

October 2017 ERCOT Monthly Operations Report

Reliability and Operations Subcommittee Meeting

December 7th, 2017

Table of Contents

[1. Report Highlights 2](#_Toc498949384)

[2. Frequency Control 3](#_Toc498949385)

[2.1. Frequency Events 3](#_Toc498949386)

[2.2. Responsive Reserve Events 4](#_Toc498949387)

[2.3. Load Resource Events 4](#_Toc498949388)

[3. Reliability Unit Commitment 4](#_Toc498949389)

[4. Wind Generation as a Percent of Load 5](#_Toc498949390)

[5. Congestion Analysis 5](#_Toc498949391)

[5.1. Notable Constraints for October 5](#_Toc498949392)

[5.2. Generic Transmission Constraint Congestion 8](#_Toc498949393)

[5.3. Manual Overrides for October 8](#_Toc498949394)

[5.4. Congestion Costs for Calendar Year 2017 8](#_Toc498949395)

[6. System Events 9](#_Toc498949396)

[6.1. ERCOT Peak Load 9](#_Toc498949397)

[6.2. Load Shed Events 9](#_Toc498949398)

[6.3. Stability Events 9](#_Toc498949399)

[6.4. Notable PMU Events 10](#_Toc498949400)

[6.5. DC Tie Curtailment 10](#_Toc498949401)

[6.6. TRE/DOE Reportable Events 10](#_Toc498949402)

[6.7. New/Updated Constraint Management Plans 10](#_Toc498949403)

[6.8. New/Modified/Removed RAS 10](#_Toc498949404)

[6.9. New Procedures/Forms/Operating Bulletins 10](#_Toc498949405)

[7. Emergency Conditions 10](#_Toc498949406)

[7.1. OCNs 10](#_Toc498949407)

[7.2. Advisories 11](#_Toc498949408)

[7.3. Watches 11](#_Toc498949409)

[7.4. Emergency Notices 11](#_Toc498949410)

[8. Application Performance 11](#_Toc498949411)

[8.1. TSAT/VSAT Performance Issues 11](#_Toc498949412)

[8.2. Communication Issues 11](#_Toc498949413)

[8.3. Market System Issues 11](#_Toc498949414)

[9. Model Updates 11](#_Toc498949415)

[Appendix A: Real-Time Constraints 13](#_Toc498949416)

# Report Highlights

* The unofficial ERCOT peak for October was 62,181 MW.
* There were four frequency events in October. PMU data indicates the ERCOT system transitioned well in each case.
* There were three instances where Responsive Reserves were deployed, all of which were the result of frequency events.
* There were two RUC commitments in October.
* The level of reportable SCED congestion increased in October. This congestion was mostly due to planned outages as well as high wind output. There were thirty six instances over 31 days on the Generic Transmission Constraints (GTCs) in October. There were two days on the North-Houston GTC, two days on the Valley Import GTC, two days on the Zorillo-Ajo GTC, twenty nine days on the Panhandle GTC and one day on the North Edinburg-Lobo GTC in October. There was no activity on the remaining GTCs during the Month.
* There was one DC Tie curtailment in October.
* A new record for the instantaneous penetration of wind energy was set by ERCOT with 54.22% of the total load being served by wind power at 4 a.m. on Oct 27, 2017.

# Frequency Control

## Frequency Events

The ERCOT Interconnection experienced four frequency events in October, all of which resulted from Resource trips. The average event duration was approximately 0:03:55.

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. All events listed below indicate the ERCOT system met these standards and transitioned well after each disturbance.

Reported frequency events will include both frequency events where frequency was outside the range of 60±0.1 Hz as well as those determined to be Frequency Measurable Events (FME) as defined by BAL-001-TRE-1. Delta Frequency is defined as the difference between the pre-perturbation and post-perturbation frequency. The Duration of Event is defined as the time it takes for the frequency to recover to lesser/greater of the frequency at the time of the frequency event (t(0) or “A-point”) for low/high-frequency events, respectively. Further details on FMEs can be found in the MIS posted BAL-001-TRE-1 PDCWG Unit Performance reports. A summary of the frequency events is provided below:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Date and Time** | **Delta Frequency** | **Max/Min Frequency** | **Duration of Event** | **PMU Data** | **MW Loss** | **Load** | **Wind** | **Inertia** |
| **(Hz)** | **(Hz)** | **Oscillation Mode (Hz)** | **Damping Ratio** | **(MW)** | **%**  | **(GW-s)** |
| 10/6/2017 11:16 | 0.098 | 59.85 | 0:04:24 | 0.62 | 11% | 831  |  46,692  | 17% |  271,465  |
| 10/8/2017 5:00 | 0.062 | 59.86 | 0:04:04 | 0.67 | 11% | 692  |  31,456  | 24% |  221,611  |
| 10/28/2017 5:41 | 0.077 | 59.90 | 0:03:59 | No PMU Report Created | 536  |  31,857  | 13% |  203,928  |
| 10/29/2017 19:24 | 0.082 | 59.88 | 0:03:14 | 0.84 | 23% | 561  |  35,530  | 15% |  189,716  |

 (Note: frequency events highlighted in blue have been identified as FMEs per BAL-001-TRE-1 and the Performance Disturbance Compliance Working group. PMU reports are typically generated when frequency drops below 59.9, but PMU data is available for other events.)

 Currently, the Critical Inertia Level for ERCOT is approximately 100,000 MW-s (Source: [link](http://www.ercot.com/content/wcm/key_documents_lists/77622/06.__Inertia_Background_for_ROS.pptx))



(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 October. 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** |
|
| 10/6/2017 11:16:40 | 10/6/2017 11:20:09 | 0:03:24 | 583.52 |
| 10/8/2017 5:00:57 | 10/8/2017 5:04:00 | 0:03:00 | 507.56 |
| 10/29/2017 19:24:17 | 10/29/2017 19:27:06 | 0:02:44 | 506.90 |

## Load Resource Events

None.

# 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 October.

There were two HRUC commitments in October.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Resource Location** | **# of Resources** | **Operating Day** | **Total # of Hours Committed** | **Total MWhs** | **Reason For Commitment** |
| North Central | 1 | 10/3/2017 | 8 | 2,635 | Congestion |
| North Central | 1 | 10/4/2017 | 8 | 2,657 | Congestion |

# Wind Generation as a Percent of Load



# Congestion Analysis

The number of congestion events experienced by the ERCOT system increased in October. There were thirty six instances over 31 days on the Generic Transmission Constraints (GTCs) in October.

## Notable Constraints for October

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 October, please see Appendix A at the end of this report.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Contingency Name** | **Overloaded Element** | **# of Days Constraint Active** | **Congestion Rent** | **Transmission Project** |
|
| Jewet-Sng 345kV | Btu\_Jack\_Creek - Twin Oak Switch 345kV | 15 | $36,779,486.93 | Houston Import Project (4458) |
| Basecase | PNHNDL GTC | 29 | $30,491,746.65 | South Plains RPG Proposal & Panhandle Loop (5180, 5208) |
| Victoria-V\_Dupsw 138kV | Formosa - Lolita 138kV | 8 | $7,332,846.48 |  |
| HCKSW-ALLNC&RNKSW 345kV | Blue Mound - Wagley Robertson 138kV | 10 | $6,095,157.69 | Saginaw 345/138 kV auto (6273) |
| CENTER to PH ROBINSON LIN A | Exxon - Lynch 138kV | 1 | $4,416,430.94 |  |
| CENTER to PH ROBINSON LIN A | Channelview - Lynch 138kV | 8 | $3,651,251.54 |  |
| COLETO CREEK to VICTORIA LIN 1 | Coleto Creek - Victoria 138kV | 4 | $3,091,685.96 |  |
| Meadow to Oasis 345 KV | Intermediate - Southwyck 138kV | 1 | $2,850,906.92 |  |
| Asphalt Mines to Blewett (3) | Hamilton Road - Maverick 138kV | 18 | $1,328,349.82 | Brackettville to Escondido (5206) |
| HCKSW-ALLNC&RNKSW 345kV | Wagley Robertson - Summerfield 138kV | 1 | $1,168,271.78 | Saginaw 345/138 kV auto (6273) |
| Rns-Rtw & Sng-Tb 345kv | Singleton - Zenith 345kV | 6 | $1,118,198.93 | Houston Import Project (4458) |
| Rns-Rtw & Sng-Tb 345kv | Singleton - Zenith 345kV | 8 | $1,109,437.80 | Houston Import Project (4458) |
| Elmcreek-Sanmigl 345kV | Pawnee Switching Station - Calaveras 345kV | 1 | $1,084,408.34 |  |
| Basecase | VALIMP GTC | 2 | $1,006,508.71 |  |
| Alazan to Barney Davis (2)13 | Rodd Field - Holly 138kV | 6 | $948,506.79 |  |
| COLETO CREEK to VICTORIA LIN 1 | Coleto Creek - Victoria 138kV | 10 | $879,834.22 |  |
| COLETO CREEK GEN COLETOG1 | Blessing - Lolita 138kV | 10 | $500,948.40 |  |
| Alazan to Barney Davis (2)13 | Barney Davis - Rodd Field 138kV | 3 | $433,637.23 |  |
| Wirtz-Burnet&Starck 138kV | Granite Mountain - Marble Falls 138kV | 13 | $402,889.97 |  |
| SNDSW-AUSTRO 345kV | Howard Lane Tap - Howard Lane Aen 138kV | 13 | $401,327.29 | Howard Lane to Wells Branch Transmission Line Upgrade (5945) |
| Victoria-V\_Dupsw 138kV | Greenlake - Weaver Road 69kV | 5 | $393,639.29 |  |
| Re Roserock Solar Plant to F | Barrilla - Fort Stockton Switch 69kV | 4 | $368,759.79 | Far West Texas Project |
| Dl-Wap02 & Hoc-Wap05 | H O Clarke - Karsten 69kV | 3 | $353,927.44 |  |
| CITGO N OAK PARK to HIWAY 9 LIN 1 | Morris Street - Nueces Bay 138kV | 4 | $309,592.84 |  |
| Elmcreek-Sanmigl 345kV | Blessing - Lolita 138kV | 6 | $251,219.37 |  |
| MCELMURRAY TAP SWITCHYARD to BUTMA | Eskota Switch - Trent 69kV | 15 | $226,485.80 | Eskota 69 kV line: Rebuild 69 kV line (6042) |
| SNDSW-AUSTRO 345kV | Gilleland - Mcneil Lcra 138kV | 3 | $185,365.36 |  |
| Basecase | Pig Creek - Solstice 138kV | 9 | $169,849.75 | Solstice to Permian Basin: Rebuild 138 kV line (5257,5259) |
| WOODWARD 1 TAP to WOODWARD 1 LIN 1 | Airport Tnp - 16th Street Tnp 138kV | 7 | $141,217.96 | Far West Texas Project |
| Meadow to Ph Robinson 345 KV | Seminole Tnp - Friendswood Tnp 138kV | 5 | $128,555.32 | Rebuild Magnolia - Seminole 138 kV line (4010) |
| FORT STOCKTON PLANT TRX 69T1 138/6 | Pig Creek - Solstice 138kV | 10 | $116,170.28 | Solstice to Permian Basin: Rebuild 138 kV line (5257,5259) |
| MERCERS GAP SW to COMANCHE SWITCH | Holder 138/69kV | 3 | $114,986.98 |  |
| B\_Davis-Airline AEP 138kV | Naval Base 138/69kV | 3 | $110,983.75 |  |
| FRIEND RANCH to SONORA LIN 1 | Sonora 138/69kV | 6 | $109,486.58 |  |
| Marion-Cleasp&Zorn 345kV | Henne - Zorn 138kV | 5 | $92,247.67 |  |
| ASPERMONT AEP to PAINT CREEK LIN 1 | Aspermont Aep 138/69kV | 8 | $88,847.92 |  |
| FORT STOCKTON PLANT TRX 69T1 138/6 | Solstice - Pig Creek Tap 138kV | 3 | $87,416.19 | Solstice to Permian Basin: Rebuild 138 kV line (5257,5259) |
| Bronco to ALPINE REA LIN 1 | Alpine - Paisano 69kV | 13 | $74,723.10 |  |
| Coleto Creek to Lon Hill 345 | Warburton Road Switching Station - Victoria 138kV | 5 | $70,510.26 |  |
| ROCK ISLAND to GLIDDEN LCRA LIN 1 | Glidden Lcra 138/69kV | 5 | $70,229.45 |  |
| BLESSING TRX 1382 345/138 | Sargent Sub - Franklins Camp Sub 69kV | 5 | $63,017.59 |  |
| Prssw-Vlses&Vlyso 138kV | Brookstone Tap - Bonham Lake Poi 138kV | 3 | $57,643.71 |  |
| ENNIS CREEK SWITCH TRX FMR1 138/69 | Morgan Creek Ses - Sun Switch 138kV | 5 | $52,270.60 |  |
| Fergus-Granmo&Wirtz-Starck 138kV | Flat Rock Lcra - Wirtz 138kV | 3 | $51,209.88 |  |
| Entpr-Trses & Mlses-Scses 34 | Herty North Switch - Nacogdoches Se 138kV | 4 | $47,267.08 |  |
| Colorado to Sheridan (2)138/ | Glidden Lcra 138/69kV | 4 | $26,839.90 |  |
| BRACKETTVILLE to HAMILTON ROAD LIN | Hamilton Road - Maverick 138kV | 8 | $26,746.56 | Brackettville to Escondido (5206) |
| LAQUINTA to LOBO LIN 1 | Bruni Sub 138/69kV | 5 | $22,966.18 |  |
| JARDIN to DILLEY SWITCH AEP LIN 1 | Dilley Switch Aep - Cotulla Sub 69kV | 4 | $20,592.96 | Rebuild Dilley to Cotulla (5222) |
| WOODWARD 1 TAP to WOODWARD 1 LIN 1 | Woodward 2 - Rio Pecos 138kV | 6 | $13,876.99 | Far West Texas Project |
| Meadow to Oasis 345 KV | Polk - Midtown 138kV | 3 | $10,529.94 |  |
| Elmcreek-Stp 345kv | Blessing - Lolita 138kV | 3 | $9,214.95 |  |
| KLEBERG AEP to LOYOLA SUB LIN 1 | Loyola Sub 138/69kV | 3 | $6,901.93 |  |
| ENNIS WEST SWITCH to WAXAHACHIE PU | Trumbull - Ennis Switch 138kV | 3 | $5,536.19 |  |
| SOUTH LANE CITY to LANE CITY LIN 1 | Sargent Sub - Franklins Camp Sub 69kV | 3 | $3,683.04 |  |
| Basecase | Wkn\_Bkr - Ena Snyder Wind 69kV | 3 | $1,700.30 |  |
| Asphalt Mines to Blewett (3) | Eagle Hydro Tap - Escondido 138kV | 3 | $1,690.80 |  |
| Bighil-Kendal 345kV | Rocksprings - Friess Ranch 69kV | 6 | $1,301.06 |  |

## Generic Transmission Constraint Congestion

There were two days on the North-Houston GTC, two days on the Valley Import GTC, two days on the Zorillo-Ajo GTC, twenty nine days on the Panhandle GTC and one day on the North Edinburg-Lobo GTC in October. 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 for October

None.

## Congestion Costs for Calendar Year 2017

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 | 27,859 | 104,594,832.75 | South Plains RPG Proposal & Panhandle Loop (5180, 5208) |
| HCKSW-ALLNC&RNKSW 345kV | Blue Mound - Wagley Robertson 138kV | 10,422 | 73,403,975.05 | Saginaw 345/138 kV auto (6273) |
| Rns-Rtw & Sng-Tb 345kv | Singleton - Zenith 345kV | 17,992 | 65,817,213.99 | Houston Import Project (4458) |
| Jewet-Sng 345kV | Btu\_Jack\_Creek - Twin Oak Switch 345kV | 19,192 | 60,476,241.65 | Houston Import Project (4458) |
| Rns-Rtw & Sng-Tb 345kv | Singleton - Zenith 345kV | 9,538 | 33,061,259.86 | Houston Import Project (4458) |
| NORTH PHARR to POLK AVENUE LIN 1 | North Mcallen - West Mcallen 138kV | 2,541 | 32,283,806.21 | Pharr 138 kV Loop (4493) |
| White\_Pt-Mccampbe&Hecker 138 | Whitepoint - Rincon 138kV | 1,352 | 24,325,582.27 | Melon Creek: Build new (2979) |
| CRLNW-LWSSW 345kV | Carrollton Northwest - Lakepointe Tnp 138kV | 6,300 | 23,917,330.89 | Upgrade existing NW Carrollton - LakePointe 138 kV Line (5488) |
| HCKSW-ALLNC&RNKSW 345kV | Wagley Robertson - Summerfield 138kV | 1,482 | 21,954,071.94 | Saginaw 345/138 kV auto (6273) |
| Victoria-V\_Dupsw 138kV | Formosa - Lolita 138kV | 2,494 | 18,630,462.92 |  |
| NORTH PHARR to PHARR Magic Valley | North Mcallen - West Mcallen 138kV | 703 | 15,031,152.13 | Pharr 138 kV Loop (4493) |
| Hecker\_White\_Pt 138kv | Whitepoint - Rincon 138kV | 1,447 | 14,822,421.12 | Melon Creek: Build new (2979) |
| Nedin-Mv\_Wedn4&Mv\_Palm4 138k | Azteca Sub - Se Edinburg 138kV | 1,675 | 13,608,219.01 |  |
| Jewet-Sng 345kV | Gibbons Creek - Twin Oak Switch 345kV | 306 | 10,861,578.84 | Houston Import Project (4458) |
| Jewet-Sng 345kV | Gibbons Creek - Singleton 345kV | 1,610 | 10,791,453.58 | Houston Import Project (4458) |
| White\_Pt-Hecker&I\_Dupsw 138k | Whitepoint - Rincon 138kV | 761 | 9,477,211.29 | Melon Creek: Build new (2979) |
| NORTH EDINBURG TRX 1382 345/138 | North Edinburg 345/1kV | 434 | 8,304,991.43 | Stewart Road: Construct 345 kV cut-in (5604) |
| Elmcreek-Sanmigl 345kV | Pawnee Switching Station - Calaveras 345kV | 531 | 7,657,659.04 |  |
| Jewet-Sng 345kV | Singleton - Gibbons Creek 345kV | 2,887 | 7,620,579.90 | Houston Import Project (4458) |
| Re Roserock Solar Plant to F | Barrilla - Fort Stockton Switch 69kV | 1,862 | 6,943,786.65 | Far West Texas Project |

# System Events

## ERCOT Peak Load

The unofficial ERCOT peak load for the month was 62,181 MW and occurred on October 9th during hour ending 17:00.

## 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 reportable events in October.

## DC Tie Curtailment

There was one DC Tie curtailment in October.

|  |  |  |  |
| --- | --- | --- | --- |
| **Date**  | **Curtailing Period** | **# of Curtailments (Tags)** | **Curtailment Reason** |
|
| 10/8/2017 | HE16 | 1 | Transmission Watch |

## TRE/DOE Reportable Events

None.

## New/Updated Constraint Management Plans

* MP\_2017\_12 that was developed to address congestion associated with the contingency SIH2PEC9 is no longer need it due to TNMP TO reported the new 138/69kV IHT1\_LOSIDE transformer at IH 20 TNP (IH20) station is now in service. This plan has been deleted from the OPPLANS in EMS.

## New/Modified/Removed RAS

None.

## New Procedures/Forms/Operating Bulletins

ERCOT has revised the following procedure manuals, effective October 30, 2017.

|  |  |
| --- | --- |
| **Procedure Title** | **POB** |
| DC Tie Desk | [813](http://www.ercot.com/content/wcm/pobs/139738/Power_Operations_Bulletin_813.doc) |
| [Real](http://www.ercot.com/content/wcm/pobs/134275/Power_Operations_Bulletin_805.doc) Time Desk | [814](http://www.ercot.com/content/wcm/pobs/139741/Power_Operations_Bulletin_814.doc) |
| Resource Desk | [815](http://www.ercot.com/content/wcm/pobs/139744/Power_Operations_Bulletin_815.doc) |
| Shift Supervisor Desk | [816](http://www.ercot.com/content/wcm/pobs/139747/Power_Operations_Bulletin_816.doc) |
| Transmission and Security Desk | [817](http://www.ercot.com/content/wcm/pobs/139750/Power_Operations_Bulletin_817.doc) |

# Emergency Conditions

## OCNs

None.

##  Advisories

|  |  |
| --- | --- |
| **Date and Time** | **Description** |
| 10/7/17 16:33 | Advisory issued due to Physical Responsive Capability being below 3000 MW. |

## Watches

|  |  |
| --- | --- |
| **Date and Time** | **Description** |
| 10/8/17 15:50 | ERCOT is issuing a Transmission Watch for the Railroad DC Tie due to transfer capability. This may result in the curtailment of DC-Tie imports and exports to CENACE. |

## 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** |

|  |  |
| --- | --- |
| ONCOR | 5 |
| ERCOT | 4 |
| AEP | 2 |
| CENTERPOINT | 1 |

# Appendix A: Real-Time Constraints

The following is a complete list of constraints activated in SCED for the month of October. 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 | PNHNDL | n/a | n/a | 29 |
| SBRAUVA8 | HAMILT\_MAVERI1\_1 | HAMILTON | MAVERICK | 18 |
| DJEWSNG5 | JK\_TOKSW\_1 | TOKSW | JK\_CK | 15 |
| SMCEABS8 | 6585\_\_A | ESKSW | TRNT | 15 |
| SMCEABS8 | 6585\_\_A | TRNT | ESKSW | 15 |
| SCOCBAR9 | ALPINE\_PAIS1\_1 | ALPINE | PAIS | 13 |
| DAUSSND5 | HWRDLN\_1 | HWRDTP | HWRDLN | 13 |
| SCOCBAR9 | ALPINE\_PAIS1\_1 | PAIS | ALPINE | 13 |
| DWIRSTA8 | 342T195\_1 | GRANMO | MARBFA | 13 |
| DHCKRNK5 | 6270\_\_C | BLMND | WGROB | 10 |
| UCOLCOL1 | BLESSI\_LOLITA1\_1 | BLESSING | LOLITA | 10 |
| XFTS89 | PIGCRE\_SOLSTI1\_1 | SOLSTICE | PIGCREEK | 10 |
| XFTS89 | PIGCRE\_SOLSTI1\_1 | PIGCREEK | SOLSTICE | 10 |
| DHCKRNK5 | 6270\_\_C | WGROB | BLMND | 10 |
| SVICCO28 | COLETO\_VICTOR2\_1 | COLETO | VICTORIA | 10 |
| BASE CASE | PIGCRE\_SOLSTI1\_1 | SOLSTICE | PIGCREEK | 9 |
| SASPPAI8 | ASPM\_69T1 | ASPM | ASPM | 8 |
| SPHRCTR5 | CV\_LH\_03\_A | LH | CV | 8 |
| DRNS\_TB5 | SNGZEN98\_A | SNG | ZEN | 8 |
| DVICV\_D8 | FORMOS\_LOLITA1\_1 | LOLITA | FORMOSA | 8 |
| SBRAHAM8 | HAMILT\_MAVERI1\_1 | HAMILTON | MAVERICK | 8 |
| SWOORI38 | TNAF\_TNFS\_1 | 16TH\_ST | TNAF | 7 |
| SWOORI38 | TNAF\_TNFS\_1 | TNAF | 16TH\_ST | 7 |
| SALAN\_28 | HOLLY4\_RODD\_F1\_1 | HOLLY4 | RODD\_FLD | 6 |
| DELMSAN5 | BLESSI\_LOLITA1\_1 | BLESSING | LOLITA | 6 |
| DBIGKEN5 | FRIR\_ROCKSP1\_1 | FRIR | ROCKSPRS | 6 |
| SWOORI38 | RIOPEC\_WOODW21\_1 | WOODWRD2 | RIOPECOS | 6 |
| SWOORI38 | RIOPEC\_WOODW21\_1 | RIOPECOS | WOODWRD2 | 6 |
| DRNS\_TB5 | SNGZEN99\_A | SNG | ZEN | 6 |
| SALAN\_28 | HOLLY4\_RODD\_F1\_1 | RODD\_FLD | HOLLY4 | 6 |
| SSONFRI8 | SONR\_69-1 | SONR | SONR | 6 |
| DFERSTA8 | BURNET\_AT3 | BURNET | BURNET | 6 |
| DSNG\_TB5 | SNGZEN98\_A | SNG | ZEN | 6 |
| SCOLLON5 | VICTO\_WARBU\_1A\_1 | VICTORIA | WARBURTN | 5 |
| DMARZOR5 | 89T204\_1 | ZORN | HENNE | 5 |
| SLAQLOB8 | BRUNI\_69\_1 | BRUNI | BRUNI | 5 |
| SMDOPHR5 | G138\_10C\_1 | FRDSWOOD | SEMINOLE | 5 |
| DVICV\_D8 | GREENL\_WEAVER1\_1 | WEAVERRD | GREENLK | 5 |
| DSNG\_TB5 | SNGZEN99\_A | SNG | ZEN | 5 |
| SROCGL28 | GLIDDE\_AT2 | GLIDDE | GLIDDE | 5 |
| SKNADM28 | 6474\_\_A | SUNSW | MGSES | 5 |
| XBLE58 | SAR\_FRAN\_1 | FRANKC | SARGNTS | 5 |
| DENTSCS5 | 1170\_\_A | NCDSE | HNRSW | 4 |
| SWCSBOO8 | BARL\_FTSW1\_1 | FTSW | BARL | 4 |
| SVICCOL8 | COLETO\_VICTOR1\_1 | COLETO | VICTORIA | 4 |
| SROCGL18 | GLIDDE\_AT2 | GLIDDE | GLIDDE | 4 |
| SHIWCIT8 | MORRIS\_NUECES1\_1 | NUECES\_B | MORRIS | 4 |
| SJARDIL8 | DIL\_COTU\_1 | DILLEYSW | COTULAS | 4 |
| SMGIENW8 | 921\_\_D | ENSSW | TRU | 3 |
| SZEPCMN8 | HLD\_FMR1 | HLD | HLD | 3 |
| DELMTEX5 | BLESSI\_LOLITA1\_1 | BLESSING | LOLITA | 3 |
| DDL\_HOC8 | HOCKR\_53\_A | KR | HOC | 3 |
| SMDOOAS5 | PK\_MID90\_A | MID | PK | 3 |
| DAUSSND5 | 211T147\_1 | GILLCR | MCNEIL\_ | 3 |
| SALAN\_28 | B\_DAVI\_RODD\_F1\_1 | B\_DAVIS | RODD\_FLD | 3 |
| SBRAUVA8 | EAGLHY\_ESCOND1\_1 | EAGLHYTP | ESCONDID | 3 |
| SKLELOY8 | LOYOLA\_69\_1 | LOYOLA | LOYOLA | 3 |
| SLCLAN8 | SAR\_FRAN\_1 | FRANKC | SARGNTS | 3 |
| DFERSTA8 | 38T365\_1 | WIRTZ | FLATRO | 3 |
| XFTS89 | PIGTAP\_SOLSTI1\_1 | SOLSTICE | PIGTAP | 3 |
| BASE CASE | SNYDER\_WKN\_BK1\_1 | ENAS | WKN\_BKR | 3 |
| XHHG58 | HHGT\_T2H | HHGT | HHGT | 3 |
| DPRSVLY5 | 1530\_\_C | BRTNT | BLPOI | 3 |
| DB\_DPHA8 | NAVALBAS\_NBA1 | NAVALBAS | NAVALBAS | 3 |
| XACS58 | IH20\_IHT1 | IH20 | IH20 | 2 |
| XN\_S58 | N\_SHARPE\_PS3 | N\_SHARPE | N\_SHARPE | 2 |
| SN\_SLON5 | N\_SHARPE\_PS3 | N\_SHARPE | N\_SHARPE | 2 |
| SSPUASP8 | ROTN\_WOLFGA1\_1 | WOLFGANG | ROTN | 2 |
| DMLSENT5 | ELKTN\_MR3L | ELKTN | ELKTN | 2 |
| BASE CASE | LGD\_SANTIA1\_1 | LGD | SANTIAGO | 2 |
| DCRLLSW5 | 589\_C\_1 | LWSVS | CRLNW | 2 |
| DMTSCOS5 | 6474\_\_A | SUNSW | MGSES | 2 |
| SMDOOAS5 | BCVPSA03\_A | PSA | BCV | 2 |
| DLONWAR5 | LONHILL\_PAWNEE\_1 | PAWNEE | LON\_HILL | 2 |
| SSCUSU28 | ASPM\_CONA1\_1 | ASPM | CONA | 2 |
| SRNGMO29 | BOW\_FMR1 | BOW | BOW | 2 |
| BASE CASE | TUNACR\_SIRIUS\_1 | SIRIUS | TUNACR | 2 |
| BASE CASE | ZO\_AJO | n/a | n/a | 2 |
| SCLETE25 | IH20\_IHT1 | IH20 | IH20 | 2 |
| DODEMDS5 | MDSSW\_MR1L | MDSSW | MDSSW | 2 |
| BASE CASE | N\_TO\_H | n/a | n/a | 2 |
| DELMSAN5 | PAWNEE\_SPRUCE\_1 | PAWNEE | CALAVERS | 2 |
| SNORODE5 | PIGCRE\_SOLSTI1\_1 | SOLSTICE | PIGCREEK | 2 |
| UCOLCOL1 | SAR\_FRAN\_1 | FRANKC | SARGNTS | 2 |
| BASE CASE | VALIMP | n/a | n/a | 2 |
| DWTRTRC5 | 1750\_\_B | SGOVL | KLBTP | 2 |
| SLCSTH25 | 505\_\_A | THSES | SAMSW | 2 |
| DBIGKEN5 | SONR\_69-1 | SONR | SONR | 2 |
| SWIRFE28 | 342T195\_1 | GRANMO | MARBFA | 2 |
| DFERGRA8 | 654T654\_1 | WIRTZ | STARCK | 2 |
| DGREBOW5 | 6560\_\_B | MRKLY | RICSW | 2 |
| SRDODES8 | 940\_\_C | ENWSW | WXHCH | 2 |
| DWIRGRA8 | BURNET\_AT3 | BURNET | BURNET | 2 |
| SMDSODE5 | MDSSW\_MR1L | MDSSW | MDSSW | 2 |
| DELMSAN5 | PAWNEE\_SPRUCE\_1 | CALAVERS | PAWNEE | 2 |
| DMCARIO8 | PIGCRE\_SOLSTI1\_1 | SOLSTICE | PIGCREEK | 2 |
| SMNHODE8 | PIGTAP\_SOLSTI1\_1 | SOLSTICE | PIGTAP | 2 |
| DBBSJEW5 | 920\_\_E | MTFSW | TLC | 2 |
| DENTSCS5 | ELKTN\_MR3L | ELKTN | ELKTN | 2 |
| SMCEABS8 | MKLT\_TRNT1\_1 | TRNT | MKLT | 2 |
| BASE CASE | NWF\_NOTSW\_1 | NWF | NOTSW | 2 |
| SWIRFER8 | 342T195\_1 | GRANMO | MARBFA | 1 |
| SMCEABS8 | 6780\_\_A | ESKSW | LONGWRTH | 1 |
| SODLBRA8 | EAGLHY\_ESCOND1\_1 | EAGLHYTP | ESCONDID | 1 |
| SCITNE28 | GARZA\_69A1 | GARZA | GARZA | 1 |
| SCOLLON5 | HAISLE\_LON\_HI1\_1 | LON\_HILL | HAISLEY | 1 |
| SNICBLU8 | HARI\_MILES1\_1 | MILES | HARI | 1 |
| SHSAPB38 | IH20\_IHT1 | IH20 | IH20 | 1 |
| XFTS89 | M\_69\_J1\_1 | IH20 | PECOS | 1 |
| SBOSWHT8 | OLKW\_BOS\_1 | BOSQUESW | LKWHITNY | 1 |
| DELMSAN5 | POT\_OAKS\_1 | OAKS9 | POTEETS | 1 |
| DFORELK5 | 1400\_\_G | LWSNR | BSPTP | 1 |
| DBBSRCH5 | 2050\_\_C | CRSCN | RICES | 1 |
| DMCSCDH8 | 3160\_\_A | CDCSW | OKCLS | 1 |
| DBBSRCH5 | 920\_\_E | MTFSW | TLC | 1 |
| SDUKNE28 | ADERHO\_ELSA1\_1 | ADERHOLD | ELSA | 1 |
| SN\_SLON5 | AIRLIN\_CABANI1\_1 | AIRLINE | CABANISS | 1 |
| SSONFRI8 | ATSO\_SONR1\_1 | ATSO | SONR | 1 |
| DCBYQNM8 | CBYDKR83\_A | CBY | DKR | 1 |
| DHOCGV89 | GN\_TC\_37\_A | TC | GN | 1 |
| SMDOOAS5 | IR\_SO\_05\_A | IR | SO | 1 |
| SAJORI25 | N\_SHARPE\_PS3 | N\_SHARPE | N\_SHARPE | 1 |
| SHSAPB38 | PBSES\_MR1L | PBSES | PBSES | 1 |
| DTOKJK\_5 | RBS\_HRN\_1 | RBS | HRN | 1 |
| DELMTEX5 | SAR\_FRAN\_1 | FRANKC | SARGNTS | 1 |
| DWIRSTA8 | 223T180\_1 | LAKEWY | MARSFO | 1 |
| DTRSRCH5 | 228\_\_A | LEG | NAVARRO | 1 |
| DNAVLEG5 | 60\_\_A | BBSES | NAVARRO | 1 |
| SLEGNA35 | 920\_\_E | MTFSW | TLC | 1 |
| DBBSRCH5 | 925\_\_A | TRSES | MTFSW | 1 |
| DJACALV8 | BOW\_FMR1 | BOW | BOW | 1 |
| SPHRCTR5 | EXNLH\_03\_A | EXN | LH | 1 |
| SSONFRI8 | FDR\_OZNC\_1 | FRIEND\_R | OZNC | 1 |
| SN\_SLON5 | HOLLY4\_RODD\_F1\_1 | RODD\_FLD | HOLLY4 | 1 |
| SKINKLE8 | LOYOLA\_69\_1 | LOYOLA | LOYOLA | 1 |
| SN\_SAJO5 | LOYOLA\_69\_1 | LOYOLA | LOYOLA | 1 |
| BASE CASE | NE\_LOB | n/a | n/a | 1 |
| SNORODE5 | PIGTAP\_SOLSTI1\_1 | SOLSTICE | PIGTAP | 1 |
| DSAMTHS5 | 228\_\_A | LEG | NAVARRO | 1 |
| DFERCOR8 | 342T195\_1 | GRANMO | MARBFA | 1 |
| DMARPA\_8 | 38T365\_1 | WIRTZ | FLATRO | 1 |
| SMDOOAS5 | AE\_LV\_04\_A | AE | LV | 1 |
| SCOLPAW5 | COLETO\_KENEDS1\_1 | COLETO | KENEDSW | 1 |
| SMDOOAS5 | GT\_MID90\_A | GT | MID | 1 |
| XN\_S58 | HOLLY4\_RODD\_F1\_1 | RODD\_FLD | HOLLY4 | 1 |
| XNED258 | NEDIN\_138H | NEDIN | NEDIN | 1 |
| DNEDPAL8 | NEDIN\_N\_MCAL1\_1 | NEDIN | N\_MCALLN | 1 |
| SBOSELM5 | 1030\_\_B | BOSQUESW | RGH | 1 |
| DRNS\_TB5 | 155T217\_1 | BELLSO | PT | 1 |
| XHUT58 | 211T147\_1 | GILLCR | MCNEIL\_ | 1 |
| DFERSTA8 | 318T313\_1 | WIRTZ | JOHNCI | 1 |
| DHCKRNK5 | 6271\_\_C | WGROB | SUMRFELD | 1 |
| SHOLWES8 | ARCADI\_SOUTH\_1\_1 | ARCADIA | SOUTH\_SI | 1 |
| SNICBLU8 | HARI\_MILES1\_1 | HARI | MILES | 1 |
| DTOKJK\_5 | HRN\_DANS\_1 | HRN | DANSBY | 1 |
| BASE CASE | M\_69\_J1\_1 | IH20 | PECOS | 1 |
| DFORELK5 | SGVSW\_MR2H | SGVSW | SGVSW | 1 |
| SALAN\_28 | AIRLIN\_CABANI1\_1 | AIRLINE | CABANISS | 1 |
| XPH3R58 | DIBMNT21\_A | DIB | MNT | 1 |
| SWCSBOO8 | FTST\_69T1 | FTST | FTST | 1 |
| SPAWLON5 | RAY\_ALOE\_1 | RAYBURN | ALOES | 1 |
| DTHSLCS5 | 290\_\_A | LCSES | THSES | 1 |
| SSPUMW18 | ASPM\_CONA1\_1 | ASPM | CONA | 1 |
| DLONWAR5 | BONIVI\_RINCON1\_1 | RINCON | BONIVIEW | 1 |
| SOAKNIC8 | CONCHO\_VRBS1\_1 | CONCHO | VRBS | 1 |
| XN\_S58 | HOLLY4\_RODD\_F1\_1 | HOLLY4 | RODD\_FLD | 1 |
| SN\_SLON5 | LOYOLA\_69\_1 | LOYOLA | LOYOLA | 1 |
| DCALBEC8 | N3\_U2\_1 | CALAVERS | BRAUNIG | 1 |
| XWHT58 | WHTNY\_MR2L | WHTNY | WHTNY | 1 |
| DMCSCDH8 | 3130\_\_B | INDST | CMPST | 1 |
| DFER\_WI8 | 49T191\_1 | FERGUS | HORSBA | 1 |
| SBBSNA55 | 60\_\_A | BBSES | NAVARRO | 1 |
| SPHRCTR5 | AZ\_QNM85\_A | QNM | AZ | 1 |
| DWO5\_EU8 | GT\_MID90\_A | GT | MID | 1 |
| DLONWAR5 | REFUG\_VICTO\_1C\_1 | VICTORIA | OCONNOR | 1 |