

June 2024 ERCOT Monthly Operations Report

Reliability and Operations Subcommittee Meeting

August 1, 2024

Table of Contents

[1. Report Highlights 2](#_Toc162526249)

[2. Frequency Control 3](#_Toc162526250)

[2.1. Frequency Events 3](#_Toc162526251)

[2.2. ERCOT Contingency Reserve Events 4](#_Toc162526252)

[2.3. Responsive Reserve Events 4](#_Toc162526253)

[2.4. Load Resource Events 5](#_Toc162526254)

[3. Reliability Unit Commitment 5](#_Toc162526255)

[4. IRR, Wind, and Solar Generation as a Percent of Load 5](#_Toc162526256)

[5. Largest Net-Load Ramps 8](#_Toc162526257)

[6. Congestion Analysis 9](#_Toc162526258)

[6.1. Notable Constraints 9](#_Toc162526259)

[6.2. Generic Transmission Constraint Congestion 19](#_Toc162526260)

[6.3. Manual Overrides 19](#_Toc162526261)

[6.4. Congestion Costs for Calendar Year 2024 20](#_Toc162526262)

[7. System Events 21](#_Toc162526263)

[7.1. ERCOT Peak Load 21](#_Toc162526264)

[7.2. Load Shed Events 21](#_Toc162526265)

[7.3. Stability Events 21](#_Toc162526266)

[7.4. Notable PMU Events 21](#_Toc162526267)

[7.5. DC Tie Curtailment 21](#_Toc162526268)

[7.6. TRE/DOE Reportable Events 21](#_Toc162526269)

[7.7. New/Updated Constraint Management Plans 22](#_Toc162526270)

[7.8. New/Modified/Removed RAS 22](#_Toc162526271)

[7.9. New Procedures/Forms/Operating Bulletins 22](#_Toc162526272)

[8. Emergency Conditions 22](#_Toc162526273)

[8.1. OCNs 22](#_Toc162526274)

[8.2. Advisories 22](#_Toc162526275)

[8.3. Watches 23](#_Toc162526276)

[8.4. Emergency Notices 23](#_Toc162526277)

[9. Application Performance 23](#_Toc162526278)

[9.1. TSAT/VSAT Performance Issues 23](#_Toc162526279)

[9.2. Communication Issues 23](#_Toc162526280)

[9.3. Market System Issues 23](#_Toc162526281)

[10. Model Updates 23](#_Toc162526282)

[Appendix A: Real-Time Constraints 25](#_Toc162526283)

# Report Highlights

* The unofficial ERCOT peak demand was 79,698 MW for the month of June on 6/30/2024 HE 18:00; this is 1,128 MW less than the June 2023 peak demand of 80,826 MW on 06/27/2023 HE 18:00.
* A Wind Generation Record of 27,881 MW was set on 06/17/2024 at interval ending 21:15.
* A Solar Generation Record of 19,395 MW was set on 06/22/2024 at interval ending 13:15.
* There were 4 frequency events.
* There were no ERCOT Contingency Reserve Service (ECRS) event.
* There were no Responsive Reserve Service (RRS) events.
* There were 3 DC Tie Curtailments.
* There were 15 HRUC commitments.
* There was 1 advisory issued for a geomagnetic disturbance of [K-7].
* There was 1 advisory issued for a geomagnetic disturbance of [K-8].
* The following GTCs saw congestion in June:

|  |  |
| --- | --- |
| GTC | Days Congestion |
| North Edinburg to Lobo | 27 |
| Zapata Starr | 26 |
| Panhandle GTC | 21 |
| West Texas Export | 15 |
| Nelson Sharpe to Rio Hondo | 14 |
| E\_PASP | 11 |
| E\_PATA | 4 |
| I\_KALO | 4 |
| North to Houston | 5 |
| East Texas | 3 |
| I\_PASP | 2 |
| Treadwell | 2 |
| Hamilton | 1 |
| Valley Export | 1 |
| Williamson-Burnet Import | 1 |

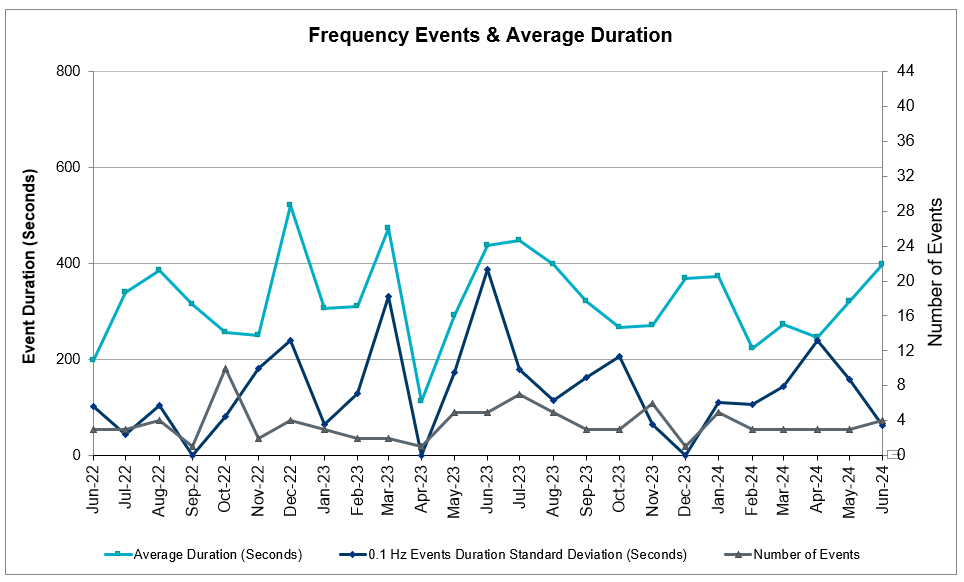
# Frequency Control

## Frequency Events

The ERCOT Interconnection experienced 4 frequency events, which resulted from units tripping. The average event duration was 00:06:38.

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 ECRS deployment. Frequency events that have been identified as Frequency Measurable Events (FME) for purposes of BAL-001-TRE-2 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 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. In the case of negative delta frequency, the MW Loss column could refer to load loss.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Date and Time** | **Delta Frequency** | **Max/Min Frequency** | **Duration of Event** | **PMU Data** | | **MW Loss** | **Load** | **IRR** | **Inertia** |
| **(Hz)** | **(Hz)** | **Oscillation Mode (Hz)** | **Damping Ratio** | **(MW)** | **%** | **(MW-s)** |
| 6/3/2024 23:19:36 | 0.059 | 59.939 | 00:07:45 | 0.7 | 14 | 478 | 57,719 | 30% | 287,855 |
| 6/19/2024 7:15:13 | 0.106 | 59.900 | 00:06:55 | 0.68 | 16 | 793 | 50,915 | 31% | 261,922 |
| 6/25/2024 9:36:49 | 0.062 | 59.952 | 00:06:41 | 0.59 | 16 | 461 | 64,937 | 46% | 309,524 |
| 6/29/2024 19:57:23 | 0.103 | 59.908 | 00:05:12 | 0.69 | 12 | 822 | 75,547 | 30% | 329,424 |



(Note: All data on this graph encompasses frequency event analysis based on BAL-001-TRE-2.)

## ERCOT Contingency Reserve Events

There were 0 events where ERCOT Contingency Reserve MWs were released to SCED. 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 |
| N/A | N/A | N/A | N/A | N/A |

## Responsive Reserve Events

There were 0 events where Responsive Reserve MWs were released to SCED.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date and Time Released to SCED** | **Date and Time Recalled** | **Duration of Event** | **Maximum MWs Released** | **Comments** |
| N/A | N/A | N/A | N/A | N/A |

## Load Resource Events

There were no events where Load Resource MWs were released to SCED.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date and Time Released to SCED** | **Date and Time Recalled** | **Duration of Event** | **Maximum MWs Released** | **Comments** |
| N/A | N/A | N/A | N/A | N/A |

# Reliability Unit Commitment

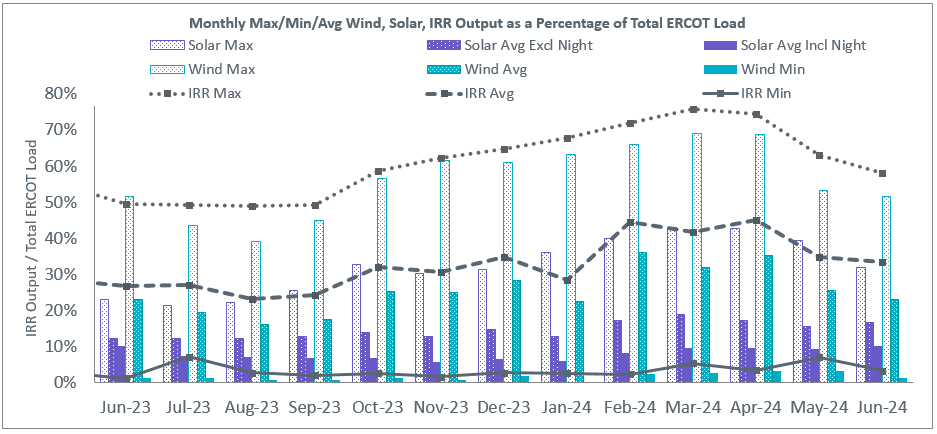
ERCOT reports on Reliability Unit Commitments (RUC) monthly. Commitments are reported grouped by operating day and weather zone. The total number of hours committed is the sum of the hours for all the units in the specified region. Additional information on RUC commitments can be found on the MIS secure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

There were no DRUC commitments.

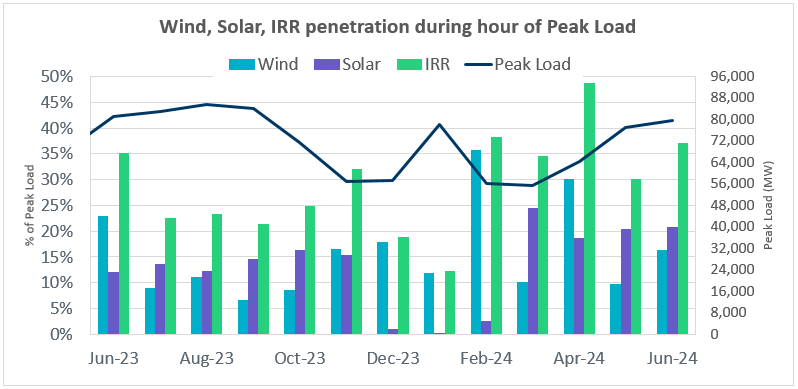
There were 15 HRUC commitments.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Resource Location** | **# of Resources** | **Operating Day** | **Total # of Hours Committed** | **Total MWhs** | **Reason for Commitment** |
| EAST, NORTH\_CENTRAL | 3 | June 9, 2024 | 8 | 3,139.0 | Capacity |
| NORTH\_CENTRAL | 1 | June 10, 2024 | 6 | 342.0 | Capacity |
| NORTH\_CENTRAL, SOUTH\_CENTRAL | 4 | June 12, 2024 | 20 | 2,197.0 | Capacity, Minimum Run Time |
| SOUTH\_CENTRAL | 1 | June 13, 2024 | 6 | 1,200.0 | DSALHUT5 |
| SOUTH\_CENTRAL | 1 | June 14, 2024 | 6 | 1,200.0 | E\_PASP |
| NORTH\_CENTRAL, SOUTH\_CENTRAL | 2 | June 23, 2024 | 11 | 1,975.0 | Capacity |
| NORTH\_CENTRAL | 1 | June 24, 2024 | 19 | 2,945.0 | Minimum Run Time |
| NORTH\_CENTRAL | 1 | June 26, 2024 | 11 | 1,705.0 | Capacity |
| NORTH\_CENTRAL | 1 | June 27, 2024 | 1 | 155.0 | Minimum Run Time |

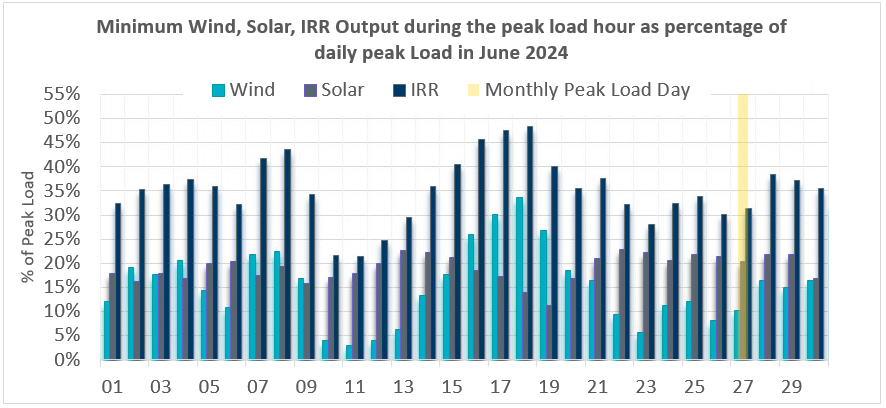
# IRR, Wind, and Solar Generation as a Percent of Load

The graph below shows the maximum, minimum and average aggregate solar, wind and IRR output as a percentage of total ERCOT load when evaluated as 10-minute averaged intervals, over the past 13 months. Current wind and solar generation and penetration records are listed in the footnote below[[1]](#footnote-2). Maximum IRR penetration for the month was 58.15% on 06/16/2024 interval ending 08:50 and minimum IRR penetration for the month was 3.19% on 06/12/2024 interval ending 06:20.

During the hour of peak load for the month, hourly integrated wind generation was 12,975 MW and solar generation was 16,598 MW. The graph below shows the wind and solar penetration percentage during the hour of the peak load in the last 13 months.



Lastly, the graph below shows the minimum wind, solar, and IRR output during the peak load hour as a percentage of the daily peak load for every day in the month.



# Largest Net-Load Ramps

The net-load ramp is defined as the change in net-load (load minus wind and PVGR generation) during the defined time horizon. Such a variation in net-load needs to be accommodated in grid operations to ensure that the reliability of the grid is satisfactorily maintained. The largest net-load ramp during 5-min, 10-min, 15-min, 30-min and 60-min in June 2024 was 1,978 MW, 2,883 MW, 3,466 MW, 4,547 MW, and 7,498 MW, respectively. The comparison with respect to the historical values is given in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Month and Year** | **5 min** | **10 min** | **15 min** | **30 min** | **60 min** |
| June 2014 | 919 MW | 1,329 MW | 1,873 MW | 3,516 MW | 5,724 MW |
| June 2015 | 1,038 MW | 1,771 MW | 2,489 MW | 3,119 MW | 5,360 MW |
| June 2016 | 1,183 MW | 1,716 MW | 2,148 MW | 3,131 MW | 5,975 MW |
| June 2017 | 751 MW | 1,287 MW | 1,772 MW | 3,106 MW | 5,573 MW |
| June 2018 | 1,029 MW | 1,413 MW | 2,035 MW | 3,590 MW | 6,320 MW |
| June 2019 | 824 MW | 1,284 MW | 1,706 MW | 2,985 MW | 5,684 MW |
| June 2020 | 902 MW | 1,615 MW | 2,340 MW | 3,726 MW | 7,015 MW |
| June 2021 | 1,442 MW | 2,157 MW | 2,646 MW | 3,468 MW | 5,963 MW |
| June 2022 | 1,064 MW | 1,588 MW | 2,166 MW | 4,035 MW | 7,866 MW |
| June 2023 | 1,044 MW | 1,672 MW | 2,316 MW | 4,075 MW | 7,845 MW |
| June 2024 | 1,978 MW | 2,883 MW | 3,466 MW | 4,547 MW | 7,498 MW |
| 6/1/2024 | 6/1/2024 | 6/1/2024 | 6/1/2024 | 6/26/2024 |
| (IE 10:07) | (IE 10:09) | (IE 10:09) | (IE 10:23) | (IE 11:10) |
| All Months in 2014-2024 | 1,978 MW | 3,107 MW | 4,588 MW | 8,901 MW | 16,522 MW |
| 6/1/2024 | 1/29/2024 | 1/29/2024 | 1/29/2024 | 1/29/2024 |
| (IE 10:07) | (IE 17:05) | (IE 17:10) | (IE 17:11) | (IE 17:17) |

# Congestion Analysis

## Notable Constraints

Nodal protocol section 3.20 specifies that ERCOT shall identify transmission constraints that are binding in Real-Time three or more Operating Days 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, including approved transmission upgrades from TPIT that may provide some congestion relief based on ERCOT’s engineering judgement. Rows highlighted in blue indicate the congestion was affected by one or more outages. For a list of all constraints activated in SCED, please see Appendix A at the end of this report.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Contingency Name** | **Overloaded Element** | **Contingency Name** | **Overloaded Element** | **# of Days Constraint Binding** | **Congestion Rent** |
|  |
| BASE CASE | WESTEX | Basecase | WESTEX GTC | 12 | $22,947,793.45 |  |
| MHARNED5 | BURNS\_RIOHONDO\_1 | Manual dbl ckt for NEDIN-BONILLA 345kV & RIOH-PRIM138kV | Burns Sub - Rio Hondo 138kV | 24 | $13,496,780.10 |  |
| DSALHUT5 | 1710\_\_C | SALSW - HUTTO 345KV | Bell County - Salado Switch 138kV | 22 | $13,037,132.00 |  |
| MRACNED8 | BURNS\_RIOHONDO\_1 | manual NORTH EDINBURG to REDTAP LIN 1 | Burns Sub - Rio Hondo 138kV | 6 | $8,263,738.40 |  |
| BASE CASE | NE\_LOB | Basecase | NE\_LOB GTC | 26 | $7,765,373.99 |  |
| DWPWFWP5 | STPWAP39\_1 | TWR(345) WAP-WLF64 & WAP-WLY72 | South Texas Project - Wa Parish 345kV | 16 | $5,486,687.21 |  |
| DSALTM58 | SEA\_AAT1 | SALSW TO KNBSW 345 AND TMPSW TO BELCNTY 138 DBLCKT | Seaton 138kV | 22 | $5,294,087.17 |  |
| DHENZOR8 | 261T272\_1 | Mccala-Henne & Zorn 138kV | Crosswinds - Turnersville 138kV | 1 | $4,998,759.64 |  |
| DMGSCON5 | 6471\_\_C | MGSES-LNGSW\_and\_MGSES-CONSW\_345\_DBLCKT | Morgan Creek Ses - Navigation Sub 138kV | 7 | $4,954,379.16 |  |
| DCONLNG5 | 6471\_\_C | CONSW-MGSES\_and\_CONSW-LNGSW\_345kV\_DBLCKT | Morgan Creek Ses - Navigation Sub 138kV | 16 | $4,849,887.36 |  |
| DTMPBE58 | 1660\_\_C | TMPSW TO KNBSW 345 AND TMPSW TO BELCNTY 138 DBLCKT | Round Rock Northeast - Hutto Switch 138kV | 5 | $4,571,990.72 |  |
| SNWEWES8 | BURNS\_RIOHONDO\_1 | WESLACO SWITCH to NORTH MERCEDES LIN 1 | Burns Sub - Rio Hondo 138kV | 12 | $4,273,154.05 |  |
| DTMPBE58 | 1680\_\_A | TMPSW TO KNBSW 345 AND TMPSW TO BELCNTY 138 DBLCKT | Georgetown South - Round Rock Westinghouse 138kV | 4 | $4,245,859.59 |  |
| MPASTNE5 | BURNS\_RIOHONDO\_1 | manual double NEDIN to PALMITO 345 & NEDIN to STEWART 345 | Burns Sub - Rio Hondo 138kV | 4 | $4,179,717.27 |  |
| SHCKRNK5 | 106\_\_A | HICKS SWITCH to HICKS SWITCH LIN \_A | Hicks Switch - Alliance 345kV | 7 | $3,820,842.94 |  |
| SRAYRI38 | HAINE\_\_LA\_PAL1\_1 | LAS PULGAS to RAYMONDVILLE 2 LIN 1 | Haine Drive - La Palma 138kV | 17 | $3,289,936.10 |  |
| MW\_LVLT5 | 15060\_\_B | Manual VLTA\_345 - W\_LD\_345 ckt 345 kV | Koch Tap - Vealmoor 138kV | 13 | $3,007,129.34 |  |
| MLOBFOR5 | ASHERT\_CATARI1\_1 | manual double Lobo to fowlerton 1&2 345 | Asherton - Catarina 138kV | 13 | $2,699,162.50 |  |
| DHUTGEA8 | 1710\_\_C | HUTTO TO RNDRK 138 AND HUTTO TO GEORSO 138 DBLCKT | Bell County - Salado Switch 138kV | 3 | $2,674,701.08 |  |
| MHARNED5 | HAINE\_\_LA\_PAL1\_1 | Manual dbl ckt for NEDIN-BONILLA 345kV & RIOH-PRIM138kV | Haine Drive - La Palma 138kV | 23 | $2,424,700.11 |  |
| SBELTMP8 | 1680\_\_A | BELL COUNTY to TEMPLE SWITCH LIN \_A | Georgetown South - Round Rock Westinghouse 138kV | 1 | $2,270,358.66 |  |
| SWALNAA8 | COLLE\_JUPIT\_1 | NAAMAN to NAAMAN LIN 1 | College - Jupiter 138kV | 4 | $2,207,804.12 |  |
| SBWDDBM5 | LPLMK\_LPLNE\_1 | BLACKWATER DRAW SWITCH to DOUBLE MOUNTAIN SWITCH LIN 1 | Mackenzie Substation - Northeast Substation 115kV | 13 | $2,197,999.80 |  |
| DBIGKEN5 | REDCRE\_WEISS1\_1 | Bighil-Kendal 345kV | San Angelo Red Creek - Weiss 138kV | 14 | $2,167,446.33 |  |
| SBELTMP8 | 1660\_\_C | BELL COUNTY to TEMPLE SWITCH LIN \_A | Round Rock Northeast - Hutto Switch 138kV | 2 | $2,071,539.28 |  |
| SPEBTRU8 | 940\_\_A | GAMMA to GAMMA LIN \_D | Ennis West Switch - Templeton 138kV | 3 | $1,923,696.60 |  |
| SCRMSAR8 | ORNT\_REDCRE1\_1 | SAN ANGELO RED CREEK to Weiss LIN 1 | Orient - San Angelo Red Creek 138kV | 5 | $1,879,718.70 |  |
| BASE CASE | PNHNDL | Basecase | PNHNDL GTC | 16 | $1,712,111.78 |  |
| MLARMIL8 | DEL\_MA\_LAREDO1\_1 | Manual MILO - LAREDO VFT NORTH | Del Mar - Laredo Plant 138kV | 2 | $1,674,245.03 |  |
| MLOBFOR5 | CATARI\_PILONC1\_1 | manual double Lobo to fowlerton 1&2 345 | Catarina - Piloncillo 138kV | 5 | $1,647,241.34 |  |
| DBAKCED5 | 6056\_\_A | BAKESW-CEDACA 345kV & BAKESW-CEDACA 345kV | Longshore Switch - Consavvy Switch 345kV | 6 | $1,636,364.34 |  |
| DWLFMOS5 | 6520\_\_E | WLFSW-MOSSW 345&WLFSW-ODEHV 345\_\_\_\_TRPLCKT-1of3 | Odessa Ehv Switch - Yarbrough Sub 138kV | 20 | $1,612,399.84 |  |
| SDBMFID5 | LPLHY\_LPLDB\_1 | DOUBLE MOUNTAIN SWITCH to DOUBLE MOUNTAIN SWITCH LIN 1 | Holly Substation - Dunbar Substation 115kV | 5 | $1,596,760.63 |  |
| SSTILOM8 | SCARBI\_TITAN\_1\_1 | STILLMAN to LOMA ALTA SUBSTATION LIN 1 | Titan Substation - South Carbide 138kV | 3 | $1,415,116.11 |  |
| DCONLNG5 | 14040\_\_A | CONSW-MGSES\_and\_CONSW-LNGSW\_345kV\_DBLCKT | Polecat Creek Switch - Dewey Lake Tap 138kV | 10 | $1,370,968.98 |  |
| SECRDMT8 | 6235\_\_A | Dermott Switch to Dermott Switch LIN \_A | China Grove Switch - Snyder 138kV | 1 | $1,369,414.33 |  |
| SNLAGAT8 | DEL\_MA\_LAREDO1\_1 | NORTH LAREDO Switch to GATEWAY WEST TAP LIN 1 | Del Mar - Laredo Plant 138kV | 5 | $1,366,718.82 |  |
| SDELLAR8 | LARDVN\_LASCRU1\_1 | DEL MAR to DEL MAR LIN 1 | Laredo Vft North - Las Cruces 138kV | 3 | $1,309,974.48 |  |
| SBAKCED5 | 6056\_\_A | BAKERSFIELD SWITCHYARD to CEDAR CANYON LIN 1 | Longshore Switch - Consavvy Switch 345kV | 8 | $1,276,169.14 |  |
| DBIGKEN5 | TREADW\_YELWJC1\_1 | Bighil-Kendal 345kV | Yellow Jacket - Treadwell 138kV | 16 | $1,200,820.12 |  |
| MLOBFOR5 | LARDVN\_LASCRU1\_1 | manual double Lobo to fowlerton 1&2 345 | Laredo Vft North - Las Cruces 138kV | 10 | $1,067,546.27 |  |
| BASE CASE | E\_PASP | Basecase | E\_PASP GTC | 8 | $964,601.58 |  |
| DBIGSCH5 | PALOUS\_WOLFCA1\_1 | Big Hill - Schneeman Draw & Big Hill - Schneeman Draw 2 | Palouse - Wolfcamp 138kV | 11 | $936,801.73 |  |
| SBENS\_M8 | BENTS\_FRTER\_1B\_1 | SOUTH MCALLEN to BENTSEN LIN 1 | Frontera - South Mission 138kV | 11 | $880,266.69 |  |
| DRNS\_TB5 | OB\_ZEN71\_A | Rns-Rtw & Sng-Tb 345kV | Obrien - Zenith 345kV | 3 | $879,604.01 |  |
| BASE CASE | ZAPSTR | Basecase | ZAPSTR GTC | 23 | $878,367.36 |  |
| DVLSPAC5 | 871\_\_A | VLSES-PACSW 345&PRSSW-VLYSO 345 DBLCKT | Commerce Switch - Commerce 138kV | 6 | $833,984.67 |  |
| SW\_GODE5 | 15060\_\_B | ODESSA EHV SWITCH to ODESSA EHV SWITCH LIN 1 | Koch Tap - Vealmoor 138kV | 4 | $735,803.72 |  |
| DSTEXP12 | BLESSI\_LOLITA1\_1 | South Texas # 1 & # 2 | Blessing - Lolita 138kV | 16 | $729,610.03 |  |
| DCAGCI58 | 255T279\_1 | Cagnon-Kendal 345 &Cico-Mengcr 138 | Medina Lake - Pipe Creek 138kV | 4 | $707,792.40 |  |
| DBIGKEN5 | ORNT\_REDCRE1\_1 | Bighil-Kendal 345kV | Orient - San Angelo Red Creek 138kV | 5 | $664,717.64 |  |
| DLWSRNK5 | 587\_\_A | LWSSW TO RNKSW AND LWSSW TO KRWSW 345 DBLCKT | Argyle - Highlands Tnp 138kV | 3 | $592,390.63 |  |
| DMTSCOS5 | 6437\_\_F | DMTSW TO SCOSW 345 DBLCKT | Knapp - Scurry Chevron 138kV | 7 | $539,728.29 |  |
| DVENFTS5 | 245\_\_A | VENSW-FTSSW & VENSW-SAMSW 345 DBLCKT | St Johns Switch - Bale Switch 345kV | 5 | $537,510.33 |  |
| DBIGSCH5 | BAKRFLD\_CEDCAN\_1 | Big Hill - Schneeman Draw & Big Hill - Schneeman Draw 2 | Cedar Canyon - Bakersfield 345kV | 5 | $532,957.41 |  |
| SHAYZO25 | 6T227\_1 | HAYS ENERGY to ZORN LIN 1 | Zorn - Hays Energy 345kV | 8 | $516,822.79 |  |
| SBTPBNT8 | MYRA\_VAL\_1 | BENNETT ROAD SWITCH to WISE COUNTY LIN \_B | Myra - Valley View Bepc 138kV | 5 | $475,498.55 |  |
| DZORHAY5 | BERGHE\_AT1H | ZORN - HAYSEN 345KV | Bergheim 345kV | 4 | $474,751.62 |  |
| DRESMCM8 | RINCON\_WHITE\_2\_1 | I\_DUPS - RESNIK & MCCAMPBE 2 138KV | Whitepoint - Rincon 138kV | 6 | $467,349.19 |  |
| DZORHAY5 | BERGHE\_AT1L | ZORN - HAYSEN 345KV | Bergheim 138kV | 5 | $348,736.05 |  |
| DGRMGRS8 | 6830\_\_B | FIREROCK TO BRNWD 138 AND FIREROCK TO BANGS 69 DBLCKT | Cottonwood Road Switch - Olney Pod 69kV | 5 | $202,678.14 |  |
| SCMNCPS5 | 651\_\_B | COMANCHE SWITCH (Oncor) to COMANCHE PEAK SES LIN \_A | Comanche Tap - Comanche Switch (Oncor) 138kV | 4 | $186,135.66 |  |
| DBIGKEN5 | HAMILT\_MAXWEL1\_1 | Bighil-Kendal 345kV | Hamilton Road - Maxwell 138kV | 10 | $180,087.33 |  |
| DRNKLWS5 | 584\_\_A | RNKSW TO LWSSW 345 AND RNKSW TO W DENT 345 DBLCKT | Argyle - Krum Tap Switch 138kV | 3 | $164,573.74 |  |
| SBRAPIN8 | HAMILT\_MAVERI1\_1 | BRACKETTVILLE to BRACKETTVILLE LIN 1 | Hamilton Road - Maverick 138kV | 14 | $163,761.03 |  |
| SN\_SLON5 | N\_SHARPE\_XF1 | LON HILL to NELSON SHARPE LIN 1 | Nelson Sharpe 345kV | 3 | $160,031.13 |  |
| DWO5\_EU8 | HY\_WZ\_24\_A | TWR (345/138) EU-SF09 & WO-JN72 | Hayes - Westchase 138kV | 3 | $158,766.78 |  |
| DGRSPKR5 | 6377\_\_A | GRSES TO PKRSW 345 DBLCKT | Barton Chapel Wind Farm - Oran Sub 138kV | 3 | $155,807.15 |  |
| DCAGCO58 | 656T656\_1 | Cagnon-Kendal 345 & Cico-Comfor 138 | Bergheim - Kendall 345kV | 4 | $151,898.97 |  |
| DBIGKEN5 | MADDUX\_TREADW1\_1 | Bighil-Kendal 345kV | Maddux - Treadwell 138kV | 5 | $146,485.38 |  |
| BASE CASE | NELRIO | Basecase | NELRIO GTC | 10 | $140,074.31 |  |
| BASE CASE | I\_KALO | Basecase | I\_KALO GTC | 4 | $133,559.12 |  |
| MMDOOAS5 | MSNPET04\_A | MANUAL MEADOW to OASIS CKT 99 LIN A | Monsan Cogen - Petson 138kV | 3 | $133,049.94 |  |
| MPEAMOO8 | PALDRO\_DILLEY\_1 | manual PEARSALL to MOORE 138 KV (PRIOR TO PEARSALL\_HORIZ.1 LINE ENERGIZATION) | Paloduro Sub - Dilley Switch Aep 138kV | 8 | $114,694.11 |  |
| SRICGRS8 | 6840\_\_B | GRAHAM SES to RICE SWITCH LIN \_A | Anarene - Navy Kickapoo Switch 69kV | 5 | $93,262.13 |  |
| DVLSPAC5 | 389\_\_A | VLSES-PACSW 345&PRSSW-VLYSO 345 DBLCKT | Monticello Ses - Woodard Switch 345kV | 6 | $79,589.33 |  |
| SN\_SAJO5 | LASPUL\_RAYMND1\_1 | AJO to AJO LIN 1 | Las Pulgas - Raymondville 2 138kV | 5 | $78,200.32 |  |
| SRRDLCS5 | 245\_\_A | Rattlesnake Rd Switch to LAKE CREEK SES LIN \_A | St Johns Switch - Bale Switch 345kV | 5 | $69,797.03 |  |
| SFORYEL8 | HEXT\_MASONS1\_1 | FORT MASON to FORT MASON LIN 1 | Mason Switching Station - Hext Lcra 69kV | 4 | $58,297.98 |  |
| DRAZSA89 | 2585\_1 | Double Circuit RAZORBAC to DRYFRIO 138 kV & UVALDE to SABINAL 69 kV | Moore Switching Station - Downie Switching Station 138kV | 5 | $52,073.39 |  |
| SBRAUVA8 | BRACKE\_ESCOND1\_1 | ODLAW SWITCH to ASPHALT MINES LIN 1 | Brackettville - Escondido 138kV | 6 | $50,423.97 |  |
| DCAGCO58 | 583T583\_1 | Cagnon-Kendal 345 & Cico-Comfor 138 | Mason Creek - Bandera 138kV | 4 | $41,807.05 |  |
| SOWLBIG8 | BISON\_STRS1\_1 | Owls to BIG LAKE LIN 1 | Bison - Strauss Rea 69kV | 4 | $39,198.05 |  |
| DBUCRGP5 | 651\_\_B | MANUAL DOUBLE RGPSW - KLNSW 345 KV & BUCSW - KLNSW 345 KV | Comanche Tap - Comanche Switch (Oncor) 138kV | 3 | $28,086.16 |  |
| DRAZSA89 | READIN\_UVALDE1\_1 | Double Circuit RAZORBAC to DRYFRIO 138 kV & UVALDE to SABINAL 69 kV | Uvalde Aep - Reading 138kV | 3 | $11,862.02 |  |
| SMADSAP8 | MADDUX\_SAPOWE2\_1 | MADDUX to SAN ANGELO POWER STATION LIN 1 | Maddux - San Angelo Power Station 138kV | 5 | $9,882.63 |  |

## Generic Transmission Constraint Congestion

|  |  |
| --- | --- |
| GTC | Days Congestion |
| North Edinburg to Lobo | 27 |
| Zapata Starr | 26 |
| Panhandle GTC | 21 |
| West Texas Export | 15 |
| Nelson Sharpe to Rio Hondo | 14 |
| E\_PASP | 11 |
| E\_PATA | 4 |
| I\_KALO | 4 |
| North to Houston | 5 |
| East Texas | 3 |
| I\_PASP | 2 |
| Treadwell | 2 |
| Hamilton | 1 |
| Valley Export | 1 |
| Williamson-Burnet Import | 1 |

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 2024

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** | **Overloaded Element** | **# of 5-min SCED** | **Estimated Congestion Rent (2024)** |
| Basecase | WESTEX GTC | 16,357 | $87,831,482.64 |
| MGSES TO CCRSW 345 AND BTRCK TO MGSES 345 DBLCKT | Tonkawa Switch - Morgan Creek Ses 345kV | 7,456 | $87,576,954.87 |
| BAKERSFIELD SWITCHYARD to CEDAR CANYON LIN 1 | Hargrove - Twin Buttes 138kV | 5,254 | $38,340,408.00 |
| Basecase | NE\_LOB GTC | 20,866 | $31,918,984.93 |
| Manual dbl ckt for NEDIN-BONILLA 345kV & RIOH-PRIM138kV | Burns Sub - Rio Hondo 138kV | 13,258 | $30,889,971.88 |
| SALSW - HUTTO 345KV | Bell County - Salado Switch 138kV | 6,085 | $29,998,962.38 |
| BLACKWATER DRAW SWITCH to DOUBLE MOUNTAIN SWITCH LIN 1 | Northwest Substation - Mcdonald Substation 115kV | 4,428 | $23,761,397.68 |
| Basecase | PNHNDL GTC | 18,703 | $23,607,124.54 |
| manual double NEDIN to PALMITO 345 & NEDIN to STEWART 345 | Burns Sub - Rio Hondo 138kV | 1,772 | $15,541,874.05 |
| CONSW-MGSES\_and\_CONSW-LNGSW\_345kV\_DBLCKT | Morgan Creek Ses - Navigation Sub 138kV | 3,475 | $13,412,664.02 |
| FOWLERTON TRX FOWLRTON\_AUTO1 345/138 | Laredo Vft North - Las Cruces 138kV | 6,265 | $13,110,290.05 |
| CONSW-MGSES\_and\_CONSW-LNGSW\_345kV\_DBLCKT | Falcon Seaboard - Morgan Creek Ses 345kV | 6,624 | $12,768,515.79 |
| MGSES-LNGSW\_and\_MGSES-CONSW\_345\_DBLCKT | Morgan Creek Ses - Navigation Sub 138kV | 1,916 | $12,048,650.47 |
| SALSW TO KLNSW 345 DBLCKT | Harker Heights South - Killeen Switch 138kV | 5,004 | $11,899,287.91 |
| EVERMAN SWITCH TRX EVRSW\_4\_1 345/138 | Everman Switch 345kV | 386 | $11,447,643.03 |
| Basecase | I\_KALO GTC | 1,250 | $10,668,983.19 |
| CCRSW TO SWESW 345 AND BTRCK TO MGSES 345 DBLCKT | Tonkawa Switch - Morgan Creek Ses 345kV | 6,265 | $10,452,257.39 |
| manual NORTH EDINBURG to REDTAP LIN 1 | Burns Sub - Rio Hondo 138kV | 937 | $10,333,018.08 |
| MANUAL DOUBLE TMPCR - THSES AND TMPSW - BLFSW 345 KV DBCKT | Perry 138kV | 2,725 | $10,146,209.07 |
| Basecase | EASTEX GTC | 431 | $9,702,373.81 |

# System Events

## ERCOT Peak Load

The unofficial ERCOT peak load for the month was 79,698 MW and occurred on 06/30/2024, during hour ending 18:00. Instantaneous peak was 80,629 MW. Actual peak for same month last year was 80,826 MW.

## Load Shed Events

None.

## Stability Events

None.

## Notable PMU Events

ERCOT analyzes PMU data for any significant system disturbances that do not fall into the Frequency Events category reported in section 2.1. The results are summarized in this section once the analysis has been completed.

There were no PMU events outside of those reported in section 2.1.

## DC Tie Curtailment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Date** | **DC Tie** | **Curtailing Period** | **# of Tags Curtailed** | **Initiating Event** | **Curtailment Reason[[2]](#footnote-3),[[3]](#footnote-4)** |
| 6/14/2024 | DC\_L | 6/14/2024 11:42 – 6/15/2024 10:24 | 4 | Tie was derated to 66 MW |  |
| 6/20/2024 | DC\_L | 6/20/2024 02:17 – 6/21/2024 17:50 | 4 | Forced Outage |  |
| 6/25/2024 | DC\_L | 6/25/2024 04:13 – 7/02/2024 |  | Forced Outage |  |

## TRE/DOE Reportable Events

BPUB Submitted a DOE 417 for 06/07/2024 - Suspicious activity to its Facility.

ONCOR Submitted a DOE-417 for 06/10/2024 - Loss of electric service to more than 50,000 customers for 1 hour or more.

## New/Updated Constraint Management Plans

Updated MPs:

* MP\_2024\_01, MP\_2023\_06

## New/Modified/Removed RAS

None.

## New Procedures/Forms/Operating Bulletins

|  |  |  |
| --- | --- | --- |
| **Date** | **Subject** | **Bulletin No.** |
| 06/27/2024 | Real Time Desk V1 Rev 96 | 1142 |
| 06/27/2024 | Transmission and Security Desk V1 Rev 111 | 1143 |

# Emergency Conditions

## OCNs

None.

## Advisories

|  |  |
| --- | --- |
| **Date and Time** | **Message** |
| Jun 28, 2024 8:51:00 CST | Advisory issued for a geomagnetic disturbance of [K-8] until [16:00]. |
| Jun 28, 2024 9:28:41 CST | Advisory issued for a geomagnetic disturbance of [K-7] until [16:00]. |

## Watches

None.

## Emergency Notices

None.

# Application Performance

## TSAT/VSAT Performance Issues

None

## Communication Issues

None.

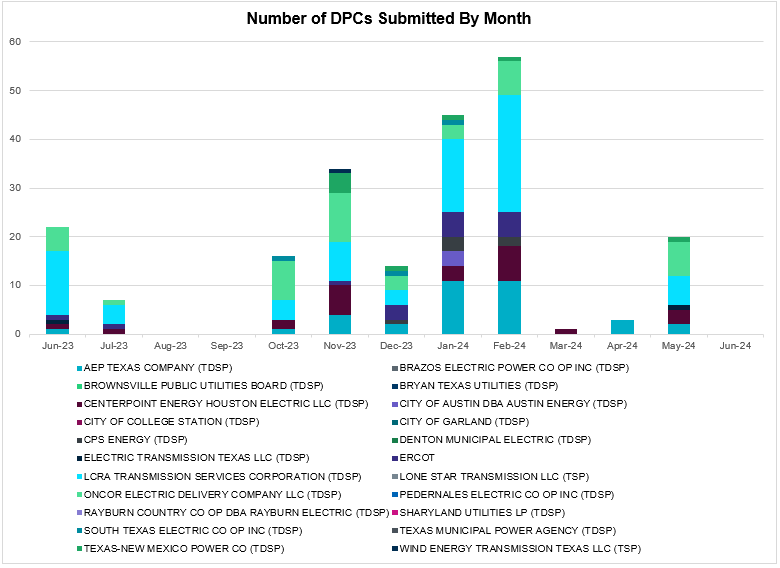
## Market System Issues

None.

# Model Updates

The Downstream Production Change (DPC) process allows ERCOT to make changes in the one-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** |
| AEP TEXAS COMPANY (TDSP) | 0 |
| BRAZOS ELECTRIC POWER CO OP INC (TDSP) | 0 |
| BROWNSVILLE PUBLIC UTILITIES BOARD (TDSP) | 0 |
| BRYAN TEXAS UTILITIES (TDSP) | 0 |
| CENTERPOINT ENERGY HOUSTON ELECTRIC LLC (TDSP) | 0 |
| CITY OF AUSTIN DBA AUSTIN ENERGY (TDSP) | 0 |
| CITY OF COLLEGE STATION (TDSP) | 0 |
| CITY OF GARLAND (TDSP) | 0 |
| CPS ENERGY (TDSP) | 0 |
| DENTON MUNICIPAL ELECTRIC (TDSP) | 0 |
| ELECTRIC TRANSMISSION TEXAS LLC (TDSP) | 0 |
| ERCOT | 0 |
| LCRA TRANSMISSION SERVICES CORPORATION (TDSP) | 0 |
| LONE STAR TRANSMISSION LLC (TSP) | 0 |
| ONCOR ELECTRIC DELIVERY COMPANY LLC (TDSP) | 0 |
| PEDERNALES ELECTRIC CO OP INC (TDSP) | 0 |
| RAYBURN COUNTRY CO OP DBA RAYBURN ELECTRIC (TDSP) | 0 |
| SHARYLAND UTILITIES LP (TDSP) | 0 |
| SOUTH TEXAS ELECTRIC CO OP INC (TDSP) | 0 |
| TEXAS MUNICIPAL POWER AGENCY (TDSP) | 0 |
| TEXAS-NEW MEXICO POWER CO (TDSP) | 0 |
| WIND ENERGY TRANSMISSION TEXAS LLC (TSP) | 0 |

# Appendix A: Real-Time Constraints

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Year | Month of the Year | Contingency Name | Overloaded Element | From Station | To Station | Count of Days |
| 2024 | 6 | BASE CASE | NE\_LOB | n/a | n/a | 27 |
| 2024 | 6 | BASE CASE | ZAPSTR | n/a | n/a | 26 |
| 2024 | 6 | MHARNED5 | HAINE\_\_LA\_PAL1\_1 | LA\_PALMA | HAINE\_DR | 26 |
| 2024 | 6 | DWLFMOS5 | 6520\_\_E | ODEHV | YARBR | 25 |
| 2024 | 6 | MHARNED5 | BURNS\_RIOHONDO\_1 | RIOHONDO | MV\_BURNS | 25 |
| 2024 | 6 | DSALHUT5 | 1710\_\_C | BELCNTY | SALSW | 25 |
| 2024 | 6 | DSALTM58 | SEA\_AAT1 | SEA | SEA | 24 |
| 2024 | 6 | SRAYRI38 | HAINE\_\_LA\_PAL1\_1 | LA\_PALMA | HAINE\_DR | 23 |
| 2024 | 6 | SBENS\_M8 | BENTS\_FRTER\_1B\_1 | S\_MISSIN | FRONTERA | 21 |
| 2024 | 6 | SBENS\_M8 | BENTS\_FRTER\_1B\_1 | FRONTERA | S\_MISSIN | 21 |
| 2024 | 6 | BASE CASE | PNHNDL | n/a | n/a | 21 |
| 2024 | 6 | DCONLNG5 | 6471\_\_C | MGSES | NAVIG | 18 |
| 2024 | 6 | MW\_LVLT5 | 15060\_\_B | VEALMOOR | KOCHTAP | 18 |
| 2024 | 6 | DSTEXP12 | BLESSI\_LOLITA1\_1 | LOLITA | BLESSING | 17 |
| 2024 | 6 | DBIGKEN5 | TREADW\_YELWJC1\_1 | TREADWEL | YELWJCKT | 17 |
| 2024 | 6 | DCONLNG5 | 14040\_\_A | PCTSW | DEWTP | 17 |
| 2024 | 6 | DWPWFWP5 | STPWAP39\_1 | STP | WAP | 17 |
| 2024 | 6 | SBRAPIN8 | HAMILT\_MAVERI1\_1 | HAMILTON | MAVERICK | 16 |
| 2024 | 6 | SBRAPIN8 | HAMILT\_MAVERI1\_1 | MAVERICK | HAMILTON | 16 |
| 2024 | 6 | BASE CASE | WESTEX | n/a | n/a | 15 |
| 2024 | 6 | SBWDDBM5 | LPLMK\_LPLNE\_1 | LPLMK | LPLNE | 15 |
| 2024 | 6 | DBIGKEN5 | REDCRE\_WEISS1\_1 | REDCREEK | WEISS | 15 |
| 2024 | 6 | BASE CASE | NELRIO | n/a | n/a | 14 |
| 2024 | 6 | MLOBFOR5 | ASHERT\_CATARI1\_1 | CATARINA | ASHERTON | 13 |
| 2024 | 6 | DBIGSCH5 | PALOUS\_WOLFCA1\_1 | PALOUSE | WOLFCAMP | 13 |
| 2024 | 6 | SNWEWES8 | BURNS\_RIOHONDO\_1 | RIOHONDO | MV\_BURNS | 13 |
| 2024 | 6 | SHAYZO25 | 6T227\_1 | HAYSEN | ZORN | 13 |
| 2024 | 6 | DMGSCON5 | 6471\_\_C | MGSES | NAVIG | 13 |
| 2024 | 6 | MLOBFOR5 | ASHERT\_CATARI1\_1 | ASHERTON | CATARINA | 13 |
| 2024 | 6 | MLOBFOR5 | LARDVN\_LASCRU1\_1 | LARDVNTH | LASCRUCE | 13 |
| 2024 | 6 | DMTSCOS5 | 6437\_\_F | SCRCV | KNAPP | 13 |
| 2024 | 6 | BASE CASE | E\_PASP | n/a | n/a | 11 |
| 2024 | 6 | SBAKCED5 | 6056\_\_A | LNGSW | CONSW | 11 |
| 2024 | 6 | MLOBFOR5 | CATARI\_PILONC1\_1 | PILONCIL | CATARINA | 11 |
| 2024 | 6 | MLOBFOR5 | CATARI\_PILONC1\_1 | CATARINA | PILONCIL | 11 |
| 2024 | 6 | DBIGKEN5 | HAMILT\_MAXWEL1\_1 | MAXWELL | HAMILTON | 11 |
| 2024 | 6 | SBONNED5 | BURNS\_RIOHONDO\_1 | RIOHONDO | MV\_BURNS | 11 |
| 2024 | 6 | SHCKRNK5 | 106\_\_A | HCKSW | ALLNC | 10 |
| 2024 | 6 | DRESMCM8 | RINCON\_WHITE\_2\_1 | RINCON | WHITE\_PT | 9 |
| 2024 | 6 | SFORYEL8 | HEXT\_MASONS1\_1 | MASONSW | HEXT | 9 |
| 2024 | 6 | SFORYEL8 | HEXT\_MASONS1\_1 | HEXT | MASONSW | 9 |
| 2024 | 6 | SRRDLCS5 | 245\_\_A | SJNSW | BALSW | 9 |
| 2024 | 6 | DRESMCM8 | RINCON\_WHITE\_2\_1 | WHITE\_PT | RINCON | 9 |
| 2024 | 6 | MPEAMOO8 | PALDRO\_DILLEY\_1 | PALODURO | DILLEYSW | 9 |
| 2024 | 6 | DZORHAY5 | BERGHE\_AT1L | BERGHE | BERGHE | 8 |
| 2024 | 6 | DGRMGRS8 | 6830\_\_B | CRDSW | OLNEY | 8 |
| 2024 | 6 | SFORYEL8 | HEXT\_YELWJC1\_1 | YELWJCKT | HEXT | 8 |
| 2024 | 6 | SFORYEL8 | HEXT\_YELWJC1\_1 | HEXT | YELWJCKT | 8 |
| 2024 | 6 | DBIGSCH5 | BAKRFLD\_CEDCAN\_1 | CEDACA | BAKESW | 7 |
| 2024 | 6 | SN\_SAJO5 | LASPUL\_RAYMND1\_1 | LASPULGA | RAYMND2 | 7 |
| 2024 | 6 | SDBMFID5 | LPLHY\_LPLDB\_1 | LPLDB | LPLHY | 7 |
| 2024 | 6 | SBTPBNT8 | MYRA\_VAL\_1 | MYRA | VALYVIEW | 7 |
| 2024 | 6 | MRACNED8 | BURNS\_RIOHONDO\_1 | RIOHONDO | MV\_BURNS | 7 |
| 2024 | 6 | DCAGCI58 | 255T279\_1 | PIPECR | MEDILA | 7 |
| 2024 | 6 | DCAGCO58 | 656T656\_1 | KENDAL | BERGHE | 7 |
| 2024 | 6 | SBRAUVA8 | BRACKE\_ESCOND1\_1 | BRACKETT | ESCONDID | 7 |
| 2024 | 6 | DBAKCED5 | 6056\_\_A | LNGSW | CONSW | 7 |
| 2024 | 6 | DTMPBE58 | 1680\_\_A | RRWES | GEORSO | 6 |
| 2024 | 6 | MPASTNE5 | BURNS\_RIOHONDO\_1 | RIOHONDO | MV\_BURNS | 6 |
| 2024 | 6 | DBIGKEN5 | ORNT\_REDCRE1\_1 | REDCREEK | ORNT | 6 |
| 2024 | 6 | DHUTGEA8 | 1710\_\_C | BELCNTY | SALSW | 6 |
| 2024 | 6 | DCAGCO58 | 583T583\_1 | BANDER | MASOCR | 6 |
| 2024 | 6 | DVLSPAC5 | 871\_\_A | COMRC | COMSW | 6 |
| 2024 | 6 | SCRMSAR8 | ORNT\_REDCRE1\_1 | REDCREEK | ORNT | 6 |
| 2024 | 6 | SMADSAP8 | MADDUX\_SAPOWE2\_1 | SAPOWER | MADDUX | 6 |
| 2024 | 6 | DVLSPAC5 | 389\_\_A | WDDSW | MNSES | 6 |
| 2024 | 6 | SCMNCPS5 | 651\_\_B | CMNSW | CMNTP | 6 |
| 2024 | 6 | SRAYHAR8 | HAINE\_\_LA\_PAL1\_1 | LA\_PALMA | HAINE\_DR | 6 |
| 2024 | 6 | SMADSAP8 | MADDUX\_SAPOWE2\_1 | MADDUX | SAPOWER | 6 |
| 2024 | 6 | SRICGRS8 | 6840\_\_B | NVKSW | ANARN | 6 |
| 2024 | 6 | SW\_GODE5 | 15060\_\_B | VEALMOOR | KOCHTAP | 5 |
| 2024 | 6 | DWPWFCK5 | STPWAP39\_1 | STP | WAP | 5 |
| 2024 | 6 | MMDOOAS5 | MSNPET04\_A | PET | MSN | 5 |
| 2024 | 6 | SNLAGAT8 | DEL\_MA\_LAREDO1\_1 | LAREDO | DEL\_MAR | 5 |
| 2024 | 6 | DBIGKEN5 | MADDUX\_TREADW1\_1 | MADDUX | TREADWEL | 5 |
| 2024 | 6 | DTMPBE58 | 1660\_\_C | HUTTO | RRNES | 5 |
| 2024 | 6 | SRRDLCS5 | 235\_\_B | BALSW | JEWET | 5 |
| 2024 | 6 | SS\_MRAI8 | BENTSE\_S\_MCAL1\_1 | S\_MCALLN | BENTSEN | 5 |
| 2024 | 6 | DBLBYWF5 | STPWAP39\_1 | STP | WAP | 5 |
| 2024 | 6 | DRAZSA89 | 2585\_1 | DOWNIES | MOORE | 5 |
| 2024 | 6 | SPEBTRU8 | 940\_\_A | ENWSW | TMPTN | 5 |
| 2024 | 6 | DSALHUT5 | 1710\_\_E | SALSW | SALDS | 5 |
| 2024 | 6 | DVENFTS5 | 245\_\_A | SJNSW | BALSW | 5 |
| 2024 | 6 | DCONLNG5 | 6046\_\_A | MGSES | FLCNS | 5 |
| 2024 | 6 | MHARRIO5 | HAINE\_\_LA\_PAL1\_1 | LA\_PALMA | HAINE\_DR | 5 |
| 2024 | 6 | BASE CASE | N\_TO\_H | n/a | n/a | 5 |
| 2024 | 6 | DCAGCI58 | 656T656\_1 | KENDAL | BERGHE | 5 |
| 2024 | 6 | SWALNAA8 | COLLE\_JUPIT\_1 | COLLEGE | JUPITER | 5 |
| 2024 | 6 | DZORHAY5 | BERGHE\_AT1H | BERGHE | BERGHE | 5 |
| 2024 | 6 | SKOCBUZ8 | 6217\_\_A | WLVSW | GAILS | 4 |
| 2024 | 6 | DRAZSA89 | READIN\_UVALDE1\_1 | UVALDE | READING | 4 |
| 2024 | 6 | DFOWSMG5 | AEPCHKCN\_SGMOR\_1 | CHOKCNYN | SIGMOR | 4 |
| 2024 | 6 | SOWLBIG8 | BISON\_STRS1\_1 | BISON | STRS | 4 |
| 2024 | 6 | SKEYWLV8 | 15060\_\_B | VEALMOOR | KOCHTAP | 4 |
| 2024 | 6 | SNATBEA8 | 6144\_\_A | BSPRW | STASW | 4 |
| 2024 | 6 | DRNS\_TB5 | OB\_ZEN71\_A | ZEN | OB | 4 |
| 2024 | 6 | DKENCA58 | 656T656\_1 | KENDAL | BERGHE | 4 |
| 2024 | 6 | BASE CASE | I\_KALO | n/a | n/a | 4 |
| 2024 | 6 | DLWSRNK5 | 587\_\_A | ARGYL | LWSVH | 4 |
| 2024 | 6 | DVENFTS5 | 235\_\_B | BALSW | JEWET | 4 |
| 2024 | 6 | DBUCRGP5 | 651\_\_B | CMNSW | CMNTP | 4 |
| 2024 | 6 | SOWLBIG8 | BISON\_STRS1\_1 | STRS | BISON | 4 |
| 2024 | 6 | BASE CASE | E\_PATA | n/a | n/a | 4 |
| 2024 | 6 | MW\_LVLT5 | 15060\_\_A | KOCHTAP | BUZSW | 4 |
| 2024 | 6 | SVEAW\_L5 | 6217\_\_A | WLVSW | GAILS | 4 |
| 2024 | 6 | SBELTMP8 | 1660\_\_C | HUTTO | RRNES | 4 |
| 2024 | 6 | DFOWSMG5 | ASHERT\_CATARI1\_1 | ASHERTON | CATARINA | 4 |
| 2024 | 6 | SI\_DWH38 | I\_DUPS\_RESNIK2\_2 | I\_DUPSW | RESNIK | 4 |
| 2024 | 6 | SALLHCK5 | 107\_\_A | HCKSW | RNKSW | 4 |
| 2024 | 6 | DCONLNG5 | 14040\_\_E | DEWTP | MDPOD | 3 |
| 2024 | 6 | DCDHTVW5 | 310\_\_A | LIGSW | NORSW | 3 |
| 2024 | 6 | XFTS89 | ALPINE\_BRONCO1\_1 | BRONCO | ALPINE | 3 |
| 2024 | 6 | SSOLALM8 | BARL\_FMR1 | BARL | BARL | 3 |
| 2024 | 6 | SN\_SLON5 | N\_SHARPE\_XF1 | N\_SHARPE | N\_SHARPE | 3 |
| 2024 | 6 | DPRSPAC5 | 871\_\_A | COMRC | COMSW | 3 |
| 2024 | 6 | SCO2EUL8 | COLETO\_ROSATA1\_1 | COLETO | ROSATA | 3 |
| 2024 | 6 | SMCEABS8 | MKLT\_TRNT1\_1 | TRNT | MKLT | 3 |
| 2024 | 6 | DHCKRNK5 | 584\_\_A | KRMSW | ARGYL | 3 |
| 2024 | 6 | BASE CASE | EASTEX | n/a | n/a | 3 |
| 2024 | 6 | DWO5\_EU8 | HY\_WZ\_24\_A | WZ | HY | 3 |
| 2024 | 6 | DMCEBUT8 | MKLT\_TRNT1\_1 | TRNT | MKLT | 3 |
| 2024 | 6 | MANGWHP5 | BLESSI\_LOLITA1\_1 | LOLITA | BLESSING | 3 |
| 2024 | 6 | SDELLAR8 | LARDVN\_LASCRU1\_1 | LARDVNTH | LASCRUCE | 3 |
| 2024 | 6 | SSTILOM8 | SCARBI\_TITAN\_1\_1 | SCARBIDE | TITAN\_SU | 3 |
| 2024 | 6 | SW\_LVLT5 | 15060\_\_B | VEALMOOR | KOCHTAP | 3 |
| 2024 | 6 | DFERWIR8 | 34T267\_1 | SANDMO | CTECBU | 3 |
| 2024 | 6 | DRNKLWS5 | 584\_\_A | KRMSW | ARGYL | 3 |
| 2024 | 6 | DGRSPKR5 | 6377\_\_A | BRTSW | ORANS | 3 |
| 2024 | 6 | XALM689 | ALMC\_T2 | ALMC | ALMC | 3 |
| 2024 | 6 | SDIMBEV8 | BRACKE\_ESCOND1\_1 | BRACKETT | ESCONDID | 3 |
| 2024 | 6 | BASE CASE | BURNS\_RIOHONDO\_1 | RIOHONDO | MV\_BURNS | 3 |
| 2024 | 6 | MPRIRIO8 | HAINE\_\_LA\_PAL1\_1 | LA\_PALMA | HAINE\_DR | 3 |
| 2024 | 6 | SRAZDRY8 | 2585\_1 | DOWNIES | MOORE | 2 |
| 2024 | 6 | BASE CASE | RANDAD\_ZAPATA1\_1 | RANDADO | ZAPATA | 2 |
| 2024 | 6 | DWAP\_JN5 | BI\_WAP50\_A | WAP | BI | 2 |
| 2024 | 6 | SFORYEL8 | MASNPH\_MASN1\_1 | MASN | MASNPHT | 2 |
| 2024 | 6 | DSCOTKW5 | 15060\_\_B | VEALMOOR | KOCHTAP | 2 |
| 2024 | 6 | SBELTMP8 | 1680\_\_A | RRWES | GEORSO | 2 |
| 2024 | 6 | DHENZOR8 | 261T272\_1 | TURNER | CROSSWI | 2 |
| 2024 | 6 | DNOECED5 | 6056\_\_A | LNGSW | CONSW | 2 |
| 2024 | 6 | SSOLALM8 | ALPR\_BARL1\_1 | BARL | ALPR | 2 |
| 2024 | 6 | SBENRAI8 | BENTS\_FRTER\_1B\_1 | FRONTERA | S\_MISSIN | 2 |
| 2024 | 6 | SDI2DIL9 | DILLEYSW\_69A1 | DILLEYSW | DILLEYSW | 2 |
| 2024 | 6 | SBOSWHT8 | LKW\_WHT\_1 | LKWHITNY | WHTNY | 2 |
| 2024 | 6 | DRAZSA89 | UVALDE\_W\_BATE1\_1 | UVALDE | W\_BATESV | 2 |
| 2024 | 6 | SCARFRI8 | ATSO\_SONR1\_1 | SONR | ATSO | 2 |
| 2024 | 6 | DBIGSCH5 | CROSSO\_NORTMC1\_1 | NORTMC | CROSSOVE | 2 |
| 2024 | 6 | SKLELOY8 | LOYOLA\_69\_1 | LOYOLA | LOYOLA | 2 |
| 2024 | 6 | SBWDDBM5 | LPLNW\_LPLMD\_1 | LPLNW | LPLMD | 2 |
| 2024 | 6 | SW\_GODE5 | 15060\_\_A | KOCHTAP | BUZSW | 2 |
| 2024 | 6 | DCONLNG5 | 15060\_\_B | VEALMOOR | KOCHTAP | 2 |
| 2024 | 6 | DWLDSCO5 | 15060\_\_B | VEALMOOR | KOCHTAP | 2 |
| 2024 | 6 | DFOWSMG5 | CATARI\_PILONC1\_1 | CATARINA | PILONCIL | 2 |
| 2024 | 6 | DKENNO89 | COLETO\_ROSATA1\_1 | COLETO | ROSATA | 2 |
| 2024 | 6 | DFOWSMG5 | COTULA\_COTULL1\_1 | COTULAS | COTULLA | 2 |
| 2024 | 6 | MLARMIL8 | DEL\_MA\_LAREDO1\_1 | LAREDO | DEL\_MAR | 2 |
| 2024 | 6 | DFOWSMG5 | LARDVN\_LASCRU1\_1 | LARDVNTH | LASCRUCE | 2 |
| 2024 | 6 | BASE CASE | W\_LD\_138\_LDXF | W\_LD\_138 | W\_LD\_138 | 2 |
| 2024 | 6 | SSTAWIC8 | 138\_IH2\_COT\_1 | IH20 | TNCOLIET | 2 |
| 2024 | 6 | STHSVE65 | 35050\_\_B | FTSSW | VENSW | 2 |
| 2024 | 6 | DBIGKEN5 | BALLIN\_WEISS1\_1 | WEISS | BALLINGE | 2 |
| 2024 | 6 | DDILCOT8 | DILLEYSW\_69A1 | DILLEYSW | DILLEYSW | 2 |
| 2024 | 6 | SBRAPIN8 | ESCOND\_GANSO1\_1 | GANSO | ESCONDID | 2 |
| 2024 | 6 | DELMSAN5 | MAGRUD\_VICTOR2\_1 | VICTORIA | MAGRUDER | 2 |
| 2024 | 6 | DJACALV8 | MYRA\_VAL\_1 | MYRA | VALYVIEW | 2 |
| 2024 | 6 | SJMCW\_D8 | POC\_DENT\_1 | POCKRUSC | DENTON | 2 |
| 2024 | 6 | BASE CASE | RANDAD\_ZAPATA1\_1 | ZAPATA | RANDADO | 2 |
| 2024 | 6 | DRNS\_TB5 | STLTB\_66\_A | STL | TB | 2 |
| 2024 | 6 | BASE CASE | TRDWEL | n/a | n/a | 2 |
| 2024 | 6 | MDSAMFV5 | 245\_\_A | SJNSW | BALSW | 2 |
| 2024 | 6 | SNEDSTE5 | BURNS\_RIOHONDO\_1 | RIOHONDO | MV\_BURNS | 2 |
| 2024 | 6 | SFORYEL8 | MASNPH\_MASN1\_1 | MASNPHT | MASN | 2 |
| 2024 | 6 | SMCEESK8 | MKLT\_TRNT1\_1 | TRNT | MKLT | 2 |
| 2024 | 6 | DHJWFCK5 | STPWAP39\_1 | STP | WAP | 2 |
| 2024 | 6 | DCC1DUKE | BURNS\_RIOHONDO\_1 | RIOHONDO | MV\_BURNS | 2 |
| 2024 | 6 | SSTILOM8 | SCARBI\_STILLM1\_1 | STILLMAN | SCARBIDE | 2 |
| 2024 | 6 | BASE CASE | I\_PASP | n/a | n/a | 2 |
| 2024 | 6 | DCONLNG5 | 6095\_\_G | JPPOI | ALKLK | 2 |
| 2024 | 6 | SBRAPIN8 | GANSO\_MAVERI1\_1 | GANSO | MAVERICK | 1 |
| 2024 | 6 | SMV\_RIO8 | HAINE\_\_LA\_PAL1\_1 | LA\_PALMA | HAINE\_DR | 1 |
| 2024 | 6 | XPAL58 | LA\_PAL\_VCAVAZ1\_1 | LA\_PALMA | VCAVAZOS | 1 |
| 2024 | 6 | DAE\_AE\_8 | MSNPET04\_A | PET | MSN | 1 |
| 2024 | 6 | SVANRAY8 | RAYBURN\_69\_2 | RAYBURN | RAYBURN | 1 |
| 2024 | 6 | SWHILON5 | WHITE\_PT\_T3H | WHITE\_PT | WHITE\_PT | 1 |
| 2024 | 6 | BASE CASE | WILBRN | n/a | n/a | 1 |
| 2024 | 6 | SELMTH25 | 1020\_\_A | ELMOT | MCTYE | 1 |
| 2024 | 6 | DTRSENT5 | 1255\_\_B | SCSES | STCKY | 1 |
| 2024 | 6 | DVLSPAC5 | 1561\_\_A | DPREA | RCSES | 1 |
| 2024 | 6 | STHSVE65 | 35045\_\_A | SAMSW | FVLSW | 1 |
| 2024 | 6 | SECRDMT8 | 6235\_\_A | CGRSW | SNYDR | 1 |
| 2024 | 6 | DKLNRGP5 | 651\_\_B | CMNSW | CMNTP | 1 |
| 2024 | 6 | SCAGKEN5 | 656T656\_1 | KENDAL | BERGHE | 1 |
| 2024 | 6 | SCOCBAR9 | ALPINE\_BRONCO1\_1 | BRONCO | ALPINE | 1 |
| 2024 | 6 | MWHPLON5 | BLESSI\_LOLITA1\_1 | LOLITA | BLESSING | 1 |
| 2024 | 6 | MHARRIO5 | BURNS\_RIOHONDO\_1 | RIOHONDO | MV\_BURNS | 1 |
| 2024 | 6 | XBAL89 | CONCHO\_VRBS1\_1 | CONCHO | VRBS | 1 |
| 2024 | 6 | SBVFB8 | FB\_FL\_60\_A | FB | FL | 1 |
| 2024 | 6 | XVIC89 | GREENL\_NCARBI1\_1 | NCARBIDE | GREENLK | 1 |
| 2024 | 6 | XHA2S89 | OLS\_JNES\_1 | OLSEN | JNESBORO | 1 |
| 2024 | 6 | BASE CASE | VALEXP | n/a | n/a | 1 |
| 2024 | 6 | SGRILON5 | VICTO\_WARBU\_1A\_1 | VICTORIA | WARBURTN | 1 |
| 2024 | 6 | SCOMCYP8 | 122T122\_1 | COMFOR | RAYBAR | 1 |
| 2024 | 6 | DSALHUT5 | 235\_\_B | BALSW | JEWET | 1 |
| 2024 | 6 | DLWSRNK5 | 584\_\_A | KRMSW | ARGYL | 1 |
| 2024 | 6 | DGRSLNC5 | 6380\_\_D | MURRAY | PAINTCRE | 1 |
| 2024 | 6 | SSCLWF18 | 6840\_\_B | NVKSW | ANARN | 1 |
| 2024 | 6 | DELMTEX5 | BLESSI\_LOLITA1\_1 | LOLITA | BLESSING | 1 |
| 2024 | 6 | SILLFTL8 | MAXWEL\_WHITIN1\_1 | MAXWELL | WHITING | 1 |
| 2024 | 6 | DWO5\_EU8 | MIDPK\_90\_A | MID | PK | 1 |
| 2024 | 6 | DWO5\_EU8 | PK\_MID90\_A | MID | PK | 1 |
| 2024 | 6 | SLA\_RI25 | RIOHONDO\_AT1H | RIOHONDO | RIOHONDO | 1 |
| 2024 | 6 | DCONLNG5 | RKYROAD\_STILES\_1 | RCKYROAD | STILES | 1 |
| 2024 | 6 | SGODTAN5 | VICTO\_WARBU\_1A\_1 | VICTORIA | WARBURTN | 1 |
| 2024 | 6 | DMGSBIT5 | 6036\_\_A | TKWSW | MGSES | 1 |
| 2024 | 6 | SRICGRS8 | 6840\_\_A | ANARN | CRDSW | 1 |
| 2024 | 6 | SPEBTRU8 | 940\_\_B | TMPTN | WXHCH | 1 |
| 2024 | 6 | SDELLAR8 | ASHERT\_CATARI1\_1 | ASHERTON | CATARINA | 1 |
| 2024 | 6 | DSWELNC5 | BLUF\_C\_MULBER1\_1 | BLUF\_CRK | MULBERRY | 1 |
| 2024 | 6 | SN\_SCEL8 | CAL\_ROBS\_1 | CALALS | ROBSTOS | 1 |
| 2024 | 6 | SBRAHAM8 | HAMILT\_MAVERI1\_1 | MAVERICK | HAMILTON | 1 |
| 2024 | 6 | SSTPESP8 | LANCTY\_LAN\_CT1\_1 | LANCTYPM | LAN\_CTY | 1 |
| 2024 | 6 | MLOBFOR5 | LASCRU\_MILO1\_1 | LASCRUCE | MILO | 1 |
| 2024 | 6 | SZENOB5 | OB\_ZEN71\_A | ZEN | OB | 1 |
| 2024 | 6 | XPEA89 | PALDRO\_DILLEY\_1 | PALODURO | DILLEYSW | 1 |
| 2024 | 6 | SMVRLA\_8 | STEWAR\_VERTRE1\_1 | STEWART | VERTREES | 1 |
| 2024 | 6 | DCOLFA59 | VICTO\_WARBU\_1A\_1 | VICTORIA | WARBURTN | 1 |
| 2024 | 6 | SGODKAT5 | VICTO\_WARBU\_1A\_1 | VICTORIA | WARBURTN | 1 |
| 2024 | 6 | DPRSHWK8 | 1535\_\_B | TNSKA | TCOSW | 1 |
| 2024 | 6 | DTRIASH8 | 1660\_\_C | HUTTO | RRNES | 1 |
| 2024 | 6 | SKYLSAN8 | 415T415\_1 | MILLER | HENLY | 1 |
| 2024 | 6 | SCAGKEN5 | 583T583\_1 | BANDER | MASOCR | 1 |
| 2024 | 6 | DWLFMOS5 | 6485\_\_B | RLKSW | PWPOD | 1 |
| 2024 | 6 | DHENZOR8 | 85T329\_1 | BERGHE | DEVIHI | 1 |
| 2024 | 6 | SLANARR8 | BLESSI\_LOLITA1\_1 | LOLITA | BLESSING | 1 |
| 2024 | 6 | SLAQLOB8 | BRUNI\_69\_1 | BRUNI | BRUNI | 1 |
| 2024 | 6 | SCOLBAL8 | COLJ\_SANA1\_1 | SANA | COLJ | 1 |
| 2024 | 6 | MNEDPOM5 | DEL\_MA\_LAREDO1\_1 | LAREDO | DEL\_MAR | 1 |
| 2024 | 6 | BASE CASE | EBONY\_GENTIE\_1 | EBNY\_ESS | EBNY\_ESS | 1 |
| 2024 | 6 | DVICDUP8 | FORMOS\_LOLITA1\_1 | FORMOSA | LOLITA | 1 |
| 2024 | 6 | SBRAHAM8 | GANSO\_MAVERI1\_1 | GANSO | MAVERICK | 1 |
| 2024 | 6 | SSCJFS8 | GP\_TNK94\_A | TNK | GP | 1 |
| 2024 | 6 | XRIO358 | HAINE\_\_LA\_PAL1\_1 | LA\_PALMA | HAINE\_DR | 1 |
| 2024 | 6 | DRNS\_TB5 | HK\_STL66\_A | HK | STL | 1 |
| 2024 | 6 | XVIC89 | MAGRUD\_VICTOR2\_1 | VICTORIA | MAGRUDER | 1 |
| 2024 | 6 | MBRAESC8 | UVALDE\_W\_BATE1\_1 | UVALDE | W\_BATESV | 1 |
| 2024 | 6 | DTVWJON5 | 6017\_\_B | MBDSW | CMBSW | 1 |
| 2024 | 6 | XSCS58 | 960\_\_D | JKSVL | BUPOI | 1 |
| 2024 | 6 | SS\_MRAI8 | BENTS\_FRTER\_1A\_1 | BENTSEN | RAILROAD | 1 |
| 2024 | 6 | DFOWSMG5 | DILLEY\_JARDIN1\_1 | DILLEYSW | JARDIN | 1 |
| 2024 | 6 | DVICDUP8 | VICTORIA\_69A2 | VICTORIA | VICTORIA | 1 |
| 2024 | 6 | SGRICOL5 | VICTO\_WARBU\_1A\_1 | VICTORIA | WARBURTN | 1 |
| 2024 | 6 | DKENCA58 | 255T279\_1 | PIPECR | MEDILA | 1 |
| 2024 | 6 | DSALKLN5 | 641\_\_A | KLNSW | STAGE | 1 |
| 2024 | 6 | SREVDIL8 | ASHERT\_CATARI1\_1 | ASHERTON | CATARINA | 1 |
| 2024 | 6 | SCE2CEL8 | CAL\_ROBS\_1 | CALALS | ROBSTOS | 1 |
| 2024 | 6 | DKRACMV8 | MSNPET04\_A | PET | MSN | 1 |
| 2024 | 6 | MDOWOA25 | MSNPET04\_A | PET | MSN | 1 |
| 2024 | 6 | MLOBFOR5 | NLARSW\_PILONC1\_1 | PILONCIL | NLARSW | 1 |
| 2024 | 6 | BASE CASE | VICTORIA\_69A2 | VICTORIA | VICTORIA | 1 |
| 2024 | 6 | SCOMKEN8 | 115T123\_1 | KENDAL | KERRST | 1 |
| 2024 | 6 | DSALHUT5 | 1710\_\_A | SALDS | SONTERRA | 1 |
| 2024 | 6 | SVICCO28 | COLETO\_VICTOR2\_1 | COLETO | VICTORIA | 1 |
| 2024 | 6 | SCOLBAL8 | COLJ\_GLSB1\_1 | COLJ | GLSB | 1 |
| 2024 | 6 | DBIGKEN5 | FORTMA\_YELWJC1\_1 | YELWJCKT | FORTMA | 1 |
| 2024 | 6 | DBAKCED5 | HARGRO\_TWINBU1\_1 | TWINBU | HARGROVE | 1 |
| 2024 | 6 | BASE CASE | HMLTN | n/a | n/a | 1 |
| 2024 | 6 | SCOMHA38 | MAXWEL\_WHITIN1\_1 | MAXWELL | WHITING | 1 |
| 2024 | 6 | DMCEBUT8 | MERK\_MKLT1\_1 | MKLT | MERK | 1 |
| 2024 | 6 | SABMAB38 | OILMIT\_SAWGRA1\_1 | SAWGRASS | OILMITAP | 1 |
| 2024 | 6 | SWHILON5 | PELICA\_WHITE\_1\_1 | PELICAN | WHITE\_PT | 1 |
| 2024 | 6 | DSALHUT5 | 245\_\_A | SJNSW | BALSW | 1 |
| 2024 | 6 | DMGSBTR5 | 6036\_\_A | TKWSW | MGSES | 1 |
| 2024 | 6 | SCONMGS5 | 6056\_\_A | LNGSW | CONSW | 1 |
| 2024 | 6 | MANGSTP5 | BLESSI\_LOLITA1\_1 | LOLITA | BLESSING | 1 |
| 2024 | 6 | SBRAHAM8 | BRACKE\_ESCOND1\_1 | BRACKETT | ESCONDID | 1 |
| 2024 | 6 | MHARNED5 | BURNS\_HEIDLBRG\_1 | MV\_BURNS | MV\_HBRG4 | 1 |
| 2024 | 6 | DBIGKEN5 | CONCHO\_VRBS1\_1 | CONCHO | VRBS | 1 |

1. Current Wind Generation Record: 27,881 MW on 06/17/2024 at 21:15 | Current Wind Penetration Record: 69.15% on 04/10/2022 at 01:43

   Current Solar Generation Record: 19,395 MW on 06/22/2024 at 13:15 | Current Solar Penetration Record: 42.98% 03/28/2024 at 11:27 [↑](#footnote-ref-2)
2. All DC Tie Curtailments are posted publicly on the ERCOT Market Information System. See that posting for additional details for the event(s) in question. [↑](#footnote-ref-3)
3. See DC Tie Operating Procedure (<http://www.ercot.com/mktrules/guides/procedures>) for more details. [↑](#footnote-ref-4)