

April 2018 ERCOT Monthly Operations Report

Reliability and Operations Subcommittee Meeting

June 7th, 2018

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# Report Highlights

* The unofficial ERCOT peak for April was 47,885 MW.
* There were six frequency events in April. PMU data indicates the ERCOT system transitioned well in each case.
* There was three instances where Responsive Reserves were deployed.
* There was one RUC commitments in April due to congestion. Congestion in April was concentrated in the North, West, and South Load Zones. Congestion in the North can be mostly attributed to high Panhandle and West wind generation, multiple planned and forced outages, as well as high North to Houston import flows. Congestion in South was due primarily to multiple planned and forced outages and generation unavailability due to voltage control issues. Congestion in the West was due to multiple planned and forced outages and high load. There were 25 days on the Panhandle GTC, 12 days on the Nelson Sharpe – Rio Hondo GTC, and 1 day on the Valley Import GTC in April. There was no activity on the remaining GTCs during the month.
* There were two DC Tie curtailments in April. One was due to local congestion and the other was due to a forced outage of the DC Tie.

# Frequency Control

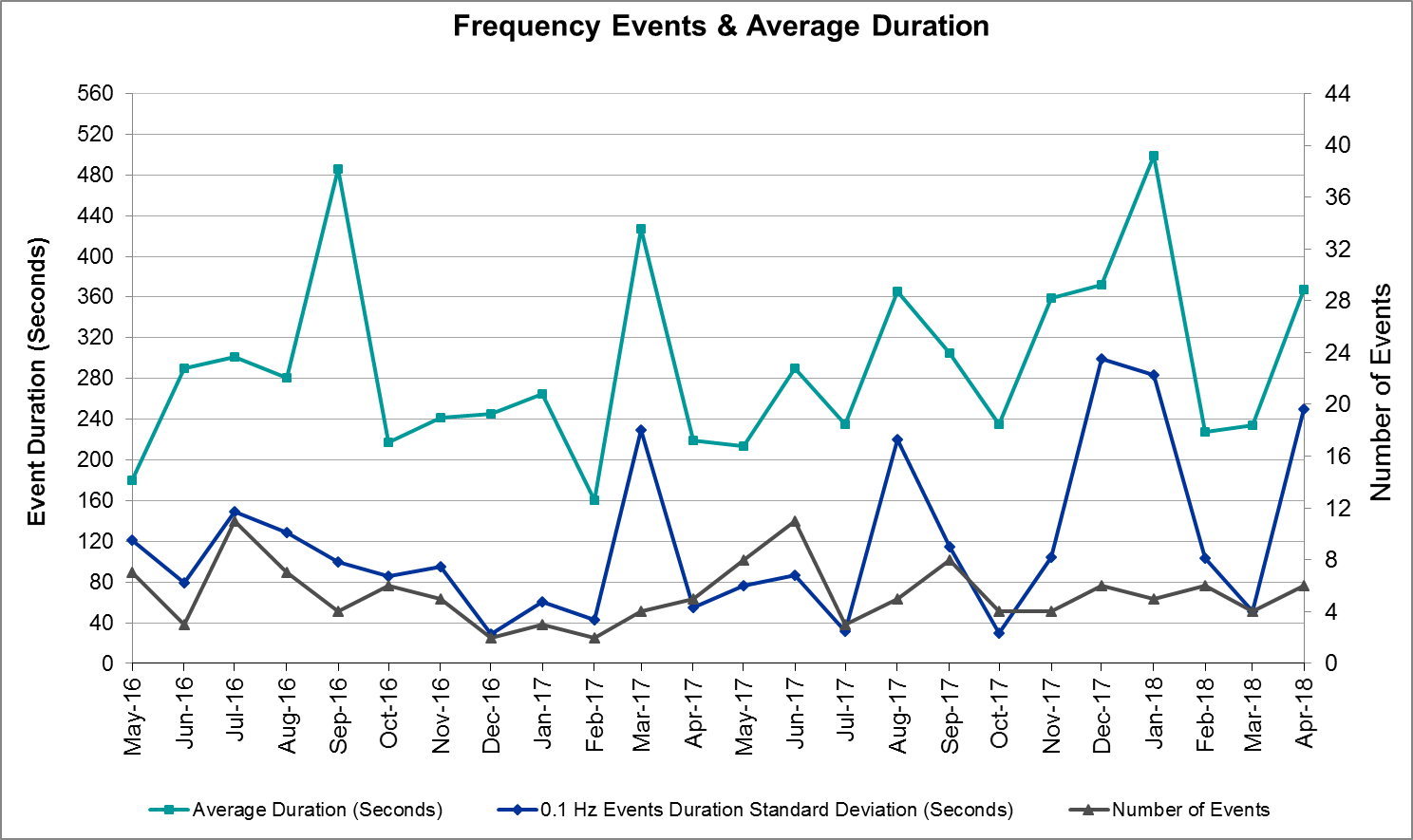
## Frequency Events

The ERCOT Interconnection experienced four frequency events in April, all of which resulted from Resource trips. The average event duration was approximately 0:06:08.

A summary of the frequency events is provided below. The reported frequency events meet one of the following criteria: Delta Frequency is 60 mHz or greater; the MW loss is 350 MW or greater; resource trip event triggered RRS deployment. Frequency events that have been identified as Frequency Measurable Events (FME) for purposes of BAL-001-TRE-1 analysis are highlighted in blue. When analyzing frequency events, ERCOT evaluates PMU data according to industry standards. Events with an oscillating frequency of less than 1 Hz are considered to be inter-area, while higher frequencies indicate local events. Industry standards specify that damping ratio for inter-area oscillations should be 3.0% or greater. For the frequency events listed below, the ERCOT system met these standards and transitioned well after each disturbance.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Date and Time** | **Delta Frequency** | **Max/Min Frequency** | **Duration of Event[[1]](#footnote-1)** | **PMU Data[[2]](#footnote-2)** | | **MW Loss** | **Load** | **Wind** | **Inertia** |
| **(Hz)[[3]](#footnote-3)** | **(Hz)** | **Oscillation Mode (Hz)** | **Damping Ratio** | **(MW)** | **%** | **(GW-s)[[4]](#footnote-4)** |
| 4/14/2018 2:02 | 0.122 | 59.897 | 0:03:19 | No Dominant Oscillation Mode | | 438 | 30,493 | 44% | 164,394 |
| 4/15/2018 1:11 | 0.095 | 59.909 | 0:11:54 | No PMU Report Created | | 349 | 29,628 | 18% | 180,352 |
| 4/18/2018 10:20 | 0.097 | 59.914 | 0:07:34 | No PMU Report Created | | 460 | 38,487 | 33% | 225,994 |
| 4/21/2018 17:11 | 0.249 | 59.719\* | 0:03:38 | 0.81 | 12% | 1250 | 36,486 | 32% | 190,214 |
| 0.75 | 13% |
| 4/28/2018 9:50 | 0.069 | 59.904 | 0:00:59 | No PMU Report Created | | 299 | 34,434 | 13% | 216,030 |
| 4/28/2018 18:15 | 0.103 | 59.910 | 0:09:23 | No PMU Report Created | | 408 | 43,739 | 15% | 234,444 |

\**This is the lowest frequency seen by ERCOT EMS. High speed data recorders shows frequency went as low as 59.709Hz.*



(Note: All data on this graph encompasses frequency event analysis based on BAL-001-TRE-1.)

## Responsive Reserve Events

There were three events where Responsive Reserve MWs were released to SCED in April. The events highlighted in blue were related to frequency events reported in Section 2.1 above.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date and Time Released to SCED** | **Date and Time Recalled** | **Duration of Event** | **Maximum MWs Released** | **Comments** |
| 4/15/2018 1:11 | 4/15/2018 1:14 | 0:02:44 | 308 |  |
| 4/21/2018 17:11 | 4/21/2018 17:15 | 0:03:40 | 1548 | Of the 1548MW of RRS requested, 1298MW came from PFR while the remainder was expected from Load Resources. 546.5MW of Load Resources tripped offline to provide their RRS obligation. |
| 4/28/2018 9:50 | 4/28/2018 9:51 | 0:00:56 | 287 |  |

## Load Resource Events

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date and Time Released** | **Date and Time Recalled** | **Duration of Event** | **Maximum MW** | **Comments** |
| 4/21/2018 17:11 | 4/21/2018 17:30 | 0:19:00 | 546.5 | At approximately 17:11 on 04/21/2018, 1,250 MW of Generation tripped off-line. Frequency dropped down to a minimum of 59.709 Hz. During the event, approximately 546 MW of Load Resources tripped offline to provide their RRS obligation. |

# Reliability Unit Commitment

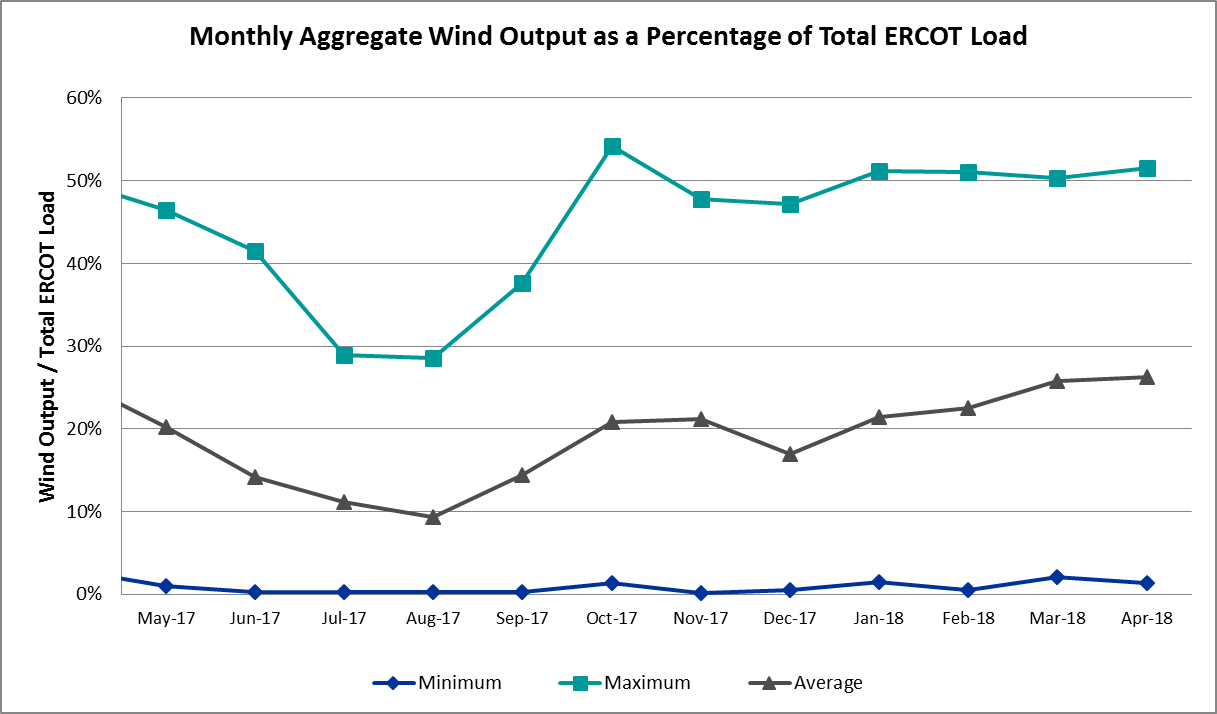
ERCOT reports on Reliability Unit Commitments (RUC) on a monthly basis. Commitments are reported grouped by operating day and weather zone. The total number of hours committed is the sum of the hours for all the units in the specified region. Additional information on RUC commitments can be found on the MIS secure site at Grid 🡪 Generation 🡪 Reliability Unit Commitment.

There were no DRUC commitments in April.

There was one HRUC commitment in April.

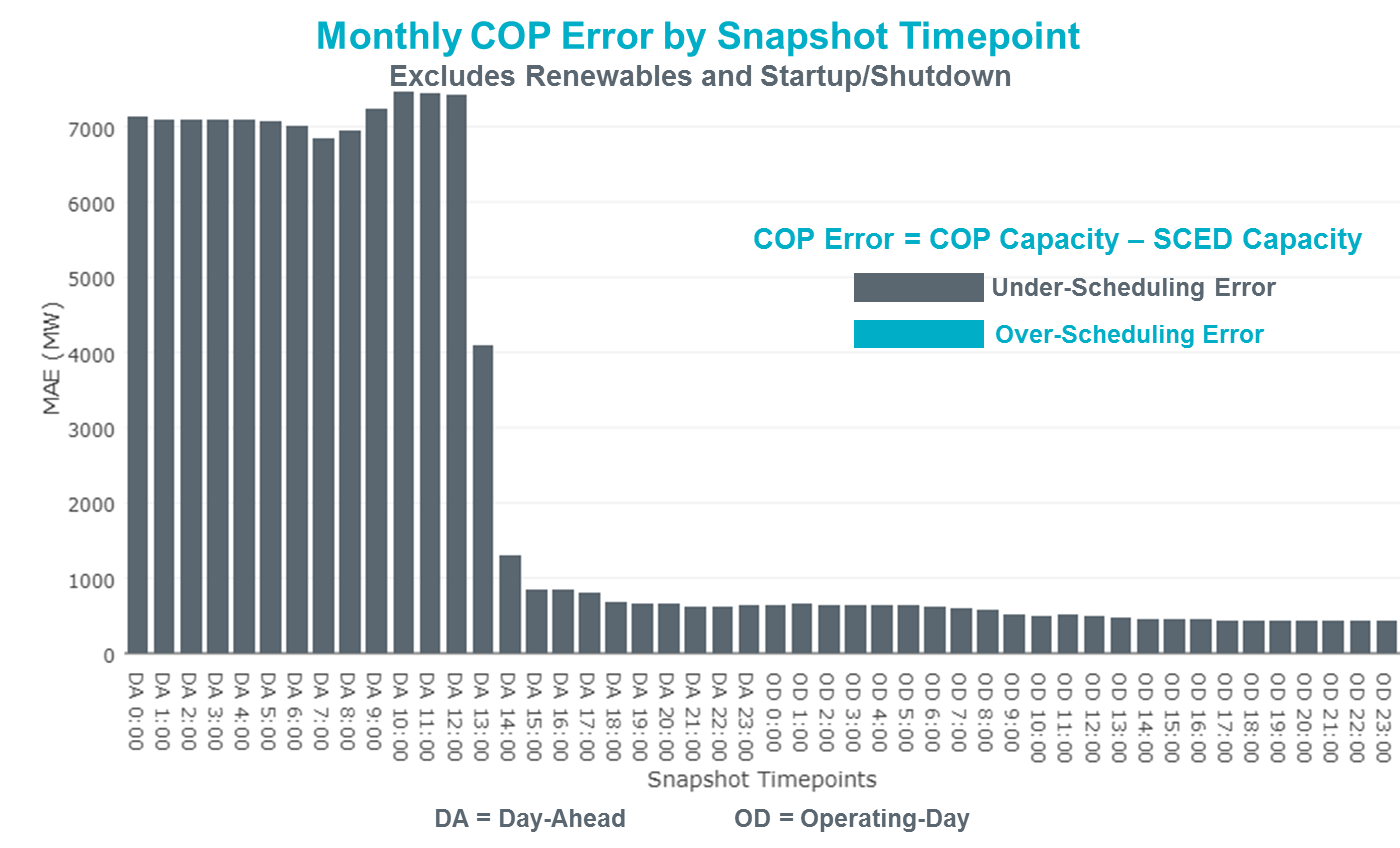
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Resource Location** | **# of Resources** | **Operating Day** | **Total # of Hours Committed** | **Total MWhs** | **Reason for Commitment** |
| North Central | 1 | 4/17/2018 | 4 | 1,740 | Congestion |

# Wind Generation as a Percent of Load

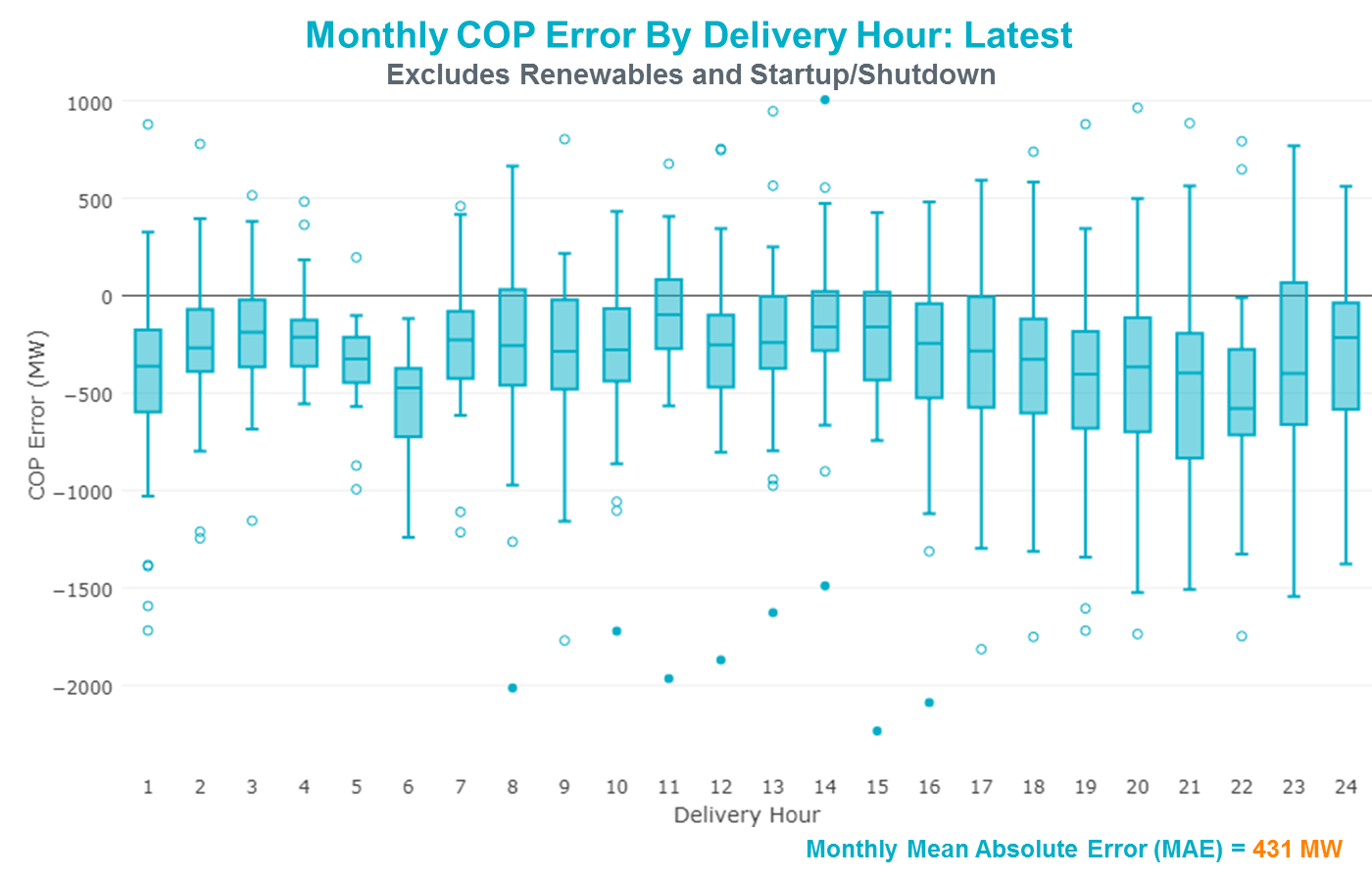


# COP Error Analysis

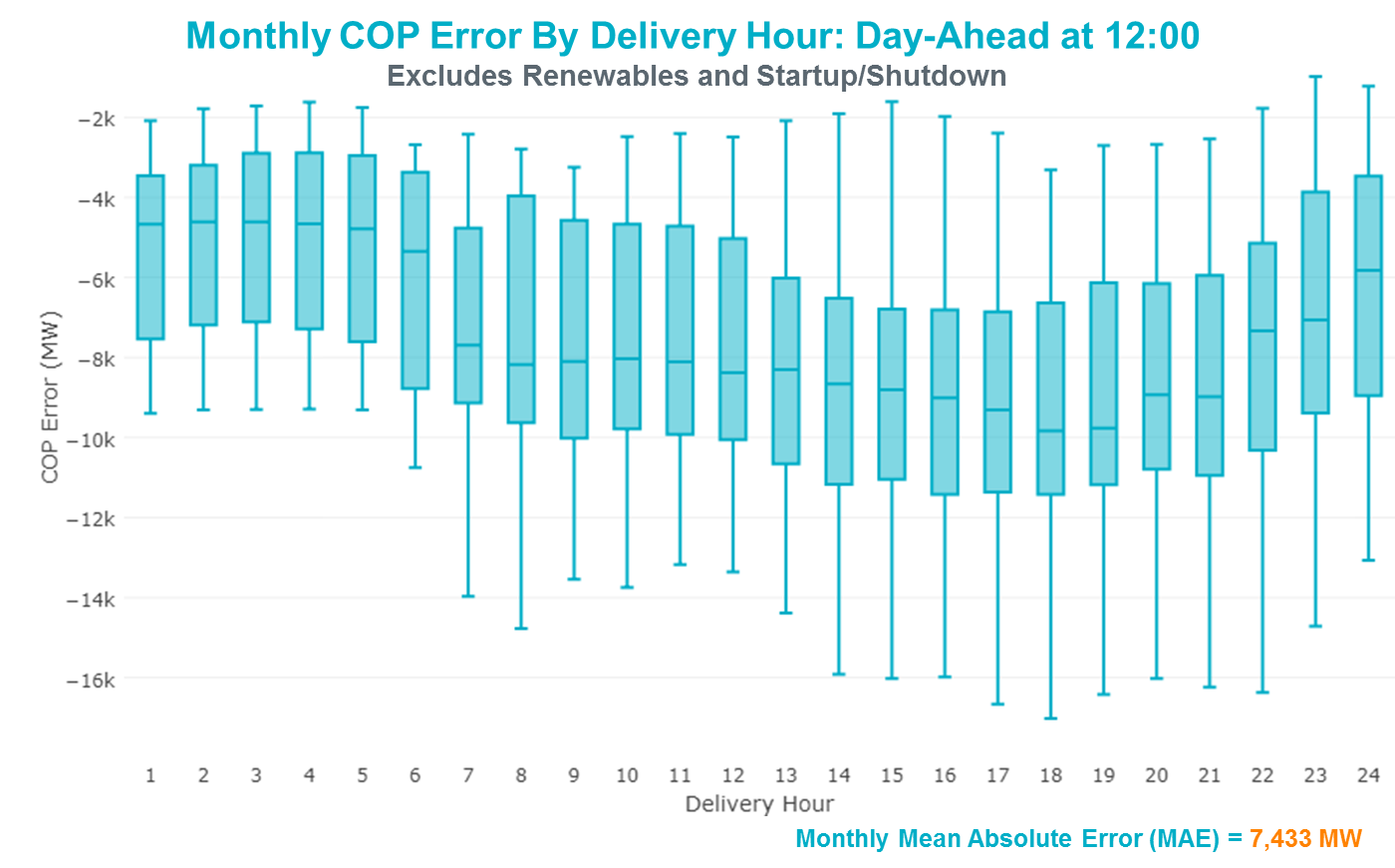
COP Error is calculated as the capacity difference between the COP HSL and real-time HSL of the unit. Mean AbsoluteError (MAE) stayed high, mostly over 7,000 MW, until Day-Ahead at 12:00, then dropped significantly to 1,310 MW by Day-Ahead at 14:00. In the following chart, Under-Scheduling Error indicates that COP had less generation capacity than real-time and Over-Scheduling Error indicates that COP had more generation capacity than real-time. Under-Scheduling persisted from beginning of Day-Ahead to end of the Operating Day. Snapshot on the Operating Day considers all Operating Hours, including past hours. However, COP error for the Operating Hour freezes after the Adjustment Period.

****

Monthly MAE for the Latest COP at the end of the Adjustment Period was 431 MW with median ranging from -579 MW for Hour-Ending (HE) 11 to -99 MW for HE 11. April 10th HE 14 had the largest Over-Scheduling Error (1,005 MW) and April 2nd HE 15 had the largest Under-Scheduling Error (-2,235 MW).



Monthly MAE for the Day-Ahead COP at 12:00 was 7,433 MW with median ranging from -9,838 MW for Hour-Ending (HE) 18 to -4,613 MW for HE 3. April 28th HE23 had the smallest Under-Scheduling Error (-979 MW) and April 24th HE 18 had the largest Under-Scheduling Error (-17,022 MW).



# Congestion Analysis

The total number of congestion events experienced by the ERCOT system decreased in April. There were 38 instances over 26 days on the Generic Transmission Constraints (GTCs) in April.

## Notable Constraints

Nodal protocol section 3.20 specifies that ERCOT shall identify transmission constraints that are active or binding three or more times within a calendar month. As part of this process, ERCOT reports congestion that meets this criterion to ROS. In addition ERCOT also highlights notable constraints that have an estimated congestion rent exceeding $1,000,000 for a calendar month. These constraints are detailed in the table below. Rows highlighted in blue indicate the congestion was affected by one or more outages. For a list of all constraints activated in SCED for the month of April, please see Appendix A at the end of this report.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contingency Name** | **Overloaded Element** | **# of Days Constraint Active** | **Congestion Rent** | **Transmission Project** |
|
| CRLNW-LWSSW 345kV | Carrollton Northwest - Lakepointe Tnp 138kV | 23 | $27,871,275 | Oncor\_NW Carrollton - LakePointe (5488) |
| Basecase | PNHNDL GTC | 25 | $14,267,102 | LP&L Option 4ow & Panhandle Loop (5180, 5208) |
| Jones Street Tnp to Lewisvil | Ti Tnp - West Tnp 138kV | 13 | $11,808,730 |  |
| Elmcreek-Sanmigl 345kV | Pawnee Switching Station - Calaveras 345kV | 6 | $4,568,451 |  |
| Wink Sub to YUCCA DRIVE SWITCH LIN | Andrews County South - Amoco Three Bar Tap 138kV | 10 | $4,289,903 |  |
| Jewet-Sng 345kV | Btu\_Jack\_Creek - Twin Oak Switch 345kV | 11 | $3,467,023 | Houston Import Project (4458) |
| CAGNON to KENDALL LIN 1 | Cico - Comfort 138kV | 21 | $3,187,828 |  |
| Basecase | Omega - Horse Hollow Generation Tie 345kV | 18 | $3,087,990 |  |
| Vensw-Evrsw 345kV | Oakhill Tap 2 - Tate Tap East 138kV | 3 | $2,910,643 |  |
| Re Roserock Solar Plant to L | Yucca Drive Switch - Gas Pad 138kV | 14 | $2,891,761 | Yucca Drive-Barilla Junction (4549) |
| Wink Sub to YUCCA DRIVE SWITCH LIN | Winkler County 6 Tnp - Wickett Tnp 69kV | 7 | $2,309,638 |  |
| KLEBERG AEP to LOYOLA SUB LIN 1 | Loyola Sub 138/69kV | 16 | $2,030,637 |  |
| MOLINA to WORMSER ROAD LIN 1 | Del Mar - Laredo Plant 138kV | 5 | $1,936,265 |  |
| DMTSW-SCOSW 345KV | Knapp - Scurry Chevron 138kV | 12 | $1,622,473 |  |
| Bighil-Kendal 345kV | Hamilton Road - Maverick 138kV | 20 | $1,617,377 | Brackettville to Escondido (5206) |
| Basecase | Pig Creek - Solstice 138kV | 26 | $1,547,763 | Solstice to Permian Basin: Rebuild 138 kV line |
| MOLINA to LOBO LIN 1 | Del Mar - Laredo Plant 138kV | 1 | $1,339,005 |  |
| Re Roserock Solar Plant to Linton | Barrilla - Fort Stockton Switch 69kV | 16 | $1,288,901 | Far West Texas Project |
| Basecase | NELRIO GTC | 12 | $1,202,979 |  |
| Wett\_Bearkat to Wett\_Sand\_Bl | Carterville - Einstein 138kV | 12 | $738,204 |  |
| Calavers-Hotwells&Laredo1 13 | Calaveras - Streich 138kV | 3 | $705,494 |  |
| CLEARFORK to TELEPHONE ROAD - Shar | Lamesa - Jim Payne Poi 138kV | 6 | $669,898 |  |
| Wink Sub to YUCCA DRIVE SWITCH LIN | No Trees Switch - Cheyenne Tap 138kV | 9 | $659,732 |  |
| Devils River to Cauthorn (6) | Hamilton Road - Maverick 138kV | 16 | $630,743 | Brackettville to Escondido (5206) |
| NORTH McCAMEY to ODESSA EHV SWITCH | Pig Creek - Solstice 138kV | 11 | $556,801 | Solstice to Permian Basin: Rebuild 138 kV line |
| Riohondo-Nedin 345kV&Harlnsw 138kV | Burns Sub - Rio Hondo 138kV | 4 | $508,804 |  |
| LAQUINTA to LOBO LIN 1 | Bruni Sub 138/69kV | 15 | $479,091 |  |
| JARDIN to DILLEY SWITCH AEP LIN 1 | Dilley Switch Aep - Cotulla Sub 69kV | 7 | $452,828 |  |
| Wett\_Bearkat to Wett\_Sand\_Bl | Eiland - Polecat Creek Switch 138kV | 13 | $439,517 |  |
| LON HILL to NELSON SHARPE LIN 1 | Loyola Sub 138/69kV | 3 | $297,496 | AEP\_Angstrom (15TPIT0069) |
| Andrews County South to Clea | Pig Creek - Solstice 138kV | 3 | $271,436 | Solstice to Permian Basin: Rebuild 138 kV line |
| Cagnon-Kendal 345 & Cico-Com | Harper Road - Kerrville Stadium 138kV | 3 | $238,437 |  |
| Asphalt Mines to Blewett (3) | Hamilton Road - Maverick 138kV | 8 | $231,789 | Brackettville to Escondido (5206) |
| ENNIS SWITCH to ENNIS WEST SWITCH | Ennis West Switch - Ennis South 138kV | 5 | $211,565 |  |
| Holly to Westside Aep 138 KV | Holly - Southside 138kV | 2 | $206,379 |  |
| ALAMITO CREEK to MARFA LIN 1 | Alpine - Paisano 69kV | 11 | $194,364 |  |
| ASHERTON to Bevo Substation LIN 1 | Turtle Creek Switching Station - West Crystal City Sub 69kV | 3 | $193,560 |  |
| CITGO N OAK PARK to NUECES BAY LIN | Morris Street - Nueces Bay 138kV | 3 | $188,951 |  |
| ENNIS SWITCH to ENNIS WEST SWITCH | Ennis Switch - Ennis West Switch 138kV | 5 | $158,862 |  |
| Lobo to San Miguel 345\_138 K | Bruni Sub 138/69kV | 3 | $113,819 |  |
| Dilleysw-Sanmgsw&Cotulas 138 | Dilley Switch Aep - Cotulla Sub 69kV | 4 | $108,112 |  |
| Wink Sub to YUCCA DRIVE SWITCH LIN | Dollarhide - No Trees Switch 138kV | 5 | $106,627 |  |
| Cagnon-Kendal 345 & Cico-Com | Clear Springs - Geronimo 138kV | 5 | $94,315 |  |
| Basecase | Randado Aep - Zapata 138kV | 14 | $87,127 |  |
| BLUFF CREEK to NICOLE LIN 1 | Tennyson - Nicole 138kV | 5 | $75,436 |  |
| Lake Arrowhead to Newport Be | Bowie 138/69kV | 5 | $28,724 |  |
| CLEARFORK to TELEPHONE ROAD - Shar | Pig Creek - Solstice 138kV | 3 | $10,456 | Solstice to Permian Basin: Rebuild 138 kV line |
| Cottonwood Road Switch to Lo | Bowie 138/69kV | 3 | $9,094 |  |
| Basecase | Solstice - Linterna 138kV | 3 | $3,865 |  |

## Generic Transmission Constraint Congestion

There were 25 days on the Panhandle GTC, 12 days on the Nelson Sharpe – Rio Hondo GTC, and 1 day on the Valley Import GTC in April. There was no activity on the remaining GTCs during the month.

Note: This is how many times a constraint has been activated to avoid exceeding a GTC limit, it does not imply an exceedance of the GTC occurred or that the GTC was binding.

## Manual Overrides

None.

## Congestion Costs for Calendar Year 2018

The following table represents the top twenty active constraints for the calendar year based on the estimated congestion rent attributed to the congestion. ERCOT updates this list on a monthly basis.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contingency** | **Binding Element** | **# of 5-min SCED Intervals** | **Estimated Congestion Rent** | **Transmission Project** |
| Basecase | PNHNDL GTC | 18,313 | $93,017,069 | LP&L Option 4ow & Panhandle Loop (5180, 5208) |
| CRLNW-LWSSW 345kV | Carrollton Northwest - Lakepointe Tnp 138kV | 11,238 | $54,600,758 | Oncor\_NW Carrollton - LakePointe (5488) |
| NORTH EDINBURG TRX 1382 345/138 | North Edinburg 345/1kV | 661 | $28,832,407 |  |
| Basecase | VALIMP GTC | 359 | $17,313,039 |  |
| Jones Street Tnp to Lewisvil | Ti Tnp - West Tnp 138kV | 1,931 | $16,150,656 |  |
| Castrvll-Razorbac&Txresrch 1 | Hondo Creek Switching Station - Moore Switching Station 138kV | 605 | $15,342,875 |  |
| Re Roserock Solar Plant to Fort STockton | Yucca Drive Switch - Gas Pad 138kV | 2,264 | $12,295,173 | Solstice to Permian Basin: Rebuild 138 kV line |
| LON HILL TRX LON\_HILL\_3\_2 345/138 | Lon Hill 345/1kV | 1,587 | $11,412,928 |  |
| Jewet-Sng 345kV | Btu\_Jack\_Creek - Twin Oak Switch 345kV | 5,059 | $10,516,883 | Houston Import Project (4458) |
| Elmcreek-Sanmigl 345kV | Pawnee Switching Station - Calaveras 345kV | 1,808 | $8,070,334 |  |
| Re Roserock Solar Plant to Fort Stockton | Barrilla - Fort Stockton Switch 69kV | 6,162 | $6,421,941 | Far West Texas Project |
| Wink Sub to YUCCA DRIVE SWITCH LIN | Andrews County South - Amoco Three Bar Tap 138kV | 829 | $6,248,536 |  |
| WOODWARD 1 TAP to WOODWARD 1 LIN 1 | 16th Street Tnp - Woodward 2 138kV | 184 | $5,867,907 | Far West Texas Project |
| NORTH PHARR to POLK AVENUE LIN 1 | North Mcallen - West Mcallen 138kV | 249 | $5,816,872 |  |
| Rns-Rtw & Sng-Tb 345kv | Singleton - Zenith 345kV | 1,919 | $5,195,375 | Houston Import Project (4458) |
| East Harrison to La Palma 69 | Haine Drive - La Palma 138kV | 471 | $5,189,980 |  |
| Wink Sub to YUCCA DRIVE SWITCH LIN | Winkler County 6 Tnp - Wickett Tnp 69kV | 1,127 | $4,538,878 | Far West Texas Project |
| Basecase | Omega - Horse Hollow Generation Tie 345kV | 5,261 | $4,304,033 |  |
| CAGNON to KENDALL LIN 1 | Cico - Comfort 138kV | 3,966 | $4,187,668 |  |
| KLEBERG AEP to LOYOLA SUB LIN 1 | Loyola Sub 138/69kV | 4,630 | $3,777,770 | AEP\_Angstrom (15TPIT0069) |

# System Events

## ERCOT Peak Load

The unofficial ERCOT peak load for the month was 47,885 MW and occurred on April 24th, during hour ending 18:00.

## Load Shed Events

None.

## Stability Events

None.

## Notable PMU Events

None.

## DC Tie Curtailment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Date** | **DC Tie** | **Curtailing Period** | **# of Tags Curtailed** | **Initiating Event** | **Curtailment Reason[[5]](#footnote-5)[[6]](#footnote-6)** |
| 4/12//2018 | Eagle Pass | HE 0700 –1100 | 2 | Forced Transmission Outage in the area | DC Tie Forced Outage |
| 4/23/2018 | Railroad | HE 1000 - 1300 & HE 2400 | 3 | DC Tie de-rated to 150MW | DC Tie de-rated to 150MW |

## TRE/DOE Reportable Events

* ONCOR submitted an EOP-004 report on April 10, 2018
  + Reportable Event Type: Physical Threat and Damage or Destruction to a Facility.
* ERCOT ISO submitted an EOP-004 report on April 21, 2018
  + Reportable Event Type: Generation Loss
* Kiowa submitted an EOP-004 report on April 21, 2018
  + Reportable Event Type: Transmission Loss

## New/Updated Constraint Management Plans

None.

## New/Modified/Removed RAS

None.

## New Procedures/Forms/Operating Bulletins

None.

# Emergency Conditions

## OCNs

None.

## Advisories

None.

## Watches

|  |  |
| --- | --- |
| **Date and Time** | **Description** |
| 4/12/2018 06:43 | ERCOT issued a Watch for the Eagle Pass DC Tie due to a trip. |
| 4/23/2018 08:52 | ERCOT issued a Watch for the Railroad DC Tie due to the Tie being de-rated to 150MW. |

## Emergency Notices

None.

# Application Performance

## TSAT/VSAT Performance Issues

None.

## Communication Issues

None.

## Market System Issues

None.

# Model Updates

The Downstream Production Change (DPC) process allows ERCOT to make changes in the on-line Network Operations Model without loading a completely new model. The purpose of this process is to allow for reliable grid operations as system conditions change between designated Network Operations Model database loads. The DPC process is limited in scope to just those items listed below, with equipment ratings updates being the most common. ERCOT has seen a rise in the use of the DPC process to make on-line updates to the Network Operations Model in recent years, instead of through the standard Network Operations Model Change Request process.

* Static Line ratings (Interim Update)
* Dynamic Line ratings (non-Interim Update)
* Autotransformer ratings (non-Interim Update)
* Breaker and Switch Normal status (Interim Update)
* Contingency Definitions (Interim Update)
* RAP and RAS changes or additions (Interim Update)
* Net Dependable and Reactive Capability (NDCRC) values (Interim Update)
* Impedance Updates (non-Interim)

|  |  |
| --- | --- |
| **Transmission Operator** | **Number of DPCs** |
| CENTERPOINT ENERGY HOUSTON ELECTRIC LLC (TDSP) | 2 |
| CPS ENERGY (TDSP) | 3 |
| ERCOT | 5 |
| ONCOR ELECTRIC DELIVERY COMPANY LLC (TDSP) | 16 |

# Appendix A: Real-Time Constraints

The following is a complete list of constraints activated in SCED for the month of April. Full contingency descriptions can be found in the Standard Contingencies List located on the MIS secure site at Grid 🡪 Generation 🡪 Reliability Unit Commitment.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contingency** | **Constrained Element** | **From Station** | **To Station** | **# of Days Constraint Active** |
| BASE CASE | PIGCRE\_SOLSTI1\_1 | SOLSTICE | PIGCREEK | 26 |
| BASE CASE | PNHNDL |  |  | 25 |
| DCRLLSW5 | 591\_\_A | LKPNT | CRLNW | 23 |
| SCAGKEN5 | 74T148\_1 | COMFOR | CICO | 21 |
| DBIGKEN5 | HAMILT\_MAVERI1\_1 | HAMILTON | MAVERICK | 20 |
| BASE CASE | HHGTOM\_1 | HHGT | OMEGA | 18 |
| SKLELOY8 | LOYOLA\_69\_1 | LOYOLA | LOYOLA | 16 |
| SCTHHA38 | HAMILT\_MAVERI1\_1 | HAMILTON | MAVERICK | 16 |
| SWCSBOO8 | BARL\_FTSW1\_1 | FTSW | BARL | 16 |
| SLAQLOB8 | BRUNI\_69\_1 | BRUNI | BRUNI | 15 |
| SWCSBOO8 | 6332\_\_A | YUCSW | GASPAD | 14 |
| BASE CASE | RANDAD\_ZAPATA1\_1 | RANDADO | ZAPATA | 14 |
| SW\_BW\_25 | EILAND\_PCTSW\_1 | EILAND | PCTSW | 13 |
| SLWVLWS8 | 588\_A\_1 | LWSVW | LWVTI | 13 |
| BASE CASE | NELRIO |  |  | 12 |
| DMTSCOS5 | 6437\_\_F | SCRCV | KNAPP | 12 |
| SW\_BW\_25 | CRTVLE\_EINSTEN\_1 | EINSTEIN | CRTRVLLE | 12 |
| SNORODE5 | PIGCRE\_SOLSTI1\_1 | SOLSTICE | PIGCREEK | 11 |
| DJEWSNG5 | JK\_TOKSW\_1 | TOKSW | JK\_CK | 11 |
| SMARALM9 | ALPINE\_PAIS1\_1 | PAIS | ALPINE | 11 |
| SMARALM9 | ALPINE\_PAIS1\_1 | ALPINE | PAIS | 11 |
| SWINYUC8 | 6100\_\_G | ACSSW | AMTBT | 10 |
| SWINYUC8 | 6101\_\_A | NOTSW | CHEYT | 9 |
| SBRAUVA8 | HAMILT\_MAVERI1\_1 | HAMILTON | MAVERICK | 8 |
| SWINYUC8 | M\_69\_F3\_1 | WICKETT | WNKLRCO6 | 7 |
| SJARDIL8 | DIL\_COTU\_1 | DILLEYSW | COTULAS | 7 |
| DELMSAN5 | PAWNEE\_SPRUCE\_1 | CALAVERS | PAWNEE | 6 |
| SCLETE25 | 6095\_\_D | LMESA | JPPOI | 6 |
| SENSENW8 | 943\_\_A | ENWSW | ENSSW | 5 |
| DCAGCO58 | 505T505\_1 | CLEASP | GERONI | 5 |
| SLKAWFS8 | BOW\_FMR1 | BOW | BOW | 5 |
| SSIEMOL8 | DEL\_MA\_LAREDO1\_1 | LAREDO | DEL\_MAR | 5 |
| SWINYUC8 | 6100\_\_F | DHIDE | NOTSW | 5 |
| SENSEN28 | 941\_\_C | ENWSW | ENSSO | 5 |
| SNICBLU8 | NICOLE\_TENNYS1\_1 | NICOLE | TENNYSON | 5 |
| DRIOHAR5 | BURNS\_RIOHONDO\_1 | RIOHONDO | MV\_BURNS | 4 |
| DDILCOT8 | DIL\_COTU\_1 | DILLEYSW | COTULAS | 4 |
| BASE CASE | LGD\_SANTIA1\_1 | LGD | SANTIAGO | 3 |
| DCAGCO58 | 59T144\_1 | KERRST | HARPRO | 3 |
| SCRDLOF9 | BOW\_FMR1 | BOW | BOW | 3 |
| SCLETE25 | PIGCRE\_SOLSTI1\_1 | SOLSTICE | PIGCREEK | 3 |
| SHOLWES8 | HOLLY4\_SOUTH\_1\_1 | HOLLY4 | SOUTH\_SI | 3 |
| DVENEVR5 | 6300\_\_I | OAKT2 | TATTP | 3 |
| SN\_SLON5 | LOYOLA\_69\_1 | LOYOLA | LOYOLA | 3 |
| DCALHOT8 | N4\_X3\_1 | CALAVERS | X3 | 3 |
| SACSCLE5 | PIGCRE\_SOLSTI1\_1 | SOLSTICE | PIGCREEK | 3 |
| SBEVASH8 | TURTLECK\_WCRYS\_1 | TURTLCRK | WCRYSTS | 3 |
| SLOBSA25 | BRUNI\_69\_1 | BRUNI | BRUNI | 3 |
| SHOLWES8 | HOLLY4\_SOUTH\_1\_1 | SOUTH\_SI | HOLLY4 | 3 |
| BASE CASE | LINTER\_SOLSTI1\_1 | LINTERNA | SOLSTICE | 3 |
| SCITNUE8 | MORRIS\_NUECES1\_1 | NUECES\_B | MORRIS | 3 |
| DHCKSAG8 | 6265\_\_A | EMSES | MRSDO | 2 |
| DTOKJK\_5 | 240\_\_A | JEWET | SNG | 2 |
| SFREGIL8 | FREDER\_AT2 | FREDER | FREDER | 2 |
| SN\_SLON5 | CELANE\_N\_SHAR1\_1 | N\_SHARPE | CELANEBI | 2 |
| SENSEN28 | 941\_\_B | ENNIS | ENSSW | 2 |
| SCTHHA38 | HAMILT\_MAXWEL1\_1 | MAXWELL | HAMILTON | 2 |
| SKNADM28 | 6474\_\_A | SUNSW | MGSES | 2 |
| SHENZOR8 | 87T233\_1 | MCCALA | HENNE | 2 |
| DCAGCI58 | 290T305\_1 | MCQUEE | CIBOLO | 2 |
| SACSCLE5 | 6345\_\_B | GNTSW | SPRTP | 2 |
| SMOSYUC8 | PIGCRE\_SOLSTI1\_1 | SOLSTICE | PIGCREEK | 2 |
| SP5CAG8 | E1\_R2\_1 | E1 | R2 | 2 |
| DRIOHAR5 | HAINE\_\_LA\_PAL1\_1 | LA\_PALMA | HAINE\_DR | 2 |
| SCOLBAL8 | DRSY\_SANA\_T1\_1 | SANA\_TAP | DRSY | 2 |
| SCLETE25 | 6345\_\_B | GNTSW | SPRTP | 2 |
| DWIRSTA8 | 342T195\_1 | GRANMO | MARBFA | 1 |
| SCLEZOR5 | 505T505\_1 | CLEASP | GERONI | 1 |
| DCAGCO58 | 583T583\_1 | BANDER | MASOCR | 1 |
| DEMSSAG8 | 6270\_\_C | WGROB | BLMND | 1 |
| DGREBOW5 | 6560\_\_B | MRKLY | RICSW | 1 |
| SCOLKEN8 | BEEVIL\_NORMAN1\_1 | BEEVILLE | NORMANNA | 1 |
| SBUEHAM8 | EAGLHY\_ESCOND1\_1 | EAGLHYTP | ESCONDID | 1 |
| DCAGCO58 | HAMILT\_MAVERI1\_1 | HAMILTON | MAVERICK | 1 |
| SLCLAN8 | SAR\_FRAN\_1 | FRANKC | SARGNTS | 1 |
| SLMRREN8 | TCOSW\_AX1L | TCOSW | TCOSW | 1 |
| XACS58 | 6095\_\_D | LMESA | JPPOI | 1 |
| DB\_DAIR8 | AIRLIN\_CABANI1\_1 | AIRLINE | CABANISS | 1 |
| SPLUPIN8 | CUERO\_AT3 | CUERO | CUERO | 1 |
| DCPSES12 | MAXWEL\_WHITIN1\_1 | MAXWELL | WHITING | 1 |
| SFPPLOS5 | 163T232\_1 | CHAPHI | WALLER | 1 |
| SMARALM9 | ALMC\_PAIS1\_1 | PAIS | ALMC | 1 |
| SWCSBOO8 | ALPINE\_BRONCO1\_1 | BRONCO | ALPINE | 1 |
| SMGPBRN8 | BRNWD\_FMR1 | BRNWD | BRNWD | 1 |
| BASE CASE | BURNS\_RIOHONDO\_1 | RIOHONDO | MV\_BURNS | 1 |
| SN\_SAJO5 | BURNS\_RIOHONDO\_1 | RIOHONDO | MV\_BURNS | 1 |
| DCHBJOR5 | CBY\_AT3 | CBY | CBY | 1 |
| SN\_SLON5 | HOLLY4\_SOUTH\_1\_1 | HOLLY4 | SOUTH\_SI | 1 |
| BASE CASE | N\_TO\_H | n/a | n/a | 1 |
| SVANRAY8 | VND\_PLCE\_1 | PLCEDOS | VANBLT69 | 1 |
| SFMRRYS5 | 400\_\_A | FMRVL | RYSSW | 1 |
| SCNTWEB5 | 6300\_\_I | OAKT2 | TATTP | 1 |
| XSNY89 | 6690\_\_E | SNYDR | SSFTP | 1 |
| DCAGCO58 | 72T120\_1 | KENDAL | HOLLMI | 1 |
| DCAGCO58 | 87T233\_1 | MCCALA | HENNE | 1 |
| DHENZOR8 | 89T204\_1 | ZORN | HENNE | 1 |
| DGBYCRN8 | BCVPSA03\_A | PSA | BCV | 1 |
| DBIGKEN5 | EAGLHY\_ESCOND1\_1 | EAGLHYTP | ESCONDID | 1 |
| SCTHHA38 | EAGLHY\_ESCOND1\_1 | EAGLHYTP | ESCONDID | 1 |
| SW\_BW\_25 | EILAND\_CRTVLLE\_1 | CRTRVLLE | EILAND | 1 |
| SPIGSOL8 | FTST\_LINTER1\_1 | LINTERNA | FTST | 1 |
| XALM589 | ALMC\_69T1 | ALMC | ALMC | 1 |
| SWINPIN8 | CUERO\_AT3 | CUERO | CUERO | 1 |
| SWCSBOO8 | FTST\_69T1 | FTST | FTST | 1 |
| XHH2G58 | HHGT\_T1H | HHGT | HHGT | 1 |
| DMCARIO8 | PIGCRE\_SOLSTI1\_1 | SOLSTICE | PIGCREEK | 1 |
| SBAKBIG5 | PIGCRE\_SOLSTI1\_1 | SOLSTICE | PIGCREEK | 1 |
| SSONFRI8 | SONR\_69-1 | SONR | SONR | 1 |
| DFPPLOS5 | 163T232\_1 | CHAPHI | WALLER | 1 |
| SWOORI38 | 16TH\_WRD2\_1 | WOODWRD2 | 16TH\_ST | 1 |
| DCRLLSW5 | 590\_\_B | LWVJS | LKPNT | 1 |
| SACSCLE5 | 6095\_\_D | LMESA | JPPOI | 1 |
| XACS58 | 6345\_\_B | GNTSW | SPRTP | 1 |
| DFERGRA8 | 654T654\_1 | WIRTZ | STARCK | 1 |
| DCC3\_NED | BLESSI\_PALACI1\_1 | BLESSING | PALACIOS | 1 |
| SMOLLOB8 | DEL\_MA\_LAREDO1\_1 | LAREDO | DEL\_MAR | 1 |
| SFORJOS8 | LOLITA\_VICTOR1\_1 | VICTORIA | LOLITA | 1 |
| DELMSAN5 | NORMAN\_PETTUS1\_1 | PETTUS | NORMANNA | 1 |
| SAILAB48 | OVERST\_SOUTHA1\_1 | SOUTHABI | OVERSTRE | 1 |
| XACS58 | PIGCRE\_SOLSTI1\_1 | SOLSTICE | PIGCREEK | 1 |
| SPIGSOL8 | RIOPEC\_WOODW21\_1 | WOODWRD2 | RIOPECOS | 1 |
| DJEWSNG5 | SNGXGC75\_1 | GIBCRK | SNG | 1 |
| SWLFMON8 | 6345\_\_B | GNTSW | SPRTP | 1 |
| SASPPAI8 | ASPM\_69T1 | ASPM | ASPM | 1 |
| DELMTEX5 | BLESSI\_LOLITA1\_1 | BLESSING | LOLITA | 1 |
| DCALHOT8 | N4\_O3\_1 | CALAVERS | O3 | 1 |
| XACS58 | 6100\_\_F | NOTSW | DHIDE | 1 |
| DHCKRNK5 | 6270\_\_C | WGROB | BLMND | 1 |
| SACSCLE5 | 6518\_\_A | MOSSW | YUCSW | 1 |
| SSONFRI8 | ATSO\_SONR1\_1 | SONR | ATSO | 1 |
| DELMSAN5 | BEEVIL\_NORMAN1\_1 | BEEVILLE | NORMANNA | 1 |
| SWEILON8 | CHAMPL\_WEIL\_T1\_1 | WEIL\_TRC | CHAMPLIN | 1 |
| DSTPDOW5 | CKT\_3124\_1 | STP | HLJ | 1 |
| SPOLPHA8 | GCB\_100\_1 | N\_MCALLN | W\_MCALLN | 1 |
| DKENCA58 | MARION\_AT2H | MARION | MARION | 1 |
| SEAGHAM8 | MAXWEL\_WHITIN1\_1 | MAXWELL | WHITING | 1 |

1. The Duration of Event is defined as the time it takes for the frequency to recover to pre-disturbance frequency or 60 Hz as applicable. [↑](#footnote-ref-1)
2. PMU reports are typically generated when frequency drops below 59.9, but PMU data is available for other events. [↑](#footnote-ref-2)
3. Delta Frequency is defined as the difference between the starting point of the frequency event (t(0) or “A-point”) and minimum/maximum frequency (“C-Point”). [↑](#footnote-ref-3)
4. Currently, the Critical Inertia Level for ERCOT is approximately 100,000 MW-s (Source: link) [↑](#footnote-ref-4)
5. All DC Tie Curtailments are posted publically on the ERCOT Market Information System. See that posting for additional details for the event(s) in question. [↑](#footnote-ref-5)
6. See DC Tie Operating Procedure (<http://www.ercot.com/mktrules/guides/procedures>) for more details. [↑](#footnote-ref-6)