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| --- | --- | --- | --- |
| NPRR Number | [868](http://www.ercot.com/mktrules/issues/NPRR868) | NPRR Title | As-Built Hub and Load Zone Calculation |
| Date of Decision | April 10, 2018 |
| Action | Approved |
| Timeline  | Urgent |
| Effective Date | April 11, 2018 |
| Priority and Rank Assigned | Not Applicable |
| Nodal Protocol Sections Requiring Revision  | 2.1, Definitions 3.4, Load Zones3.5.2.1, North 345 kV Hub (North 345)3.5.2.2, South 345 kV Hub (South 345)3.5.2.3, Houston 345 kV Hub (Houston 345)3.5.2.4, West 345 kV Hub (West 345)3.5.2.6, ERCOT Bus Average 345 kV Hub (ERCOT 345 Bus)4.5.1, DAM Clearing Process4.6.1.2, Day-Ahead Settlement Point Prices for Load Zones7.5.1, Nature and Timing |
| Related Documents Requiring Revision/ Related Revision Requests | None |
| Revision Description | This Nodal Protocol Revision Request (NPRR) modifies the Hub Bus and Load Zone definitions and price calculations to account for the current usage of power flow buses as opposed to Electrical Buses in the Day-Ahead Market (DAM) and Congestion Revenue Right (CRR) Auction systems. In some cases there can be differences between power flow buses and Electrical Buses, and it is more suitable for power flow buses to be used. Real-Time currently uses Electrical Buses for the Hub and Load Zone calculations. Further, the rewritten formulas provide clarification for the scenario when buses are de-energized in contingency analysis. |
| Reason for Revision |  Addresses current operational issues. Meets Strategic goals (tied to the [ERCOT Strategic Plan](http://www.ercot.com/content/news/presentations/2013/ERCOT%20Strat%20Plan%20FINAL%20112213.pdf) or directed by the ERCOT Board). Market efficiencies or enhancements Administrative Regulatory requirements Other: (explain)*(please select all that apply)* |
| Business Case | The current system implementation of how Hubs and Load Zones are modeled in the DAM and CRR Auctions is the most appropriate implementation. This NPRR provides transparency by aligning the Protocols with ERCOT systems. ERCOT intends to seek a future NPRR and system change to bring the Real-Time Markets (RTMs) into alignment after careful consideration with stakeholders. |
| Credit Work Group Review | ERCOT Credit Staff and the Credit Work Group (Credit WG) have reviewed NPRR868 and do not believe that it requires changes to credit monitoring activity or the calculation of liability. |
| PRS Decision | On 3/8/18, PRS voted unanimously to grant NPRR868 Urgent status. PRS then voted unanimously to recommend approval of NPRR868 as submitted and to forward NPRR868 and the Impact Analysis to TAC. All Market Segments were present for the votes. |
| Summary of PRS Discussion | On 3/8/18, there was no discussion. |
| TAC Decision | On 3/22/18, TAC voted unanimously to recommend approval of NPRR868 as recommended by PRS in the 3/8/18 PRS Report with a proposed effective date of upon Board approval. All Market Segments were present for the vote. |
| Summary of TAC Discussion | On 3/22/18, there was no discussion. |
| ERCOT Opinion | ERCOT supports approval of NPRR868. |
| Board Decision | On 4/10/18, the ERCOT Board approved NPRR868 as recommended by TAC in the 3/22/18 TAC Report. |

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| Sponsor |
| Name | Carrie Bivens |
| E-mail Address | carrie.bivens@ercot.com |
| Company | ERCOT |
| Phone Number | 512-248-6678 |
| Market Segment | Not applicable |

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| --- |
| **Market Rules Staff Contact** |
| **Name** | Brittney Albracht |
| **E-Mail Address** | Brittney.Albracht@ercot.com  |
| **Phone Number** | 512-225-7027 |

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| **Comments Received** |
| Comment Author | **Comment Summary** |
| None |  |

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| Market Rules Notes |

Please note the following NPRR(s) also propose revisions to the following section(s):

* NPRR848, Separate Clearing Prices for RRS
	+ Section 4.5.1
* NPRR860, Day-Ahead Market (DAM) Clean-Up
	+ Section 4.5.1

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| Proposed Protocol Language Revision |

## DEFINITIONS

Hub Bus

(1) In the Day-Ahead Market (DAM) and Congestion Revenue Right (CRR) Auction, an energized power flow bus or group of energized power flow buses are defined as a single element in the Hub definition. The Locational Marginal Price (LMP) of the Hub Bus is the simple average of the LMPs assigned to each energized power flow bus in the Hub Bus. If all power flow buses within a Hub Bus are de-energized, the LMP of the Hub does not include the de-energized Hub Bus. If power flow buses within a Hub Bus are de-energized under contingency, the disconnected MWs are redistributed among remaining energized power flow buses. This is used solely for calculating the prices of existing Hub Buses defined in Section 3.5.2, Hub Definitions; or

(2) In the Real-Time Market (RTM), an energized Electrical Bus or group of energized Electrical Buses defined as a single element in the Hub definition. The LMP of the Hub Bus is the simple average of the LMPs assigned to each energized Electrical Bus in the Hub Bus. If all Electrical Buses within a Hub Bus are de-energized, the LMP of the Hub does not include the de-energized Hub Bus. This is used solely for calculating the prices of existing Hub Buses defined in Section 3.5.2.

Load Zone

(1) In the DAM and CRR Auction, a group of power flow buses assigned to the same zone under Section 3.4, Load Zones. Every power flow bus in ERCOT with a Load must be assigned to a Load Zone for Settlement purposes.

(2) In the RTM, a group of Electrical Buses assigned to the same zone under Section 3.4. Every Electrical Bus in ERCOT with a Load must be assigned to a Load Zone for Settlement purposes.

(3) A NOIE Load Zone is a type of Load Zone.

3.4 Load Zones

(1) ERCOT shall assign every power flow bus to a Load Zone for Day-Ahead Market (DAM) and Congestion Revenue Right (CRR) Settlement purposes. ERCOT shall calculate a Settlement Point Price for each Load Zone using the Load-weighted aggregated Shift Factors of the applicable energized power flow buses for each constraint. The Load-weighting must be determined using the Load distribution factors.

(2) ERCOT shall assign every Electrical Bus to a Load Zone for Real-Time Market (RTM) Settlement purposes. ERCOT shall calculate a Settlement Point Price for each Load Zone as the Load-weighted average of the Locational Marginal Prices (LMPs) at all Electrical Buses assigned to that Load Zone. The Load-weighting must be determined using the Load, if any, from the State Estimator at each Electrical Bus.

3.5.2.1 North 345 kV Hub (North 345)

(1) The North 345 kV Hub is composed of the following Hub Buses:

|  | ERCOT Operations |  |
| --- | --- | --- |
| No. | Hub Bus | kV | Hub |
| 1 | ANASW | 345 | NORTH |
| 2 | CN345 | 345 | NORTH |
| 3 | WLSH | 345 | NORTH |
| 4 | FMRVL | 345 | NORTH |
| 5 | LPCCS | 345 | NORTH |
| 6 | MNSES | 345 | NORTH |
| 7 | PRSSW | 345 | NORTH |
| 8 | SSPSW | 345 | NORTH |
| 9 | VLSES | 345 | NORTH |
| 10 | ALNSW | 345 | NORTH |
| 11 | ALLNC | 345 | NORTH |
| 12 | BNDVS | 345 | NORTH |
| 13 | BNBSW | 345 | NORTH |
| 14 | BBSES | 345 | NORTH |
| 15 | BOSQUESW | 345 | NORTH |
| 16 | CDHSW | 345 | NORTH |
| 17 | CNTRY | 345 | NORTH |
| 18 | CRLNW | 345 | NORTH |
| 19 | CMNSW | 345 | NORTH |
| 20 | CNRSW | 345 | NORTH |
| 21 | CRTLD | 345 | NORTH |
| 22 | DCSES | 345 | NORTH |
| 23 | EMSES | 345 | NORTH |
| 24 | ELKTN | 345 | NORTH |
| 25 | ELMOT | 345 | NORTH |
| 26 | EVRSW | 345 | NORTH |
| 27 | KWASS | 345 | NORTH |
| 28 | FGRSW | 345 | NORTH |
| 29 | FORSW | 345 | NORTH |
| 30 | FRNYPP | 345 | NORTH |
| 31 | GIBCRK | 345 | NORTH |
| 32 | HKBRY | 345 | NORTH |
| 33 | VLYRN | 345 | NORTH |
| 34 | JEWET | 345 | NORTH |
| 35 | KNEDL | 345 | NORTH |
| 36 | KLNSW | 345 | NORTH |
| 37 | LCSES | 345 | NORTH |
| 38 | LIGSW | 345 | NORTH |
| 39 | LEG  | 345 | NORTH |
| 40 | LFKSW | 345 | NORTH |
| 41 | LWSSW | 345 | NORTH |
| 42 | MLSES | 345 | NORTH |
| 43 | MCCREE | 345 | NORTH |
| 44 | MDANP | 345 | NORTH |
| 45 | ENTPR | 345 | NORTH |
| 46 | NCDSE | 345 | NORTH |
| 47 | NORSW | 345 | NORTH |
| 48 | NUCOR | 345 | NORTH |
| 49 | PKRSW | 345 | NORTH |
| 50 | KMCHI | 345 | NORTH |
| 51 | PTENN | 345 | NORTH |
| 52 | RENSW | 345 | NORTH |
| 53 | RCHBR | 345 | NORTH |
| 54 | RNKSW | 345 | NORTH |
| 55 | RKCRK | 345 | NORTH |
| 56 | RYSSW | 345 | NORTH |
| 57 | SGVSW | 345 | NORTH |
| 58 | SHBSW | 345 | NORTH |
| 59 | SHRSW | 345 | NORTH |
| 60 | SCSES | 345 | NORTH |
| 61 | SYCRK | 345 | NORTH |
| 62 | THSES | 345 | NORTH |
| 63 | TMPSW | 345 | NORTH |
| 64 | TNP\_ONE | 345 | NORTH |
| 65 | TRCNR | 345 | NORTH |
| 66 | TRSES | 345 | NORTH |
| 67 | TOKSW | 345 | NORTH |
| 68 | VENSW | 345 | NORTH |
| 69 | WLVEE | 345 | NORTH |
| 70 | W\_DENT | 345 | NORTH |
| 71 | WTRML | 345 | NORTH |
| 72 | WCSWS | 345 | NORTH |
| 73 | WEBB | 345 | NORTH |
| 74 | WHTNY | 345 | NORTH |
| 75 | WCPP | 345 | NORTH |

(2) The North 345 kV Hub Price uses the aggregated Shift Factors of the Hub Buses for each hour of the Settlement Interval of the Day-Ahead Market (DAM) in the Day-Ahead and is the simple average of the time-weighted Hub Bus prices for each 15-minute Settlement Interval in Real-Time, for each Hub Bus included in this Hub.

(3) The Day-Ahead Settlement Point Price of the Hub for a given Operating Hour is calculated as follows:

**DASPP** *North345* **= DASL –** $\begin{array}{c}Σ\\c\end{array}$**(DAHUBSF***North345, c***\* DASP** *c***),**

 **if HBBC**North345**≠0**

**DASPP** *North345* **= DASPP***ERCOT345Bus***, if HBBC***North345***=0**

Where:

DAHUBSF *North345, c =* $\begin{array}{c}Σ\\hb\end{array}$(HUBDF *hb, North345, c* \* DAHBSF *hb, North345, c*)

DAHBSF *hb, North345, c =* $\begin{array}{c}Σ\\pb\end{array}$(HBDF *pb, hb, North345, c* \* DASF *pb, hb, North345, c*)

HUBDF *hb, North345, c =* IF(HB*North345, c*=0, 0, 1 **/** HB *North345, c*)

HBDF *pb, hb, North345, c =* IF(PB*hb, North345, c*=0, 0, 1 **/** PB *hb, North345, c*)

The above variables are defined as follows:

| Variable | Unit | Definition |
| --- | --- | --- |
| DASPP *North345* | $/MWh | *Day-Ahead Settlement Point Price*⎯The DAM Settlement Point Price at the Hub, for the hour. |
| DASL | $/MWh | *Day-Ahead System Lambda*⎯The DAM Shadow Price for the system power balance constraint for the hour. |
| DASP *c* | $/MWh | *Day-Ahead Shadow Price for a binding transmission constraint*⎯The DAM Shadow Price for the constraint *c* for the hour. |
| DAHUBSF *North345,c* | none | *Day-Ahead Shift Factor of the Hub ⎯*The DAM aggregated Shift Factor of a Hub for the constraint *c* for the hour. |
| DAHBSF *hb,North345,c* | none | *Day-Ahead Shift Factor of the Hub Bus⎯*The DAM aggregated Shift Factor of a Hub Bus *hb* for the constraint *c* for the hour. |
| DASF *pb,hb,North345,c* | none | *Day-Ahead Shift Factor of the power flow bus⎯*The DAM Shift Factor of a power flow bus *pb* that is a component of Hub Bus *hb* for the constraint *c* for the hour. |
| HUBDF *hb, North345,c* | none | *Hub Distribution Factor per Hub Bus in a constraint*⎯The distribution factor of Hub Bus *hb* for the constraint *c* for the hour.  |
| HBDF *pb, hb, North345,c* | none | *Hub Bus Distribution Factor per power flow bus of Hub Bus in a constraint*⎯The distribution factor of power flow bus *pb* that is a component of Hub Bus *hb* for the constraint *c* for the hour.  |
| *pb* | none | An energized power flow bus that is a component of a Hub Bus for the constraint *c*. |
| PB *hb, North345,c* | none | The total number of energized power flow buses in Hub Bus *hb* for the constraint *c*. |
| *hb* | none | A Hub Bus that is a component of the Hub with at least one energized power flow bus for the constraint *c*. |
| HBBC *North345* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus in base case. |
| HB *North345,c* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus for the constraint *c*. |
| *c* | none | A DAM binding transmission constraint for the hour caused by either base case or a contingency. |

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(4) The Real-Time Settlement Point Price of the Hub for a given 15-minute Settlement Interval is calculated as follows:

RTSPP *North345* = Max [-$251, (RTRSVPOR + RTRDP +

 (HUBDF *hb, North345* \* ((RTHBP *hb, North345, y* \*

 TLMP *y*) / (TLMP *y*))))], if HB*North345*≠0

RTSPP *North345* = RTSPP*ERCOT345Bus*, if HB*North345*=0

Where:

RTRSVPOR = (RNWF  *y* \* RTORPA *y*)

RTRDP = (RNWF*y* \* RTORDPA*y*)

RNWF *y* = TLMP *y* / TLMP *y*

RTHBP *hb, North345, y* = (HBDF *b, hb, North345* \* RTLMP *b, hb, North345, y*)

HUBDF *hb, North345* = IF(HB*North345*=0, 0, 1 **/** HB *North345*)

HBDF *b, hb, North345* = IF(B*hb, North345*=0, 0, 1 **/** B *hb, North345*)

The above variables are defined as follows:

|  |  |  |
| --- | --- | --- |
| Variable | Unit | Description |
| RTSPP *North345* | $/MWh | *Real-Time Settlement Point Price*⎯The Real-Time Settlement Point Price at the Hub, for the 15-minute Settlement Interval. |
| RTHBP *hb, North345, y* | $/MWh | *Real-Time Hub Bus Price at Hub Bus per Security-Constrained Economic Dispatch* (*SCED) interval*⎯The Real-Time energy price at Hub Bus *hb* for the SCED interval *y*. |
| RTRSVPOR | $/MWh | *Real-Time Reserve Price for On-Line Reserves*⎯The Real-Time Reserve Price for On-Line Reserves for the 15-minute Settlement Interval. |
| RTORPA*y* | $/MWh | *Real-Time On-Line Reserve Price Adder per interval*⎯The Real-Time price adder for On-Line Reserves for the SCED interval *y*. |
| RTRDP | $/MWh | *Real-Time On-Line Reliability Deployment Price*⎯The Real-Time price for the 15-minute Settlement Interval, reflecting the impact of reliability deployments on energy prices that are calculated from the Real-Time On-Line Reliability Deployment Price Adder.  |
| RTORDPA *y* | $/MWh | *Real-Time On-Line Reliability Deployment Price Adder*⎯The Real-Time price adder that captures the impact of reliability deployments on energy prices for the SCED interval *y.*  |
| RNWF *y* | none | *Resource Node Weighting Factor per interval*⎯The weight used in the Resource Node Settlement Point Price calculation for the portion of the SCED interval *y* within the Settlement Interval. |
| RTLMP *b, hb, North345, y* | $/MWh | *Real-Time Locational Marginal Price at Electrical Bus of Hub Bus per interval*⎯The Real-Time LMP at Electrical Bus *b* that is a component of Hub Bus *hb*, for the SCED interval *y*. |
| TLMP *y* | second | *Duration of SCED interval per interval*⎯The duration of the portion of the SCED interval *y* within the 15-minute Settlement Interval |
| HUBDF *hb, North345* | none | *Hub Distribution Factor per Hub Bus*⎯The distribution factor of Hub Bus *hb*.  |
| HBDF *b, hb, North345* | none | *Hub Bus Distribution Factor per Electrical Bus of Hub Bus*⎯The distribution factor of Electrical Bus *b* that is a component of Hub Bus *hb*.  |
| *y* | none | A SCED interval in the 15-minute Settlement Interval. The summation is over the total number of SCED runs that cover the 15-minute Settlement Interval. |
| *b* | none | An energized Electrical Bus that is a component of a Hub Bus. |
| B *hb, North345* | none | The total number of energized Electrical Buses in Hub Bus *hb*. |
| *hb* | none | A Hub Bus that is a component of the Hub. |
| HB*North345* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus. |

3.5.2.2 South 345 kV Hub (South 345)

(1) The South 345 kV Hub is composed of the following Hub Buses:

|  | ERCOT Operations |  |
| --- | --- | --- |
| No. | Hub Bus | kV | Hub |
| 1 | AUSTRO | 345 | SOUTH |
| 2 | BLESSING | 345 | SOUTH |
| 3 | CAGNON | 345 | SOUTH |
| 4 | COLETO | 345 | SOUTH |
| 5 | CLEASP | 345 | SOUTH |
| 6 | NEDIN | 345 | SOUTH |
| 7 | FAYETT | 345 | SOUTH |
| 8 | FPPYD1 | 345 | SOUTH |
| 9 | FPPYD2 | 345 | SOUTH |
| 10 | GARFIE | 345 | SOUTH |
| 11 | GUADG | 345 | SOUTH |
| 12 | HAYSEN | 345 | SOUTH |
| 13 | HILLCTRY | 345 | SOUTH |
| 14 | HOLMAN | 345 | SOUTH |
| 15 | KENDAL | 345 | SOUTH |
| 16 | LA\_PALMA | 345 | SOUTH |
| 17 | LON\_HILL | 345 | SOUTH |
| 18 | LOSTPI | 345 | SOUTH |
| 19 | LYTTON\_S | 345 | SOUTH |
| 20 | MARION | 345 | SOUTH |
| 21 | PAWNEE | 345 | SOUTH |
| 22 | RIOHONDO | 345 | SOUTH |
| 23 | RIONOG | 345 | SOUTH |
| 24 | SALEM | 345 | SOUTH |
| 25 | SANMIGL | 345 | SOUTH |
| 26 | SKYLINE | 345 | SOUTH |
| 27 | STP | 345 | SOUTH |
| 28 | CALAVERS | 345 | SOUTH |
| 29 | BRAUNIG | 345 | SOUTH |
| 30 | WHITE\_PT | 345 | SOUTH |
| 31 | ZORN | 345 | SOUTH |

(2) The South 345 kV Hub Price uses the aggregated Shift Factors of the Hub Buses for each hour of the Settlement Interval of the DAM in the Day-Ahead and is the simple average of the time-weighted Hub Bus prices for each 15-minute Settlement Interval in Real-Time, for each Hub Bus included in this Hub.

(3) The Day-Ahead Settlement Point Price of the Hub for a given Operating Hour is calculated as follows:

**DASPP** *South345* **= DASL –** $\begin{array}{c}Σ\\c\end{array}$**(DAHUBSF***South345, c***\* DASP** *c***),**

 **if HBBC**South345**≠0**

**DASPP** *South345* **= DASPP***ERCOT345Bus***, if HBBC***South345***=0**

Where:

DAHUBSF *South345, c =* $\begin{array}{c}Σ\\hb\end{array}$(HUBDF *hb, South345, c* \* DAHBSF *hb, South345, c*)

DAHBSF *hb, South345, c =* $\begin{array}{c}Σ\\pb\end{array}$(HBDF *pb, hb, South345, c* \* DASF *pb, hb, South345, c*)

HUBDF *hb, South345, c =* IF(HB*South345, c*=0, 0, 1 **/** HB *South345, c*)

HBDF *pb, hb, South345, c =* IF(PB*hb, South345, c*=0, 0, 1 **/** PB *hb, South345, c*)

The above variables are defined as follows:

| Variable | Unit | Definition |
| --- | --- | --- |
| DASPP *South345* | $/MWh | *Day-Ahead Settlement Point Price*⎯The DAM Settlement Point Price at the Hub, for the hour. |
| DASL | $/MWh | *Day-Ahead System Lambda*⎯The DAM Shadow Price for the system power balance constraint for the hour. |
| DASP *c* | $/MWh | *Day-Ahead Shadow Price for a binding transmission constraint*⎯The DAM Shadow Price for the constraint *c* for the hour. |
| DAHUBSF *South345,c* | none | *Day-Ahead Shift Factor of the Hub ⎯*The DAM aggregated Shift Factor of a Hub for the constraint *c* for the hour. |
| DAHBSF *hb,South345,c* | none | *Day-Ahead Shift Factor of the Hub Bus⎯*The DAM aggregated Shift Factor of a Hub Bus *hb* for the constraint *c* for the hour. |
| DASF *pb,hb,South345,c* | none | *Day-Ahead Shift Factor of the power flow bus⎯*The DAM Shift Factor of a power flow bus *pb* that is a component of Hub Bus *hb* for the constraint *c* for the hour. |
| HUBDF *hb, South345,c* | none | *Hub Distribution Factor per Hub Bus in a constraint*⎯The distribution factor of Hub Bus *hb* for the constraint *c* for the hour.  |
| HBDF *pb, hb, South345,c* | none | *Hub Bus Distribution Factor per power flow bus of Hub Bus in a constraint*⎯The distribution factor of power flow bus *pb* that is a component of Hub Bus *hb* for the constraint *c* for the hour.  |
| *pb* | none | An energized power flow bus that is a component of a Hub Bus for the constraint *c*. |
| PB *hb, South345,c* | none | The total number of energized power flow buses in Hub Bus *hb* for the constraint *c*. |
| *hb* | none | A Hub Bus that is a component of the Hub with at least one energized power flow bus for the constraint *c*. |
| HBBC *South345* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus in base case. |
| HB *South345,c* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus for the constraint *c*. |
| *c* | none | A DAM binding transmission constraint for the hour caused by either base case or a contingency. |

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(4) The Real-Time Settlement Point Price of the Hub for a given 15-minute Settlement Interval is calculated as follows:

RTSPP *South345* = Max [-$251, (RTRSVPOR + RTRDP +

 (HUBDF *hb, South345* \* ((RTHBP *hb, South345, y* \* TLMP *y*) / (TLMP *y*))))], if HB*South345*≠0

RTSPP *South345* = RTSPP*ERCOT345Bus*, if HB*South345*=0

Where:

RTRSVPOR = (RNWF  *y* \* RTORPA *y*)

RTRDP = ( RNWF*y* \* RTORDPA*y*)

RNWF *y* = TLMP *y* / TLMP *y*

RTHBP *hb, South345, y* = (HBDF *b, hb, South345* \* RTLMP *b, hb, South345, y*)

HUBDF *hb, South345* = IF(HB*South345*=0, 0, 1 **/** HB*South345*)

HBDF *b, hb, South345* = IF(B*hb, South345*=0, 0, 1 **/** B *hb, South345*)

The above variables are defined as follows:

|  |  |  |
| --- | --- | --- |
| Variable | Unit | Description |
| RTSPP *South345* | $/MWh | *Real-Time Settlement Point Price*⎯The Real-Time Settlement Point Price at the Hub, for the 15-minute Settlement Interval. |
| RTHBP *hb, South345, y* | $/MWh | *Real-Time Hub Bus Price at Hub Bus per SCED interval*⎯The Real-Time energy price at Hub Bus *hb* for the SCED interval *y*. |
| RTRSVPOR | $/MWh | *Real-Time Reserve Price for On-Line Reserves*⎯The Real-Time Reserve Price for On-Line Reserves for the 15-minute Settlement Interval. |
| RTORPA*y* | $/MWh | *Real-Time On-Line Reserve Price Adder per interval*⎯The Real-Time On-Line Reserve Price Adder for the SCED interval *y*. |
| RTRDP | $/MWh | *Real-Time On-Line Reliability Deployment Price-*⎯The Real-Time price for the 15-minute Settlement Interval, reflecting the impact of reliability deployments on energy prices that are calculated from the Real-Time On-Line Reliability Deployment Price Adder.  |
| RTORDPA *y* | $/MWh | *Real-Time On-Line Reliability Deployment Price Adder –*The Real-Time price adder that captures the impact of reliability deployments on energy prices for the SCED interval *y.*  |
| RNWF *y* | none | *Resource Node Weighting Factor per interval*⎯The weight used in the Resource Node Settlement Point Price calculation for the portion of the SCED interval *y* within the Settlement Interval. |
| RTLMP *b, hb, South345, y* | $/MWh | *Real-Time Locational Marginal Price at Electrical Bus of Hub Bus per interval*⎯The Real-Time LMP at Electrical Bus *b* that is a component of Hub Bus *hb*, for the SCED interval *y*. |
| TLMP *y* | second | *Duration of SCED interval per interval*⎯The duration of the portion of the SCED interval *y* within the 15-minute Settlement Interval. |
| HUBDF *hb, South345* | none | *Hub Distribution Factor per Hub Bus*⎯The distribution factor of Hub Bus *hb*.  |
| HBDF *b, hb, South345* | none | *Hub Bus Distribution Factor per Electrical Bus of Hub Bus*⎯The distribution factor of Electrical Bus *b* that is a component of Hub Bus *hb*.  |
| *y* | none | A SCED interval in the 15-minute Settlement Interval. The summation is over the total number of SCED runs that cover the 15-minute Settlement Interval. |
| *b* | none | An energized Electrical Bus that is a component of a Hub Bus. |
| B *hb, South345* | none | The total number of energized Electrical Buses in Hub Bus *hb*. |
| *hb* | none | A Hub Bus that is a component of the Hub. |
| HB*South345* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus. |

3.5.2.3 Houston 345 kV Hub (Houston 345)

(1) The Houston 345 kV Hub is composed of the following listed Hub Buses:

|  | ERCOT Operations |  |
| --- | --- | --- |
| No. | Hub Bus | kV | Hub |
| 1 | ADK | 345 | HOUSTON |
| 2 | \_BI | 345 | HOUSTON |
| 3 | CBY | 345 | HOUSTON |
| 4 | CTR | 345 | HOUSTON |
| 5 | CHB | 345 | HOUSTON |
| 6 | DPW | 345 | HOUSTON |
| 7 | DOW | 345 | HOUSTON |
| 8 | RNS | 345 | HOUSTON |
| 9 | GBY | 345 | HOUSTON |
| 10 | \_JN | 345 | HOUSTON |
| 11 | \_KG | 345 | HOUSTON |
| 12 | KDL | 345 | HOUSTON |
| 13 | \_NB | 345 | HOUSTON |
| 14 | \_OB | 345 | HOUSTON |
| 15 | PHR | 345 | HOUSTON |
| 16 | SDN | 345 | HOUSTON |
| 17 | SMITHERS | 345 | HOUSTON |
| 18 | THW | 345 | HOUSTON |
| 19 | WAP | 345 | HOUSTON |
| 20 | \_WO | 345 | HOUSTON |

(2) The Houston 345 kV Hub Price uses the aggregated Shift Factors of the Hub Buses for each hour of the Settlement Interval of the DAM in the Day-Ahead and is the simple average of the time-weighted Hub Bus prices for each 15-minute Settlement Interval in Real-Time, for each Hub Bus included in this Hub.

(3) The Day-Ahead Settlement Point Price of the Hub for a given Operating Hour is calculated as follows:

**DASPP** *Houston345* **= DASL –** $\begin{array}{c}Σ\\c\end{array}$**(DAHUBSF***Houston345, c***\* DASP** *c***),**

 **if HBBC**Houston345**≠0**

**DASPP** *Houston345* **= DASPP***ERCOT345Bus***, if HBBC***Houston345***=0**

Where:

DAHUBSF *Houston345, c =* $\begin{array}{c}Σ\\hb\end{array}$(HUBDF *hb, Houston345, c* \* DAHBSF *hb, Houston345, c*)

DAHBSF *hb, Houston345, c =* $\begin{array}{c}Σ\\pb\end{array}$(HBDF *pb, hb, Houston345, c* \* DASF *pb, hb, Houston345, c*)

HUBDF *hb, Houston345, c =* IF(HB*Houston345, c*=0, 0, 1 **/** HB *Houston345, c*)

HBDF *pb, hb, Houston345, c =* IF(PB*hb, Houston345, c*=0, 0, 1 **/** PB *hb, Houston345, c*)

The above variables are defined as follows:

| Variable | Unit | Definition |
| --- | --- | --- |
| DASPP *Houston345* | $/MWh | *Day-Ahead Settlement Point Price*⎯The DAM Settlement Point Price at the Hub, for the hour. |
| DASL | $/MWh | *Day-Ahead System Lambda*⎯The DAM Shadow Price for the system power balance constraint for the hour. |
| DASP *c* | $/MWh | *Day-Ahead Shadow Price for a binding transmission constraint*⎯The DAM Shadow Price for the constraint *c* for the hour. |
| DAHUBSF *Houston345,c* | none | *Day-Ahead Shift Factor of the Hub ⎯*The DAM aggregated Shift Factor of a Hub for the constraint *c* for the hour. |
| DAHBSF *hb,Houston345,c* | none | *Day-Ahead Shift Factor of the Hub Bus⎯*The DAM aggregated Shift Factor of a Hub Bus *hb* for the constraint *c* for the hour. |
| DASF *pb,hb,Houston345,c* | none | *Day-Ahead Shift Factor of the power flow bus⎯*The DAM Shift Factor of a power flow bus *pb* that is a component of Hub Bus *hb* for the constraint *c* for the hour. |
| HUBDF *hb, Houston345,c* | none | *Hub Distribution Factor per Hub Bus in a constraint*⎯The distribution factor of Hub Bus *hb* for the constraint *c* for the hour.  |
| HBDF *pb, hb, Houston345,c* | none | *Hub Bus Distribution Factor per power flow bus of Hub Bus in a constraint*⎯The distribution factor of power flow bus *pb* that is a component of Hub Bus *hb* for the constraint *c* for the hour.  |
| *pb* | none | An energized power flow bus that is a component of a Hub Bus for the constraint *c*. |
| PB *hb, Houston345,c* | none | The total number of energized power flow buses in Hub Bus *hb* for the constraint *c*. |
| *hb* | none | A Hub Bus that is a component of the Hub with at least one energized power flow bus for the constraint *c*. |
| HBBC *Houston345* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus in base case. |
| HB *Houston345,c* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus for the constraint *c*. |
| *c* | none | A DAM binding transmission constraint for the hour caused by either base case or a contingency. |

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(4) The Real-Time Settlement Point Price of the Hub for a given 15-minute Settlement Interval is calculated as follows:

RTSPP *Houston345* = Max [-$251, (RTRSVPOR + RTRDP +

 (HUBDF *hb, Houston345* \* ((RTHBP *hb, Houston345, y* \*

 TLMP *y*) / (TLMP *y*))))], if HB*Houston345*≠0

RTSPP *Houston345* = RTSPP*ERCOT345Bus*, if HB*Houston345*=0

Where:

RTRSVPOR = (RNWF  *y* \* RTORPA *y*)

RTRDP = (RNWF*y* \* RTORDPA*y*)

RNWF *y* = TLMP *y* / TLMP *y*

RTHBP *hb, Houston345, y* = (HBDF *b, hb, Houston345* \* RTLMP *b, hb, Houston345, y*)

HUBDF *hb, Houston345* = IF(HB*Houston345*=0, 0, 1 **/** HB*Houston345*)

HBDF *b, hb, Houston345* = IF(B*hb, Houston345*=0, 0, 1 **/** B *hb, Houston345*)

The above variables are defined as follows:

| Variable | Unit | Description |
| --- | --- | --- |
| RTSPP *Houston345* | $/MWh | *Real-Time Settlement Point Price*⎯The Real-Time Settlement Point Price at the Hub, for the 15-minute Settlement Interval. |
| RTHBP *hb, Houston345, y* | $/MWh | *Real-Time Hub Bus Price at Hub Bus per SCED interval*⎯The Real-Time energy price at Hub Bus *hb* for the SCED interval *y*. |
| RTRSVPOR | $/MWh | *Real-Time Reserve Price for On-Line Reserves*⎯The Real-Time Reserve Price for On-Line Reserves for the 15-minute Settlement Interval. |
| RTORPA*y* | $/MWh | *Real-Time On-Line Reserve Price Adder per interval*⎯The Real-Time On-Line Reserve Price Adder for the SCED interval *y*. |
| RTRDP | $/MWh | *Real-Time On-Line Reliability Deployment Price*⎯The Real-Time price for the 15-minute Settlement Interval, reflecting the impact of reliability deployments on energy prices that are calculated from the Real-Time On-Line Reliability Deployment Price Adder.  |
| RTORDPA *y* | $/MWh | *Real-Time On-Line Reliability Deployment Price Adder*⎯The Real-Time price adder that captures the impact of reliability deployments on energy prices for the SCED interval *y.*  |
| RNWF *y* | none | *Resource Node Weighting Factor per interval*⎯The weight used in the Resource Node Settlement Point Price calculation for the portion of the SCED interval *y* within the Settlement Interval. |
| RTLMP *b, hb, Houston345, y* | $/MWh | *Real-Time Locational Marginal Price at Electrical Bus of Hub Bus per interval*⎯The Real-Time LMP at Electrical Bus *b* that is a component of Hub Bus *hb*, for the SCED interval *y*. |
| TLMP *y* | second | *Duration of SCED interval per interval*⎯The duration of the portion of the SCED interval *y* within the 15-minute Settlement Interval |
| HUBDF *hb, Houston345* | none | *Hub Distribution Factor per Hub Bus*⎯The distribution factor of Hub Bus *hb*.  |
| HBDF *b, hb, Houston345* | none | *Hub Bus Distribution Factor per Electrical Bus of Hub Bus*⎯The distribution factor of Electrical Bus *b* that is a component of Hub Bus *hb*.  |
| *y* | none | A SCED interval in the 15-minute Settlement Interval. The summation is over the total number of SCED runs that cover the 15-minute Settlement Interval. |
| *b* | none | An energized Electrical Bus that is a component of a Hub Bus. |
| B *hb, Houston345* | none | The total number of energized Electrical Buses in Hub Bus *hb*. |
| *hb* | none | A Hub Bus that is a component of the Hub. |
| HB*Houston345* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus. |

3.5.2.4 West 345 kV Hub (West 345)

(1) The West 345 kV Hub is composed of the following listed Hub Buses:

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| --- | --- | --- |
|  | ERCOT Operations |  |
| No. | Hub Bus | kV | Hub |
| 1 | ABMB | 345 | WEST |
| 2 | BOMSW | 345 | WEST |
| 3 | OECCS | 345 | WEST |
| 4 | BTRCK | 345 | WEST |
| 5 | FSHSW | 345 | WEST |
| 6 | FLCNS | 345 | WEST |
| 7 | GRSES | 345 | WEST |
| 8 | JCKSW | 345 | WEST |
| 9 | MDLNE | 345 | WEST |
| 10 | MOSSW | 345 | WEST |
| 11 | MGSES | 345 | WEST |
| 12 | DCTM | 345 | WEST |
| 13 | ODEHV | 345 | WEST |
| 14 | OKLA | 345 | WEST |
| 15 | SARC | 345 | WEST |
| 16 | SWESW | 345 | WEST |
| 17 | TWINBUTE | 345 | WEST |

(2) The West 345 kV Hub Price uses the aggregated Shift Factors of the Hub Buses for each hour of the Settlement Interval of the DAM in the Day-Ahead and is the simple average of the time weighted Hub Bus prices for each 15-minute Settlement Interval in Real-Time, for each Hub Bus included in this Hub.

(3) The Day-Ahead Settlement Point Price of the Hub for a given Operating Hour is calculated as follows:

**DASPP** *West345* **= DASL –** $\begin{array}{c}Σ\\c\end{array}$**(DAHUBSF***West345, c***\* DASP** *c***),**

 **if HBBC**West345**≠0**

**DASPP** *West345* **= DASPP***ERCOT345Bus***, if HBBC***West345***=0**

Where:

DAHUBSF *West345, c =* $\begin{array}{c}Σ\\hb\end{array}$(HUBDF *hb, West345, c* \* DAHBSF *hb, West345, c*)

DAHBSF *hb, West345, c =* $\begin{array}{c}Σ\\pb\end{array}$(HBDF *pb, hb, West345, c* \* DASF *pb, hb, West345, c*)

HUBDF *hb, West345, c =* IF(HB*West345, c*=0, 0, 1 **/** HB *West345, c*)

HBDF *pb, hb, West345, c =* IF(PB*hb, West345, c*=0, 0, 1 **/** PB *hb, West345, c*)

The above variables are defined as follows:

| Variable | Unit | Definition |
| --- | --- | --- |
| DASPP *West345* | $/MWh | *Day-Ahead Settlement Point Price*⎯The DAM Settlement Point Price at the Hub, for the hour. |
| DASL | $/MWh | *Day-Ahead System Lambda*⎯The DAM Shadow Price for the system power balance constraint for the hour. |
| DASP *c* | $/MWh | *Day-Ahead Shadow Price for a binding transmission constraint*⎯The DAM Shadow Price for the constraint *c* for the hour. |
| DAHUBSF *West345,c* | none | *Day-Ahead Shift Factor of the Hub ⎯*The DAM aggregated Shift Factor of a Hub for the constraint *c* for the hour. |
| DAHBSF *hb,West345,c* | none | *Day-Ahead Shift Factor of the Hub Bus⎯*The DAM aggregated Shift Factor of a Hub Bus *hb* for the constraint *c* for the hour. |
| DASF *pb,hb,West345,c* | none | *Day-Ahead Shift Factor of the power flow bus⎯*The DAM Shift Factor of a power flow bus *pb* that is a component of Hub Bus *hb* for the constraint *c* for the hour. |
| HUBDF *hb, West345,c* | none | *Hub Distribution Factor per Hub Bus in a constraint*⎯The distribution factor of Hub Bus *hb* for the constraint *c* for the hour.  |
| HBDF *pb, hb, West345,c* | none | *Hub Bus Distribution Factor per power flow bus of Hub Bus in a constraint*⎯The distribution factor of power flow bus *pb* that is a component of Hub Bus *hb* for the constraint *c* for the hour.  |
| *pb* | none | An energized power flow bus that is a component of a Hub Bus for the constraint *c*. |
| PB *hb, West345,c* | none | The total number of energized power flow buses in Hub Bus *hb* for the constraint *c*. |
| *hb* | none | A Hub Bus that is a component of the Hub with at least one energized power flow bus for the constraint *c*. |
| HBBC *West345* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus in base case. |
| HB *West345,c* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus for the constraint *c*. |
| *C* | none | A DAM binding transmission constraint for the hour caused by either base case or a contingency. |

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(4) The Real-Time Settlement Point Price of the Hub for a given 15-minute Settlement Interval is calculated as follows:

RTSPP *West345* = Max [-$251, (RTRSVPOR + RTRDP +

 (HUBDF *hb, West345* \* ((RTHBP *hb, West345, y* \* TLMP *y*) / (TLMP *y*))))], if HB*West345*≠0

RTSPP *West345* = RTSPP*ERCOT345Bus*, if HB*West345*=0

Where:

RTRSVPOR = (RNWF  *y* \* RTORPA *y*)

RTRDP = (RNWF*y* \* RTORDPA*y*)

RNWF *y* = TLMP *y* / TLMP *y*

RTHBP *hb, West345, y* = (HBDF *b, hb, West345* \* RTLMP *b, hb, West345, y*)

HUBDF *hb, West345* = IF(HB *West345*=0, 0, 1 **/** HB*West345*)

HBDF *b, hb, West345* = IF(B*hb, West345*=0, 0, 1 **/** B *hb, West345*)

The above variables are defined as follows:

| Variable | Unit | Description |
| --- | --- | --- |
| RTSPP *West345* | $/MWh | *Real-Time Settlement Point Price*⎯The Real-Time Settlement Point Price at the Hub, for the 15-minute Settlement Interval. |
| RTRSVPOR | $/MWh | *Real-Time Reserve Price for On-Line Reserves*⎯The Real-Time Reserve Price for On-Line Reserves for the 15-minute Settlement Interval. |
| RTORPA*y* | $/MWh | *Real-Time On-Line Reserve Price Adder per interval*⎯The Real-Time On-Line Reserve Price Adder for the SCED interval *y*. |
| RTRDP | $/MWh | *Real-Time On-Line Reliability Deployment Price*⎯The Real-Time price for the 15-minute Settlement Interval, reflecting the impact of reliability deployments on energy prices that are calculated from the Real-Time On-Line Reliability Deployment Price Adder.  |
| RTORDPA *y* | $/MWh | *Real-Time On-Line Reliability Deployment Price Adder*⎯The Real-Time price adder that captures the impact of reliability deployments on energy prices for the SCED interval *y.*  |
| RNWF *y* | none | *Resource Node Weighting Factor per interval*⎯The weight used in the Resource Node Settlement Point Price calculation for the portion of the SCED interval *y* within the Settlement Interval. |
| RTHBP *hb, West345, y* | $/MWh | *Real-Time Hub Bus Price at Hub Bus per SCED interval*⎯The Real-Time energy price at Hub Bus *hb* for the SCED interval *y*. |
| RTLMP *b, hb, West345, y* | $/MWh | *Real-Time Locational Marginal Price at Electrical Bus of Hub Bus per interval*⎯The Real-Time LMP at Electrical Bus *b* that is a component of Hub Bus *hb*, for the SCED interval *y*. |
| TLMP *y* | second | *Duration of SCED interval per interval*⎯The duration of the portion of the SCED interval *y* within the 15-minute Settlement Interval. |
| HUBDF *hb, West345* | none | *Hub Distribution Factor per Hub Bus*⎯The distribution factor of Hub Bus *hb*.  |
| HBDF *b, hb, West345* | none | *Hub Bus Distribution Factor per Electrical Bus of Hub Bus*⎯The distribution factor of Electrical Bus *b* that is a component of Hub Bus *hb*.  |
| *Y* | none | A SCED interval in the 15-minute Settlement Interval. The summation is over the total number of SCED runs that cover the 15-minute Settlement Interval. |
| *B* | none | An energized Electrical Bus that is a component of a Hub Bus. |
| B *hb, West345* | none | The total number of energized Electrical Buses in Hub Bus *hb*. |
| *hb* | none | A Hub Bus that is a component of the Hub. |
| HB*West345* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus. |

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| ***[NPRR817: Insert Section 3.5.2.5 below upon system implementation and renumber accordingly:]*****3.5.2.5 Panhandle 345 kV Hub (Pan 345)**(1) The Panhandle 345 kV Hub is composed of the following listed Hub Buses:

|  |  |  |
| --- | --- | --- |
|  | ERCOT Operations |  |
| No. | Hub Bus | kV | Hub |
| 1 | ABERNATH | 345 | PAN |
| 2 | AJ\_SWOPE | 345 | PAN |
| 3 | ALIBATES | 345 | PAN |
| 4 | CTT\_CROS | 345 | PAN |
| 5 | CTT\_GRAY | 345 | PAN |
| 6 | OGALLALA | 345 | PAN |
| 7 | RAILHEAD | 345 | PAN |
| 8 | TESLA | 345 | PAN |
| 9 | TULECNYN | 345 | PAN |
| 10 | W\_CW\_345 | 345 | PAN |
| 11 | WHIT\_RVR | 345 | PAN |
| 12 | WINDMILL | 345 | PAN |

(2) The Panhandle 345 kV Hub Price uses the aggregated Shift Factors of the Hub Buses for each hour of the Settlement Interval of the DAM in the Day-Ahead and is the simple average of the time weighted Hub Bus prices for each 15-minute Settlement Interval in Real-Time, for each Hub Bus included in this Hub.(3) The Day-Ahead Settlement Point Price of the Hub for a given Operating Hour is calculated as follows: **DASPP** *Pan345* **=**  **DASL –** $\begin{array}{c}Σ\\c\end{array}$**(DAHUBSF***Pan345, c***\* DASP** *c***),**  **if HBBC**Pan345**≠0****DASPP** *Pan345* **=**  **DASPP***ERCOT345Bus***, if HBBC***Pan345***=0**Where:DAHUBSF *Pan345, c =* $\begin{array}{c}Σ\\hb\end{array}$(HUBDF *hb, Pan345, c* \* DAHBSF *hb, Pan345, c*)DAHBSF *hb, Pan345, c =* $\begin{array}{c}Σ\\pb\end{array}$(HBDF *pb, hb, Pan345, c* \* DASF *pb, hb, Pan345, c*)HUBDF *hb, Pan345, c =* IF(HB*Pan345, c*=0, 0, 1 **/** HB *Pan345, c*)HBDF *pb, hb, Pan345, c =* IF(PB*hb, Pan345, c*=0, 0, 1 **/** PB *hb, Pan345, c*)The above variables are defined as follows:

| Variable | Unit | Definition |
| --- | --- | --- |
| DASPP *Pan345* | $/MWh | *Day-Ahead Settlement Point Price*⎯The DAM Settlement Point Price at the Hub, for the hour. |
| DASL | $/MWh | *Day-Ahead System Lambda*⎯The DAM Shadow Price for the system power balance constraint for the hour. |
| DASP *c* | $/MWh | *Day-Ahead Shadow Price for a binding transmission constraint*⎯The DAM Shadow Price for the constraint *c* for the hour. |
| DAHUBSF *Pan345,c* | none | *Day-Ahead Shift Factor of the Hub ⎯*The DAM aggregated Shift Factor of a Hub for the constraint *c* for the hour. |
| DAHBSF *hb,Pan345,c* | none | *Day-Ahead Shift Factor of the Hub Bus⎯*The DAM aggregated Shift Factor of a Hub Bus *hb* for the constraint *c* for the hour. |
| DASF *pb,hb,Pan345,c* | none | *Day-Ahead Shift Factor of the power flow bus⎯*The DAM Shift Factor of a power flow bus *pb* that is a component of Hub Bus *hb* for the constraint *c* for the hour. |
| HUBDF *hb, Pan345,c* | none | *Hub Distribution Factor per Hub Bus in a constraint*⎯The distribution factor of Hub Bus *hb* for the constraint *c* for the hour.  |
| HBDF *pb, hb, Pan345,c* | none | *Hub Bus Distribution Factor per power flow bus of Hub Bus in a constraint*⎯The distribution factor of power flow bus *pb* that is a component of Hub Bus *hb* for the constraint *c* for the hour.  |
| *pb* | none | An energized power flow bus that is a component of a Hub Bus for the constraint *c*. |
| PB *hb, Pan345,c* | none | The total number of energized power flow buses in Hub Bus *hb* for the constraint *c*. |
| *hb* | none | A Hub Bus that is a component of the Hub with at least one energized power flow bus for the constraint *c*. |
| HBBC *Pan345* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus in base case. |
| HB *Pan345,c* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus for the constraint *c*. |
| *c* | none | A DAM binding transmission constraint for the hour caused by either base case or a contingency. |

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(4) The Real-Time Settlement Point Price of the Hub for a given 15-minute Settlement Interval is calculated as follows:**RTSPP** *Pan345* **= Max [-$251, (RTRSVPOR + RTRDP +**  **(HUBDF** *hb, Pan345* **\* (****(RTHBP** *hb, Pan345, y* **\* TLMP** *y***) / (** **TLMP** *y***))))], if HB***Pan345***≠0****RTSPP** *Pan345* **= RTSPP** *ERCOT345Bus*, **if HB***Pan345***=0**Where:RTRSVPOR =  (RNWF  *y* \* RTORPA *y*)RTRDP =  (RNWF *y* \* RTORDPA *y*)RNWF *y* = TLMP *y* / TLMP *y*RTHBP *hb, Pan345, y* =  (HBDF *b, hb, Pan345* \* RTLMP *b, hb, Pan345, y*)HUBDF *hb, Pan345* = IF(HB *Pan345*=0, 0, 1 **/** HB*Pan345*)HBDF *b, hb, Pan345* = IF(B*hb, Pan345*=0, 0, 1 **/** B *hb, Pan345*)The above variables are defined as follows:

| **Variable** | **Unit** | **Description** |
| --- | --- | --- |
| RTSPP *Pan345* | $/MWh | *Real-Time Settlement Point Price*⎯The Real-Time Settlement Point Price at the Hub for the 15-minute Settlement Interval. |
| RTRSVPOR | $/MWh | *Real-Time Reserve Price for On-Line Reserves*⎯The Real-Time Reserve Price for On-Line Reserves for the 15-minute Settlement Interval. |
| RTORPA*y* | $/MWh | *Real-Time On-Line Reserve Price Adder per interval*⎯The Real-Time On-Line Reserve Price Adder for the SCED interval *y*. |
| RTRDP | $/MWh | *Real-Time On-Line Reliability Deployment Price*⎯The Real-Time price for the 15-minute Settlement Interval, reflecting the impact of reliability deployments on energy prices that are calculated from the Real-Time On-Line Reliability Deployment Price Adder.  |
| RTORDPA *y* | $/MWh | *Real-Time On-Line Reliability Deployment Price Adder*⎯The Real-Time price adder that captures the impact of reliability deployments on energy prices for the SCED interval *y.*  |
| RNWF *y* | none | *Resource Node Weighting Factor per interval*⎯The weight used in the Resource Node Settlement Point Price calculation for the portion of the SCED interval *y* within the Settlement Interval. |
| RTHBP *hb, Pan345, y* | $/MWh | *Real-Time Hub Bus Price at Hub Bus per SCED interval*⎯The Real-Time energy price at Hub Bus *hb* for the SCED interval *y*. |
| RTLMP *b, hb, Pan345, y* | $/MWh | *Real-Time Locational Marginal Price at Electrical Bus of Hub Bus per interval*⎯The Real-Time LMP at Electrical Bus *b* that is a component of Hub Bus *hb* for the SCED interval *y*. |
| TLMP *y* | second | *Duration of SCED interval per interval*⎯The duration of the portion of the SCED interval *y* within the 15-minute Settlement Interval. |
| HUBDF *hb, Pan345* | none | *Hub Distribution Factor per Hub Bus*⎯The distribution factor of Hub Bus *hb*.  |
| HBDF *b, hb, Pan345* | none | *Hub Bus Distribution Factor per Electrical Bus of Hub Bus*⎯The distribution factor of Electrical Bus *b* that is a component of Hub Bus *hb*.  |
| *y* | none | A SCED interval in the 15-minute Settlement Interval. The summation is over the total number of SCED runs that cover the 15-minute Settlement Interval. |
| *b* | none | An energized Electrical Bus that is a component of a Hub Bus. |
| B *hb, Pan345* | none | The total number of energized Electrical Buses in Hub Bus *hb*. |
| *hb* | none | A Hub Bus that is a component of the Hub. |
| HB*Pan345* | none | The total number of Hub Buses in the Hub with at least one energized component in each Hub Bus. |

 |

3.5.2.6 ERCOT Bus Average 345 kV Hub (ERCOT 345 Bus)

(1) The ERCOT Bus Average 345 kV Hub is composed of the Hub Buses listed in Section 3.5.2.1, North 345 kV Hub (North 345); Section 3.5.2.2, South 345 kV Hub (South 345); Section 3.5.2.3, Houston 345 kV Hub (Houston 345); and Section 3.5.2.4,West 345 kV Hub (West 345).

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| ***[NPRR817: Replace paragraph (1) above with the following upon system implementation:]***(1) The ERCOT Bus Average 345 kV Hub is composed of the Hub Buses listed in Section 3.5.2.1, North 345 kV Hub (North 345); Section 3.5.2.2, South 345 kV Hub (South 345); Section 3.5.2.3, Houston 345 kV Hub (Houston 345); and Section 3.5.2.4,West 345 kV Hub (West 345). The Panhandle 345 kV Hub is not included in the ERCOT Bus Average 345 kV Hub price. |

(2) The ERCOT Bus Average 345 kV Hub uses the aggregated Shift Factors of the Hub Buses for each hour of the Settlement Interval of the DAM in the Day-Ahead and is the simple average of the time weighted Hub Bus prices for each 15-minute Settlement Interval in Real-Time, for each Hub Bus included in this Hub.

(3) The Day-Ahead Settlement Point Price of the Hub for a given Operating Hour is calculated as follows:

**DASPP** *ERCOT345Bus* **= DASL –** $\begin{array}{c}Σ\\c\end{array}$**(DAHUBSF***ERCOT345Bus, c***\* DASP** *c***),**

 **if HBBC**ERCOT345Bus**≠0**

**DASPP** *ERCOT345Bus* **= 0, if HBBC***ERCOT345Bus***=0**

Where:

DAHUBSF *ERCOT345Bus, c =* $\begin{array}{c}Σ\\hb\end{array}$(HUBDF *hb, ERCOT345Bus, c* \* DAHBSF *hb, ERCOT345Bus, c*)

DAHBSF *hb, ERCOT345Bus, c  =* $\begin{array}{c}Σ\\pb\end{array}$(HBDF *pb, hb, ERCOT345Bus, c* \* DASF *pb, hb, ERCOT345Bus, c*)

HUBDF *hb, ERCOT345Bus, c =* IF(HB*ERCOT345Bus, c*=0, 0, 1 **/** HB *ERCOT345Bus, c*)

HBDF *pb, hb, ERCOT345Bus, c =* IF(PB*hb, ERCOT345Bus, c*=0, 0, 1 **/** PB *hb, ERCOT345Bus, c*)

The above variables are defined as follows:

| Variable | Unit | Definition |
| --- | --- | --- |
| DASPP *ERCOT345Bus* | $/MWh | *Day-Ahead Settlement Point Price*⎯The DAM Settlement Point Price at the Hub, for the hour. |
| DASL | $/MWh | *Day-Ahead System Lambda*⎯The DAM Shadow Price for the system power balance constraint for the hour. |
| DASP *c* | $/MWh | *Day-Ahead Shadow Price for a binding transmission constraint*⎯The DAM Shadow Price for the constraint *c* for the hour. |
| DAHUBSF *ERCOT345Bus,c* | none | *Day-Ahead Shift Factor of the Hub ⎯*The DAM aggregated Shift Factor of a Hub for the constraint *c* for the hour. |
| DAHBSF *hb,ERCOT345Bus,c* | none | *Day-Ahead Shift Factor of the Hub Bus⎯*The DAM aggregated Shift Factor of a Hub Bus *hb* for the constraint *c* for the hour. |
| DASF *pb,hb,ERCOT345Bus,c* | none | *Day-Ahead Shift Factor of the power flow bus⎯*The DAM Shift Factor of a power flow bus *pb* that is a component of Hub Bus *hb* for the constraint *c* for the hour. |
| HUBDF *hb,ERCOT345Bus,c* | none | *Hub Distribution Factor per Hub Bus in a constraint*⎯The distribution factor of Hub Bus *hb* for the constraint *c* for the hour.  |
| HBDF *pb, hb, ERCOT345Bus,c* | none | *Hub Bus Distribution Factor per power flow bus of Hub Bus in a constraint*⎯The distribution factor of power flow bus *pb* that is a component of Hub Bus *hb* for the constraint *c* for the hour.  |
| *pb* | none | An energized power flow bus that is a component of a Hub Bus for the constraint *c*. |
| PB *hb, ERCOT345Bus,c* | none | The total number of energized power flow buses in Hub Bus *hb* for the constraint *c*. |
| *hb* | none | A Hub Bus that is a component of the ERCOT Bus Average 345 kV Hub (ERCOT 345 Bus) with at least one energized power flow bus for the constraint *c*. The Hub “ERCOT 345 Bus” includes any Hub Bus defined in the Hub “North 345”, “South 345”, “Houston 345” and “West 345”.  |
| HBBC *ERCOT345Bus* | none | The total number of Hub Buses in the ERCOT Bus Average 345 kV Hub (ERCOT 345 Bus) with at least one energized component in each Hub Bus in base case. The Hub “ERCOT 345 Bus” includes any Hub Bus defined in the Hub “North 345”, “South 345”, “Houston 345” and “West 345”. |
| HB *ERCOT345Bus,c* | none | The total number of Hub Buses in the ERCOT Bus Average 345 kV Hub (ERCOT 345 Bus) with at least one energized component in each Hub Bus for the constraint *c*. The Hub “ERCOT 345 Bus” includes any Hub Bus defined in the Hub “North 345”, “South 345”, “Houston 345” and “West 345”. |
| *c* | none | A DAM binding transmission constraint for the hour caused by either base case or a contingency. |

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(4) The Real-Time Settlement Point Price of the Hub for a given 15-minute Settlement Interval is calculated as follows:

RTSPP *ERCOT345Bus* = Max [-$251, (RTRSVPOR + RTRDP +

 (HUBDF *hb, ERCOT345Bus* \* ((RTHBP *hb, ERCOT345Bus, y* \* TLMP *y*) / (TLMP *y*))))], if HB *ERCOT345Bus* ≠0

RTSPP *ERCOT345Bus* = 0, if HB*ERCOT345Bus* =0

Where:

RTRSVPOR = (RNWF  *y* \* RTORPA *y*)

RTRDP = (RNWF *y* \* RTORDPA *y*)

RNWF *y* = TLMP *y* / TLMP *y*

RTHBP *hb, ERCOT345Bus, y* = (HBDF *b, hb, ERCOT345Bus* \* RTLMP *b, hb, ERCOT345Bus, y*)

HUBDF *hb, ERCOT345Bus* = 1 **/** (HB*North345* + HB*South345* + HB*Houston345* + HB*West345*)

If Electrical Bus *b* is a component of “North 345”

 HBDF *b, hb, ERCOT345Bus* = IF(B *hb, North345*=0, 0, 1 **/** B *hb, North345*)

Otherwise

 If Electrical Bus *b* is a component of “South 345”

 HBDF *b, hb, ERCOT345Bus* = IF(B *hb, South345*=0, 0, 1 **/** B *hb, South345*)

Otherwise

 If Electrical Bus *b* is a component of “Houston 345”

 HBDF *b, hb, ERCOT345Bus* = IF(B *hb, Houston345*=0, 0, 1 **/** B *hb, Houston345*)

Otherwise

 HBDF *b, hb, ERCOT345Bus* = IF(B *hb, West345*=0, 0, 1 **/** B *hb, West345*)

The above variables are defined as follows:

| Variable | Unit | Description |
| --- | --- | --- |
| RTSPP *ERCOT345Bus* | $/MWh | *Real-Time Settlement Point Price*⎯The Real-Time Settlement Point Price at the Hub, for the 15-minute Settlement Interval. |
| RTRSVPOR | $/MWh | *Real-Time Reserve Price for On-Line Reserves*⎯The Real-Time Reserve Price for On-Line Reserves for the 15-minute Settlement Interval. |
| RTORPA*y* | $/MWh | *Real-Time On-Line Reserve Price Adder per interval*⎯The Real-Time On-Line Reserve Price Adder for the SCED interval *y*. |
| RTRDP | $/MWh | *Real-Time On-Line Reliability Deployment Price*⎯The Real-Time price for the 15-minute Settlement Interval, reflecting the impact of reliability deployments on energy prices that are calculated from the Real-Time On-Line Reliability Deployment Price Adder.  |
| RTORDPA *y* | $/MWh | *Real-Time On-Line Reliability Deployment Price Adder*⎯The Real-Time price adder that captures the impact of reliability deployments on energy prices for the SCED interval *y.*  |
| RNWF *y* | none | *Resource Node Weighting Factor per interval*⎯The weight used in the Resource Node Settlement Point Price calculation for the portion of the SCED interval *y* within the Settlement Interval. |
| RTHBP *hb, ERCOT345Bus, y* | $/MWh | *Real-Time Hub Bus Price at Hub Bus per SCED interval*⎯The Real-Time energy price at Hub Bus *hb* for the SCED interval *y*. |
| RTLMP *b, hb, ERCOT345Bus, y* | $/MWh | *Real-Time Locational Marginal Price at Electrical Bus of Hub Bus per interval*⎯The Real-Time LMP at Electrical Bus *b* that is a component of Hub Bus *hb*, for the SCED interval *y*. |
| TLMP *y* | second | *Duration of SCED interval per interval*⎯The duration of the portion of the SCED interval *y* within the 15-minute Settlement Interval. |
| HUBDF *hb, ERCOT345Bus* | none | *Hub Distribution Factor per Hub Bus*⎯The distribution factor of Hub Bus *hb*.  |
| HBDF *b, hb, ERCOT345Bus* | none | *Hub Bus Distribution Factor per Electrical Bus of Hub Bus*⎯The distribution factor of Electrical Bus *b* that is a component of Hub Bus *hb*.  |
| *y* | none | A SCED interval in the 15-minute Settlement Interval. The summation is over the total number of SCED runs that cover the 15-minute Settlement Interval. |
| *b* | none | An energized Electrical Bus that is a component of a Hub Bus. |
| B *hb, North345* | none | The total number of energized Electrical Buses in Hub Bus *hb* that is a component of “North 345.” |
| B *hb, South345* | none | The total number of energized Electrical Buses in Hub Bus *hb* that is a component of “South 345.” |
| B *hb, Houston345* | none | The total number of energized Electrical Buses in Hub Bus *hb* that is a component of “Houston 345.” |
| B *hb, West345* | none | The total number of energized Electrical Buses in Hub Bus *hb* that is a component of “West 345.” |
| *hb* | none | A Hub Bus that is a component of the Hub. |
| HB*North345* | none | The total number of Hub Buses in “North 345.” |
| HB*South345* | none | The total number of Hub Buses in “South 345.” |
| HB*Houston345* | none | The total number of Hub Buses in “Houston 345.” |
| HB*West345* | none | The total number of Hub Buses in “West 345.” |

4.5.1 DAM Clearing Process

(1) At 1000 in the Day-Ahead, ERCOT shall start the Day-Ahead Market (DAM) clearing process. If the processing of DAM bids and offers after 0900 is significantly delayed or impacted by a failure of ERCOT software or systems that directly impacts the DAM, ERCOT shall post a Notice as soon as practicable on the Market Information System (MIS) Public Area, in accordance with paragraph (1) of Section 4.1.2, Day-Ahead Process and Timing Deviations, extending the start time of the execution of the DAM clearing process by an amount of time at least as long as the duration of the processing delay plus ten minutes. In no event shall the extension exceed more than one hour from when the processing delay is resolved.

(2) ERCOT shall complete a Day-Ahead Simultaneous Feasibility Test (SFT). This test uses the Day-Ahead Updated Network Model topology and evaluates all Congestion Revenue Rights (CRRs) for feasibility to determine hourly oversold quantities.

(3) The purpose of the DAM is to economically and simultaneously clear offers and bids described in Section 4.4, Inputs into DAM and Other Trades.

(4) The DAM uses a multi-hour mixed integer programming algorithm to maximize bid-based revenues minus the offer-based costs over the Operating Day, subject to security and other constraints, and ERCOT Ancillary Service procurement requirements.

1. The bid-based revenues include revenues from DAM Energy Bids and Point-to-Point (PTP) Obligation bids.

(b) The offer-based costs include costs from the Startup Offer, Minimum Energy Offer, and Energy Offer Curve of any Resource that submitted a Three-Part Supply Offer, DAM Energy-Only Offers and Ancillary Service Offers.

(c) Security constraints specified to prevent DAM solutions that would overload the elements of the ERCOT Transmission Grid include the following:

(i) Transmission constraints – transfer limits on energy flows through the ERCOT Transmission Grid, e.g., thermal or stability limits. These limits must be satisfied by the intact network and for certain specified contingencies. These constraints may represent:

(A) Thermal constraints – protect Transmission Facilities against thermal overload.

(B) Generic constraints – protect the ERCOT Transmission Grid against transient instability, dynamic stability or voltage collapse.

(C) Power flow constraints – the energy balance at required Electrical Buses in the ERCOT Transmission Grid must be maintained.

(ii) Resource constraints – the physical and security limits on Resources that submit Three-Part Supply Offers:

(A) Resource output constraints – the Low Sustained Limit (LSL) and High Sustained Limit (HSL) of each Resource; and

(B) Resource operational constraints – includes minimum run time, minimum down time, and configuration constraints.

(iii) Other constraints –

(A) Linked offers – the DAM may not select any one part of that Resource capacity to provide more than one Ancillary Service or to provide both energy and an Ancillary Service in the same Operating Hour. The DAM may, however, select part of that Resource capacity to provide one Ancillary Service and another part of that capacity to provide a different Ancillary Service or energy in the same Operating Hour, provided that a Generation Resource may not offer, and the DAM may not select, linked Energy and Off-Line Non-Spinning Reserve (Non-Spin) Ancillary Service Offers in the same Operating Hour.

(B) The sum of the awarded Ancillary Service capacities for each Resource must be within the Resource limits specified in the Current Operating Plan (COP) and Section 3.18, Resource Limits in Providing Ancillary Service, and the Resource Parameters as described in Section 3.7, Resource Parameters.

(C) Block Ancillary Service Offers for a Load Resource – blocks will not be cleared unless the entire quantity block can be awarded. Because block Ancillary Service Offers cannot set the Market Clearing Price for Capacity (MCPC), a block Ancillary Service Offer may clear below the Ancillary Service Offer price for that block.

(D) Block DAM Energy Bids, DAM Energy-Only Offers, and PTP Obligation bids – blocks will not be cleared unless the entire time and/or quantity block can be awarded. Because quantity block bids and offers cannot set the Settlement Point Price, a quantity block bid or offer may clear in a manner inconsistent with the bid or offer price for that block.

(E) Combined Cycle Generation Resources – The DAM may commit a Combined Cycle Generation Resource in a time period that includes the last hour of the Operating Day only if that Combined Cycle Generation Resource can transition to a shutdown condition in the DAM Operating Day.

(d) Ancillary Service needs for each Ancillary Service include the needs specified in the Ancillary Service Plan that are not part of the Self-Arranged Ancillary Service Quantity and that must be met from available DAM Ancillary Service Offers while co-optimizing with DAM Energy Offers. ERCOT may not buy more of one Ancillary Service in place of the quantity of a different service. See Section 4.5.2, Ancillary Service Insufficiency, for what happens if insufficient Ancillary Service Offers are received in the DAM.

(5) ERCOT shall determine the appropriate Load distribution factors to allocate offers, bids, and source and sink of CRRs at a Load Zone across the energized power flow buses that are modeled with Load in that Load Zone. The Load distribution factors are based on historical State Estimator hourly distribution using a proxy day methodology representing anticipated weather conditions. If ERCOT decides, in its sole discretion, to change the Load distribution factors for reasons such as anticipated weather events or holidays, ERCOT shall select a State Estimator hourly distribution from a proxy day reasonably reflecting the anticipated Load in the Operating Day. ERCOT may also modify the Load distribution factors to account for predicted differences in network topology between the proxy day and Operating Day. ERCOT shall develop a methodology, subject to Technical Advisory Committee (TAC) approval, to describe the modification of the proxy day bus-load distribution for this purpose.

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| [NPRR831: Replace paragraph (5) above with the following upon system implementation:](5) ERCOT shall determine the appropriate Load distribution factors to allocate offers, bids, and source and sink of CRRs at a Load Zone across the energized power flow buses that are modeled with Load in that Load Zone. The non-Private Use Network Load distribution factors are based on historical State Estimator hourly distribution using a proxy day methodology representing anticipated weather conditions. The Private Use Network Load distribution factors are based on an estimated Load value considering historical net consumption at all Private Use Networks. If ERCOT decides, in its sole discretion, to change the Load distribution factors for reasons such as anticipated weather events or holidays, ERCOT shall select a State Estimator hourly distribution from a proxy day reasonably reflecting the anticipated Load in the Operating Day. ERCOT may also modify the Load distribution factors to account for predicted differences in network topology between the proxy day and Operating Day. ERCOT shall develop a methodology, subject to Technical Advisory Committee (TAC) approval, to describe the modification of the proxy day bus-load distribution for this purpose.  |

(6) ERCOT shall allocate offers, bids, and source and sink of CRRs at a Hub using the distribution factors specified in the definition of that Hub in Section 3.5.2, Hub Definitions.

(7) A Resource that has a Three-Part Supply Offer cleared in the DAM may be eligible for Make-Whole Payment of the Startup Offer and Minimum Energy Offer submitted by the Qualified Scheduling Entity (QSE) representing the Resource under Section 4.6, DAM Settlement.

(8) The DAM Settlement is based on hourly MW awards and on Day-Ahead hourly Settlement Point Prices. All PTP Options settled in the DAM are settled based on the Day-Ahead Settlement Point Prices (DASPPs). ERCOT shall assign a Locational Marginal Price (LMP) to de-energized Electrical Buses for use in the calculation of the DASPPs by using heuristic rules applied in the following order:

(a) Use an appropriate LMP predetermined by ERCOT as applicable to a specific Electrical Bus; or if not so specified

(b) Use the following rules in order:

(i) Use average LMP for Electrical Buses within the same station having the same voltage level as the de-energized Electrical Bus, if any exist.

(ii) Use average LMP for all Electrical Buses within the same station, if any exist.

(iii) Use System Lambda.

(9) The Day-Ahead MCPC for each hour for each Ancillary Service is the Shadow Price for that Ancillary Service for the hour as determined by the DAM algorithm.

(10) If the Day-Ahead MCPC cannot be calculated by ERCOT, the Day-Ahead MCPC for the particular Ancillary Service is equal to the Day-Ahead MCPC for that Ancillary Service in the same Settlement Interval of the preceding Operating Day.

(11) If the DASPPs cannot be calculated by ERCOT, all CRRs shall be settled based on Real-Time prices. Settlements for all CRRs shall be reflected on the Real-Time Settlement Statement.

(12) Constraints can exist between the generator’s Resource Connectivity Node and the Resource Node, in which case the awarded quantity of energy may be inconsistent with the clearing price when the constraint between the Resource Connectivity Node and the Resource Node is binding.

(13) PTP Obligation bids shall not be settled where the DAM clearing price for the PTP Obligation is greater than the PTP Obligation bid price plus $0.25/MW per hour.

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| [NPRR833: Replace paragraph (13) above with the following upon system implementation:](13) PTP Obligation bids shall not be awarded where the DAM clearing price for the PTP Obligation is greater than the PTP Obligation bid price plus $0.01/MW per hour. |

4.6.1.2 Day-Ahead Settlement Point Prices for Load Zones

The DASPP for a Load Zone Settlement Point for an hour is calculated as follows:

For all Load Zones except DC Tie Load Zones:

**DASPP = DASL -** $\begin{array}{c}Σ\\c\end{array}$**(DALZSF *c* \* DASP *c*)**

Where:

DALZSF *c =*$\begin{array}{c}Σ\\pb\end{array}$(DADF *pb, c* \* DASF *pb, c*)

DADF *pb, c* = DAL *pb, c* / ($\begin{array}{c}Σ\\pb\end{array}$ DAL *pb, c*)

For a DC Tie Load Zone:

**DASPP= DALMP *b***

The above variables are defined as follows:

| Variable | Unit | Definition |
| --- | --- | --- |
| DASPP | $/MWh | *Day-Ahead Settlement Point Price*⎯The DAM Settlement Point Price at the Load Zone, for the hour. |
| DALMP *b* | $/MWh | *Day-Ahead Locational Marginal Price per bus*⎯The DAM LMP at Electrical Bus *b* for the hour.  |
| DASL | $/MWh | *Day-Ahead System Lambda*⎯The DAM Shadow Price for the system power balance constraint for the hour. |
| DASP *c* | $/MWh | *Day-Ahead Shadow Price for a binding transmission constraint*⎯The DAM Shadow Price for the constraint *c* for the hour. |
| DALZSF *c* | none | *Day-Ahead Shift factor of the Load Zone ⎯*The DAM aggregated Shift Factor of a Load Zone for the constraint *c* for the hour. |
| DASF *pb, ,c* | none | *Day-Ahead Shift factor of the power flow bus⎯*The DAM Shift Factor of a power flow bus *pb* that is a component of the Load Zone for the constraint *c* for the hour. |
| DADF *pb, c* | none | *Day-Ahead Distribution factor per power flow bus for a constraint*⎯The Load distribution factor for power flow bus *pb* in the Load Zone for the constraint *c* for the hour.  |
| DAL *pb, c* | MW | *Day-Ahead Load at power flow bus for a constraint*⎯The DAM distributed load for power flow bus *pb* in the Load Zone for the constraint *c* for the hour. |
| *b* | none | An Electrical Bus that is assigned to the DC Tie Load Zone. |
| *pb* | none | An energized power flow bus that is assigned to the Load Zone for the constraint *c*. |
| *c* | None | A DAM binding transmission constraint for the hour caused by either base case or a contingency. |

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***7.5.1 Nature and Timing***

(1) The Congestion Revenue Right (CRR) Auction auctions the available network capacity of the ERCOT transmission system not allocated as described in Section 7.4, Preassigned Congestion Revenue Rights Overview, or sold in a previous auction. The CRR Auction also allows CRR Owners an opportunity to offer for sale CRRs that they hold. Each CRR Auction allows for the purchase of CRR products as described in paragraph (5) of Section 7.3, Types of Congestion Revenue Rights to Be Auctioned, in strips of one or more consecutive months and allows for the reconfiguration of all CRR blocks that were previously awarded for the months covered by that CRR Auction.

(2) The CRR Network Model must be based on, but is not the same as, the Network Operations Model. For the purposes of CRR Network Model construction for a CRR Long-Term Auction Sequence, ERCOT may, at its sole discretion, utilize the same or similar CRR Network Model inputs for multiple consecutive months. The CRR Network Model must, to the extent practicable, include the same topology, contingencies, and operating procedures as used in the Network Operations Model as reasonably expected to be in place for each month. The expected network topology used in the CRR Network Model for any month or set of months must include all Outages from the Outage Scheduler and identified by ERCOT as expected to have a significant impact upon transfer capability during that time. These Outages included in the CRR Network Model shall be posted on the Market Information System (MIS) Secure Area consistent with model posting requirements by ERCOT with accompanying cause and duration information, as indicated in the Outage Scheduler. Transmission system upgrades and changes must be accounted for in the CRR Network Model for CRR Auctions held after the month in which the element is placed into service.

(a) ERCOT shall use Dynamic Ratings in the CRR Network Model as required under Section 3.10.8, Dynamic Ratings.

(b) The CRR Network Model must use the peak Load conditions of the month or set of months being modeled.

(c) ERCOT’s criteria for determining if an Outage should be in the CRR Network Model shall be in accordance with these Protocols and described in the Operating Guides.

(3) ERCOT shall model bids and offers into the CRR Auction as flows based on the MW offer and defined source and sink. When the Simultaneous Feasibility Test (SFT) is run, the model must weight the power flow buses and Hub Buses included in a Hub or Load Zone appropriately to determine the system impacts of the CRRs.

(a) To distribute injections and withdrawals to buses within a Hub, ERCOT shall use distribution factors specified in Section 3.5.2, Hub Definitions.

(b) To distribute injections and withdrawals to power flow buses in Load Zones, ERCOT shall use the Load-weighted distribution factors for On-Peak Hours in each Load Zone. For a CRR Monthly Auction, ERCOT shall derive CRR Auction Load distribution factors with the set of Load distribution factors constructed in accordance with the ERCOT Load distribution factor methodology specified in paragraph (5) of Section 4.5.1, DAM Clearing Process, for use in the Day-Ahead Market (DAM). For a CRR Long-Term Auction Sequence, ERCOT shall derive CRR Auction Load distribution factors from the corresponding planning model or with the set of Load distribution factors constructed in accordance with the ERCOT Load distribution factor methodology specified in paragraph (5) of Section 4.5.1, for use in the DAM. ERCOT shall notify the market as to which method was used for each CRR Network Model in a CRR Long-Term Auction Sequence in the corresponding auction notice. ERCOT shall post the CRR Auction Load distribution factors as part of the CRR Network Model pre-auction posting.

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| ***[NPRR831: Replace paragraph (b) above with the following upon system implementation:]***(b) To distribute injections and withdrawals to power flow buses in Load Zones, ERCOT shall use the Load-weighted distribution factors for On-Peak Hours in each Load Zone. For a CRR Monthly Auction, ERCOT shall derive CRR Auction Load distribution factors with the set of Load distribution factors constructed in accordance with the ERCOT Load distribution factor methodology specified in paragraph (5) of Section 4.5.1, DAM Clearing Process, for use in the Day-Ahead Market (DAM). For a CRR Long-Term Auction Sequence, ERCOT shall derive CRR Auction Load distribution factors from the corresponding planning model or with the set of Load distribution factors constructed in accordance with the ERCOT Load distribution factor methodology specified in paragraph (5) of Section 4.5.1, for use in the DAM. ERCOT shall notify the market as to which method was used for each CRR Network Model in a CRR Long-Term Auction Sequence in the corresponding auction notice. ERCOT shall post the CRR Auction Load distribution factors as part of the CRR Network Model pre-auction posting. Private Use Network net Load will be redacted from this posting. |

(4) ERCOT shall conduct CRR Auctions as follows:

(a) The CRR Monthly Auction, held once per calendar month, shall include the sale of one-month terms of Point-to-Point (PTP) Options and PTP Obligations for the month immediately following the month during which the CRR bid submission window closes.

(b) Twice per year, a CRR Long-Term Auction Sequence shall be held, selling PTP Options and PTP Obligations, subject to the following constraints:

(i) Each CRR Long-Term Auction Sequence shall consist of six successive CRR Auctions, each of which offers for sale CRRs spanning a term of six consecutive calendar months (either January through June, or July through December). In each such CRR Auction, CRRs shall be offered in one-month strips or in strips of up to six consecutive months within the term covered by the auction.

(ii) The CRR Long-Term Auction Sequence shall operate in chronological order, first providing a CRR Auction covering the next six-month (January through June, or July through December) period that has not yet commenced, and then five successive CRR Auctions for the five six-month periods thereafter.

(c) No later than April 1 of each calendar year, ERCOT shall publish an update to the CRR activity calendar on the MIS Public Area, with the following requirements:

(i) The calendar shall include activity dates for all CRR Monthly Auctions, all CRR Auctions that are part of a CRR Long-Term Auction Sequence, and all Pre-Assigned Congestion Revenue Right (PCRR) annual allocations for the remainder of the current calendar year and for the two subsequent calendar years.

(ii) Any posted date on the CRR activity calendar shall only be modified if ERCOT determines that the successful execution of the auction would be jeopardized without such modification. If a delay in completion of a CRR Auction that is part of a CRR Long-Term Auction Sequence results in a condition whereby an overlap of credit posting requirements for consecutive CRR Auctions within that sequence would occur, subsequent CRR Auctions within the sequence shall be delayed by the minimum amount of time required to relieve such overlap. For any changes to the posted auction activity dates, ERCOT will send a Market Notice to provide the new date(s) and to explain the need for the change.

(iii) The CRR activity calendar must be approved by the Wholesale Market Subcommittee (WMS) prior to the annual posting.

(5) For each CRR Auction, the CRR Auction Capacity shall be defined as follows:

(a) For the CRR Monthly Auction, 90%.

(b) For any CRR Auction that is part of a CRR Long-Term Auction Sequence, 70%, 55%, 40%, 30%, 20%, or 10% for the first, second, third, fourth, fifth, and sixth six-month windows sold in the sequence, respectively.

(6) For any month covered by a CRR Auction that is part of a CRR Long-Term Auction Sequence, ERCOT shall offer network capacity equal to:

(a) The expected network topology for that month, scaled down to the CRR Auction Capacity percentage; minus

(b) All outstanding CRRs that were previously allocated for the month, scaled down to the CRR Auction Capacity percentage; minus

(c) All outstanding CRRs that were previously awarded for the month in any previous CRR Auction.

(7) For the CRR Monthly Auction, ERCOT shall offer network capacity equal to the difference between:

(a) The expected transmission network topology in the CRR Network Model of the month for which the CRRs are effective scaled down to the CRR Auction Capacity percentage; and

(b) All outstanding CRRs that were previously awarded or allocated for the month.