Solar Study
Progress Report to RPG

Cathey Carter
April 21, 2016

Background and Disclaimer

- The 2014 LTSA identified potential for 16+ GW of solar generation in ERCOT by 2029. The majority of the solar interconnection requests are concentrated in the West and Far West weather zones where the transmission system is relatively weak.

- The purpose of this study is to identify the steady-state impacts of various levels of solar resource penetration on the ERCOT grid.

- The projects identified in this study are conceptual only and are not intended to be recommended without further analysis. The projects could serve to inform future transmission planning and interconnection studies, but they have not been reviewed for dynamic stability or optimized for costs.

Development of Study Cases - Generation

- The latest 2018 West/Far West summer peak case from the 2015 Regional Transmission Plan (RTP) is the base case for the study, but the wind generation in the West and far West weather zones are increased to the CDR summer level.

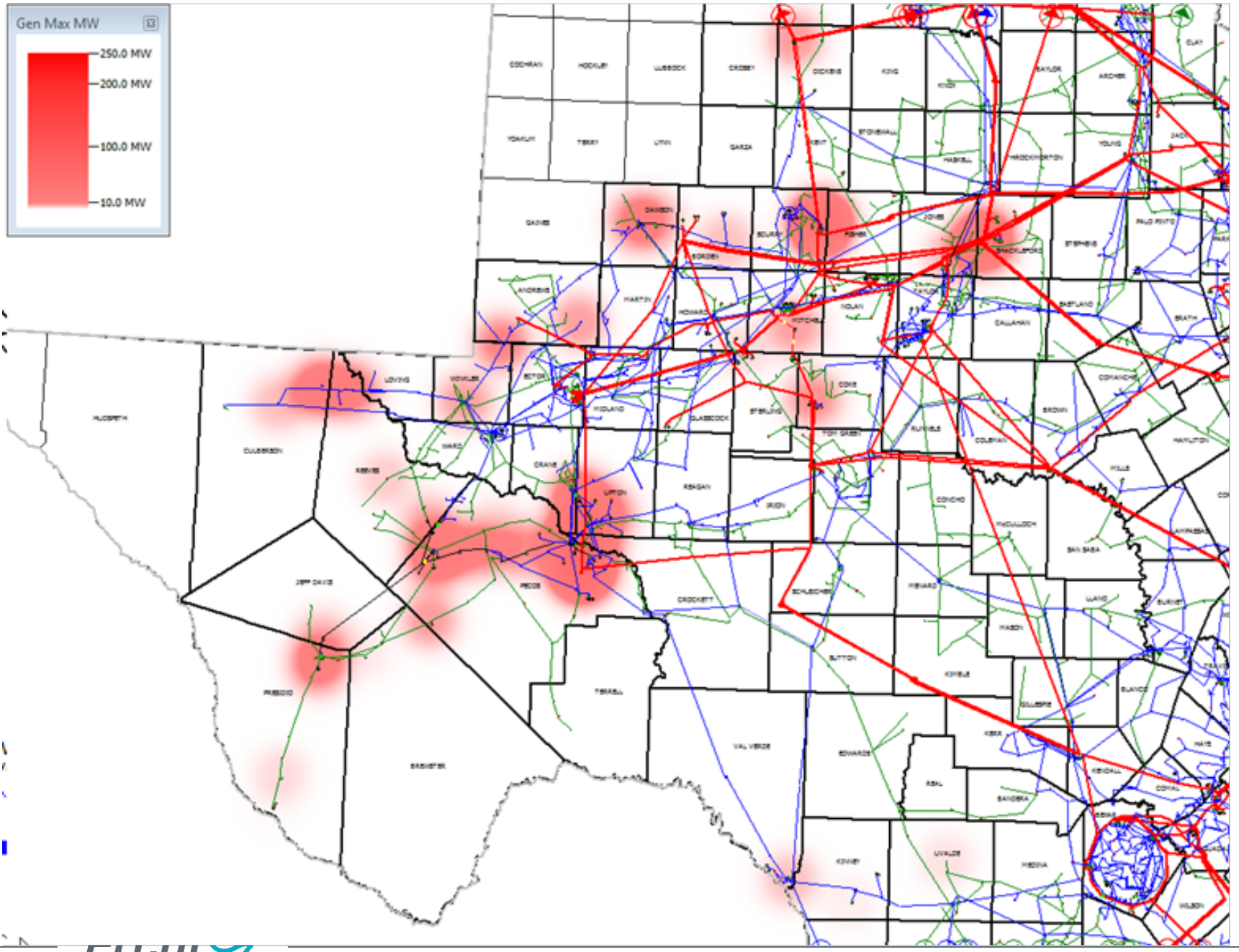
- All solar projects in the West, Far West and North weather zones are included in the study. The solar projects in the South and South Central weather zones (395 MW in total) are not included in this study. Three in-service solar projects in the west (71 MW total) are included.

- Three projects previously identified as duplicates have been cancelled and are not included.

Development of Study Cases - Generation

- The remaining solar generators and projects total 8120 MW. These are grouped into three study stages based on the project status. Projects in stage1 will be studied first. After that projects in stage 2 will be studied and finally the projects in stage 3 will be studied.

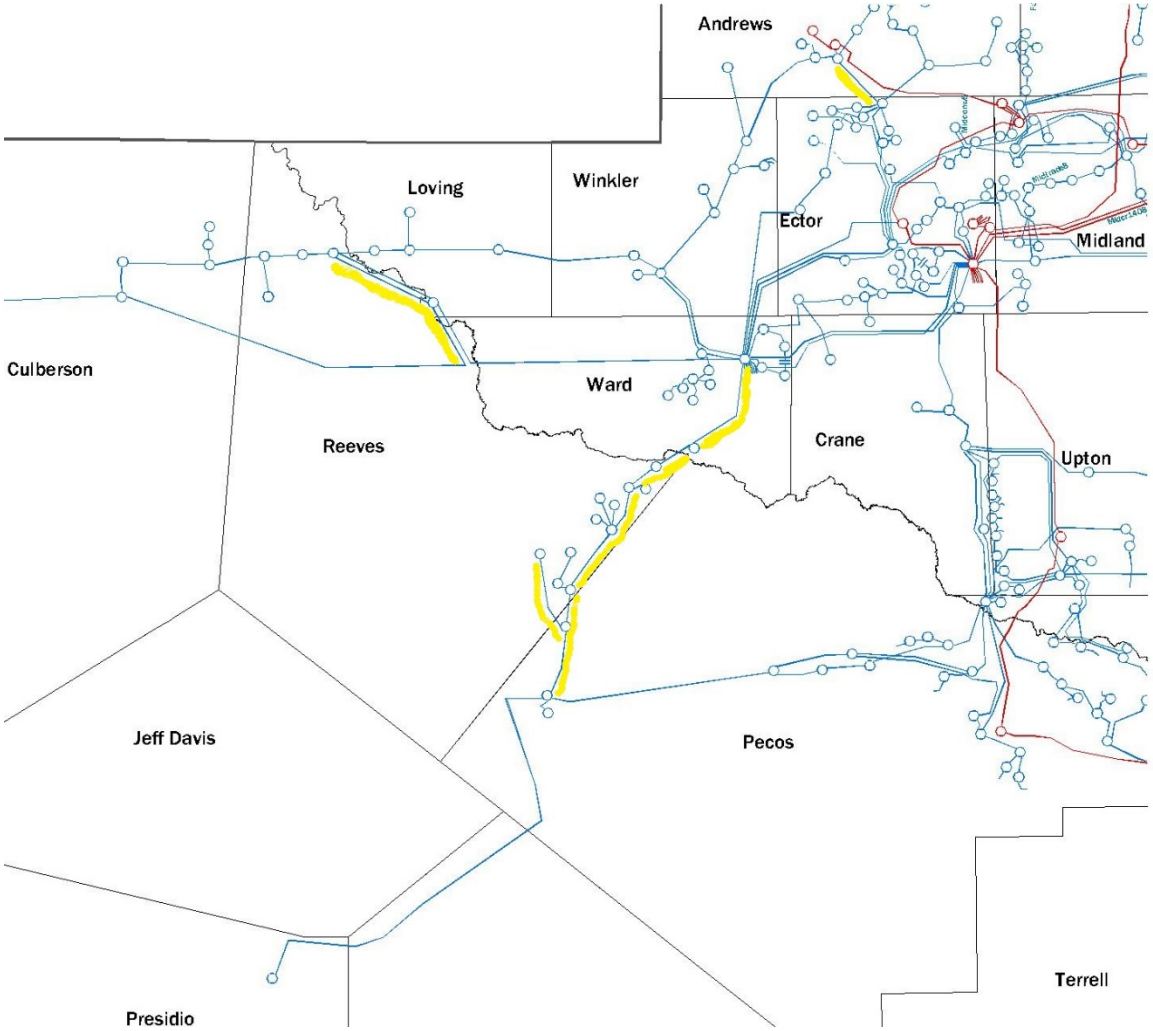
	MW	Stage 1	Stage 2	Stage 3
In Service	71	Yes	Yes	Yes
IA Signed	1860	Yes	Yes	Yes
No IA but FIS Complete	250	Yes	Yes	Yes
No IA and FIS Incomplete	5940	No	50% capacity	Yes
Total MW in Stage		2181	5151	8121


Gen Max MW
250.0 MW
200.0 MW
100.0 MW
10.0 MW

Development of Study Cases - Transmission

- The LCRA Camp Woods – Leakey 69kV upgrade project was added.
- The AEP/Oncor 138kV Barilla – Permian project was added.
- The Oncor Riverton – Sand Lake 138kV project was added.
- The Oncor Andrews County – Holt 138kV project was added.
- The Brazos Salt Creek 345kV auto and 138kV line project was added.

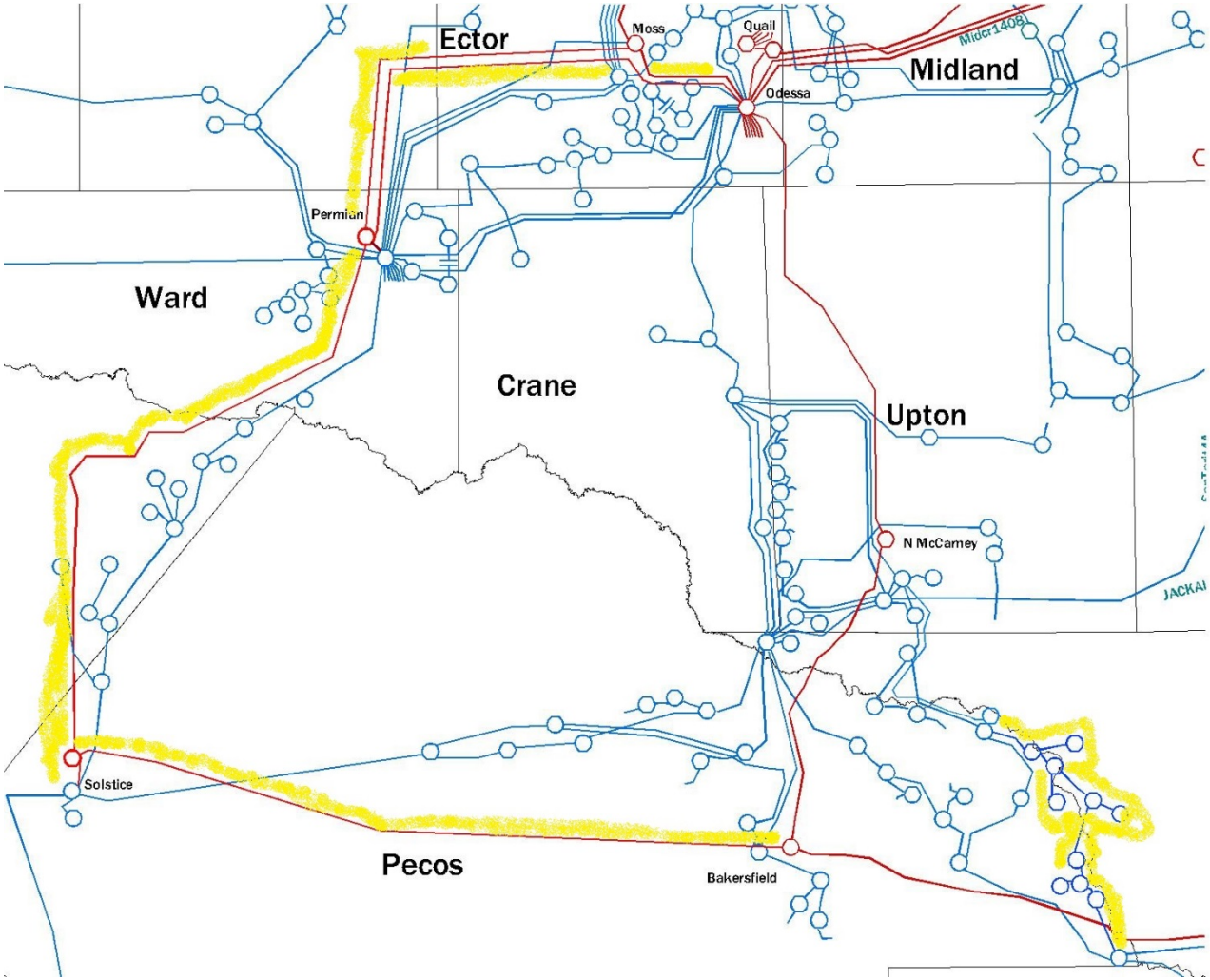
Development of Study Cases - Transmission



2181 MW Stage 1 Possible Upgrades

- 345kV Permian: one 600 MVA 345-138kV auto, 32.5 mile line to Moss, 50 mile line to Odessa
- 345kV Solstice: one 600 MVA 345-138kV autotransformer, 60 mile line to Permian Basin, 70 mile line to Bakersfield
- 138kV Tuna Creek – Sirius upgrade from 153 MVA to 445 MVA, less than 1/10 mile
- 28 mile conversion of 266 MVA 69kV to 445 MVA 138kV: West Yates – Alley Oop – Ooola – Dinny – Iraan – Cactus – Sheffield – Fort Lancaster, plus 3 radial taps

Stage 1 345kV Additions + 138kV Conversion



5151 MW Stage 2 Possible Upgrades, 1 of 3

- 345kV Solstice: second 600 MVA 345-138kV autotransformer
- Upgrade existing 345kV lines from 1045 to 1631 MVA ratings
  - Morgan Creek – Tonkawas, 20 miles
  - Sweetwater East – Bitter Creek, 8 miles
- New 138kV Alamito – Solstice line, ~75 miles, 445 MVA
- New 138kV Hamilton – Camp Wood 221 MVA line and 200 MVA 138-69kV autotransformer at Camp Wood, ~60 miles
- New 138kV Holder – Dressy 170 MVA line and 62 MVA 138-69kV autotransformer, ~20 miles
  - 6352 Sana Tap – 6356 Dressy 69kV normally open

5151 MW Stage 2 Possible Upgrades, 2 of 3

- New ~5 mile 138kV Swtrdr – Sweetwater 124 MVA line and 100 MVA 138-69kV autotransformer at north end
  - 1379 Loraine – 1380 Roscoe 69kV normally open

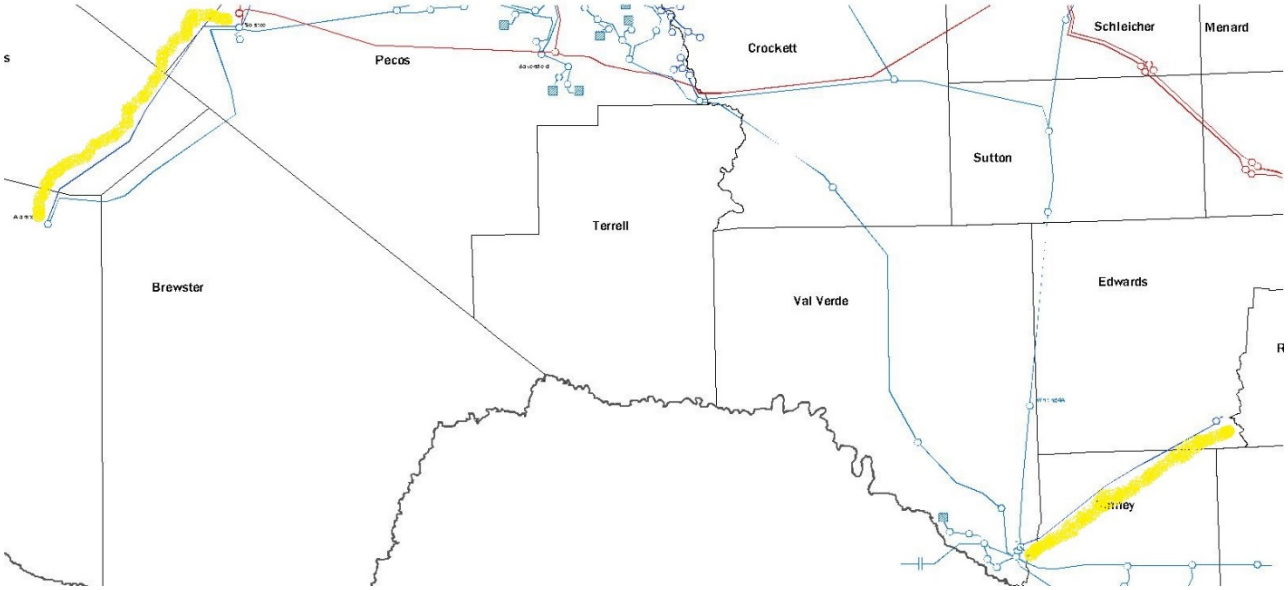
- Other 69kV line sections normally opened:
  - 6342 Novice – 6343 Talpatl
  - 6511 Atso - Ozonec

- Upgrade existing 138kV lines
  - 67 mile Alamito – Solstice, 151 MVA to 445 MVA
  - 45 mile Willow Valley - Exsharn – Bluff Creek – China Grove and Knapp – Scurry Church – Ennis Tap, less than 200 MVA to 495 MVA
  - Amoco – Dolarhide to rate C 167 MVA

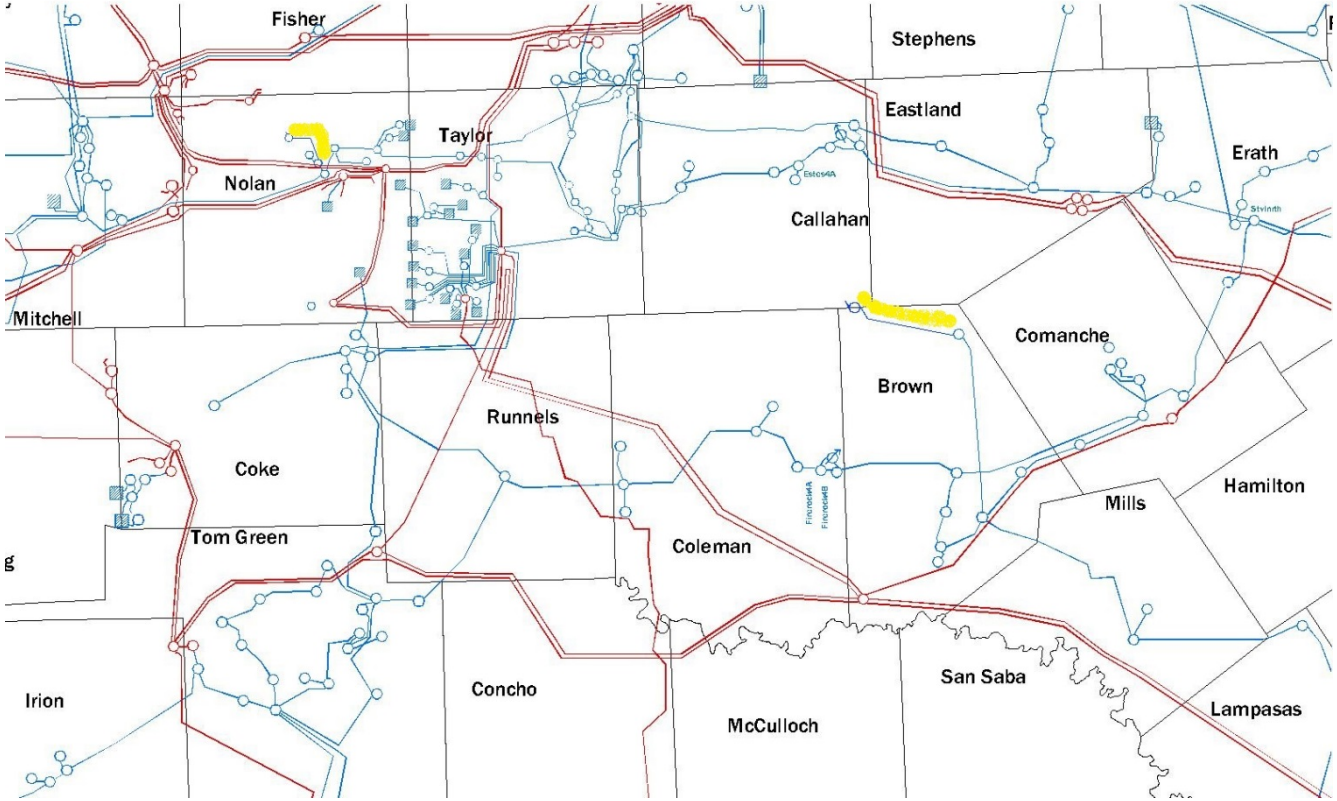
5151 MW Stage 2 Possible Upgrades, 3 of 3

- Upgrade existing 69kV TN Pecos – TN Reeves Co from 33 MVA to168 MVA, ~10 miles
- Upgrade existing 69kV Alpine – Paisano – Alamito from 27 MVA to 60 MVA, ~22 miles
- Comstock 138kV statcom, SVC, synchronous condenser, or similar
- Move 69kV generation connections to 138kV:
  - 7 projects, total of 342 MW

Stage 2 Additions (south)



Stage 2 Additions (north)



8121 MW Stage 3 Possible Upgrades, 1 of 2

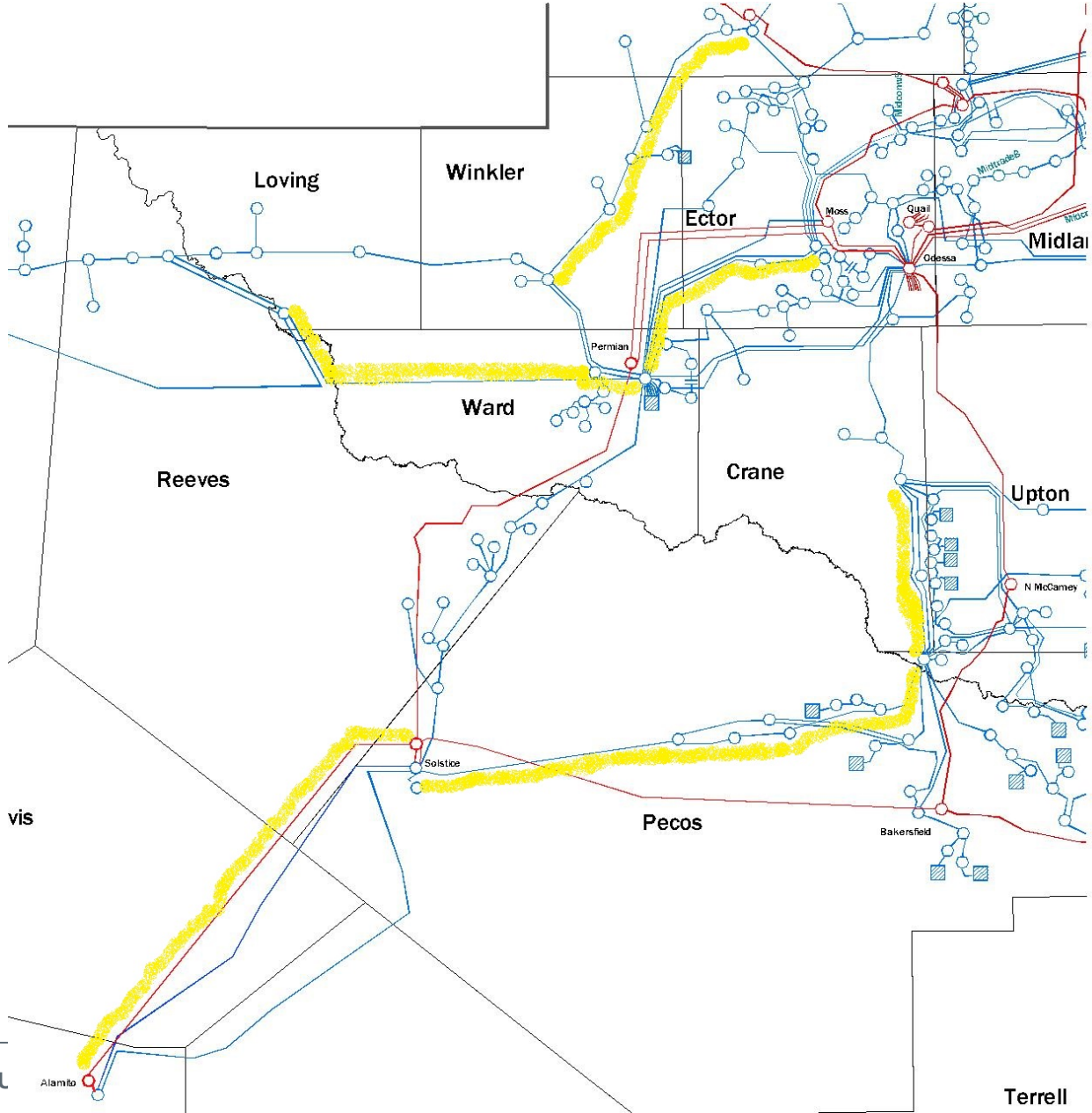
- 345kV Alamito: one 600 MVA 345-138kV autotransformer, 65 mile line to Solstice

- Upgrade existing 138kV lines:
  - Permian – Mentone to 966 MVA
  - Permian – Moss and Permian – Ector Harp – Moss to 495 MVA
  - Wink – Wildcat – Loving – Andrews Ranch – El Mar – Mason – Sand Bend – Orla – Screwbean – Black River – Culberson to rate C 614 MVA
  - Wink – Cheyenne – No Trees – Dolarhide – Amoco – Andrews County South to 495 MVA
  - Rio Pecos – Crane to 445 MVA
  - Rio Pecos – TN Woodward – TN 16th St – TN Airport – Ft Stockton – Solstice to 445 MVA

8121 MW Stage 3 Possible Upgrades, 2 of 2

- Mentone 138kV statcom, SVC, synchronous condenser, or similar
- Replace both 138-69kV autotransformers at Alamito with 77 MVA matching-impedance autos.
- Upgrade existing 69kV to 60 MVA:
  - Ferris sw – Ferris sub
  - Ferris sw – Sabinal
  - Ferris sw - Downie

Stage 3 345kV Addition and 138kV Upgrades



Summary of all Upgrades, 1 of 2

- **Stage 1, 2181 MW**
  - (2) 600 MVA 345-138kV autotransformers
  - 212 new 345kV ckt-miles
  - < 1/10 mile 138kV upgrade
  - 28 miles 69kV to 138kV conversion
- **Stage 2, 5151 MW**
  - (1) 600 MVA 345-138kV autotransformer
  - 28 miles 345kV upgrades
  - 160 miles new 138kV (all new ROW)
  - (1) 138kV SVC or statcom
  - (3) new 138-69kV autos – 200 MVA, 100 MVA, and 62 MVA
  - 112 miles rebuild 138kV
  - 32 miles 69kV upgrades

Summary of all Upgrades, p2 of 2

- **Stage 3, 8121 MW**
  - (1) 600 MVA 345-138kV autotransformer
  - 65 miles new 345kV
  - 243 miles 138kV upgrade
  - (1) 138kV SVC or statcom
  - (2) 77 MVA 138-69kV autotransformers
  - 27 miles 69kV upgrade

Next

- Update for current generation interconnection requests
- Write Report
- Dynamic Studies ?
- Economic Studies ?

- Questions?