Analysis of TCC Credit Policy Background

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I. TCC MARKET CREDIT RISK

The NYISO faces at least two different kinds of credit risk stemming from the TCC market. First, Market Participants (MPs) routinely purchase TCCs that are negatively priced in the TCC auctions, *i.e.*, TCCs that are considered a liability because they are expected to entail payments by the TCC holder to the NYISO, as opposed to payments from the NYISO congestion rent account to the TCC holder. In the case of these negatively priced TCCs, the TCC purchaser is actually paid to take ownership of the TCC. Absent credit requirements, there would be a risk that a TCC holder could be unable or unwilling to make the subsequent payments when required, inflicting losses on the NYISO that would ultimately be borne by other MPs.

Second, there is a potential for TCC auction participants to buy TCCs at positive prices, *i.e.*, TCCs that are considered an asset in that they are expected, at the time of the auction, to entail payments from the NYISO congestion rent account to the TCC holder. Sometimes, however, these positive priced TCCs turn out in practice to require payments by the TCC holder to the NYISO congestion rent account. As in the first case, absent credit requirements, there would be a risk that a TCC holder could be unable or unwilling to make these payments when required. The current NYISO credit policies address these risks by requiring TCC holders to maintain credit coverage based on the absolute value of the sale price of the TCC in the auction.

II. LIMITATIONS OF THE CURRENT TCC CREDIT POLICY

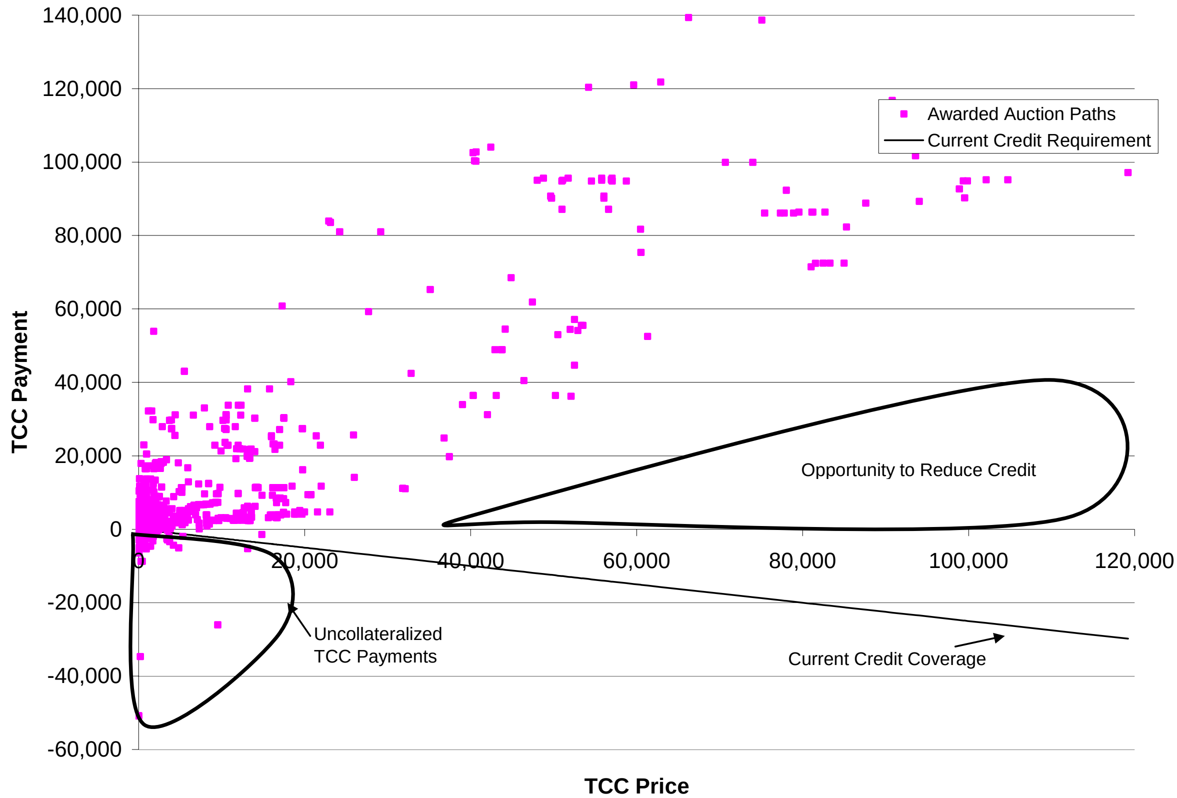
There are two notable areas of potential improvements to the current TCC credit requirements. First, the current TCC credit requirements may not adequately protect the NYISO and its MPs from default on certain TCCs that turn out to require payments by the TCC holder. This could result in defaults by thinly collateralized entities causing losses that would ultimately be socialized among all MPs as a bad debt loss. A second potential limitation of the current TCC credit requirements is that it may impose credit requirements that are too stringent for holding some TCCs, raising the effective cost of holding congestion hedges.

The current initial credit requirement results in relatively high levels of uncollateralized TCC payments[1] on negatively priced TCCs and TCCs with relatively low positive sale prices, while there is little or no potential for payment obligations on the high priced positively valued TCCs whose holders bear most of the current credit requirement. These issues can be illustrated using the historical NYISO TCC auction results for annual TCCs.

While the combination of these circumstances has generally provided sufficient collateral coverage overall for MPs broadly participating in the TCC markets, a more optimum approach would be a policy that better aligns the collateral coverage with the risk of the individual instruments being purchased within an MP's portfolio. The following analysis looks at the historical outcomes of TCC prices, payments and credit coverage and seeks to present alternatives for further consideration.

Figure 1 portrays the historical relationship between TCC prices, credit coverage and payments for positively priced annual TCCs, showing that the payments due to the NYISO (*i.e.*, points below the "Credit Coverage" line in Figure 1) on positively priced TCC paths have been concentrated on TCC paths with prices near zero. While a significant credit requirement is currently imposed to hold TCCs with large positive prices, payments as a result of TCCs with such large positive prices were not remotely near zero, much less negative.[1] It is also seen that very large payments have been required by the holders of a few TCCs with positive prices, but very low prices, with a few instances of payments in excess of $20,000/MW up to about $50,000/MW.

Figure 1
TCC Returns and Prices
Positively Priced Annual TCCs



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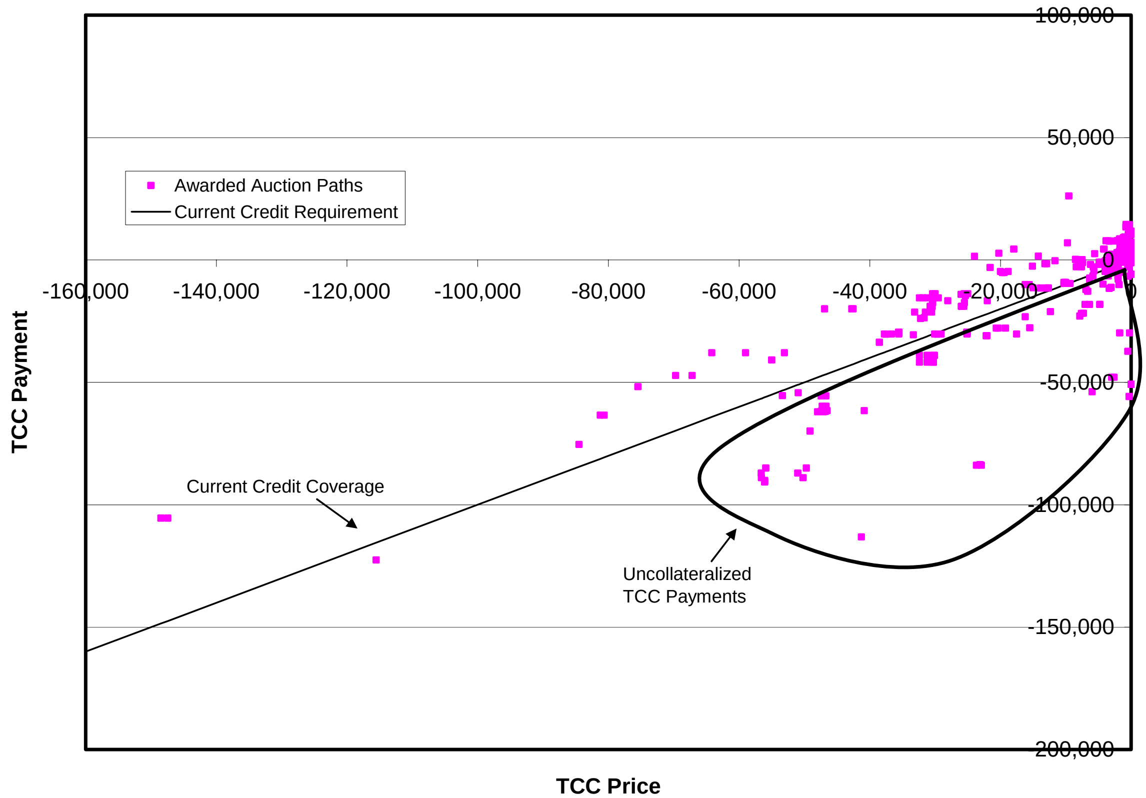
1 The NYISO annual TCC auctions typically have multiple rounds with TCC prices that can vary by round. For the purpose of Figure 1, the TCC price is the price in the round of the auction in which the TCC was purchased.

Figure 2 portrays the similar relationship between uncollateralized TCC payments, required credit coverage, and the TCC price for negatively priced annual TCCs. It can be seen that there have been many instances of uncollateralized TCC payments in excess of $10,000/MW (*i.e.*, points greater than $10,000 per TCC below the "Current Credit Coverage" line) and several instances of uncollateralized TCC payments in excess of $50,000 per TCC on negatively priced TCCs.

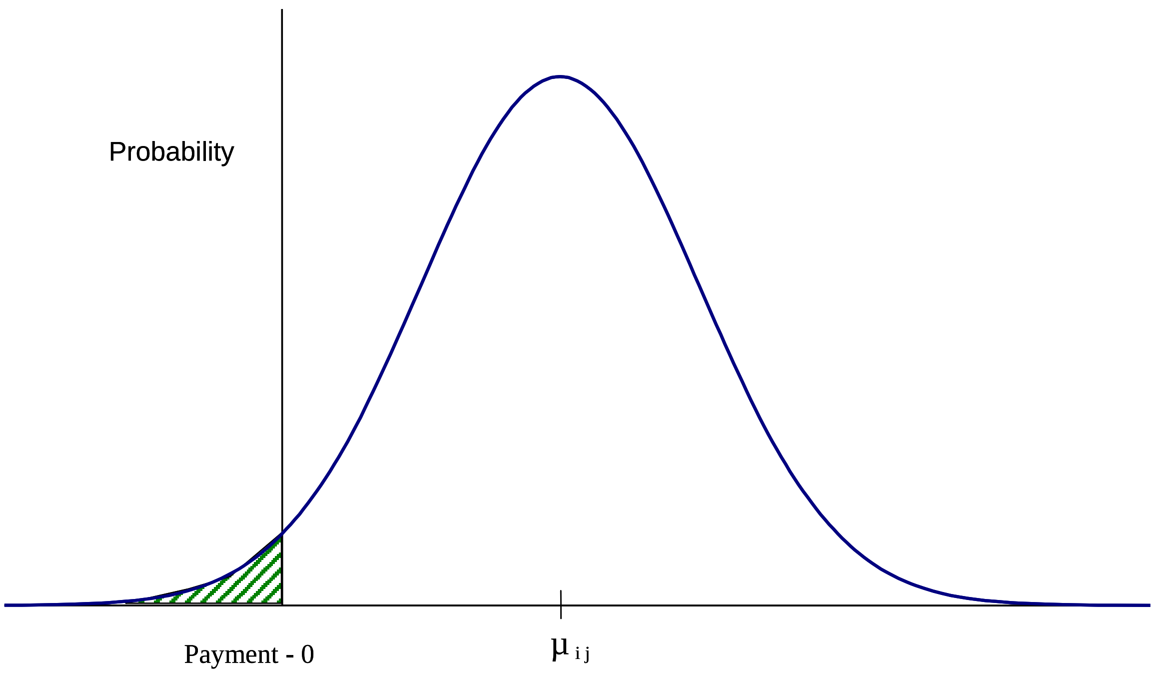
Figure 2
TCC Returns and Prices
Negatively Priced Annual TCCs



III. CONCEPTUAL FRAMEWORK FOR AN IMPROVED TCC CREDIT POLICY

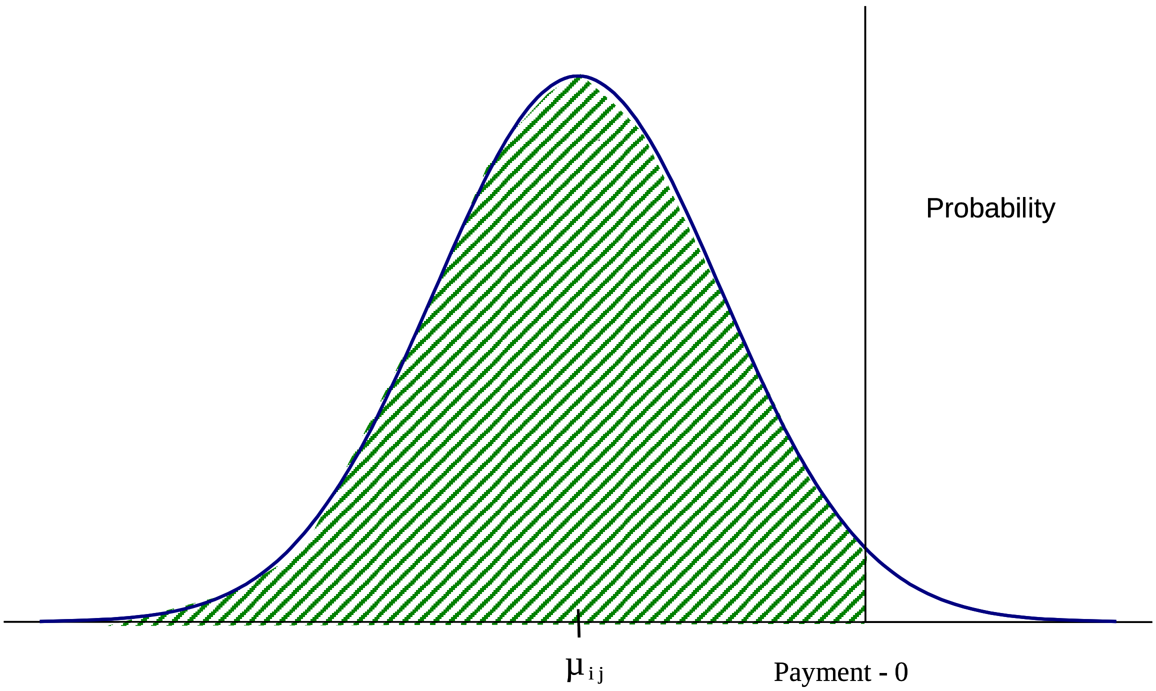
Conceptually, the NYISO seeks to define a credit requirement for each TCC that provides a specified level of assurance of payment by the TCC holder (*i.e.*, a given probability of uncollateralized TCC payments). If we think of the TCC payment as a random variable with a mean (μ_{ij}) and a probability distribution around this mean, then for each TCC_{ij} there is an associated probability of a payment to the NYISO being required, as illustrated by the shaded region in Figure 3. If the mean of the returns (μ_{ij}) is significantly positive, then the probability of the TCC 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 TCC holder may also be small.

Figure 3
Distribution of Payments to Positively Priced TCC Holders



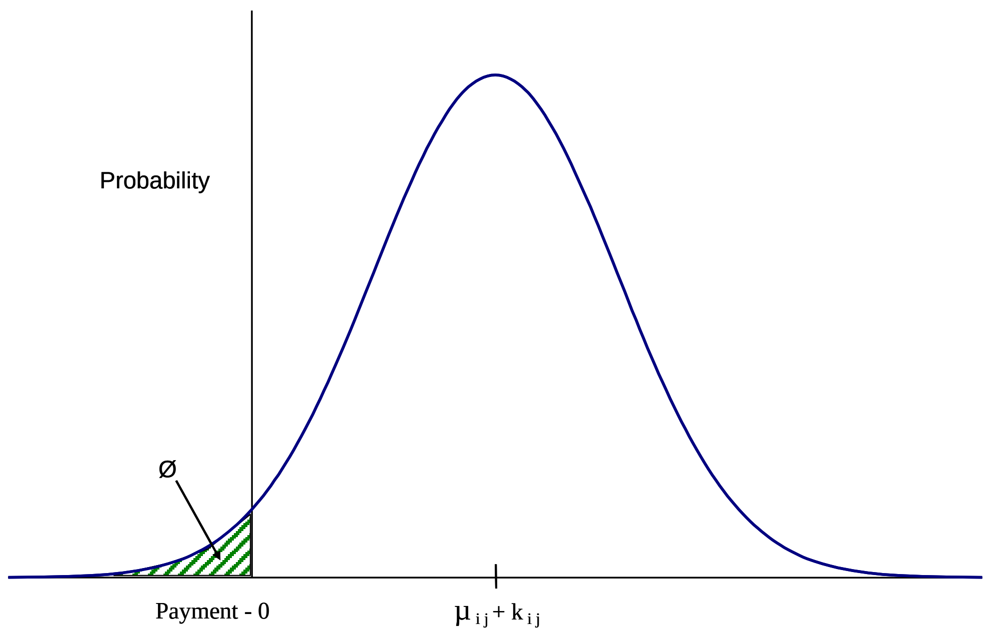
However, if the mean of the distribution of TCC payments is negative as portrayed in Figure 4, then the probability that the TCC holder will be obligated to make payments to the NYISO for TCC_{ij} will generally be quite high as illustrated by the shaded area in Figure 4. The maximum potential payment may also be relatively high, and the probability of required payments in excess of the expected value would often be around 50%.

Figure 4
Distribution of Payments by Negatively Priced TCC Holders



If TCC holders were not required to maintain any credit coverage, then the probability of uncollateralized TCC payments would be measured by the shaded areas in Figures 3 and 4. Clearly, for some TCCs the probability of uncollateralized TCC payments could be very high, giving rise to the potential for inadequately capitalized market participants to take on obligations that they could not honor when payments were required. By setting an appropriate credit requirement (K_{ijt}) for each TCC_{ij}, the ISO can in principle assure that the probability of uncollateralized TCC payments (payment + credit coverage < 0) is less than or equal to a defined probability (ϕ) for all TCCs. This is illustrated in Figure 5, where the imposition of a credit requirement K_{ijt} reduces the probability of an uncollateralized TCC payment for a negatively priced TCC from the shaded area in Figure 4 to ϕ, represented by the shaded area in Figure 5 below.

Figure 5
Distribution of Returns Net of Credit Requirement for Negatively Priced TCC Holders



Under this approach, the credit requirement needed to assure that the probability of uncollateralized TCC payments is less than the target level may be zero for TCCs with substantial positive expected values (high positive auction prices). TCCs with negative expected values, on the other hand, would have credit requirements in excess of the absolute value of their auction price, as would TCCs with small positive auction prices.

The application of this conceptual approach to defining credit coverage can be shown in terms of the relationship between TCC prices, payments and credit coverage portrayed in Figures 1 and 2. Figure 6 portrays the current NYISO TCC credit requirement and compares it to the expected payments due to the NYISO on the TCCs. The region below the x-axis reflects payments due to the NYISO. As shown in Figure 6, the credit coverage currently required to hold negatively priced annual TCCs is equal to the absolute value of the auction price, roughly the expected value of the payments due to the NYISO. The credit coverage currently required to hold a positively priced annual TCC is 25 percent of the absolute value of the auction price, roughly 25 percent of the expected payments due from the NYISO.

Figure 6
Expected Annual TCC Payments and Credit Coverage

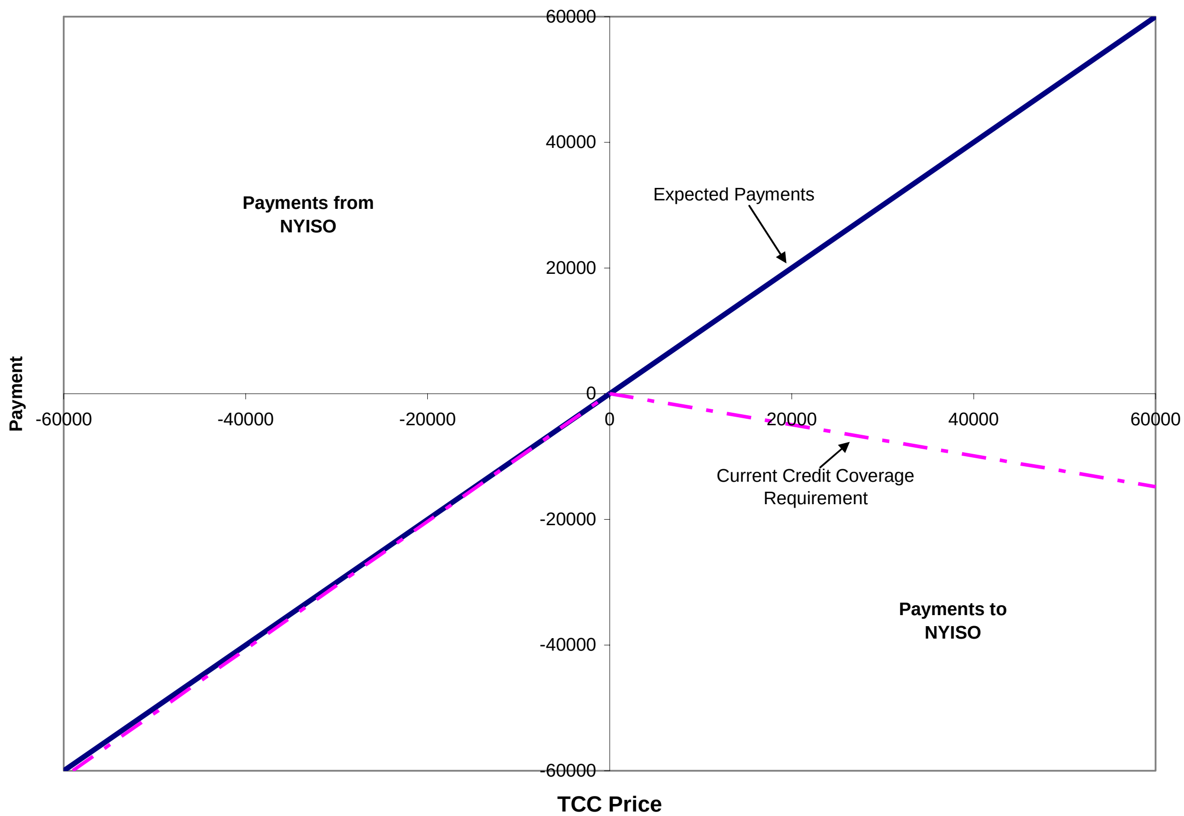
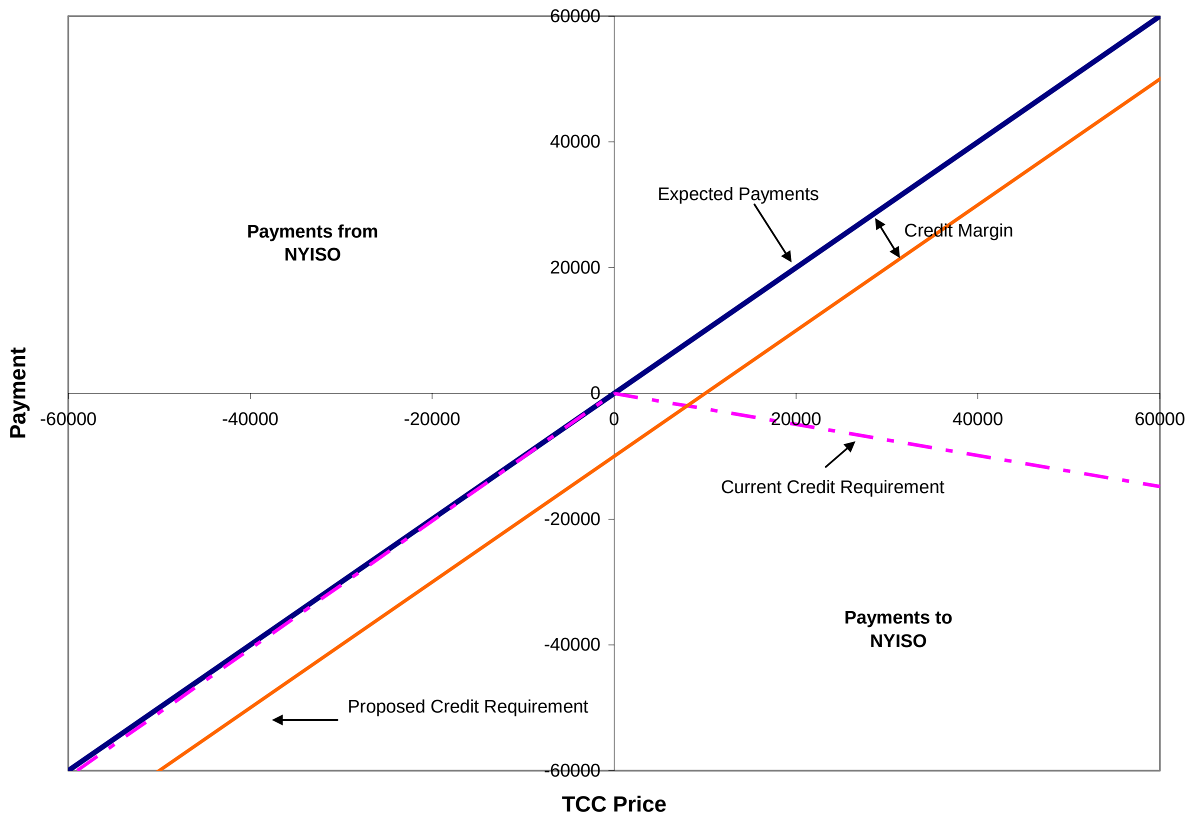


Figure 7 portrays a probabilistic credit requirement under which the required credit coverage reflects both the expected level of payments for each TCC and the dispersion of actual payments around the expected level. The credit margin provides some assurance that the market participant will be able to cover its liabilities in the event actual payments due to the NYISO are greater than the expected value of payments due to the NYISO. The larger the credit margin, the smaller the likelihood of uncollateralized TCC payments (i.e., smaller ϕ).

Figure 7
Probabilistic Credit Requirement for Annual TCCs

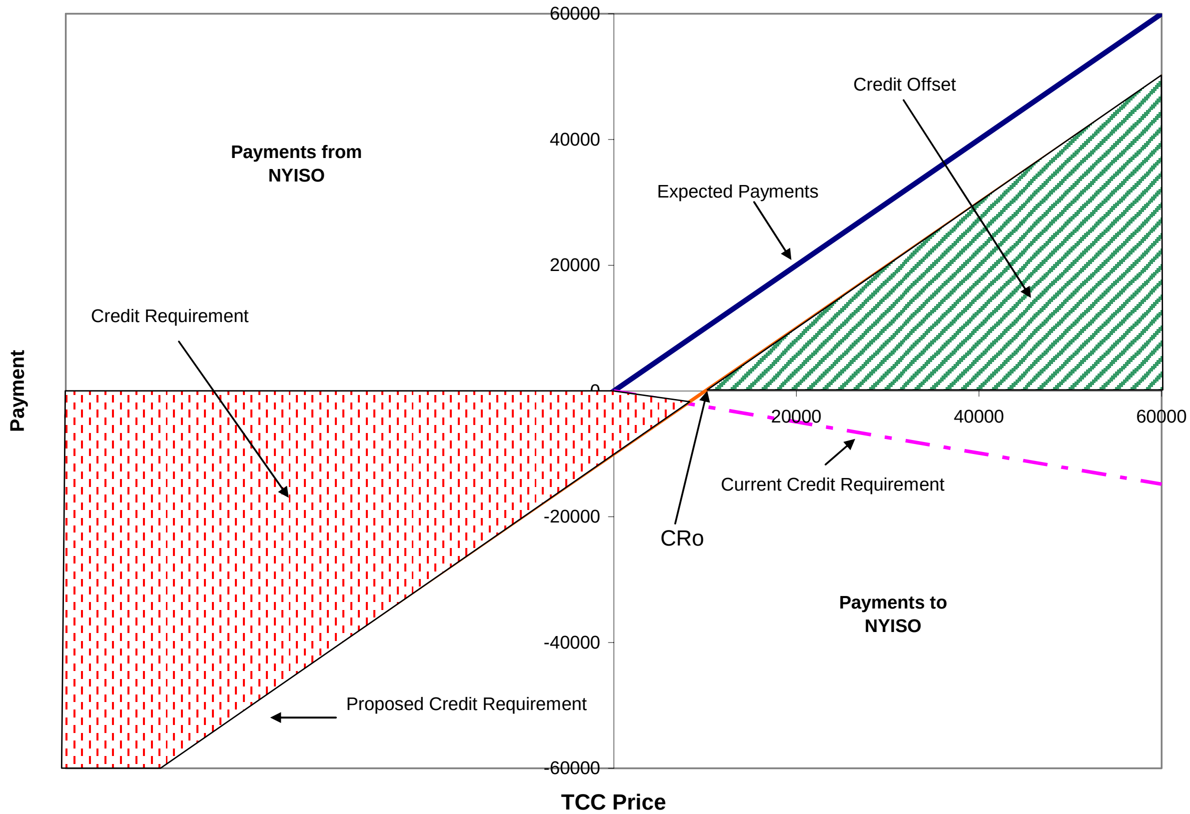


As illustrated in Figure 7, a negatively priced annual TCC with a price of -\$40,000 in the auction would require credit coverage of around \$50,000 to hold (*i.e.*, about \$10,000 more than the expected payments due to the NYISO). A TCC with a zero price in the auction would have a credit coverage requirement of roughly \$10,000, compared to the zero credit coverage today. Conversely, a positively priced annual TCC with a price of \$60,000 in the auction would provide a credit offset of roughly \$50,000 (which could be used to reduce the credit coverage required to hold the market participant's overall portfolio of TCCs), or about \$10,000 less than the expected value of the payments to the TCC holder.

Figure 8 further illustrates the distinction between the TCCs for which market participants must provide credit coverage to hold and the TCCs which provide a credit offset that reduces the credit coverage required to hold the market participant's overall portfolio of TCCs. The Red Region on the left of Figure 8 labeled "Credit Requirement" shows the range of TCC auction prices over which credit coverage would be required for market participants to hold those TCCs. The required credit coverage is largest for TCCs with large negative prices in the auction but is non-zero even for TCCs with zero and low positive auction prices.

The Green Region on the right of Figure 8 labeled "Credit Offset" shows the range of TCC auction prices over which a credit offset would be provided by holding these TCCs. Thus, no credit coverage would be required to hold any TCC with an auction price above CRo, and the holding would potentially provide an offset against other TCC credit requirements.

Figure 8
Credit Requirements and Offset for Annual TCCs



To summarize the rules for determining credit requirements under such a probabilistic credit requirement:

1. All TCCs with a price less than CRo (a low positively priced TCC) would have a credit requirement as defined by the "Proposed Credit Requirement" line to the left of CRo in Figure 8. The required credit coverage would be largest for TCCs with large negative prices in the auction but would be non-zero even for TCCs with zero and low positive prices.

2. All TCCs with a price higher than CRo would receive a credit offset, the amount of which would also be determined by the "Proposed Credit Requirement" line to the right

of CRo in Figure 8. The credit offset would be largest for TCCs with high positive prices in the auction, reflecting the very high probability that the NYISO would be making large payments to the TCC holder.

IV. EMPIRICAL EVALUATION OF TCC CREDIT RISK

Given this conceptual framework, the empirical question is how to analyze the probability distribution of TCC payments so an appropriate credit requirement can be established. Three general approaches were considered.

1. One approach would be to separately analyze the historical distribution of TCC payments for each TCC source-sink path, using historical TCC payment data to estimate both the mean and distribution of payments for each path.

2. A second approach would be to estimate the mean of the distribution of TCC payments relative to the TCC auction price and then separately analyze the historical distribution of the difference between the estimated mean and TCC payments for each TCC source-sink path.

3. A third approach would be to estimate the mean of the distribution of TCC payments relative to the TCC auction price as under the second approach, but then to analyze the historical distribution of the difference between the estimated mean and the actual TCC payments across all TCC source-sink pairs in a single analysis.

A variety of considerations suggest that it is preferable for the NYISO to apply the third approach in assessing the level of credit coverage required to attain the target level of protection against default. The critical advantages and disadvantages of each approach are outlined below.

A. Path-Specific Payment Distribution

The first potential approach to setting the appropriate credit requirement for TCC holders would be to analyze the historical distribution of the TCC payout for each TCC_{ij} (*i.e.*, for each path). This approach would have the advantage of estimating a specific credit requirement for each path. There are, however, a number of practical difficulties with this estimation approach. The most critical problem is that the payments to TCCs with differing sources and sinks do not have a common mean across paths and they likely do not have a common variance. Estimating the distribution of the TCC payouts and ultimately the level of credit coverage required to protect against a given probability of uncollateralized TCC payments using this approach requires estimating the mean of the distribution for each duration for each path and then the distribution of payments around this mean. If the mean varies seasonally and from year to year with market conditions such as gas and oil prices, as seems likely, there would be more parameters to estimate than observations, making it impossible to even estimate the means, much less reliably estimate the distribution of returns around this mean. This approach has therefore not been applied.

B. Path-Specific Distribution of Net Payments

A second approach to defining credit requirements would again estimate a separate credit requirement for each TCC path but instead of attempting to estimate the mean of the TCC payment distribution for each path, this approach would assume that the mean is a function of the

TCC auction price.[2] This approach would address the unworkability of the first methodology if the expected TCC payout varies from period to period (as is almost certainly the case), by using the TCC auction price to define the expected TCC payment.

There are two related difficulties with this approach. First, this approach would have high implementation costs, requiring that the NYISO estimate the credit requirement for each potential TCC path and apply the results of each calculation to the determination of the credit requirement for TCCs on each individual path. Since there are roughly 140,000 paths on which TCCs could be purchased, both the estimation process and the application process for 140,000 distinct formulas would be complex to implement. Second, there would be very few observations for estimating the expected payments based on the auction price and then estimating the variability of the payments to TCCs on each path sold in the six-month and annual auctions. Although an auction price and TCC payment could be calculated for every auction period, there would be too few observations on each path to even reject the hypothesis of a common variance across the paths, let alone reliably estimate the variances. For these reasons, it is not proposed that the NYISO apply this second approach.

C. Generalized Distribution of Net Payments

The third approach is closely related to the second approach, again based on the assumption that the mean of the distribution of TCC payments is a function of the TCC auction price. Under the third approach, however, the NYISO would not estimate a separate model of the variability of TCC payments for each path ij but would instead estimate a model for all paths ij, imposing some restrictions on the structure of the model to reduce the number of parameters to be estimated. The NYISO would thereby estimate a single formula that could be applied to determining the credit requirement for TCCs on all paths. By combining the estimation across all TCCs one would gain observations, while by imposing restrictions on parameter values across the TCCs ij, one would reduce the number of parameters to be estimated. The key restriction would be that rather than attempting to estimate independently the variance of the TCC payment deviation for every path ij, it would instead be assumed that the variance is either constant across all paths or that the variance varies across all paths with pre-determined factors such as the month or season of the year (for monthly and capability period TCCs), and the TCC price.[3] The consultants assisting the NYISO with the review of its TCC credit coverage policy, Scott Harvey of LECG and David Babbel of the Wharton School, recommend use of this third approach.

D. TCC Sample

There are roughly 140,000 source sink pairs on which TCCs could be sold. In practice, however, TCCs have been sold only on a few percent of these possible paths. Another choice affecting empirical analysis of the variability of TCC payments is whether this analysis should be

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[2] It is not necessarily assumed that the TCC auction price is equal to the expected value of the payments, it is only assumed that the mean is a function of the TCC price. The TCC price will potentially differ from the expected value of TCC payments due to the time value of money (especially for the longer-term TCCs) since the TCC is paid for before the payments are received, due to costs associated with the credit requirement, particularly under the current system, and potentially due to risk aversion.

[3] These factors need to be predetermined in the sense that they are known at the end of the auction so that credit requirements for the TCCs sold in the auction can be established.

undertaken based on all possible TCC paths or only those paths on which market participants have historically purchased TCCs.

The analysis of historical returns was based on those paths on which TCCs have actually been purchased. This approach avoids the possibility of estimating credit coverage requirements based on the variability of payments over a set of paths that has little if any relationship to the paths on which MPs actually purchase TCCs. While no reason has been identified that causes us to anticipate that the variability of the payments to the TCCs actually purchased would be materially different from the variability of the payments to all possible TCCs, it is a possibility.

The main analysis was based on the payments to the TCCs that were actually purchased in each auction. A sensitivity analysis was undertaken that expanded the sample to cover the payments and prices in all auctions of a given duration for any path on which a TCC was purchased in any auction of that duration. This expanded sample lead to a somewhat higher estimate of the variability of TCC payments.

The analysis of the variability of TCC payments therefore does not attempt to account for any potential increase in variability that might occur with a change in the TCC purchasing behavior by auction participants.

E. Other Empirical Issues

If TCCs were priced daily like exchange traded contracts, the NYISO could base its credit coverage requirement on the volatility of these daily prices, and quickly liquidate any positions for which a MP failed to meet a demand for credit support. A limitation of the TCC market, that also limits the NYISO's credit coverage policy options, is that the NYISO cannot continuously observe changes in market values for TCCs, particularly six month and annual TCCs. The NYISO can observe the overall historical difference between the actual and expected payments to an annual TCC, but we cannot observe whether the expected market value of the TCC changed suddenly or gradually. Since we cannot observe these changes we also cannot estimate the distribution of these changes in the expected payments for six-month and annual TCCs over periods such as a month.[4] In addition, the NYISO currently does not administer balance of period auctions, so if a MP failed to meet a demand for credit support to maintain credit coverage on a six month TCC, the NYISO would have to either resell the TCC in each monthly auction and offset losses with the credit coverage or to use the credit coverage to offset the losses over the remaining term of the TCC.

V. HISTORICAL DATA

Table 9 portrays the average historical TCC credit requirement under the current credit policy (the row entitled "current") and compares it to the credit requirement under several alternative TCC credit policies. Because the proposed credit requirement would include an offset for TCCs with high positive expected values, the actual credit requirement for market participants under historical auction results would depend on the mix of positive and negatively

[4] Option B provides for the NYISO to project future payment obligations on TCCs based on historical payments over the 3 prior months. Because option B is applied to TCC payments rather than TCC prices, by the time a change in the level of payment obligations is reflected in the credit requirement under option B the TCC holder would likely either have defaulted or covered its obligations.

priced TCCs held by individual market participants, which has not been analyzed over the historical period. The credit requirement for these alternative policies is therefore represented in Table 9 by a range. The maximum would be the total credit requirement if all TCCs requiring credit coverage were held by entities that did not hold any TCCs providing an offset. Conversely, the minimum would be the total required credit coverage if the offset provided by high priced TCCs were fully utilized to reduce the credit overage on TCCs requiring credit coverage.

The total uncollateralized payments represent the total amount of TCC payments due to the NYISO that would not be fully covered by the credit requirement, if each TCC were held by a different entity. This calculation does not account for portfolio effects.

The total payments due from TCC holders on TCCs purchased in the auctions included in the calculation in Table 9 were $129,343,620.[5] The final column calculates the proportion of payments that were uncollateralized at the TCC level (*i.e.*, if they were not held as part of a portfolio with offsetting credits) as a fraction of these total TCC payments.

Table 9
Historical Total Average TCC Credit Requirement and Uncollateralized TCC Payments

	Average Credit Requirement All TCCs		Total Uncollateralized TCC Payments	Percent Uncollateralized Payments
	Maximum	Minimum		
Current	$ 60,068,341	$ 60,068,341	$ (66,597,084)	51%
3%	$ 78,156,655	$ 33,320,682	$ (24,998,342)	19%
Mixed[2]	$ 70,387,435	$ 19,200,778	$ (25,677,051)	20%
5%	$ 59,697,250	$ 3,496,582	$ (32,971,012)	25%

Notes:

1. The column entitled "maximum" shows the average credit requirement over the historical period under the assumption that none of the TCCs with a credit offset would be held by market participants having a credit requirement. Thus, for this calculation, all credit offsets were set to zero.
2. The column entitled "minimum" shows the average credit requirement over the historical period under the assumption that all TCCs with a credit offset were held by market particpants able to utilize the credit offset. The actual impact of the changes in TCC credit coverage requirements would be somewhere between the maximum and minimum figures.
3. The calculation of an "average credit requirement" is premised on the current auction mix in which at any point in time there is only one set of monthly TCCs, one set of six-month TCCs and two sets of annual TCCs outstanding. These average credit requirement calculations are intended to be illustrative. They are derived from the average credit requirement for TCCs actually sold in monthly auctions, in six-month TCC auctions, and in annual TCC auctions. The calculations do not attempt to adjust for changes over time in the proportion of the grid sold in six-month and annual auctions and they do not attempt to account for indirect impacts of 912 MW oversale.
4. The column entitled "total uncollateralized payments" portrays the total amount by which payments by TCC holders would have exceeded the credit requirement for holding those TCCs, calculated on a TCC-by-TCC basis (i.e., not aggregated over market participant portfolios), and summed over the auctions.
5. All three columns exclude the six-month and annual TCCs sold in the Spring 2002 auction.

[5] In calculating the total payments due from TCC holders purchased in the auctions included in Table 9, it was found that the table distributed for the April 23rd meeting had been based on the average uncollateralized payments in annual auctions, rather than total uncollateralized payments. The corrected figures are shown in Table 9.

Appendix

There was a request for the formulas embedded in the excel credit calculator. The alternative credit coverage formulas for annual awarded TCCs are shown below:

The 1% level:

$$+3.888 \sqrt{e^{10.9729 + .6514 (\ln(|p| + e) + .6633 * Zone\ J}} - .9696\ P_{ijt}$$

The 3% level:

$$+2.447 \sqrt{e^{10.9729 + .6514 (\ln(|p| + e) + .6633 * Zone\ J}} - .9696\ P_{ijt}$$

The 5% level:

$$+1.909 \sqrt{e^{10.9729 + .6514 (\ln(|p| + e) + .6633 * Zone\ J}} - .9696\ P_{ijt}$$

The 10% level:

$$+1.272 \sqrt{e^{10.9729 + .6514 (\ln(|p| + e) + .6633 * Zone\ J}} - .9696\ P_{ijt}$$

The 25% level:

$$+.5003 \sqrt{e^{10.9729 + .6514 (\ln(|p| + e) + .6633 * Zone\ J}} - .9696\ P_{ijt}$$

The alternative credit coverage formulas for six-month awarded TCCs are as shown below.

The 1% level:

$$+4.308 \sqrt{e^{11.6866 + .4749 \left(\ln\left(|p_{ijt}| + e\right)\right) + .4856\ Zone\ J - .0373\ Summer}} - .8166\ P_{ijt}$$

The 3% level:

$$+2.565\ \sqrt{e^{11.6866+.4749\left(\ln\left(\left|p_{ijt}\right|+e\right)\right)+.4856\ Zone\ J-.0373\ Summer}}\ -\ .8166\ P_{ijt}$$

The 5% level:

$$+1.952\ \sqrt{e^{11.6866+.4749\left(\ln\left(\left|p_{ijt}\right|+e\right)\right)+.4856\ Zone\ J-.0373\ Summer}}\ -\ .8166\ P_{ijt}$$

The 10% level:

$$+1.259\ \sqrt{e^{11.6866+.4749\left(\ln\left(\left|p_{ijt}\right|+e\right)\right)+.4856\ Zone\ J-.0373\ Summer}}\ -\ .8166\ P_{ijt}$$

The 25% level:

$$+.478\ \sqrt{e^{11.6866+.4749\left(\ln\left(\left|p_{ijt}\right|+e\right)\right)+.4856\ Zone\ J-.0373\ Summer}}\ -\ .8166\ P_{ijt}$$

The alternative credit coverage formulas for monthly TCCs are as shown below:

The 1% level:

$$+3.811\ \sqrt{e^{11.2682+0.3221(\ln(\left|p_{ijt}\right|+e+1.3734*ZoneJ+2.001*ZoneK+Month}}\ -\ .8152\ P_{ijt}$$

The 3% level:

$$+2.221\ \sqrt{e^{11.2682+0.3221(\ln(\left|p_{ijt}\right|+e+1.3734*ZoneJ+2.001*ZoneK+Month}}\ -\ .8152\ P_{ijt}$$

The 5% level:

$$+1.680\ \sqrt{e^{11.2682+0.3221(\ln(\left|p_{ijt}\right|+e+1.3734*ZoneJ+2.001*ZoneK+Month}}\ -\ .8152\ P_{ijt}$$

The 10% level:

$$+1.083\ \sqrt{e^{11.2682+0.3221(\ln(\left|p_{ijt}\right|+e+1.3734*ZoneJ+2.001*ZoneK+Month}}\ -\ .8152\ P_{ijt}$$

The 25% level:

$$+0.430\ \sqrt{e^{11.2682+0.3221(\ln(\left|p_{ijt}\right|+e+1.3734*ZoneJ+2.001*ZoneK+Month}}\ -\ .8152\ P_{ijt}$$

P denotes auction price

Zone J = 1 if TCC sources or sinks but not both in Zone J, zero otherwise

Zone K = 1 if TCC sources or sinks but not both in Zone K and does not source or sink in Zone J, 0 otherwise.

Summer = 1 for six month TCCs sold in spring auction

“Month” takes the following values:

January = 0

February = -0.0201

March = 0.1065

April = -0.3747

May = 0.8181

June = 0.2835

July = 0.5201

August = 0.7221

September = 0.242

October = 0.32

November = -0.7681

December = -0.3836