70 percent of the $990 historic payments to the CRR, or $693, for a net credit requirement of $307. In New England, the CRR holder would not have to pay anything at the end of the auction but it would have to maintain credit coverage for the $1,000 purchase price, with no offset for expected CRR payments.

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[4] To avoid confusion, we will consistently refer to financial rights as CRRs, although they are referred to as FTRs in PJM, MISO and ISO-NE, and TCCs in New York.

Alternatively, consider a CRR with an auction price of $100 and historic payments of -$50 (i.e., historically the CRR was a counterflow CRR). In New York the CRR holder would have to pay $100 for the CRR and would also have to maintain credit coverage for $100. In PJM, the CRR holder would not have to pay for the CRR at the end of the auction but would have to maintain credit coverage for the price of the CRR ($100) plus the expected CRR payments to PJM ($50) for a total credit requirement of $150. The PJM credit coverage superficially appears higher than the NYISO requirement in this instance but it is actually lower since the NYISO CRR holder would have paid for the CRR and be required to maintain $100 in credit coverage. In New England, the CRR holder would simply have to maintain credit coverage for $100.

Now consider a negatively priced TCC. Under current NYISO credit and settlement policies the TCC holder would be paid for holding the TCC at the end of the TCC auction. It would, however, be required to maintain credit coverage equal to this payment over the term of the CRR. Under PJM credit and settlement policies the FTR holder would not receive any payments at the end of the auction but would also only have to maintain credit coverage over the term of the CRR to the extent that the historic payments differed from the auction price. Under ISO-New England credit and settlement policies, the FTR holder would not receive any payment at the end of the auction but also would not have any credit coverage requirement over the term of the CRR.

To illustrate the differences, consider a CRR with a price of -$1,000 in a monthly auction and historic payments of -$990. In the NYISO, the CRR holder would be paid $1,000 at the end of the auction and would have to maintain credit coverage for the same $1,000 over the term of the CRRs. In effect, there is no credit burden. In PJM, the CRR holder would not receive any payments at the end of the auction. Since in the hypothetical the historic payments are less than the CRR price, the CRR holder would not have to maintain any credit coverage. In ISO New England, there would be no credit requirement for holding this CRR. The PJM, NYISO and ISO New England credit policies for negatively priced CRR are actually very similar, therefore, once differences in the timing of auction settlements are taken into account.

III. CAISO CREDIT REQUIREMENT FOR BIDDING

An initial credit issue in the CAISO CRR markets is assuring that market participants submitting bids in the various auctions have the financial ability to cover their purchases. While CRRs can be withheld from entities that fail to make the payments required to cover their auction awards, this is an undesirable outcome because the invalid purchases would potentially have affected other CRR prices and might have caused offers for counterflow CRRs to be accepted at high price levels. All ISOs therefore require that CRR bidders have adequate credit to cover the purchase of all of the CRRs on which they submit offers, up to their offer price. This will generally exceed the level of required payments because low bids will not win and other bids will be accepted at price levels well below the offer cap. It is recommended that the CAISO require a similar level of credit coverage. No credit coverage would be required to purchase CRRs with negative offer caps, as no payment by the CRR holder would be required.

IV. CAISO INITIAL CREDIT REQUIREMENT

A. Negatively Priced CRRs

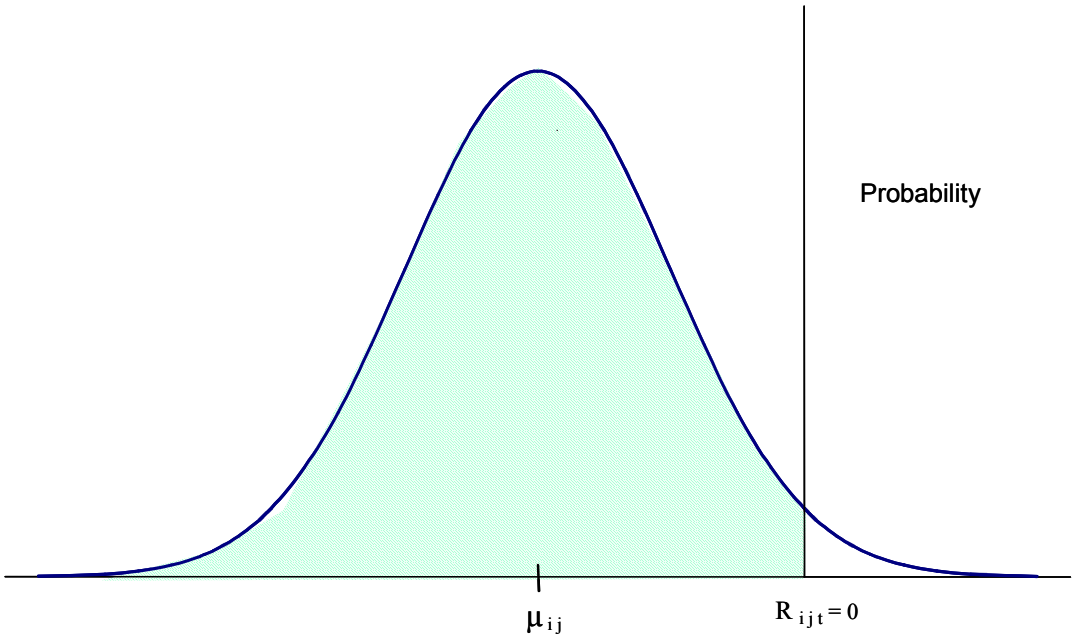
An obvious credit risk associated with the sale of CRRs in the CAISO CRR auctions is the possibility that thinly capitalized entities could buy counterflow (negatively priced) CRRs, take the auction payments and default when payments on the counterflow CRR are due.[5] A CRR credit requirement can address this risk in part by requiring that entities purchasing CRRs at negative prices in the auction maintain credit equal to the absolute value of the CRR auction price. Thus, an entity that buys a counterflow CRR in an auction in exchange for receipt of a payment of $10,000,000 would be required to maintain credit coverage for $10,000,000, which would cover the expected value of the required future payments by the CRR holder.

If the CRR payment (R_{ijt}) is a normally distributed random variable with a mean (μ_{ij}) and a standard deviation (σ_{ij}), then for each CRR_{ij} there is an associated probability of observing a payment to the CAISO being required in month t ($R_{ijt} < 0$), as illustrated by the shaded region in Figure 1.

[5] This risk exists because the CAISO proposes to settle CRR auctions prior to settling payments to CRR holders for the relevant period. If payments and charges for the purchase of CRRs in an auction were settled at the same time that payments to CRR holders were settled, this risk would not be present and less credit would be needed to protect the CAISO against uncollateralized CRR payments. Under such a settlement system, however, the buyer of the counterflow CRR would lose the value of the cash for the period of the time between the auction and the settlement of CRR charges for the month, which would result in a foregone value at least as large and probably larger than the cost of maintaining an equivalent amount of credit coverage. In drawing comparisons of credit policies across ISOs it is essential to take account of these differences in settlement timing as the settlement system with a lower credit requirement may impose a larger overall financial burden on CRR holders.

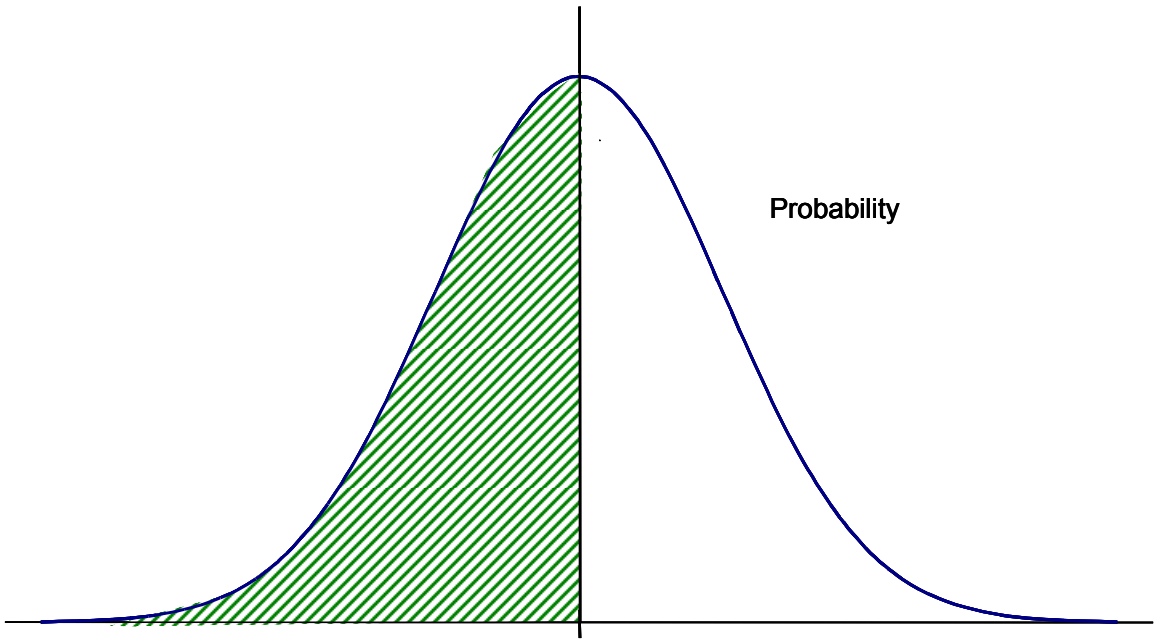
If the mean of the distribution of CRR payments were negative as portrayed in Figure 1, there would be a substantial likelihood that the CRR holder would incur an obligation to make payments to the CAISO. Absent a credit requirement, the expected value of an uncollateralized TCC payment for this CRR would be (μ_{ij}).

Figure 1
Distribution of Payments by Holders of Negatively Priced CRRs



By imposing a credit requirement of K_{ij} (K >0), the value of uncollateralized CRR payments would be $R_{ij} + K_{ij}$ ($R_{ij} < 0$ implying an obligation to make payments to the CAISO). If K_{ij} were set equal to the expected level of CRR payments for a negatively priced CRR, the expected value of uncollateralized payments would be reduced to zero, as illustrated in Figure 2.

Figure 2
Distribution of Payments by Negatively Priced CRR Holders



$$R_{ijt} + K_{ij} = 0; K_{ij} = -\mu_{ij}$$

A limitation of a credit policy that only requires credit coverage for the expected level of CRR payments is that there would be a considerable likelihood (50 percent of the distribution is symmetric) that the CRR holder will be obligated to make CRR payments in excess of its credit coverage (i.e., Rijt + $K_{ij} < 0$, as illustrated by the shaded area in Figure 2.

Thus, such a CRR credit requirement would not directly protect the CAISO against default should the required payments by the CRR holder turn out to be larger, i.e., more negative, than the CRR price in the auction. While the holder of a counterflow CRR would have credit coverage for the expected value of payments to the CAISO, there would be no initial credit requirement covering potential payments in excess of the expected value of the CRR.[6] Since the reason for holding positively valued CRRs is to hedge against the volatility of congestion charges, there is an underlying expectation that actual payments may differ significantly from the expected payment, implying that holders of negatively priced CRRs may be required to make

[6] To the extent that such negatively priced CRRs are held by generators with resources located at the CRR source, the potential payment due on the CRR is potentially backed not only by the CAISO initial credit requirement but also by the potentially offsetting payments to the supplier in the day-ahead market. Whether the generator ownership actually hedges the CRR holding depends, however, on the other forward positions taken by the supplier.

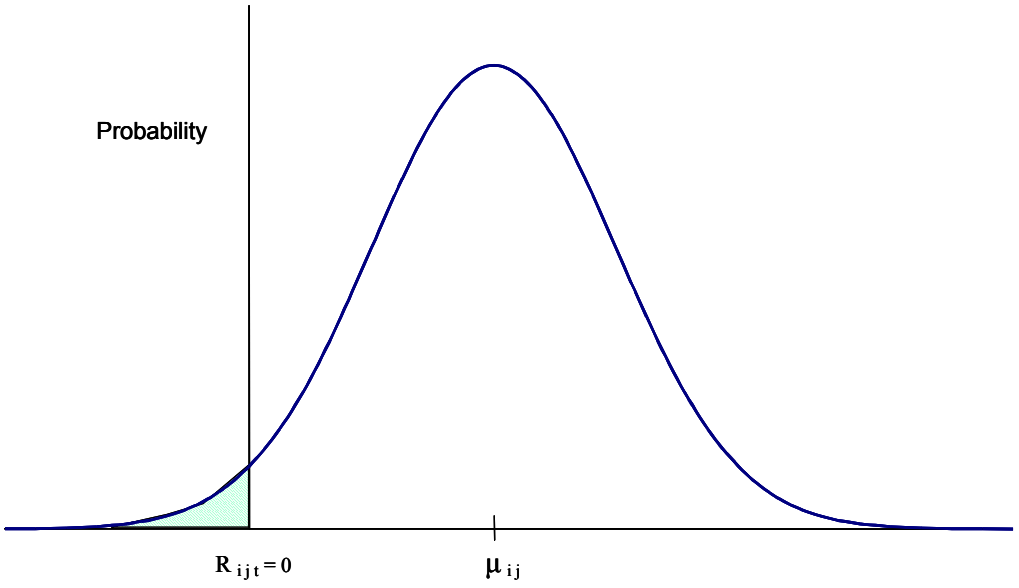
payments for their CRR holdings that are in excess of the expected level, i.e., in excess of the absolute value of the price of the counterflow CRR and thus in excess of such a credit requirement. It is precisely because of the potential for higher than expected congestion payments that CRRs are available as hedges against the volatility of congestion charges.

B. Positively Priced CRRs

A second kind of credit risk that the CAISO's CRR credit policies should address is the possibility that a CRR which is positively priced in the CRR auction in which it is purchased subsequently becomes negatively valued in the day-ahead market, requiring net payments by the CRR holder to the CAISO's congestion rent account. While the probability of negative returns is likely so low as to be negligible for some CRRs, such as CRRs sourced outside the Bay Area and sinking in the San Francisco sub-LAP, this will not be the case for all positively priced CRRs.

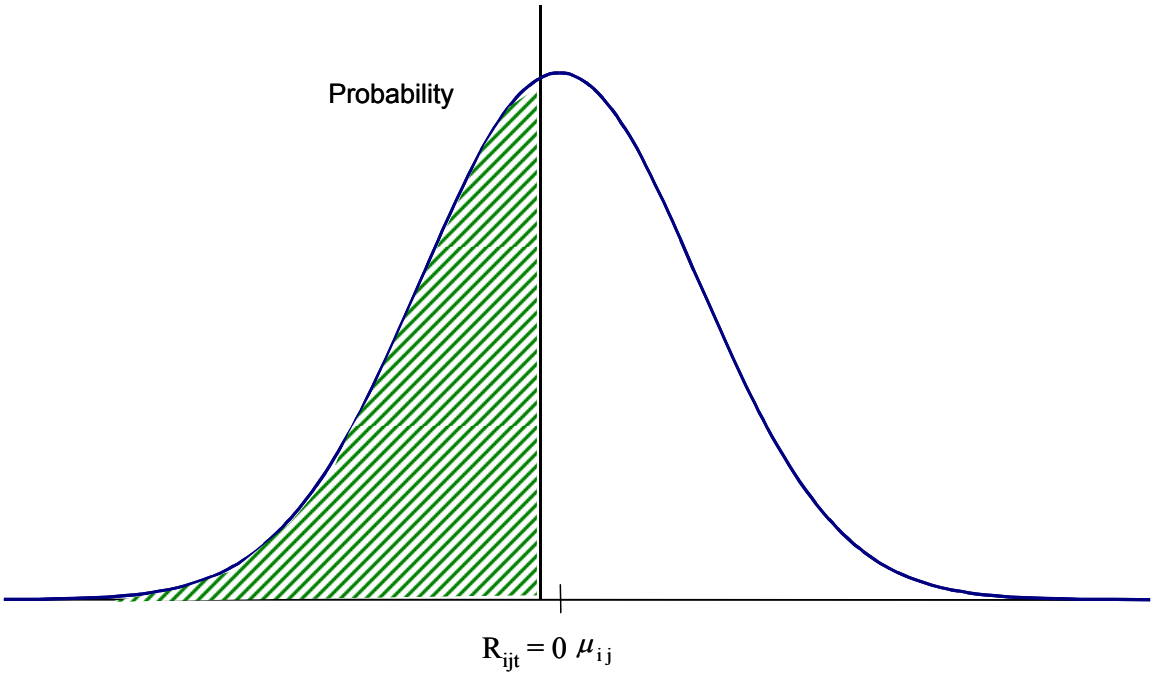
If the mean of the returns (μ_{ij}) is significantly positive, then the probability of the CRR holder being required to make a payment may be relatively small, as shown in Figure 3, and the maximum value of the potential payment by the CRR holder may also be small.

Figure 3
Distribution of payments to Positively Priced CRR



For some positively priced CRRs, however, there may be a significant probability that the CRR values in the day-ahead market could become negative as a result of slight variations in congestion patterns. This is illustrated in Figure 4, in which the expected CRR payment is positive but close to zero, and the shaded area portrays the probability that the CRR holder will be obligated to make payments to the CAISO.

Figure 4
Distribution of Payments to Positively Priced CRR



If no credit coverage were required of holders of CRRs with positive but low prices, there would be a potential exposure to uncollateralized CRR payments by the holders of positively priced CRRs, particularly those having auction prices that are near zero.

Another element of the CAISO's credit policy is how it will account for CRRs with negative credit requirements (CRRs found to have such a large positive expected value that the calculated credit requirement is negative because the distribution of CRR payments is such that even low probability outcomes result in payments to the CRR holder) in determining the overall credit requirement for the CRR holder's portfolio. Thus, a further credit policy choice for the CAISO is whether to set these negative credit requirements to zero or to allow them to offset the credit requirement on other CRRs held by the same entity. Under such a policy, the CAISO would not zero out negative credit requirements calculated for particular CRRs but would add them to the credit requirement for the other CRRs held by that entity. Such a policy has the potential to materially reduce market participant credit requirements but the actual impact would depend on the specific CRR portfolios held by particular market participants. While such an offset would reduce or perhaps eliminate the credit requirement for market participants holding a

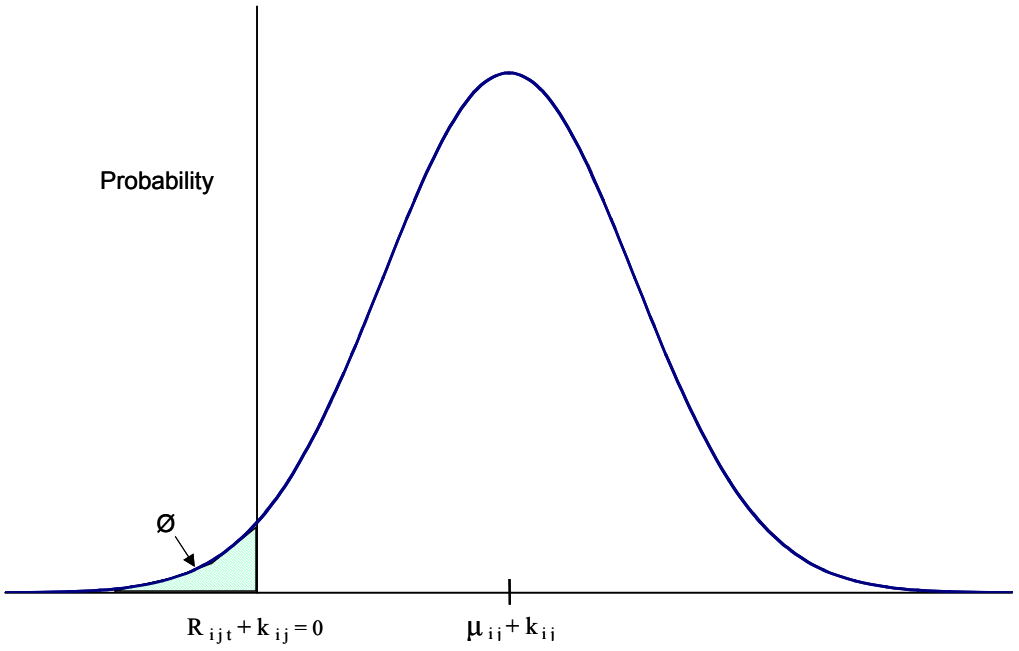
variety of positively priced CRRs and a few negatively valued CRRs, it would not affect the credit requirement for market participants holding only negatively valued CRRs.[7]

C. Analytical Framework for Defining CRR Credit Requirements

Conceptually, the CAISO seeks to define a credit requirement for each CRR that provides a specified level of assurance of payment by the CRR holder (i.e., a given probability of uncollateralized CRR payments or expected value of uncollateralized CRR payments).

By setting an appropriate credit requirement (K_{ijt}) for each CRR_{ij} in auction t, the ISO can in principle assure that the probability of uncollateralized CRR payments ($R_{ijt} + K_{ijt} < 0$) is less than or equal to a defined threshold (ϕ) for all CRRs. This is illustrated in Figure 5, where the imposition of a credit requirement K_{ijt} reduces the probability of an uncollateralized CRR payment ($R_{ijt} + K_{ijt} < 0$) for a negatively priced CRR from the shaded area in Figure 1 to the shaded area ϕ in Figure 5.

Figure 5
Distribution of Payments Net of Credit Requirement for Negatively Priced CRR



Under this approach, the credit requirement (K_{ijt}) needed to assure that the probability of uncollateralized CRR payments is less than the threshold value may be zero for CRRs with substantial positive expected values (high positive auction prices). CRRs with large negative

[7] The credit offset value would decline over time as payments are made to the holder, and remaining payments fall. Thus, at the end of the term the credit value of the CRR would be much lower than at the beginning. This could be accounted for either through an explicit process for reducing the credit offset over time or by limiting the offset to the credit requirement for other CRRs of the same duration, so both the credit exposure and offset would decline in parallel.

expected values, on the other hand, would likely have credit requirements in excess of the absolute value of their auction price, as would CRRs with small positive auction prices.

Given this role of credit requirements for CRR holders, empirical questions for the CAISO are how to determine the appropriate credit threshold (ϕ,) and how given the credit threshold (ϕ), the appropriate credit requirement for each CRR should be set. If the credit requirement that is required to reduce the probability of uncollateralized CRR payments on the CRR whose returns are portrayed in Figure 1were also required of the entity holding the CRR whose returns are portrayed in Figure 3, the credit requirement would be greatly excessive for the holder of the CRR portrayed in Figure 3 and the probability of uncollateralized CRR payments would be zero. It is therefore desirable to set credit requirements that reflect the riskiness of individual CRR holdings but this goal is counterbalanced by a need for reasonable administrative ease in setting and applying the credit requirements to the thousands of CRRs sold on hundreds of paths in a typical auction.

Ideally, the CAISO credit coverage for negatively priced and low priced positively priced CRRs should cover the expected payments due for holding the CRRs plus a margin to cover the variability of the payment stream and the resulting potential for payment obligations in excess of the expected level.

In the long run the CAISO will be able to utilize data on the historic variability of TCC payments around the auction price to develop credit requirements that cover payment obligations at the desired probability level. At MRTU start-up, however, the historical data required for such an analysis will obviously not be available. Three potential approaches to defining the credit requirements for CRRs have been identified. One approach would be to base the initial credit requirement solely on the auction price. This approach would be easy to apply but has the disadvantage that it would provide no credit protection for payment obligations in excess of the expected level during a period in which auction prices will be based on limited information.

A second approach to defining A CRR credit requirement would be to base the estimate of CRR payment variability on the historical level of variability in congestion on path 15. This measure of payment variability would not capture the full range of CRR payment variability under MRTU, but has the advantage of being based on actual market outcomes and the California transmission system.

A third possible approach to defining the initial credit requirement would be to base the estimate of CRR payment variability on the historical level of FTR payment variability and FTR prices on actual FTR auction purchases in one of the eastern ISOs, such as PJM. This approach would have the advantage of basing the variability analysis on the kind of CRRs actually purchased by market participants, but the variability would not reflect California conditions.

D. Initial Credit Requirement for Longer-Term CRRs

In the future, the CAISO may begin selling CRRs with a duration of more than one year. Until such time as adequate data are available, the simplest option would be to assume that successive annual returns are independent, so the standard deviation of the two year returns would, for example, be 1.44 times the standard deviation of the one year returns. Under this approach, the

credit requirement for a n year CRR would be $\sqrt{n}$ times the credit requirement for a one-year CRR.

V. CAISO CREDIT REQUIREMENT ADJUSTMENTS OVER TIME

An important component of the CAISO's overall CRR credit requirement is the potential for the CAISO to require additional credit support during the term of a CRR if the expected level of payments due the CAISO increases after the initial credit requirement is determined before payments are made by the CRR holder. One feature of CRRs that constrains the CAISO CRR credit policy is that because CRRs are not continuously traded, the CAISO cannot observe changes in the market value of a CRR between auctions. The CAISO therefore cannot continuously mark CRR values to market, which limits its ability to require additional credit support as the change in market value occurs over time. The CAISO could track the net CRR obligations of individual CRR holders on a daily basis, including a rough projection of payments over the remaining term of the CRR based on the payment obligation incurred on the CRR portfolio to date during the month and require additional credit coverage but there is not a straightforward method for projecting future payments on a daily basis.

Another complication affecting CAISO credit policy for CRRs is how the credit requirement is adjusted as payments are made and the CRR approaches its expiration. The source of the potential problem is that if the CAISO credit requirement does not decline over time on long-term CRRs, there could be a large credit requirement even when there is little remaining exposure to congestion payments. Such a feature of CAISO collateral policies would reduce the potential for adverse credit exposure for the CAISO, but would go too far in the other direction. If an entity sold a one-year counterflow CRR for $10 million and had paid $8 million to the CAISO congestion account over the first ten months of the term absent any adjustment, the market participant would have to maintain the full $10 million in credit on this CRR during the last two months despite the small likely remaining exposure to congestion charges.

As noted above, in conventional forward energy contract and financial derivative markets the issues arising from changes in the market value of contracts over time are addressed through mark-to-market accounting and credit requirements whereby the credit requirements are periodically adjusted based on the change in value of the contract over its remaining term. A difficulty for the CAISO in directly applying these principles to the CRR market is that CRRs are not continuously traded, so that there is not a readily available market price to use in reassessing the relationship between the current credit coverage and the current value of the contract.

Despite the lack of continuous trading of CRRs, it might be possible for the CAISO to apply market-to-market principles to one-year CRRs in a manner that would adjust the credit requirement for annual CRRs at the conclusion of the next seasonal auction, as long as their were reconfiguration rounds covering the remaining duration of the annual CRRs. The valuation in the auction could be used to increase or reduce credit requirements and the same probabilistic analysis of the required credit would be applied to the remaining term of the annual CRRs.