



# **Panhandle Transfer Capability Analysis**

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**ERCOT System Planning**

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# Agenda

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- Background
- Panhandle Wind Generation Development Overview
- Study Process
  - Scenarios, Criteria, and Assumptions
- Study Results and Observations
- Schedule

# Background

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- In response to the Public Utility Commission of Texas' (Commission) April 17, 2015 Open Meeting request
- To evaluate transmission solutions (including reactive equipment) to increase transfer capability in the Texas Panhandle (Panhandle) using
  - The cost-effectiveness standard under the Competitive Renewable Energy Zones (CREZ) Order, and
  - The current reliability and economic planning criteria in ERCOT Protocol Section 3.11.2.

# Panhandle Wind Generation Development Overview

Status <sup>(1)</sup>	Generation Capacity (MW)	Cumulative Capacity (MW)
Operational	1561	1561
Planned (PG 6.9) <sup>(2)</sup>	2043	<b><u>3604</u></b>
Planned (IA) <sup>(4)</sup>	3870	7474

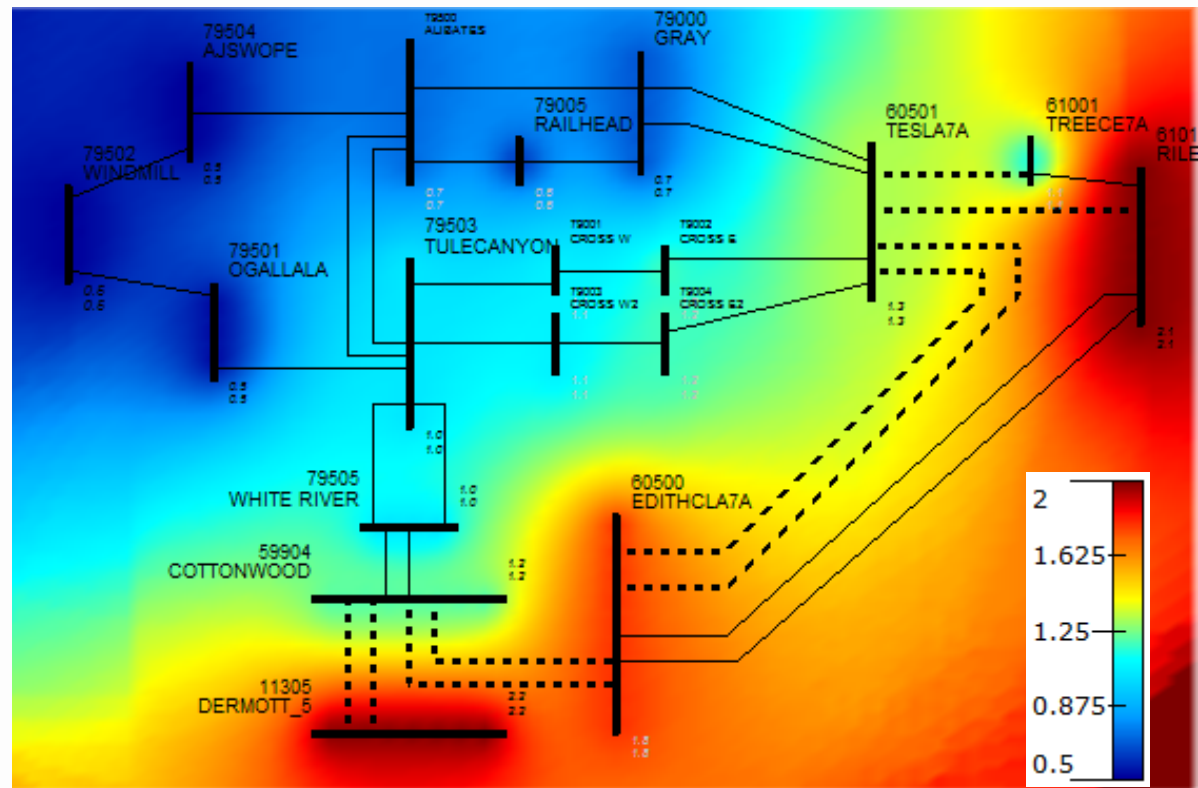
- (1). Based on GINR (Generator Interconnection Request) data as of July 10, 2015
- (2). PG 6.9: Planning Guide 6.9 Modeling Requirement (Interconnection Agreement and Collateral for Transmission Equipment)
- (3). IA: Interconnection Agreement Only

# Potential Variations

- Wind plant design
  - Wind projects with ~1000 MW capacity that met PG 6.9 at start of study (May 19, 2015) have not completed interconnection studies.
  - Different wind plant designs may be implemented that are different from those initial proposed during the GINR process
    - Wind turbine technology
    - Voltage support and voltage ride through capability
  - More uncertainty for future projects
- Actual implementation
  - Certain wind plant controllers for weak grid condition can provide better reliability support
  - Additional dynamic reactive devices can provide more reliability support than static shunt/reactor

# Panhandle Interface

- The interface (dash line in the figure) is defined based on short circuit levels.
- Cottonwood – Dermott (Double Circuits)
- Cottonwood – Edith Clarke (Double Circuits)
- Tesla – Edith Clarke (Double Circuits)
- Tesla – Jim Treece/Riley (Double Circuits)



# Study Scenarios

Scenario	Panhandle Wind Generation Capacity (MW)	Transmission Options	
		Synchronous Condenser(s)	Second Circuit on the Alibates-Windmill-Ogallala-Tule Canyon 345 kV line
0 (Base Case)	3604	No	No
1	3604	Yes	No
2	3604	No	Yes
3*	3604	Yes	Yes
4**	3604 +X MW	Yes	Yes

\* Scenario 3 will be considered if transmission options in scenario 1 and 2 do not meet criteria.

\*\* If scenario 1 meets the study criteria, scenario 4 will be performed using scenario 1 result case as the reference to involve increasing generation capacity (X MW) on the Alibates-Windmill-Ogallala-Tule Canyon 345 kV line until the study criteria are met.

# Study Criteria

- Reliability criteria:
  - ERCOT Planning Guide;
  - NERC Standard TPL-001-4; and
  - Panhandle System Strength, based on Weighted Short Circuit Ratio (WSCR), is equal to or above 1.5.
- Economic criteria trial 1:
  - Curtailment of Panhandle annual generation is equal to or less than 2%.
- Economic criteria trial 2:
  - The annual production cost savings of a transmission project must be greater than or equal to the first year annual revenue requirement for the transmission project. The first year annual revenue requirement for a transmission project is assumed to be 15% of the estimated capital cost of the project.



# Study Assumptions

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- Panhandle wind generation output is proportionally dispatched with respect to its capacity to meet the reliability criteria.
- Apply 90% of the identified transfer capability in the Panhandle in the economic analysis to account for operational application of the limit.
- Have all series capacitors, except for Rocky Mound series capacitors, in service in the study.

# Study Results – Economic Analysis

#	Panhandle Wind Capacity (MW)	Transmission Options	Upgrade Cost Assumption (M\$)	Maximum Output (MW)(1)	Operation Limit (MW) (2)	Annual Curtailment (3)	Pass Trial 1 Criteria?	Annual Production Cost Savings/ Capital Cost (4)	Pass Trial 2 Criteria?
0	3604	N/A	0	3070	2763	3.65%	No	N/A	N/A
1	3604	SC at Alibates and Tule Canyon (5)	64.25	3510	3159	0.35%	Yes	22%	Yes
2	3604	PH Second Circuit	80	3214	2893	2.27%	No	9%	No
3	No study need.								

(1) Determined by WSCR = 1.5, which is the most binding constraint

(2) 90% of Maximum Output

(3) Less than or equal to 2% energy curtailment

(4) Greater than or equal to 15% annual cost saving compared to the project capital cost

(5) Each synchronous condenser modeled in the simulation is 150 MVA providing 1050A short circuit current to the 345 kV system. Dynamic simulations indicate that locating synchronous condensers at Alibates and Tule Canyon provide better performance with respect to voltage support and transient response than other Panhandle locations such as Gray, Windmill and Cottonwood.

# Study Results – Economic Analysis

#	Panhandle Wind Capacity (MW)	Transmission Options <sup>(1)</sup>	Upgrade Cost Assumption (M\$)	Maximum Output (MW) <sup>(5)</sup>	Operation Limit (MW)	Annual Curtailment	Pass Trial 1 Criteria?	Annual Production Cost Savings/ Capital Cost	Pass Trial 2 Criteria?
4-0	3604+300 <sup>(2)</sup>	N/A	0	3392	3053	2.95%	No	NA	NA
4-1	3604+300 <sup>(2)</sup>	PH Second Circuit	80	3619	3257	1.25%	Yes	11% <sup>(3)</sup>	No
4-2	3604+600 <sup>(2)</sup>	N/A	0	3296	2966	6.42%	No	NA	NA
4-3	3604+600 <sup>(2)</sup>	PH Second Circuit	80	3565	3209	3.68%	No	18% <sup>(4)</sup>	Yes

- (1) Scenario 1 with synchronous condensers is the base case for scenario 4.
- (2) Additional 300 MW and 600 MW were added on the Alibates-Windmill-Ogallala-Tule Canyon 345 kV line
- (3) Compared to scenario 4-0
- (4) Compared to scenario 4-2
- (5) Determined by WSCR = 1.5, which is the most binding constraint

# Study Results – Reliability Analysis

Scenario	Wind Capacity (MW)	Wind Output (MW)	Performance
0	3604	3424	Acceptable
4-3	4204	3570	Acceptable <sup>(1)</sup>

(1). Acceptable response with respect to system voltage and frequency, but for some contingencies the observed overvoltage trips of Panhandle wind resources can be more than 1000 MW depending on the assumed turbine model for wind generation additions.

- Projects with signed interconnection agreement and financial agreement prior to January 16, 2014 are not required to meet any high VRT requirement greater than 1.1 pu. (Nodal Operating Guide 2.9.1)
- The amount of overvoltage tripping observed in the study would likely be reduced with
  - more accurate modeling within the wind plants in the Panhandle.
  - site specific tuning of wind plant protection and control equipment.

# Summary

Panhandle Wind Gen (MW)	Additional Wind Gen (MW) (1)	Transmission Options		Reliability Criteria	Pass Trial 1 Criteria? (3)	Pass Trial 2 Criteria? (4)
		Synchronous Condenser(s)	PH Second Circuit			
3604	0	One at Alibates and one Tule Canyon	No	Yes	Yes	Yes
3604	300(5)	One at Alibates and one Tule Canyon	Yes	Yes	Yes	No
3604	600(5)	One at Alibates and one Tule Canyon	Yes	Yes	No	Yes

- (1) On the Alibates-Windmill-Ogallala-Tule Canyon 345kV line
- (2) Each synchronous condenser modeled in the simulation is 150 MVA providing 1050A short circuit current to the 345kV system
- (3) Less or equal to 2% energy curtailment
- (4) More than or equal to 15% annual cost saving compar to the project capital cost
- (5) Additional 300 MW and 600 MW were added on the Alibates-Windmill-Ogallala-Tule Canyon 345 kV line

# Schedule

Task	Description	Completion Date
1.	Present Study Scope to RPG	May 19, 2015
2.	Present Preliminary Study Results to RPG	August 18, 2015
3.	RPG Comments due	August 28, 2015
4.	Final Report filed with PUC	September 15, 2015

Submit comments to Shun-Hsien (Fred) Huang,  
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