2016 RTP Update

January, 2016

Outline

- 2016 RTP Overview
- 2016 RTP Key Input Assumptions
- Next steps

2016 RTP Overview

- Governing standard, protocol and guide for RTP
  - NERC Standard TPL-001-4, ERCOT Protocol Section 3.11 and Planning Guide Section 3 and 4

- ERCOT presented the study scope of 2016 RTP in the Nov-2015 RPG. The study scope has been updated based on feedback and further review. The updated 2016 RTP Scope is available in the RPG calendar website.

- ERCOT is preparing cases and working with TSPs for various load, generation and transmission models

2016 RTP Overview: Summary of Key Updates

- Key updates on the 2016 RTP Scope and Process document
  - Hydro units: Maximum dispatch levels in the reliability cases will be determined based on a review of the historical data
  - DC Tie flows will be modeled similar to the 2015 RTP, based on a review of the historical data:
    - Full import through North and East DC Ties
    - Full export through Eagle Pass, Laredo and Railroad DC Ties
  - High-wind low-load condition will be studied for the off-peak sensitivity analysis

2016 RTP Overview: Study Year

- ERCOT is currently preparing input data to build base cases for the following study years using the Oct 2015 SSWG cases:
  - Base Cases:
    - Summer peak reliability base cases:
      - Year 2018, 2019, 2021 for the near-term horizon
      - Year 2022 for the long-term horizon
    - Off-Peak reliability base case:
      - Year 2019: minimum load case
  - Sensitivity cases will be developed using secure base cases:
    - Summer peak sensitivity cases: Year 2018 and 2021
    - Off-Peak sensitivity case: Year 2019

2016 RTP Overview: Analysis and Tools

- Key Studies:
  - Reliability analysis
    - Contingency analysis (SCOPF) to evaluate events where load shed is not allowed and to develop corrective action plans
    - Multiple element contingency analysis to perform load shedding analysis and Cascading analysis
    - Short circuit analysis to identify over-duty breakers and corrective action plans
    - Long-lead time equipment analysis to identify impact of unavailability of long-lead time equipment
  - Economic analysis
- Tools to be used:
  - PowerWorld, TARA, PSS/E, POM Applications, UPLAN

2016 RTP Input Assumptions: Study Weather Zone Load

- The RTP cases will use the higher of either the aggregated weather zone load in the SSWG base cases (October 2015 Version) or the ERCOT 90th percentile weather zone load forecast.
- Study weather zone load assumed for 2016 RTP

(Unit: MW)

Year	Coast	East	North	North Central	South Central	South	West	Far West	NCP Total
2018	27,199	2,951	1,734	27,243	13,235	6,564	2,363	3,521	84,810
2019	27,507	2,988	1,769	27,500	13,552	6,660	2,401	3,672	86,050
2021	27,979	3,034	1,820	27,943	14,165	6,840	2,483	3,925	88,190
2022	28,224	3,054	1,843	28,165	14,435	6,971	2,520	4,043	89,255

Notes:
- Self served load and Freeport LNG load (655.5 MW) are included.
- Losses are not included
- Highlighted data are from ERCOT's 90th percentile forecast
- These numbers may change upon further review

2016 RTP Input Assumptions: Future Generation

- ERCOT reviewed the Generation Interconnection Status (GIS) Report and identified new generation that met Planning Guide 6.9 Requirement. Total nameplate capacity of the future generation (with in-service date of March 2016 and beyond) is shown below.

(Unit: MW)

Fuel Type	Coast	Far West	North	North Central	South	South Central	West	Grand Total
Gas	800	-	903	1,042	225	51	-	3,021
Solar	-	798	110	-	-	-	-	908
Wind	-	120	2,365	96	1,774	-	380	4,735
Grand Total	800	918	3,378	1,138	1,999	51	380	8,664

(Source: GIS Report November 2015 REVISED at http://www.ercot.com/gridinfo/resource/2015)

2016 RTP Input Assumptions: Wind dispatch output levels

Weather Zone	Base Case**	Dispatch Level Not to exceed
Coast	N/A	N/A
East	N/A	N/A
North	3%	12%
North Central	1%	12%
South Central	2%	12%
South	10%	55% (coastal) / 12% (non-coastal)*
West	3%	12%
Far West	3%	12%

* Coastal region defined as Cameron, Willacy, Kenedy, Kleberg, Nueces, San Patricio, Refugio, Aransas, Calhoun, Matagorda, and Brazoria counties per Protocol Section 3.2.6.2.2
** Summer peak base cases

- Base case capacity factor based on 15th percentile output from vendor-supplied profiles sampled for hours when ERCOT load is higher than the 95th percentile
- Dispatch may be increased for resources outside of study region to meet load, loss, and reserve requirements. Maximum dispatch is the Wind Peak Average Capacity Percentage for summer used in the December 2015 CDR
- The information from historical data and SSWG cases will be used to determine wind dispatch output level for the minimum load condition and high-wind low-load condition

2016 RTP Input Assumptions: Other Resources

- Solar units will be dispatched at 70% of their nameplate capacity for summer peak reliability cases based on analysis of vendor-supplied solar curves similar to that conducted for wind generation. It will be dispatched to 0 in the minimum load reliability case, because ERCOT minimum load generally occurs at night or during early morning
- Hydro units will be dispatched based on a review of the historical dispatch data for all reliability cases.
- DC Tie will be modeled similar to 2015 RTP
- Appendix has more details of generation including the list of switchable, mothballed, and retired units

2016 RTP Input Assumptions: Transmission

- ERCOT uses the 15SSWG Cases (posted 10/12/2015) as the start cases to build 2016 RTP base cases
- Tier 1, 2 and 3 transmission projects in the cases that do not have RPG approval will be backed out from the cases to build 2016 RTP start cases
- ERCOT sent the list of projects with no RPG approval dates in the TPIT for TSPs' review

2016 RTP Input Assumptions: Transmission (cont'd)

Weather Zone	90th percentile temperature (°F)
Coast	102.4
East	106.2
Far West	110.4
North Central	108.4
North	109.0
South Central	105.5
South	104.0
West	107.3

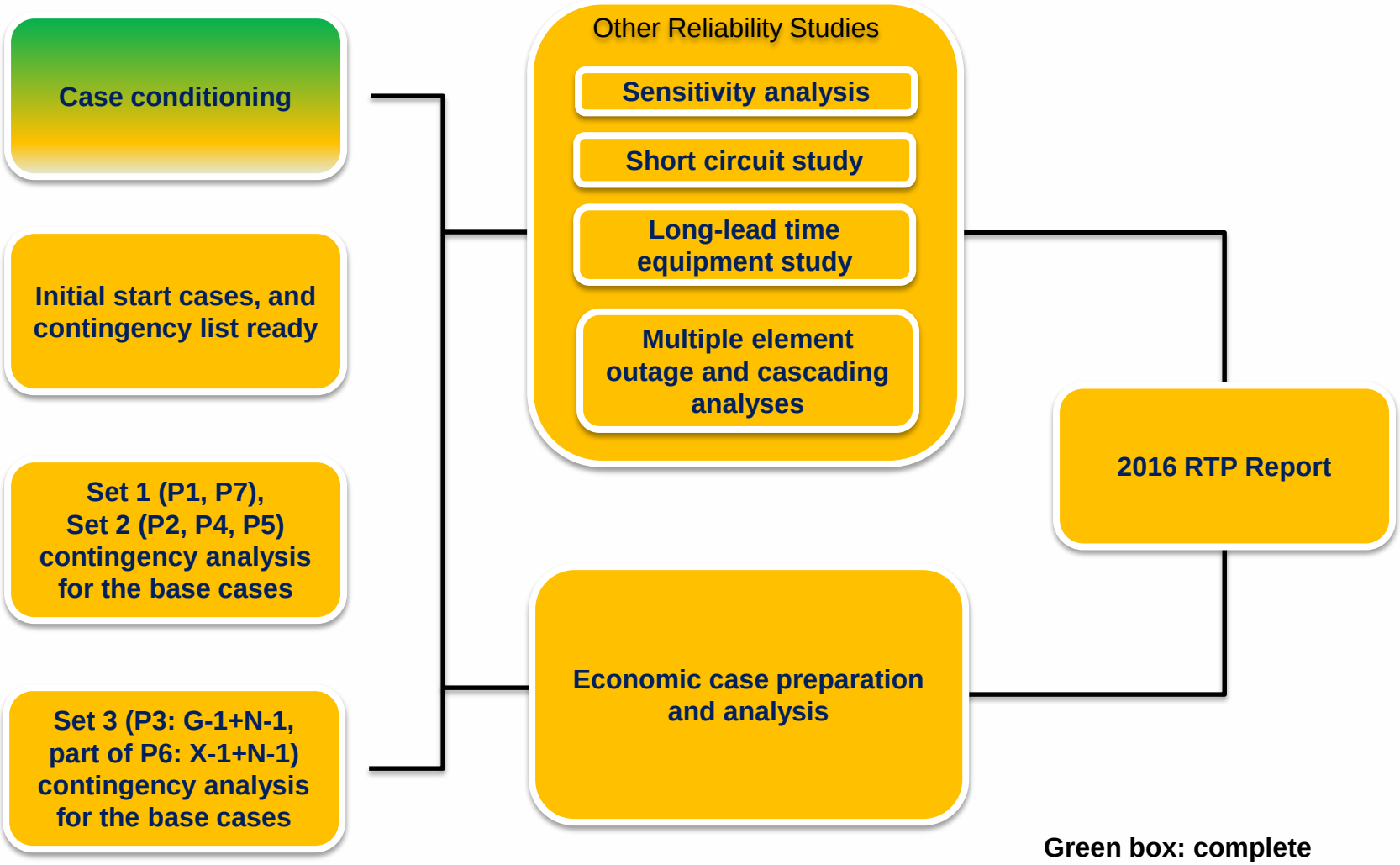
Dynamic Ratings for Reliability Analysis

- 90th percentile temperatures for each weather zone were derived based on 30 years of temperature data (1984-2013)
- Temperature data based on historical data from ERCOT databases

Next steps

- Continue to work with TSPs for case conditioning to create and publish RTP reliability start cases
- Conduct contingency analysis for the base cases and post contingency definitions and resulting violations
- Corrective action plans such as transmission upgrades or additions will be tested in collaboration with respective transmission owners
- Create and post N-1 (Set 1: P1 and P7) secure cases
- Continue to test P2, P4, and P5. After that, move on to P3 and P6-2 (G-1+N-1 and X-1+N-1) screen to identify corrective action plans to address violations

2016 RTP - Current Status



Green box: complete
Yellow box: in progress

Questions?

Appendix

SSWG load

- SSWG load based on October 2015 SSWG cases
- Includes losses, does not include self served load or Freeport LNG load

(Unit: MW)

Year	Coast	East	North	North Central	South Central	South	West	Far West	NCP Total
2017	22,505	3,148	1,800	25,597	13,183	6,033	2,273	3,432	77,971
2018	22,971	3,169	1,833	25,954	13,472	6,163	2,319	3,586	79,467
2019	23,288	3,209	1,875	26,314	13,808	6,270	2,360	3,744	80,869
2020	23,584	3,238	1,909	26,616	14,099	6,389	2,402	3,891	82,127
2021	23,813	3,275	1,947	26,905	14,439	6,420	2,454	4,008	83,260
2022	24,036	3,304	1,977	27,242	14,721	6,612	2,510	4,139	84,542

ERCOT 90th percentile load forecast

- Includes losses, does not include self served load or Freeport LNG load

(Unit: MW)

Year	Coast	East	North	North Central	South Central	South	West	Far West	NCP Total
2017	20,967	2,683	1,556	27,426	12,556	6,060	2,112	3,029	76,389
2018	21,168	2,715	1,554	27,754	12,615	6,199	2,178	3,117	77,082
2019	21,339	2,740	1,556	28,016	12,659	6,298	2,247	3,207	77,975
2020	21,496	2,766	1,560	28,243	12,693	6,386	2,319	3,297	78,760
2021	21,658	2,794	1,563	28,468	12,731	6,482	2,391	3,393	79,480
2022	21,821	2,822	1,565	28,694	12,770	6,579	2,465	3,489	80,205

New generation per PG 6.9 requirements

Project Name	In-service Date	Capacity Added (MW)	Fuel	County	TDSP	Weather Zone
PHR Peakers	3/2016	390	GAS	Galveston	Centerpoint	Coast
Antelope & Elk 1	4/2016	369	GAS	Hale	Sharyland	North
Elk 2	4/2016	202	GAS	Hale	Sharyland	North
Elk 3	4/2016	202	GAS	Hale	Sharyland	North
Sky Global Power One	4/2016	51	GAS	Colorado	SBEC/LCRA	South Central
South Plains II Phase a	5/2016	152	WIND	Floyd	Sharyland	North
South Plains II Phase b	5/2016	148	WIND	Floyd	Sharyland	North
Baytown Chiller	6/2016	270	GAS	Chambers	Centerpoint	Coast
Redgate G	6/2016	225	GAS	Hidalgo	AEP/TCC	South
Buckthorn Wind 1	6/2016	96	WIND	Erath	BEPC	North Central
Lamar Power Upgrade	6/2016	130	GAS	Lamar	Oncor	North
RE Roserock Solar	7/2016	150	SOLAR	Pecos	AEP/TNC	Far West
Gunsight Mt W	8/2016	120	WIND	Howard	Oncor	Far West
Wake Wind	8/2016	300	WIND	Dickens	WETT	North
Happy Whiteface W	8/2016	157	WIND	Deaf Smith	Sharyland	North
Paint Creek Solar	8/2016	110	SOLAR	Haskell	AEP/TNC	North
Torrecillas Wind A	9/2016	200	WIND	Webb	AEP/TCC	South

Source: Based on GIS Report November 2015 Revised

New generation per PG 6.9 requirements (cont'd)

Project Name	In-service Date	Capacity Added (MW)	Fuel	County	TDSP	Weather Zone
Torrecillas Wind B	9/2016	200	WIND	Webb	AEP/TCC	South
Los Vientos IV	9/2016	200	WIND	Starr	AEP/TCC	South
West Texas Solar	9/2016	110	SOLAR	Pecos	LCRA	Far West
Val Verde Wind	10/2016	180	WIND	Val Verde	AEP/TCC	West
Riggins Solar	10/2016	150	SOLAR	Pecos	AEP/TNC	Far West
Hidalgo & Starr Wind	10/2016	250	WIND	Hidalgo	AEP/TCC	South
Electra Wind	10/2016	360	WIND	Wilbarger	AEP/TNC	North
Midway Wind	12/2016	161	WIND	San Patricio	AEP/TCC	South
Patriot Wind	12/2016	180	WIND	Nueces	AEP/TCC	South
Colbeck's Corner W	12/2016	200	WIND	Carson	Sharyland	North
Grandview W 3	12/2016	188	WIND	Carson	Sharyland	North
Swisher Wind	12/2016	300	WIND	Swisher	Sharyland	North
San Roman Wind 1	12/2016	103	WIND	Cameron	AEP/TCC	South
Longhorn South	12/2016	160	WIND	Briscoe	Sharyland	North
Redfish W 2a	12/2016	115	WIND	Willacy	AEP/TCC	South
Redfish W 2b	12/2016	115	WIND	Willacy	AEP/TCC	South
Salt Fork 1 Wind	12/2016	200	WIND	Gray	CTT	North
Blanco Canyon Wind 1	12/2016	50	WIND	Floyd	Sharyland	North
Blanco Canyon Wind 2	12/2016	150	WIND	Floyd	Sharyland	North
Chapman Ranch Wind I	12/2016	250	WIND	Nueces	AEP/TCC	South
SP-TX-12	12/2016	180	SOLAR	Upton	LCRA	Far West
East Pecos Solar	12/2016	100	SOLAR	Pecos	AEP/TNC	Far West
RTS Wind	12/2016	200	WIND	McCulloch	LCRA	West
Friendswood G	4/2017	129	GAS	Harris	Centerpoint	Coast
Freeport LNG	6/2017	11	GAS	Brazoria	Centerpoint	Coast
Wolf Hollow 2	7/2017	1042	GAS	Hood	Oncor	North Central
Pecos Solar I	10/2017	108	SOLAR	Pecos	AEP/TNC	Far West

Source: Based on GIS Report November 2015 Revised

Switchable, Mothballed and Retired Units

Unit Name	Capacity Available to ERCOT (MW)				Weather Zone	Notes
	2018 SUM	2019 SUM / MIN	2021 SUM	2022 SUM		
KMCHI_CC1	623	623 / 665	623	623	North	Switchable
KMCHI_CC2	623	623 / 665	623	623	North	Switchable
FTR_CC1	580	580 / 640	880	880	North	Switchable (300MW unavailable to ERCOT until 2021)
TGCCS_CC1	846	846 / 908	846	846	North	Switchable
FRONTERA _CC1	-	-	-	-	South	Switchable
ANTLP_G1 - G3	-	-	-	-	North	Switchable
ELK_G1	-	-	-	-	North	Switchable
ELK_G2	-	-	-	-	North	Switchable
SILASRAY_SILAS_5	-	-	-	-	South	Retired
CALAVERS_JTD1	420	-	-	-	South	Mothballed
CALAVERS_JTD2	420	-	-	-	South	Mothballed
CTL_GT_103	-	-	-	-	Coast	Mothballed
AMOCOOIL_AMOCO_5	-	-	-	-	Coast	Mothballed
SRB_SRBGT_2	-	-	-	-	Coast	Mothballed
SRB_SRBGT_G4	-	-	-	-	Coast	Mothballed
SRB_SRBGT_G3	-	-	-	-	Coast	Mothballed
SRB_SRBGT_G2	-	-	-	-	Coast	Mothballed
SRB_SRBGT_G1	-	-	-	-	Coast	Mothballed
MLSES_UNIT2	805	805 / -	805	805	North	Seasonally Mothballed

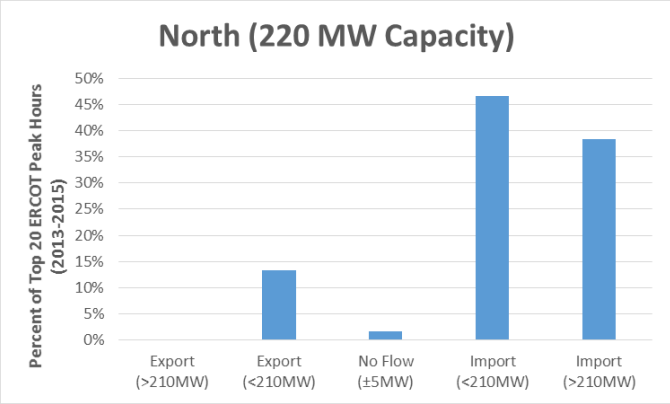
(Sources: MIS-published Notification of Suspension of Operations (NSO); December 2015 CDR Report)

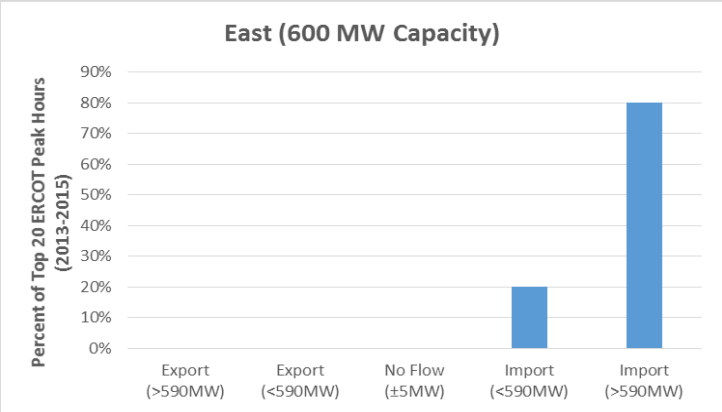
Hydro Data Analysis

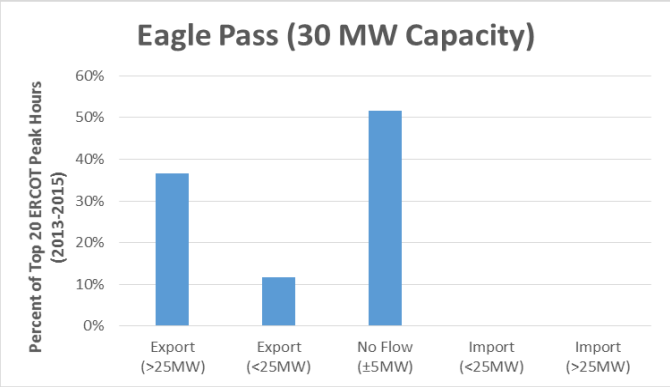
- Dec 2015 CDR shows 437.7 MW as the total available capacity based on the High Sustainable Limits (HSL) of hydro units

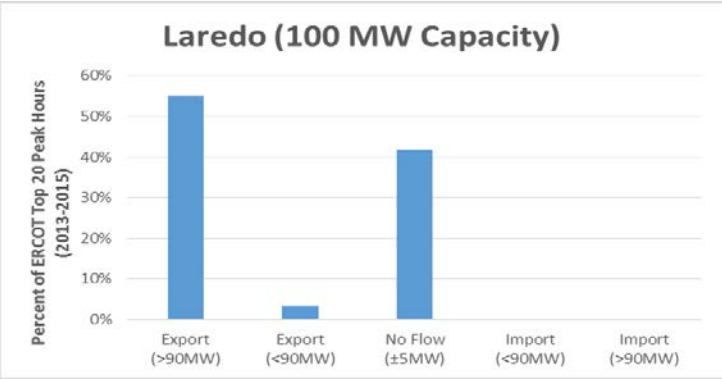
- 147 MW was the total average output from hydro units during the top 20 ERCOT peak load hours for the past three years.

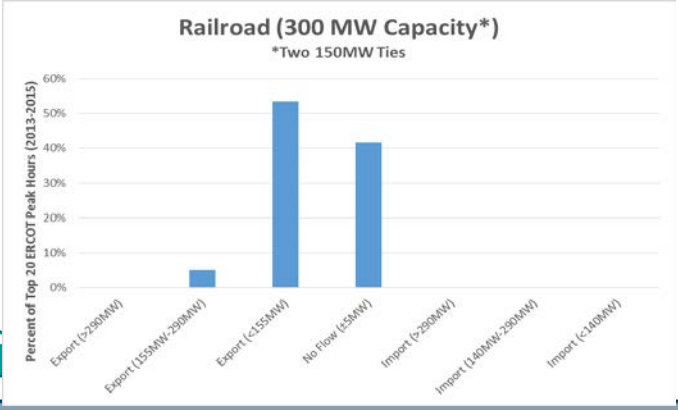
DC Tie Historical Data Analysis (Summer of 2013~2015)











Railroad tie capacity doubled last Summer:

- Approximately 250 MW flows occurred when South was at peak on August 14, 2015.
- Approximately 200 MW occurred when ERCOT was at peak on August 5, 2015

DC Tie Historical Data Analysis (cont'd)

DC Tie	Capacity	2015 RTP	CDR* (per current 2016 RTP assumption)	Max/Min/Med** Negative means export
East	600	600 Import	581 Import	601/334/599
North	220	220 Import	140 Import	219/-196/166
Laredo	100	100 (Export)	56 (Export)	0/-101/-96
Railroad	300	300 (Export)	90 (Export)	0/-201/-151
Eagle Pass	30	30 (Export)	13 (Export)	0/-29 /0

* Average flows per 2013~2015 Top 20 ERCOT peak load hours analysis
** Max/Min/Median per 2013~2015 Top 20 ERCOT peak load hours analysis

DC Tie	Capacity	Max/Min/Med*** Negative means export
East	600	601/294/599
North	220	219/-134/183
Laredo	100	0/-101/-99
Railroad	300	0/-251/-151
Eagle Pass	30	0/-29/0

*** Max/Min/Median per 2013~2015 Top 20 South peak load hours analysis