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| Credit Formulas and Detail Whitepaper for the Day-Ahead Market and Congestion Revenue Rights Auction |
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| **Version 0.1** |
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Revision History

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| --- | --- | --- | --- |
| **Date** | **Version** | **Description** | **Author** |
| 01/12/2012 | 0.1 | Initial Version | Carrie Tucker |

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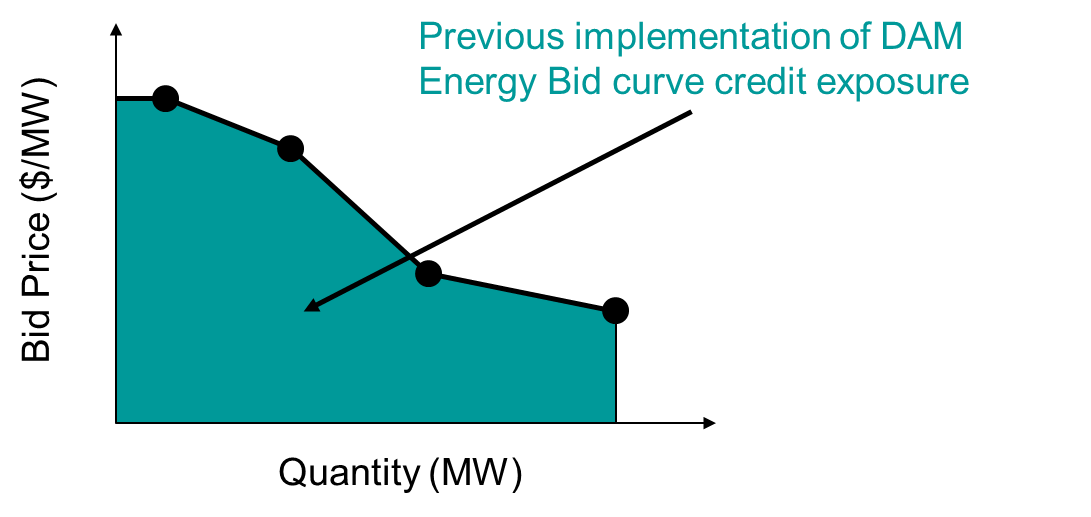
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# Credit Exposure Calculation – DAM Energy Bids

Please note that this section is in the process of being updated to incorporate the changes to the bid curve calculation contained in NPRR323. NPRR323 adjusts the credit exposure of an Energy Bid curve-type to be at that price/quantity pair to produces the maximum possible credit exposure, rather than the exposure for the entire bid area. An illustration of this concept is provided below.



Quantity (MW)

Bid Price ($/MW)

NPRR323 implementation

## Checks

1. Make the first (Q,P) pair as (q0,p0) = (0,p1)

where p1 = price of the first submitted price from (q1,p1)

1. If abs(q1-q0) < 0.01, then ignore the first segment for credit check.
2. For a line segment, if abs[q(i+1)-q(i)) < 0.01, then consider it as vertical line segment. No area under curve, no credit check required. Proceed to next line segment.

## Credit Exposure for a Line Segment

First pair = (q(i), p(i))

Second pair = (q(i+1), p(i+1))

**Credit Exposure = [q(i+1)-q(i)] \***

**0.5 \* [bidExposurePrice(p(i)) + bidExposurePrice(p(i+1))]**

*where*

bidExposurePrice(p(i)) =

IF (bidprice(p(i)) <= 0)

THEN bidExposurePrice(p(i)) = 0

ELSE bidExposurePrice(p(i)) = MAX[0, sum(A + B) ]

A = MIN (d*th*%DA-SPP, bidprice(p(i)))

B = IF (bidprice(p(i)) > A)

THEN B = e1 \* (bidprice(p(i)) – A)

ELSE B = 0

If the d*th*%DA-SPP lies between q(i) and q(i+1), then find the intercept q(d), p(d). Calculate Credit Exposure for two segments [(q(i), p(i)) – (q(d), p(d))] and [(q(d), p(d)) – (q(i+1), p(i+1))]. Total Credit Exposure for the entire segment is sum of the two credit exposures.

Also see Figures 1 and 2 for visual interpretation of the Credit Exposure calculation.



Figure 1 – Credit Exposure Calculation (Energy Bids) – Positive dth Percentile DA-SPP



Figure 2 – Credit Exposure Calculation (Energy Bids) – Negative (or zero) dth Percentile DA-SPP

## Verification – Case 1-Scan for Line Segment (q5,p5), (q6,p6) where dth SPP < 0

bidExposurePrice(q5) = MAX[0, sum(A + B) ]

where

A = MIN (d*th*%DA-SPP, bidprice) = d

B = e1 \* (bidprice – A) = e1 \* (p5 – d)

bidExposurePrice(q5) = MAX[0, (d + e1 \* (p5 – d))]

bidExposurePrice(q6) = MAX[0, (d + e1 \* (p6 – d))]

Credit Exposure = [q(6)-q(5)] \* 0.5 \* [bidExposurePrice(q5) + bidExposurePrice(q6)]

= (q6-q5) \* 0.5 \*

[MAX[0, (d + e1 \* (p5 – d))] + MAX[0, (d + e1 \* (p6 – d))]

## Verification – Case 2-Scan for Line Segment (q5,p5), (q6,p6) where p6 >= dth SPP >= 0

bidExposurePrice(q5) = MAX[0, sum(A + B) ]

where

A = MIN (d*th*%DA-SPP, bidprice) = d

B = e1 \* (bidprice – A) = e1 \* (p5 – d)

bidExposurePrice(q5) = MAX[0, (d + e1 \* (p5 – d)}]

= (d + e1 \* (p5 – d))

bidExposurePrice(q6) = (d + e1 \* (p6 – d))

Credit Exposure = [q(6)-q(5)] \* 0.5 \* [bidExposurePrice(q5) + bidExposurePrice(q6)]

= (q6-q5) \* 0.5 \* [2d + e1\*(p5+p6-2d)]

= (q6-q5) \* d \* [1-e1] + 0.5 \* (p5+p6)\*(q6-q5)

## Verification – Case 3-Scan for Line Segment (q5,p5), (q6,p6) where 0 <= p6 <= p5 <= dth SPP

bidExposurePrice(q5) = MAX[0, sum(A + B) ]

where

A = MIN (d*th*%DA-SPP, bidprice) = p5

B = 0

bidExposurePrice(q5) = MAX[0, p5] = p5

bidExposurePrice(q6) = MAX[0, p6] = p6

Credit Exposure = [q(6)-q(5)] \* 0.5 \* [bidExposurePrice(q5) + bidExposurePrice(q6)]

= [q(6)-q(5)] \* 0.5 \* (p5+p6)

## Verification – Case 4-Scan for Line Segment (q5,p5), (q6,p6) where 0 <= p6 <= dth SPP <= p5

bidExposurePrice(q5) = MAX[0, sum(A + B) ]

where

A = MIN (d*th*%DA-SPP, bidprice) = d

B = e1 \* (bidprice – A) = e1 \* (p5 – d)

bidExposurePrice(q5) = MAX[0, (d + e1 \* (p5 – d)}]

= (d + e1 \* (p5 – d))

bidExposurePrice(qd) = MAX[0, sum(A + B) ]

where

A = MIN (d*th*%DA-SPP, bidprice) = d

B = 0

bidExposurePrice(qd) = MAX[0, d] = d

bidExposurePrice(q6) = MAX[0, p6] = p6

CreditExposure1 = [q(d)-q(5)] \* 0.5 \* [bidExposurePrice(q5) + bidExposurePrice(qd)]

= [q(d)-q(5)] \* 0.5 \* [(d + e1 \* (p5 – d)) + d]

CreditExposure2 = [q(6)-q(d)] \* 0.5 \* [bidExposurePrice(qd) + bidExposurePrice(q6)]

= [q(6)-q(d)] \* 0.5 \* [d + p6]

CreditExposure = CreditExposure1 + CreditExposure2

= [q(d)-q(5)] \* 0.5 \* [(d + e1 \* (p5 – d)) + d] +

[q(6)-q(d)] \* 0.5 \* [d + p6]

= (q(d)-q(5)) + 0.5 \* (q(d)-q(5)) \* [ e1\*(p5-d)] +

[q(6)-q(d)] \* 0.5 \* [d + p6]

= (q(d)-q(5))\*d\*[1-e1] + 0.5 \* e1 \* (q(d)-q(5)) \* (p5+d) +

[q(6)-q(d)] \* 0.5 \* [d + p6]

# Credit Exposure Calculation – DAM Energy Offers

## Checks

1. Make the first (Q,P) pair as (q0,p0) = (0,p1)

where p1 = price of the first submitted price from (q1,p1)

1. If abs(q1-q0) < 0.01, then ignore the first segment for credit check.
2. For a line segment, if abs[q(i+1)-q(i)) < 0.01, then consider it as vertical line segment. No area under curve, no credit check required. Proceed to next line segment.

## Credit Exposure for a Line Segment

First pair = (q(i), p(i))

Second pair = (q(i+1), p(i+1))

**B** = [q(i+1)-q(i)] \* 95% [the Hrly diff of RT-SPP-DA-SPP)] \* e3

IF [p(i) <= a*th*%DA-SPP] //Figures 3,4,5,6

THEN

q(a) = q(i+1)

IF [p(i+1) > a*th*%DA-SPP] //Figures 5,6

THEN Calculate intercept q(a)

IF [b*th*%DA-SPP > 0]

THEN **A** = - ( (q(a)-q(i)) \* b*th*%DA-SPP \* e2)

ELSE **A** = -((q(a)-q(i)) \* b*th*%DA-SPP)

ELSE **A** = 0 //Figures 7,8

**Credit Exposure = A+B**

Also see Figures 3-8 for visual interpretation of the Credit Exposure calculation.



**Figure 3 – Credit Exposure Calculation (Energy Offers) – Positive ath Percentile above the Line Segment**



**Figure 4 – Credit Exposure Calculation (Energy Offers) – Negative ath Percentile above the Line Segment**



**Figure 5 – Credit Exposure Calculation (Energy Offers) – Positive ath Percentile intercepting the Line Segment**



**Figure 6 – Credit Exposure Calculation (Energy Offers) – Negative ath Percentile intercepting the Line Segment**



**Figure 7 – Credit Exposure Calculation (Energy Offers) – Positive ath Percentile below the Line Segment**



**Figure 8 – Credit Exposure Calculation (Energy Offers) – Negative ath Percentile below the Line Segment**

# Credit Exposure Calculation – Three-Part Offers

## Checks

1. Make the first (Q,P) pair as (q0,p0) = (0,p1)

where p1 = price of the first submitted price from (q1,p1)

1. If abs(q1-q0) < 0.01, then ignore the first segment for credit check.
2. For a line segment, if abs[q(i+1)-q(i)) < 0.01, then consider it as vertical line segment. No area under curve, no credit check required. Proceed to next line segment.

## Credit Exposure Calculation

The Credit Exposure calculation for a Three-Part offer is calculated by identifying the target line segment first.

The target line segment is one of the following line segments –

1. The last segment of the Three-Part offer curve, if yth percentile is above or below the offer curve, or
2. The segment of the Three-Part offer curve that is intercepting the yth percentile.

Target Segment first pair = (q(i), p(i))

Target Segment second pair = (q(i+1), p(i+1))

IF [p(i) <= y*th*%DA-SPP] //Figures 9,10,11,12

THEN

q(y) = q(i+1)

IF [p(i+1) > y*th*%DA-SPP] //Figures 11,12

THEN Calculate intercept q(y)

**Credit Exposure** = - [q(y) \* (z*th*%DA-SPP)]

ELSE **Credit Exposure** = 0 //Figures 13,14

Also see Figures 9-14 for visual interpretation of the Credit Exposure calculation.



**Figure 9 – Credit Exposure Calculation (Three-Part Offers) – Positive yth Percentile above the Line Segment**



**Figure 10 – Credit Exposure Calculation (Three-Part Offers) – Negative yth Percentile above the Line Segment**



**Figure 11 – Credit Exposure Calculation (Three-Part Offers) – Positive yth Percentile intercepting the Line Segment**



**Figure 12 – Credit Exposure Calculation (Three-Part Offers) – Negative yth Percentile intercepting the Line Segment**



**Figure 13 – Credit Exposure Calculation (Three-Part Offers) – Positive yth Percentile below the Line Segment**



**Figure 14 – Credit Exposure Calculation (Three-Part Offers) – Negative yth Percentile below the Line Segment**

# Credit Exposure Calculation – PTP Obligation Bids

## PTP Obligation bid credit exposure rule

## Supporting ERCOT Protocols, Section 4.4.1 , with regard to PTP Obligation bid exposure calculation only

### PTP Obligation Bids: Validation rules for Insert/Update or running Phase 2 Validation

|  |  |  |
| --- | --- | --- |
| **Validation Rule Description** | **Validation at time of submission** | **Validation in Phase 2** |
| Cannot exceed the credit limit based on credit exposure calculation for each hour:  If PTP\_PRICE is negative then consider PTP\_PRICE as zero for credit exposure calculations i.e PTP\_PRICE=0    **Default Credit Exposure=**  PTP\_MW\*(max(0,PTP\_PRICE) + uth%)  Where,  PTP\_MW= PTP Bid MW for given hour  PTP\_PRICE= PTP Bid Price ($/MWHr) for given hour  uth%=uth percentile of the hourly positive(>0) price differences between the source Real-Time SPP minus the sink Real-Time SPP over the previous 30 days for the given hour.  In addition if a QSE qualifies, the Default Credit Exposure is further reduces as described below:  Credit Exposure Reduction by netting out CRRs with PTPs: If, at a counterparty, the total CRR is greater than or equal to total MW of all PTP for a given hour and the same source/sink combination, then the credit exposure reduction is:  **Credit Exposure Reduction (complete netting)**= 0.8\*PTP\_MW\*max(0,PTP\_PRICE)  However, if the total CRRs minus the total MW of PTP is greater than zero but is less than the submitted MW of the new submitted PTP, then the credit exposure reduction is:  **Credit Exposure Reduction (partial netting)=** 0.8[or DerationFactor, if different]\*REMAINING\_CRR\_MW\*max(0,PTP\_PRICE)  Where,  REMAINING\_CRR\_MW=Total CRR MW – Total PTP MW for given hour and same combination of source/sink  The final credit exposure will be  **Final Credit Exposure = Default Credit Exposure – Credit Exposure Reduction(for qualified QSEs)** | Enforce rule only in post phase2 | Yes |

### PTP Obligation Bids: Validation rules for Cancel regarding credit exposure

|  |
| --- |
| **Validation Rule Description** |
| On cancellation, the credit exposure previously subtracted from the counterparties credit limit must be undone upon successful cancellation. Cannot exceed the credit limit based on credit exposure calculation for each hour: |

### PTP Obligation Bids: Eligibility for Credit Exposure Reduction on a QSE basis

A flag indicating eligibility for additional Credit Exposure Reduction on a QSE level will be maintained.

### PTP Obligation Bids: Maintenance of CRR ownership at counterparty level

Net CRR ownership from the CRR system on a MW basis will be maintained at an hourly and unique source/sink combination. For each PTP Bid submission/cancel, the PTP MW on an hourly basis and given source/sink combination will be compared with the Net CRR to see if full or partial reduction of credit exposure due to CRR netting can be applied.

# Credit Exposure Calculation – AS Not self-arranged

Credit Exposure = [Q \* t*th*%(DAM-AS-MCPC)]

# 

# Credit Exposure Calculation – CRR Auction

## Overview and screening process

Prior to the CRR Auction, ERCOT will conduct a two-part pre-auction screening process. First, if the Counter-Party’s CRR Auction credit limit is greater than that Counter-Party’s credit exposure as defined below, then the Counter-Party’s CRR Auction credit limit will not be a binding constraint as the CRR Auction is solved. Second, for each CRR Account Holder of a Counter-Party, if the CRR Account Holder’s self-imposed credit limit is greater than that CRR Account Holder’s credit exposure as defined below, then the CRR Account Holder’s self-imposed credit limit will likewise not be a binding constraint as the CRR Auction is solved. The implementation requirements for this NPRR are to-be-determined. It may be that in such a scenario the CRR staff will manually adjust and pass to the CRR Auction engine an extremely high credit limit, such that the budget constraint could never be binding, as a way for the CRR Auction Engine to “ignore” the credit constraints in the optimization.

1. The decisions to enforce or ignore the credit constraints in auction optimization process is listed below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scenario** | **Pre-auction Screening results for** | | **Enforce/Ignore credit constraints in auction optimization process** | |
| **CP** | **CRRAH** | **CP** | **CRRAH** |
| 1 | Fail | Fail | Enforce | Enforce |
| 2 | Fail | Pass | Enforce | Ignore |
| 3 | Pass | Fail | Ignore | Enforce |
| 4 | Pass | Pass | Ignore | Ignore |

The calculated exposure for the pre-auction screening for each CRR Account Holder is the sum of the credit exposure for PTP Obligation bids, PTP Obligation offers, and PTP Option bids for that CRR Account Holder, including the A and M values. The calculated exposure for the pre-auction screening for each Counter-Party is the sum of the credit exposure for PTP Obligation bids, PTP Obligation offers, and PTP Option bids for that Counter-Party. PTP Option offers have zero credit exposure. Separately, for PTP Obligation bids, PTP Obligation offers, and PTP Option bids each, for each source/sink Settlement Point combination, the credit exposure will use the bid price and MW quantity that produces the maximum credit exposure that could result from the auction for that source/sink Settlement Point combination.

The ERCOT Board-approved values for A and M, as referenced in Nodal Protocols Section 7.5.5.3(1)(a)(iii), are currently set at $.75/MWh and 0, respectively.

Suppose a Counter-party CP has two Account Holders CRRAH1, CRRAH2. These two Account Holders submited buy bids (obligation) with the same source/sink path, Time of Use, month(s).

**CRRAH1:**

|  |  |  |
| --- | --- | --- |
|  | **Price ($/MW)** | **Quantity (MW)** |
| Bid 1 | 10 | 1 |
| Bid 2 | 15 | 1 |

**CRRAH2:**

|  |  |  |
| --- | --- | --- |
|  | **Price ($/MW)** | **Quantity (MW)** |
| Bid 1 | 5 | 1 |

**`**

## Methodology to calculate each CRR account holder’s credit exposure:

**CE*o,a* = CEOBLBID*o,a*** + **CEOPTBID*o,a*** + **CEOBLOFFER*o,a***

**CEOBLBID*o,a*** = max [**QOBLB*(j,k),o,t,d,z,i*** \* (max(**P***bid,(j,k),o,t,d,z,i*,0) +

M\*(max(**P***bid,(j,k),o,t,d,z,i*,0)) + A), **QOBLB*(j,k),o,t,d,z,i+1*** \* (max(**P***bid,(j,k),o,t,d,z,i+1*,0) +

M\*(max(**P***bid,(j,k),o,t,d,z,i+1*,0)) + A), …, **QOBLB*(j,k),c,t,d,z,i=R*** \* (max(**P***bid,(j,k),c,t,d,z,i=R*,0) +

M\*(max(**P***bid,(j,k),o,t,d,z,i=R*,0)) + A)];

The CRR account holder’s original obligation bids (Pm,Qm) are sorted in the descending order of Pr, such that Pr+1 <=Pr <= Pr-1 (2<=r<=R+1).

Rearrange the bids as (**P***bid,(j,k),o,t,d,z,i*, **QOBLB*(j,k),o,t,d,z,i*** ) such that, **P***bid,(j,k),o,t,d,z,i* = Pm , **P***bid,(j,k),o,t,d,z,i+1* <=**P***bid,(j,k),o,t,d,z,i* <=**P***bid,(j,k),o,t,d,z,i-1*  and **QOBLB*(j,k),o,t,d,z,i* =**

**CEOBLOFFER*o,a* = max**[**QOBLO*(j,k),o,t,d,z,i*** \* (-1\*min(**P***offer,(j,k),o,t,d,z,i*,0)), **QOBLO*(j,k),o,t,d,z,i+1*** \* (-1\*min(**P***offer,(j,k),o,t,d,z,i+1*,0)), …, **QOBLO*(j,k),o,t,d,z,i=N*** \* (-1\*min(**P***offer,(j,k),o,t,d,z,i=N*,0))];

The CRR account holder’s original obligation offers (Pn,Qn) are sorted in the ascending order of Pn, such that Pn-1 <=Pn <= Pn+1 (2<=n<=N+1).

Rearrange the offers as (**P***offer,(j,k),o,t,d,z,i*, **QOBLB*(j,k),o,t,d,z,i*** ) such that, **P***offer,(j,k),o,t,d,z,i* = Pn, **P***offer,(j,k),o,t,d,z,i-1* <=**P***offer,(j,k),o,t,d,z,i* <=**P***bid,(j,k),o,t,d,z,i+1*  and **QOBLB*(j,k),o,t,d,z,i* =**

**CEOPTBID*o,a* =** max [**QOPTB*(j,k),o,t,d,z,i*** \* **P***bid,(j,k),o,t,d,z,i,***QOPTB*(j,k),o,t,d,z,i+1*** \* **P***bid,(j,k),o,t,d,z,i+1*, …,**QOPTB*(j,k),o,t,d,z,i=G*** \* **P***bid,(j,k),o,t,d,z,i=G*];

The CRR account holder’s original option bids (Pg,Qg) are sorted in the descending order of Pg, such that Pg+1 <=Pg <= Pg-1 (2<=g<=G+1).

Rearrange the bids as (**P***bid,(j,k),o,t,d,z,i*, **QOBLB*(j,k),o,t,d,z,i*** ) such that, **P***bid,(j,k),o,t,d,z,i* = Pg , **P***bid,(j,k),o,t,d,z,i+1* <=**P***bid,(j,k),o,t,d,z,i* <=**P***bid,(j,k),o,t,d,z,i-1*  and **QOBLB*(j,k),o,t,d,z,i* =**



**Figure 1 – Credit Exposure Calculation for CRRAH1**



**Figure 2 – Credit Exposure Calculation for CRRAH2**

After arrangement of CRRAH1’s bids, the calculated max credit exposure is

max[1 \* (max (15, 0) +0.75), 2 \* (max (10, 0) +0.75)] = $21.50, which is area of the rectangular under price $10/MW, as shown in Figure 1. Also Figure 2 shows the max credit exposure for CRRAH2 is max[1 \* (max (5, 0) +0.75)] = $5.75. Therefore **CEOBLBID*CRRAH1*** =21.5, **CEOBLBID*CRRAH2*** =5.75.

The calulation of **CEOPTBID*o,a*** and **CEOBLOFFER*o,a*** is similar to the process above.

## Methodology to calculate each Counter Party’s credit exposure

**CE*c,a* = CEOBLBID*c,a*** + **CEOPTBID*c,a*** + **CEOBLOFFER*c,a***

**CEOBLBID*c,a*** = max [**QOBLB*(j,k),c,t,d,z,i*** \* (max(**P***bid,(j,k),c,t,d,z,i*,0) +

M\*(max(**P***bid,(j,k),o,t,d,z,i*,0)) + A), **QOBLB*(j,k),c,t,d,z,i+1*** \* (max(**P***bid,(j,k),c,t,d,z,i+1*,0) +

M\*(max(**P***bid,(j,k),o,t,d,z,i+1*,0)) + A), …, **QOBLB*(j,k),c,t,d,z,i=R’*** \* (max(**P***bid,(j,k),c,t,d,z,i=R’*,0) +

M\*(max(**P***bid,(j,k),o,t,d,z,i=R’*,0)) + A)];

The Counter Party’s original obligation bids (Pr’,Qr’) are sorted in the descending order of Pr’, such that Pr’+1 <=Pr’ <= Pr’-1 (2<=r’<=R’+1).

Rearrange the bids as (**P***bid,(j,k),c,t,d,z,i*, **QOBLB*(j,k),c,t,d,z,i*** ) such that, **P***bid,(j,k),c,t,d,z,i* = Pr’ , **P***bid,(j,k),c,t,d,z,i+1* <=**P***bid,(j,k),c,t,d,z,i* <=**P***bid,(j,k),c,t,d,z,i-1*  and **QOBLB*(j,k),c,t,d,z,i* =**

**CEOBLOFFER*c,a* = max**[**QOBLO*(j,k),c,t,d,z,i*** \* (-1\*min(**P***offer,(j,k),c,t,d,z,i*,0)), **QOBLO*(j,k),c,t,d,z,i+1*** \* (-1\*min(**P***offer,(j,k),c,t,d,z,i+1*,0)), …, **QOBLO*(j,k),c,t,d,z,i=N’*** \* (-1\*min(**P***offer,(j,k),c,t,d,z,i=N’*,0))];

The Counter Party’s original obligation offers (Pn’,Qn’) are sorted in the ascending order of Pn’, such that Pn’-1 <=Pn’ <= Pn’+1 (2<=n’<=N’+1).

Rearrange the offers as (**P***offer,(j,k),c,t,d,z,i*, **QOBLB*(j,k),o,t,d,z,i*** ) such that, **P***offer,(j,k),c,t,d,z,i* = Pn’, **P***offer,(j,k),c,t,d,z,i-1* <=**P***offer,(j,k),c,t,d,z,i* <=**P***bid,(j,k),c,t,d,z,i+1*  and **QOBLB*(j,k),c,t,d,z,i* =**

**CEOPTBID*c,a* =** max [**QOPTB*(j,k),c,t,d,z,i*** \* **P***bid,(j,k),c,t,d,z,i***, QOPTB*(j,k),c,t,d,z,i+1*** \* **P***bid,(j,k),c,t,d,z,i+1***, …, QOPTB*(j,k),c,t,d,z,i=G’*** \* **P***bid,(j,k),c,t,d,z,i=G’*];

The Counter Party’s original option bids (Pg’,Qg’) are sorted in the descending order of Pg’, such that Pg’+1 <=Pg’ <= Pg’-1 (2<=g’<=G+1).

Rearrange the bids as (**P***bid,(j,k),c,t,d,z,i*, **QOBLB*(j,k),c,t,d,z,i*** ) such that, **P***bid,(j,k),c,t,d,z,i* = Pg’ , **P***bid,(j,k),c,t,d,z,i+1* <=**P***bid,(j,k),c,t,d,z,i* <=**P***bid,(j,k),c,t,d,z,i-1*  and **QOBLB*(j,k),c,t,d,z,i* =**

Note: **CE*c,a*** is not always equal to



**Figure 3 – Credit Exposure Calculation for Counter-Party CP**

After arrangement of all the bids of Counter-Party CP, the calculated max credit exposure is max[1 \* (max (15, 0) +0.75), 2 \* (max (10, 0) +0.75), 3 \* (max (5, 0) +0.75)] = $21.50, as shown in Figure 3. Therefore **CEOBLBID*CP*** =$21.50.

The above variables are defined as follows:

| Variable | Unit | Description |
| --- | --- | --- |
| CE*c,a* | $ | *Credit Exposure for a Counter-Party for an auction* — The calculated potential credit exposure for all CRRs that may be awarded to CRR Account Holders that belong to a Counter-Party. |
| CE*o,a* | $ | *Credit Exposure for a CRR Account Holder for an auction* — The calculated potential credit exposure for all CRRs that may be awarded to a CRR Account Holder. |
| CEOBLBID*o,a* | $ | *Credit Exposure for PTP Obligations Bid for a CRR Account Holder for an auction.* |
| CEOPTBID*o,a* | $ | *Credit Exposure for PTP Options Bid for a CRR Account Holder for an auction.* |
| CEOBLOFFER*o,a* | $ | *Credit Exposure for PTP Obligations Offered for a CRR Account Holder for an auction.* |
| CEOBLBID*c,a* | $ | *Credit Exposure for PTP Obligations Bid for a Counter-Party for an auction.* |
| CEOPTBID*c,a* | $ | *Credit Exposure for PTP Options Bid for a Counter-Party for an auction.* |
| CEOBLOFFER*c,a* | $ | *Credit Exposure for PTP Obligations Offered for a Counter-Party for an auction.* |
| P*bid,(j,k),o,t,d,z,i* | $/MW  per hour | *Bid price for PTP Bid for Hedge Type for a CRR Account Holder for a Time* Of Use block, for the delivery month per a source and sink pair |
| P*offer,(j,k),o,t,d,z,i* | $/MW  per hour | *Offer price for PTP Offer for Hedge Type for a CRR Account Holder for a Time Of Use block, for the delivery month per a source and sink pair.* |
| QOBLB (*j,k),o,t,d,z,i* | MWh | *The maximum quantity for PTP Obligations Bid that can be awarded if the clearing price is* P*bid,(j,k),o,t,d,z,i , for a CRR Account Holder for a Time Of Use block, for the delivery month per a source and sink pair.* |
| QOPTB(*j,k),o,t,d,z,i* | MWh | *The maximum quantity for PTP Options Bid that can be awarded if the clearing price is* P*bid,(j,k),o,t,d,z,i , for a CRR Account Holder for a Time Of Use block, for the delivery month per a source and sink pair.* |
| QOBLO(*j,k),o,t,d,z* | MWh | *The maximum quantity for PTP Obligations Offer that can be awarded if the clearing price is* P*offer,(j,k),o,t,d,z,i , for a CRR Account Holder for a Time Of Use block, for a delivery month per a source and sink pair.* |
| P*bid,(j,k),c,t,d,z,i* | $/MW  per hour | *Bid price for PTP Bid for Hedge Type for a Counter-Party for a Time Of Use block, for the delivery month per a source and sink pair* |
| P*offer,(j,k),c,t,d,z,i* | $/MW  per hour | *Offer price for PTP Offer for Hedge Type for a Counter-Party for a Time Of Use block, for the delivery month per a source and sink pair.* |
| QOBLB (*j,k),c,t,d,z,i* | MWh | *The maximum quantity for PTP Obligations Bid that can be awarded if the clearing price is* P*bid,(j,k),c,t,d,z,i , for a Counter-Party for a Time Of Use block, for the delivery month per a source and sink pair.* |
| QOPTB(*j,k),c,t,d,z,i* | MWh | *The maximum quantity for PTP Options Bid that can be awarded if the clearing price is* P*bid,(j,k),c,t,d,z,i , for a Counter-Party for a Time Of Use block, for the delivery month per a source and sink pair.* |
| QOBLO(*j,k),o,t,d,z* | MWh | *The maximum quantity for PTP Obligations Offer that can be awarded if the clearing price is* P*offer,(j,k),c,t,d,z,i , for a Counter-Party for a Time Of Use block, for a delivery month per a source and sink pair.* |
| A | $/MW  per hour | *Adder per TAC-recommended and ERCOT Board-approved value and/or procedure*. |
| M | None | *Multiplier per TAC-recommended and ERCOT Board-approved value and/or procedure*. |
| *a* | None | A CRR Auction. |
| *bid* | None | A PTP Bid. |
| *offer* | None | A PTP Offer. |
| *i* | None | The index of a PTP Bid/Offer for a CRR Account Holder. |
| *d* | None | Delivery Month. |
| *j* | None | A source settlement point. |
| *k* | None | A sink settlement point. |
| *t* | none | TOU block. |
| *o* | none | A CRR Account Holder. |
| *c* | none | A Counter-Party. |
| *z* | none | CRR Type (i.e. Obligation or Option). |
| *r* | none | The index of a PTP Obligation Bid for a CRR Account Holder. |
| *R* | none | Total number of PTP Obligation Bids for a CRR Account Holder. |
| *n* | none | The index of a PTP Obligation Offer for a CRR Account Holder. |
| *N* | none | Total number of PTP Obligation Offers for a CRR Account Holder. |
| *g* | none | The index of a PTP Option Bid for a CRR Account Holder. |
| *G* | none | Total number of PTP Option Bids for a CRR Account Holder. |
| *m’* | none | The index of a PTP Obligation Bid for a Counter-Party. |
| *R’* | none | Total number of PTP Obligation Bids for a Counter-Party. |
| *r’* | none | The index of a PTP Obligation Offer for a Counter-Party. |
| *N’* | none | Total number of PTP Obligation Offers for a Counter-Party. |
| *g’* | none | The index of a PTP Option Bid for a Counter-Party. |
| *G’* | none | Total number of PTP Option Bids for a Counter-Party. |