Integrated Resource Plan
Public Advisory Group

Meeting 3 – July 6, 2017

Operational Considerations,
System Operations,
Existing Conventional Resources,
Transmission and Distribution

Meeting Agenda

- **Welcome and Introduction**
- **Public Advisory Process and Meeting Schedule**
- **Operational Considerations/Requirements for Future Resources**
  - Assessment of need for additional resources
- **System Operations, Import Limits, and Balancing**
- **Existing Conventional Resources and System Generation Retirement Plan and Process**
- **Transmission & Distribution Systems Overview and Projects**
- **Discussion**

Welcome and Introduction

Presenters for this Meeting

- Maritza Perez: NM IRP Case Manager
- Omar Gallegos: Director of Resource Planning and Management
- Dave Hawkins: VP - System Operations Resource Planning & Management
- Andy Ramirez: VP - Power Generation
- Clay Doyle: VP - Transmission & Distribution and System Planning
- Myra Segal: Facilitator

Safety and Basics

- Fire Escape Routes
- Please sign in. You will be added to our PAG distribution list
  - Skype participants can email NMIRP@epelectric.com
- Facilities
- Recording of Meetings
- Terms Glossary

Safe Harbor Statement

Certain matters discussed in this Integrated Resource Plan ("IRP") public advisory group presentation other than statements of historical information are "forward-looking statements" made pursuant to the safe harbor provisions of the Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended. Such statements are subject to a variety of risks, uncertainties and other factors, most of which are beyond El Paso Electric Company's ("EPE" or the "Company") control, and many of which could have a significant impact on the Company's operations, results of operations, and financial condition, and could cause actual results to differ materially from those anticipated. Additional information concerning factors that could cause actual results to differ materially from those expressed in forward-looking statements is contained in EPE's most recently filed periodic reports. Any such forward-looking statement is qualified by reference to these risks and factors. EPE cautions that these risks and factors are not exclusive.

Management cautions against putting undue reliance on forward-looking statements or projecting any future assumptions based on such statements. Forward-looking statements speak only as of the date of this IRP public advisory group presentation, and EPE does not undertake to update any forward-looking statement contained herein, except to the extent the events or circumstances constitute material changes in this IRP that are required to be reported to the New Mexico Public Regulation Commission ("NMPRC" or "Commission") pursuant to its IRP Rule, 17.7.3 New Mexico Administrative Code.

Ground Rules

Meeting Rules and Guidelines

- **Meetings will follow the agenda**
- **Questions**
  - Public advisory group may ask clarifying questions during presentation
  - Questions that require a longer explanation will be answered at the end of the presentation
  - Skype attendees: may type in a question in instant message box
- **Discussion will follow**
  - Facilitator will assist during discussion
  - **All public input and requests submitted in writing will be responded to in writing***
- **Keep communications respectful and to the point**

*Joint Stipulation Case No. 15-00241-UT

Updated Schedule – Public Advisory Group Meetings

See full size schedule at end of packet

Meeting	Date	Time	Subject	Location
(1)	5/25/2017	2:00 p.m.- 4:00 p.m.	Kick-off and Introduction Explanation of IRP Process and Goals Resource Planning Process and Overview Preliminary Listing of Resource Options to Consider	EPE Office 555 S. Compress Rd. Las Cruces, NM
(2)	6/8/2017	2:00 p.m.- 3:30 p.m.	Summary of IRP process and introduction to system	NMPRC Offices 4th Floor Hearing Room P.E.R.A. Building 1120 Paseo de Peralta Santa Fe, NM
(3)	7/6/2017	2:00 p.m.- 4:30 p.m.	Operational Considerations/Requirements for Future Resources Assessment of need for additional resources System Operations - Reliability, Import Limits and Balancing Existing Conventional Resources System generation retirement plan and process Transmission & Distribution Systems Overview and Projects	Dona Ana County Conference Room 113 845 N. Motel Blvd. Las Cruces, NM
(4)	8/3/2017		Existing Renewable Resources and Distributed Generation (DG) Energy Efficiency (EE)/Demand Response (DR) Programs and Options Rate Considerations and Potential Impacts on Resource Planning Decisions Load Forecast Load Forecast - Impacts from EE/DR and Rate Structure	Las Cruces
(5)	9/7/2017		Conventional Capacity and Generation Option Considerations Demand Side Resource Options Renewable Energy Options (Solar, Wind, Geothermal, Storage, DG) Operational Considerations for Intermittent Resources and Balancing Renewable Portfolio Standard Impacts Renewable & Conventional Power Plant Siting and Environmental Considerations	Las Cruces
(6)	10/5/2017		DEADLINE FOR OPTION SUBMITTAL FROM PUBLIC Resource Planning Base Case Assumptions Initial Cost Estimates for Resource Planning Options Modeling and risk assumptions and the cost & general attributes of potential additional resources	Las Cruces
(7)	10/12/2017		Resource Planning Overview and Modeling for Cost of Potential Additional Resources	Santa Fe
(8)	11/16/2017		Preliminary Results with 2017 Load Forecast Presentation of Resulting 20-year Expansion Plan Development of the most cost-effective portfolio of resources for utility's IRP	Las Cruces
(9)-(10)	Jan 19, Feb 16		Informational Meetings or Discussions as Requested	LC/Santa Fe
(11)	4/30/2018		IRP Draft Presentation	Las Cruces
(12)	5/16/2018		Follow-up meeting to receive and respond to public feedback	Las Cruces
(13)	6/8/2018		Final IRP presentation showing new load forecast	Las Cruces
(14)	6/29/2018		Follow-up meeting to receive and respond to public feedback	Las Cruces
	7/15/2018		**IRP Filing Date**	

Moved DG presentation to 8/3/17

Moved Renewable Portfolio Standard Impacts to 9/7/2017

Integrated Resource Plan

Public Advisory Process

- **The purpose of the public advisory process is to receive public input and solicit public commentary concerning resource planning and related resource acquisition issues**
  - - NM Rule 17.7.3.9 (H)

- **Meeting Schedules and Agendas**
  - Participants may add their own presentations to the agendas for the **January and February** meetings

Integrated Resource Plan

Operational Considerations/Requirements for Future Resources and Assessment of need for Additional Resources

Omar Gallegos

Director of Resource Planning and Management

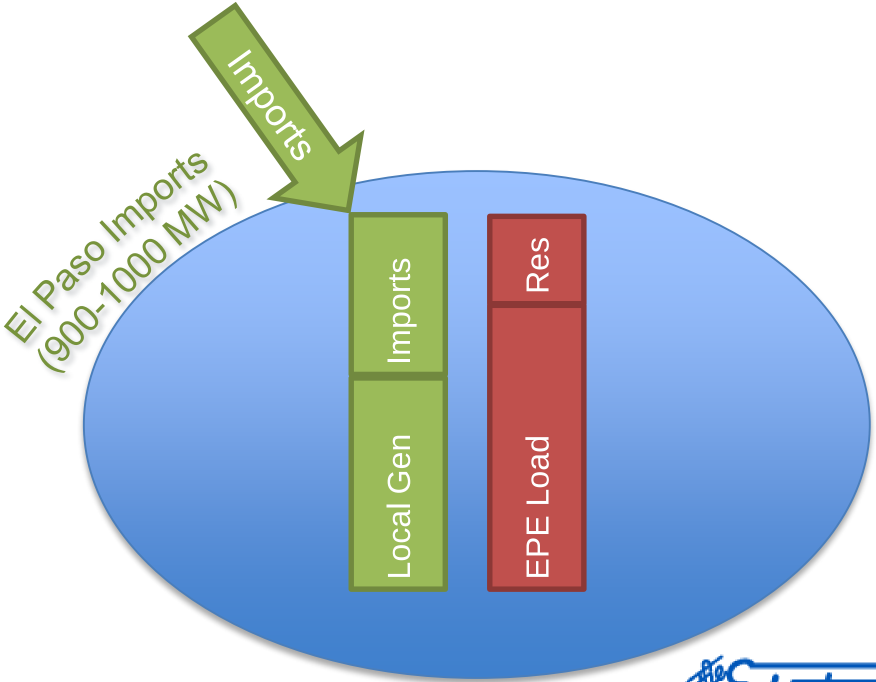
Resource Planning Considerations for Operational Reliability

- System operational behavior
- Import limitations
- Contingency reserves and reserve margin
- Variability of intermittent renewable resources
- Generation dispatch and baseload generation
- Age of retirement resources

Operational Reliability

System Operational Dynamic Behavior

- **Bulk Electric System flows across tie-lines dictated by load draw and physics**
- **As load varies, imports change almost immediately and then local generation adjusts to reset balance**
- **Need to maintain imports within transmission limitations**
- **Example of transmission line overloading resulting in a blackout**

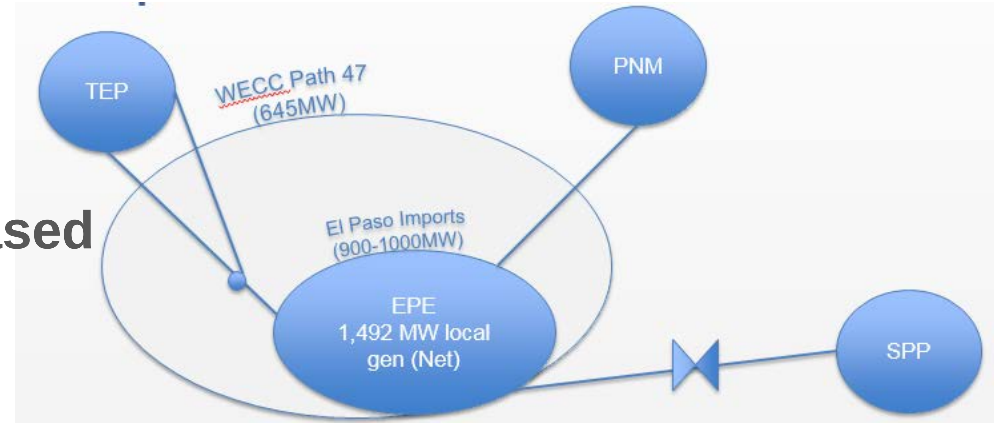


The Electric Company
El Paso Electric

Operational Reliability

Modelling of Transmission Import Limitations

- **System model for Capacity Expansion analysis**
- **Limitations on purchased power and sales**

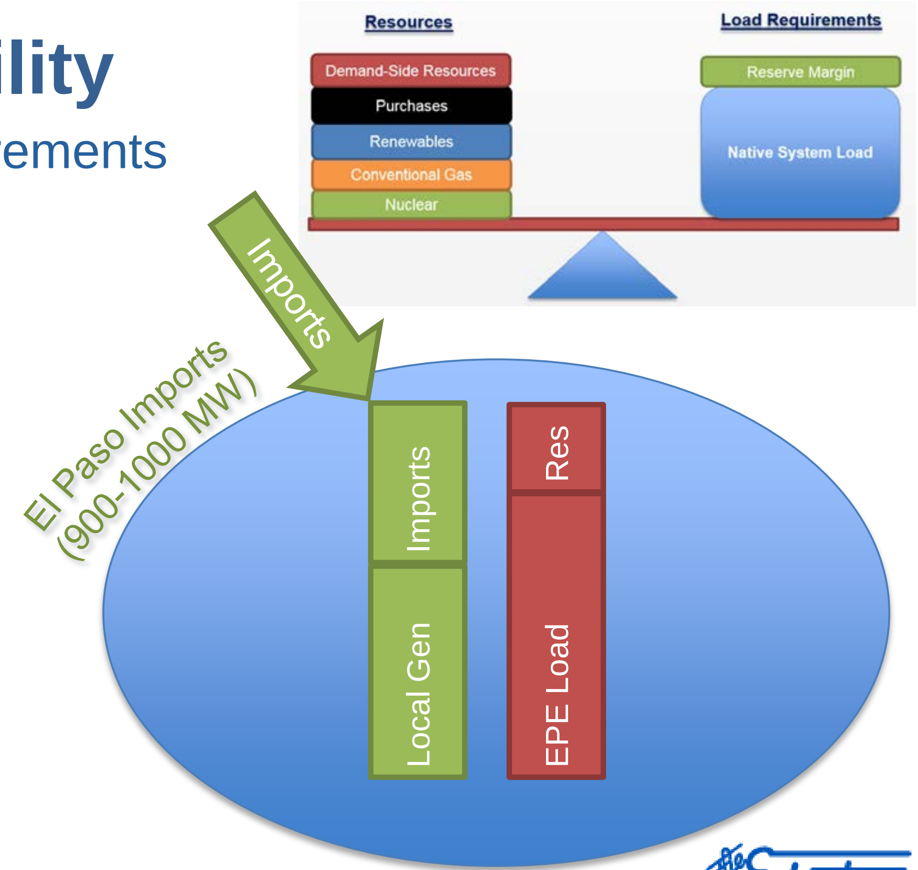


El Paso Electric

Operational Reliability

Importance of Reserve Requirements

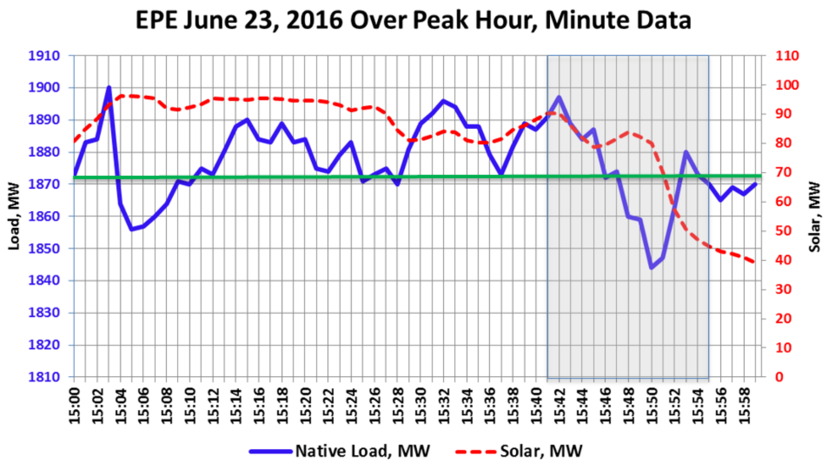
- Cover unexpected loss of generator resource
- Cover unexpected loss of transmission line (n-1)
- Cover load growth over forecast

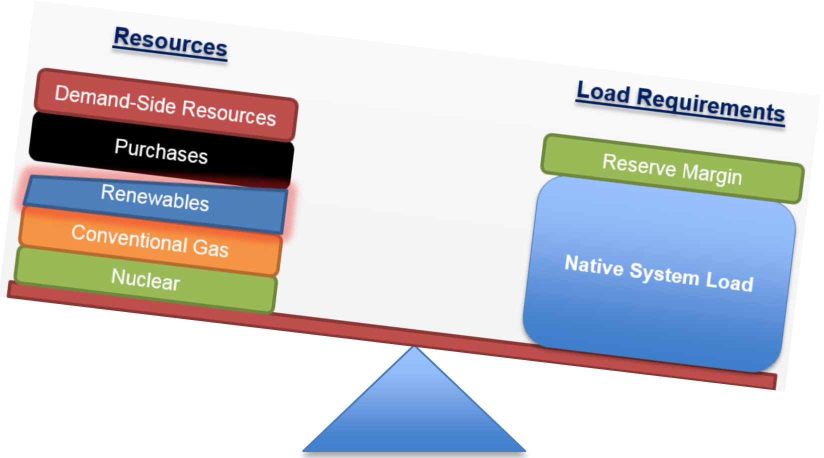


Operational Reliability

Impacts of Intermittent Generation Resources

- **Need to consider how to mitigate if penetration of renewables increases**
- **There are options, need to be conscious of intermittency**



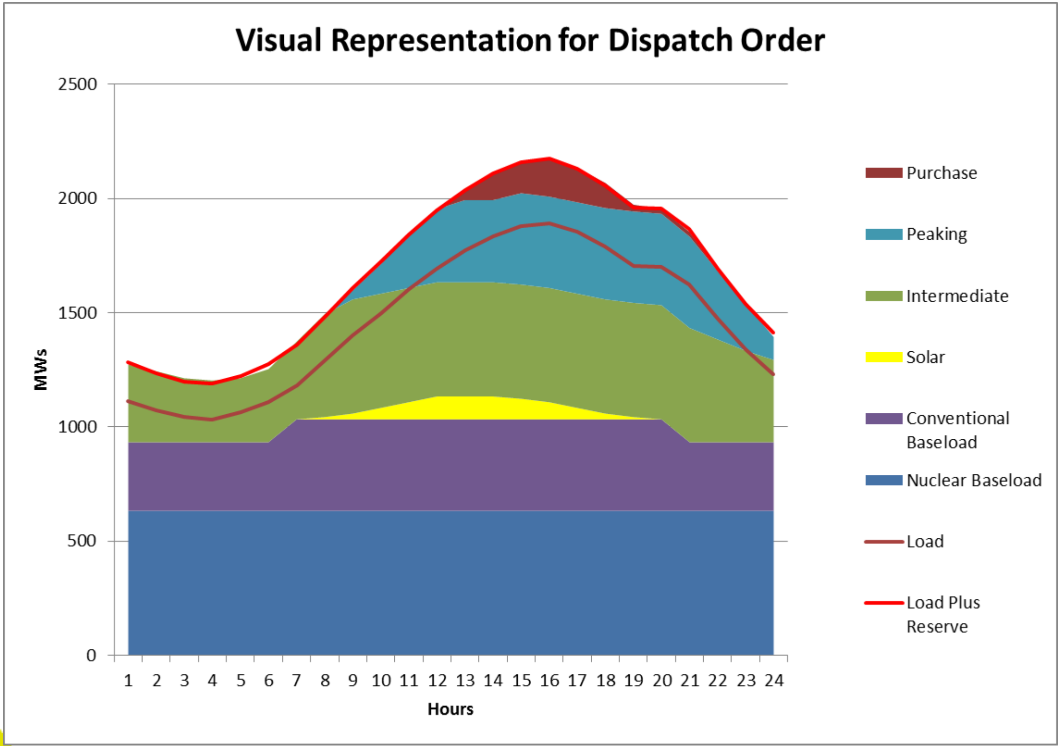


El Paso Electric

Operational Reliability

Dispatch Characteristics and Dispatch Order

- **Dispatch order**
- **Resource dispatch ability**
- **Resource ability for daily cycling**



El Paso Electric

Operational Reliability

Generation Unit Age

- Safety: Personnel safety working in proximity to high pressure systems

- Reliability: Availability and risk of catastrophic failure

- Cost Effectiveness: Unit characteristics and resulting operating cost. Including consideration for any investment required for life extensions

Questions?

Integrated Resource Plan

System Operations – Reliability, Import Limits, and Balancing

Dave Hawkins

Vice President - System Operations Resource Planning & Management

17.7.3 NMAC – Integrated Resource Plans for Electric Utilities

17.7.3.7 - Definitions

- **I. most cost effective resource portfolio** means those supply-side resources and demand-side resources that minimize the net present value of revenue requirements proposed by the utility to meet electric system demand during the planning period consistent with reliability and risk considerations;

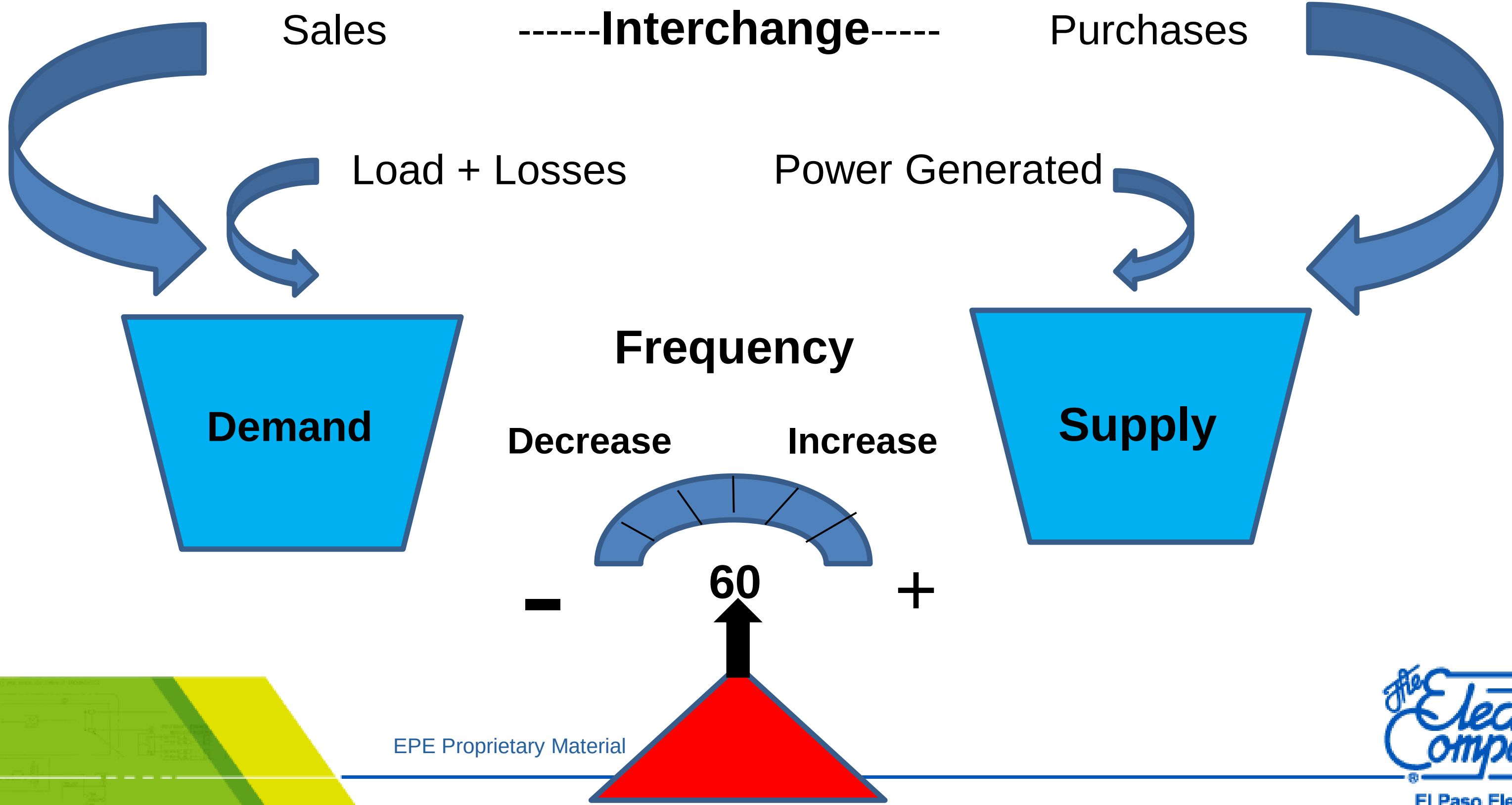
17.7.3.9(C) – Integrated Resource Plans for Electric Utilities

- **(6)** amount of capacity obtained or to be obtained through existing purchased power contracts or agreements relied upon by the utility, including the fuel type, if known, and contract duration;
- **(8)** amount of capacity and, if applicable, energy, provided annually to the utility pursuant to wheeling agreements and the duration of such wheeling agreements;
- **(10)** reserve margin and reserve reliability requirements (e.g. FERC, power pool, etc.) with which the utility must comply and the methodology used to calculate its reserve margin

17.7.3.9(G) – Integrated Resource Plans for Electric Utilities

- **(1)** To identify the most cost-effective resource portfolio, utilities shall evaluate all feasible supply and demand-side resource options on a consistent and comparable basis, and take into consideration risk and uncertainty (including but not limited to financial, competitive, reliability, operational, fuel supply, price volatility and anticipated environmental regulation). The utility shall evaluate the cost of each resource through its projected life with a life-cycle or similar analysis. The utility shall also consider and describe ways to mitigate ratepayer risk.
- **(2)** Each electric utility shall provide a summary of how the following factors were considered in, or affected, the development of resource portfolios:
  - (d) fuel diversity;
  - (e) susceptibility to fuel interdependencies;
  - (g) system reliability and planning reserve margin requirements.

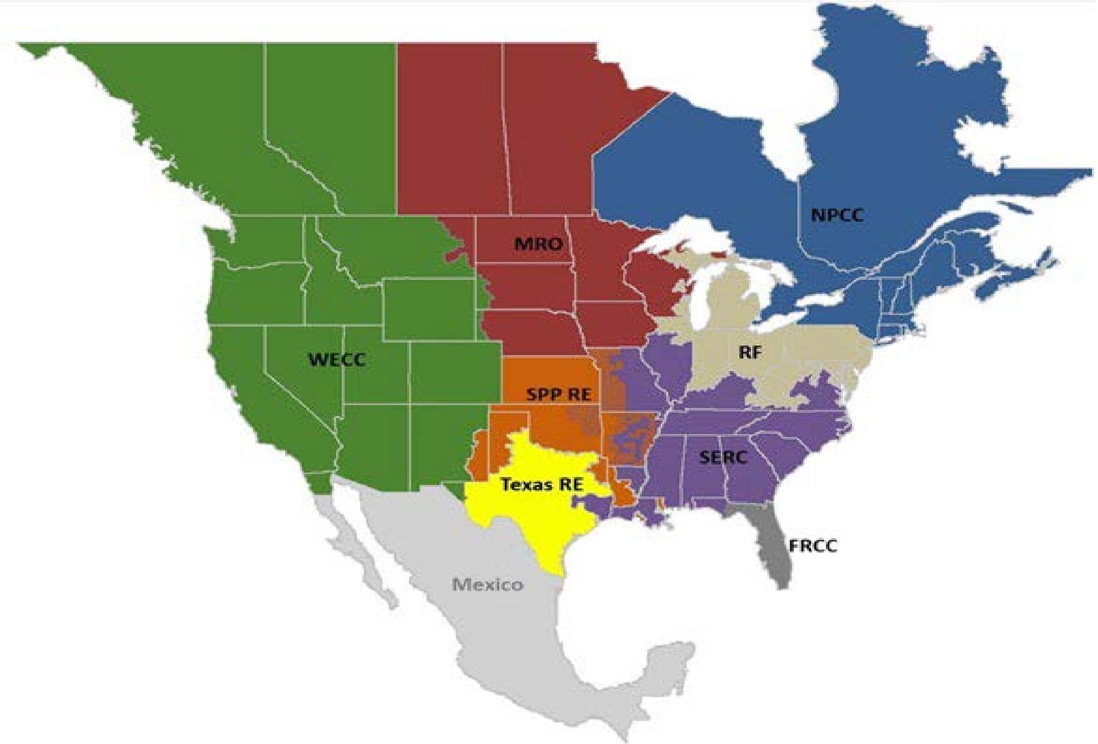
System Operations, Resource Planning & Management



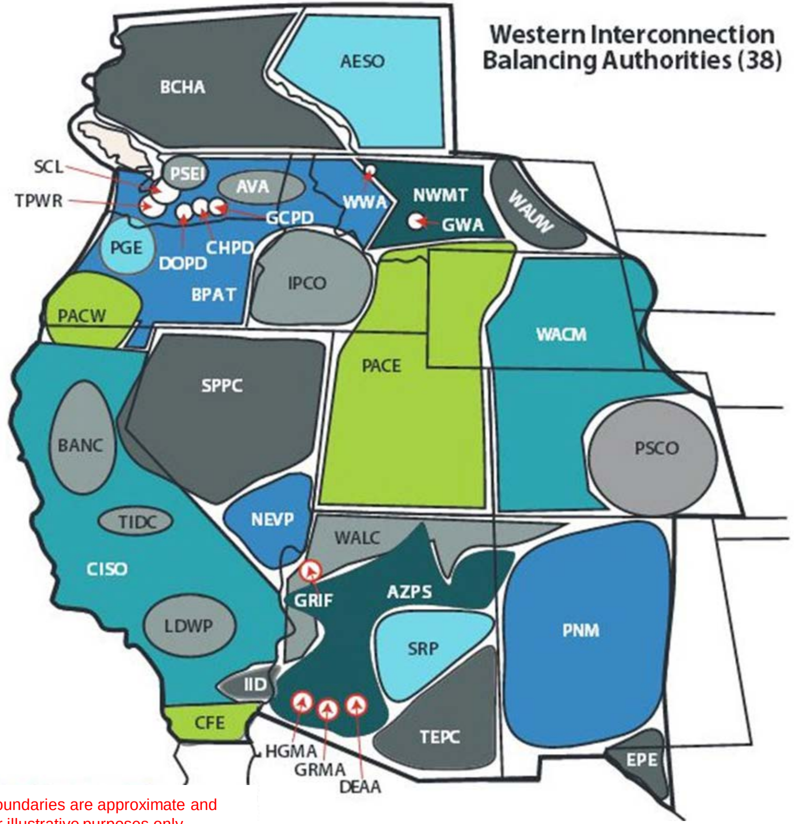
Regulatory Authorities

- Federal Energy Regulation Commission (FERC)
- North American Electric Reliability Corporation (NERC)

Reliability Of The Bulk Power System



Western Interconnection Balancing Authorities



Boundaries are approximate and
for illustrative purposes only

NERC Reliability Standards

Operating Reserves – Generation Needed Above Current Load

- **Regulating Reserves (Real Time Power Balancing)**
  - BAL-001
    - “To control Interconnection frequency within defined limits.”
  - BAL-005-0.2b
    - “..ensures that all facilities and load electrically synchronized to the Interconnection are included within the metered boundary of a Balancing Area so that balancing of resources and demand can be achieved.”
  - BAL-006-2
    - “…process for monitoring Balancing Authorities to ensure that, over the long term, Balancing Authority Areas do not excessively depend on other Balancing Authority Areas in the Interconnection for meeting their demand or Interchange obligations.”

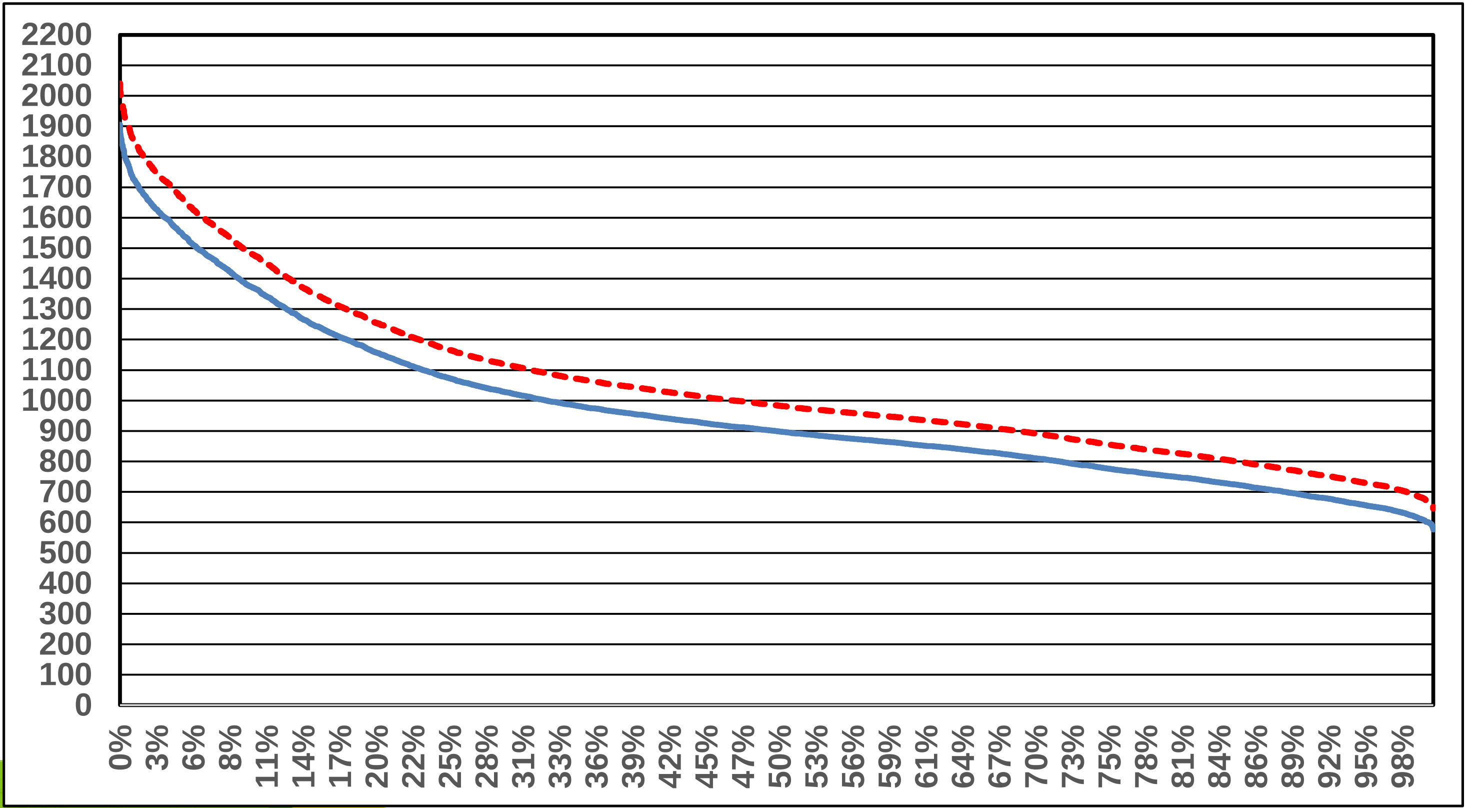
NERC Reliability Standards Continued

- **Contingency Reserves (Replacement Power due to Loss of Generation)**
  - BAL-002
    - "…to ensure the Balancing Authority is able to utilize its Contingency Reserve to balance resources and demand and return Interconnection frequency within the defined limits following a Reportable Disturbance."
  - BAL-002-WECC
    - "To specify the quantity and types of Contingency Reserve required to ensure reliability under normal and abnormal conditions."
- **Frequency Response (Replacement Power due to Grid Disturbance)**
  - BAL-003
    - "To require sufficient Frequency Response from the Balancing Authority to maintain Interconnection Frequency within predefined bounds by arresting frequency deviations and supporting frequency until the frequency is restored…"

NERC Reliability Standards Continued

- **Real Time Assessment of System Conditions**
  - TOP-001-3
    - “To prevent instability, uncontrolled separation, or Cascading outages that adversely impact the reliability of the Interconnection by ensuring prompt action to prevent or mitigate such occurrences.”
      - **R13.** Each Transmission Operator shall ensure that a Real-time Assessment is performed at least once every 30 minutes.
      - **R14.** Each Transmission Operator shall initiate its Operating Plan to mitigate a SOL exceedance identified as part of its Real-time monitoring or Real-time Assessment.
      - **R15.** Each Transmission Operator shall inform its Reliability Coordinator of actions taken to return the System to within limits when a SOL has been exceeded.

Load Duration Curve with Operating Reserves



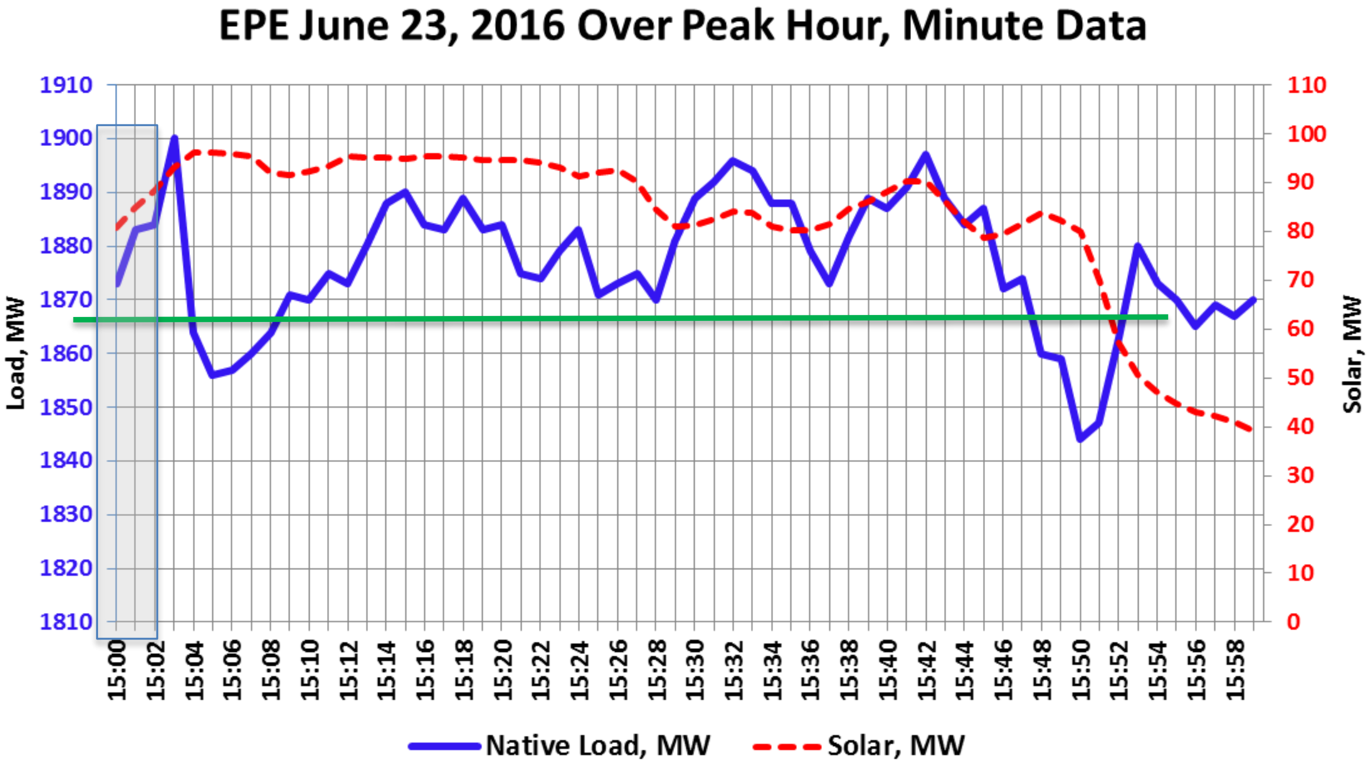
Meeting Operating Reserves - EPE's Local Generation

- **Ability to meet operating reserve determined by the generators ramp rate**
  - **"The rate, expressed in megawatts per minute, that a generator changes its output"**
- **Aggregate of individual generators ramp rates provide operating reserve capability. Example:**
  - Newman Unit 1 3 MW/min
  - Rio Grande Unit 8 5 MW/min
  - Total 8 MW/min

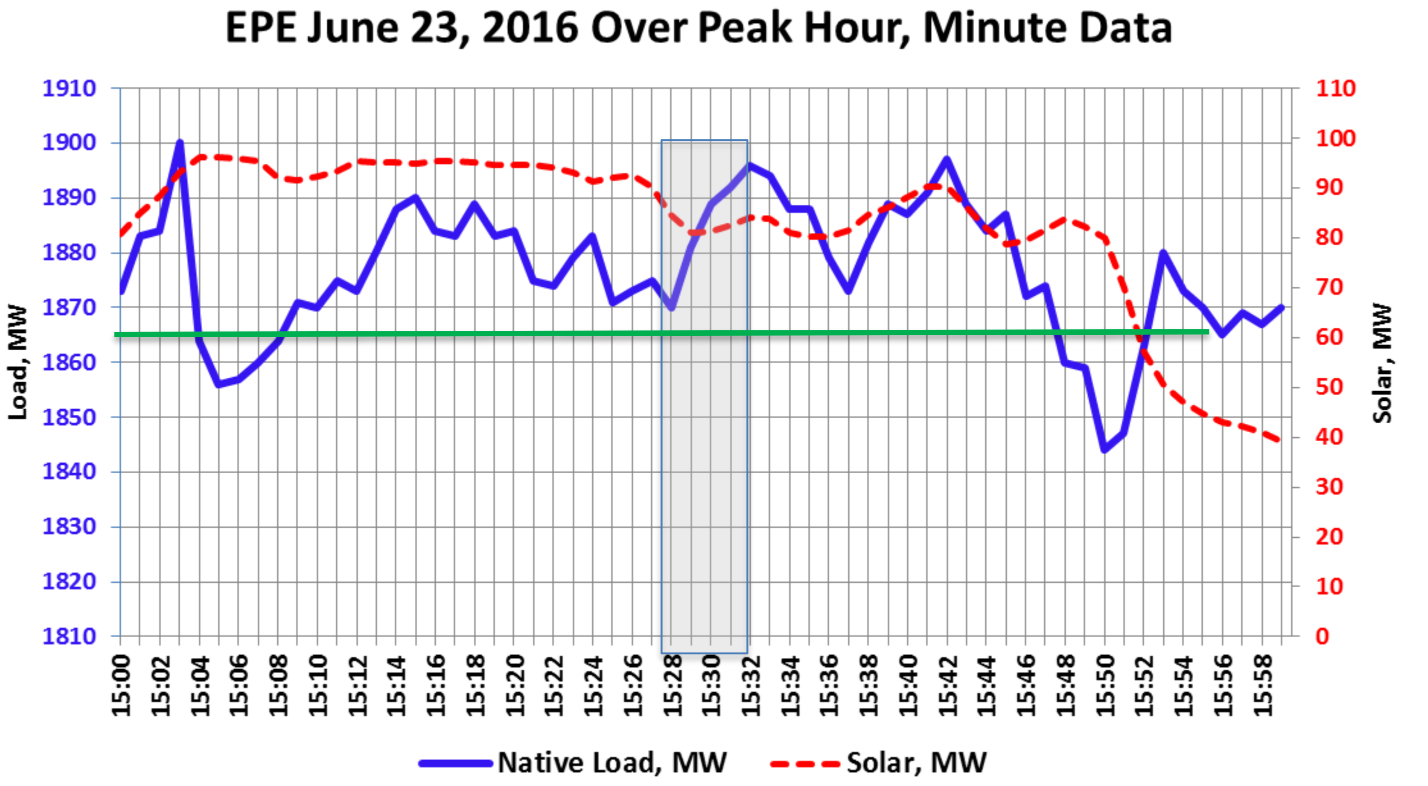
80 MW Contingency Reserves in 10 minutes.

- **EPE's Montana Units and Rio Grande Unit 9 contribute to reserves even when not synchronized to the electric grid. (50 MW/min ramp rates)**

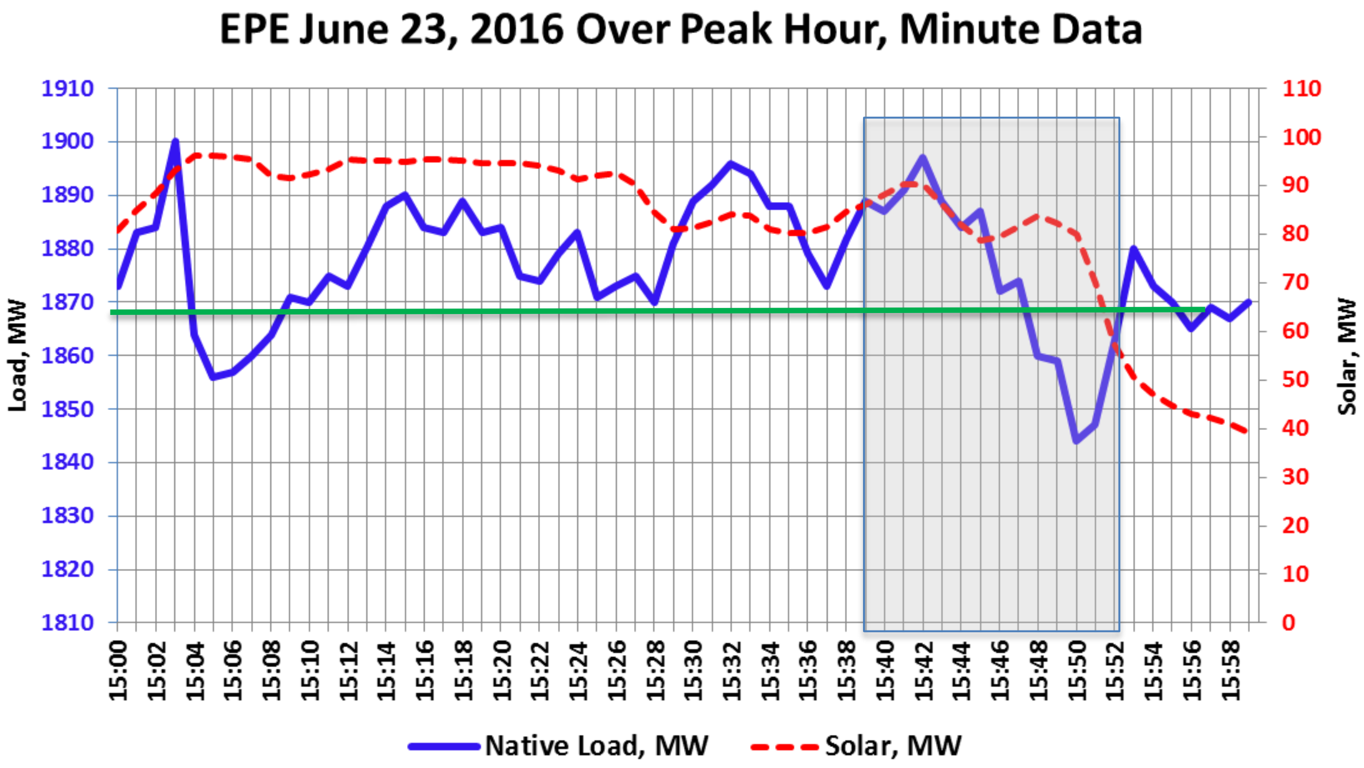
Regulating Reserves System Load vs. Solar



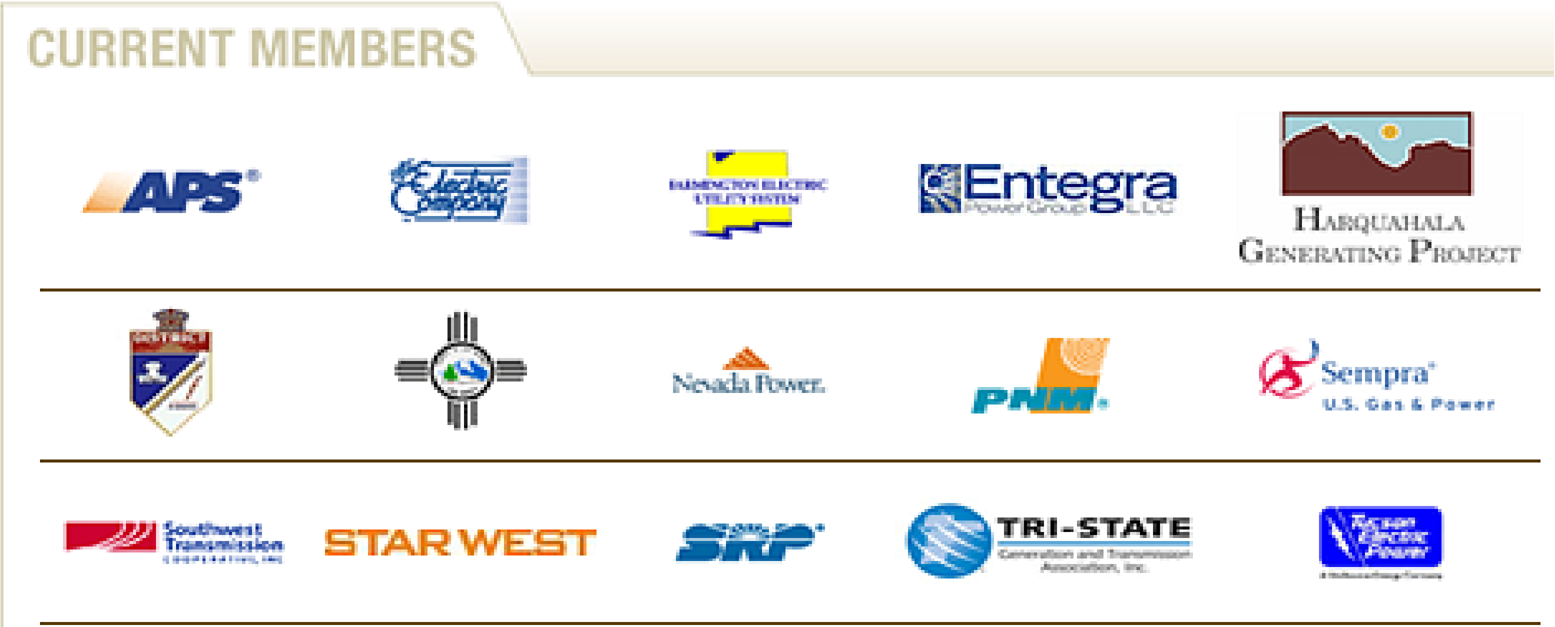
Regulating Reserves System Load vs. Solar



Regulating Reserves System Load vs. Solar

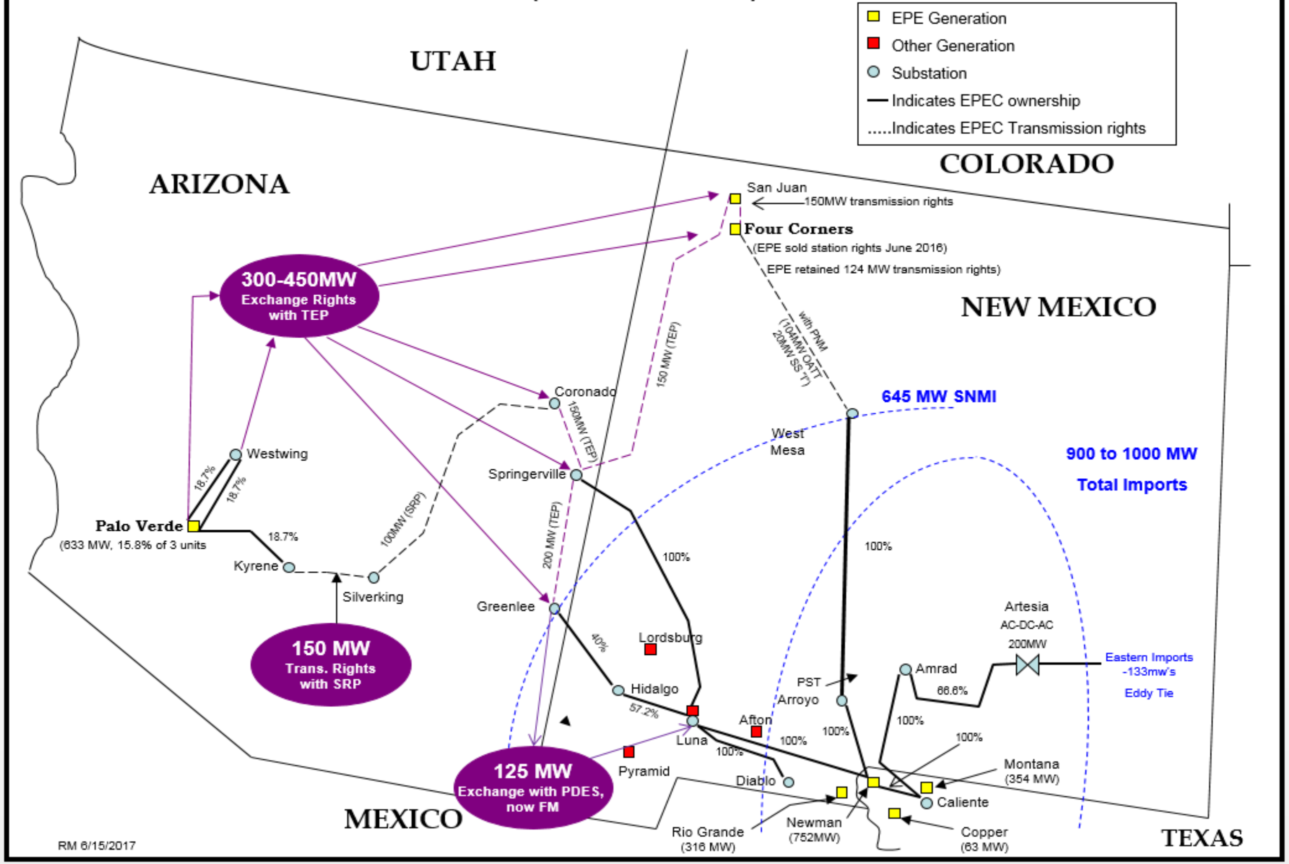


Contingency Reserves - Southwest Reserve Sharing Group

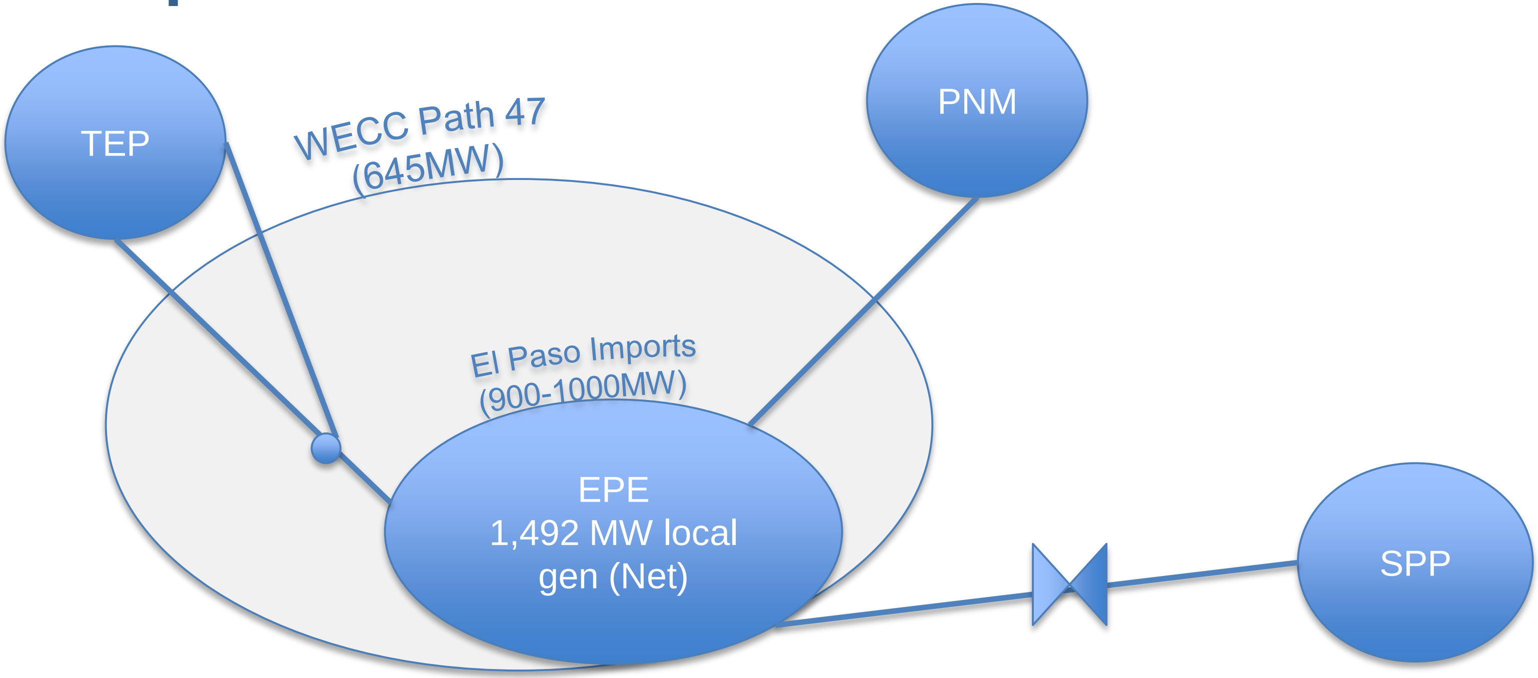


Frequency Response - 2011 San Diego Blackout

El Paso Electric Transmission Rights & Ownership
(345 KV and above)



EPE & Southern New Mexico Import Capabilities



Questions?

Integrated Resource Plan

Existing Conventional Resources and System Generation Retirement Plan and Process

Andy Ramirez

Vice President - Power Generation

17.7.3 NMAC – Integrated Resource Plans for Electric Utilities

17.7.3.9(C) – Integrated Resource Plans for Electric Utilities

- **C.** Description of existing resources. The utility's description of its existing resources used to serve its jurisdictional retail load at the time the IRP is filed shall include:
  - (1) name(s) and location(s) of utility-owned generation facilities;
  - (2) rated capacity of utility-owned generation facilities;
  - (5) existing generation facilities' expected retirement dates;
  - (7) estimated in-service dates for utility-owned generation facilities for which a certificate of public convenience and necessity (CCN) has been granted but which are not in-service;

17.7.3.9(C) – Integrated Resource Plans for Electric Utilities

– (12)(a) the utility shall provide the percentage of kilowatt-hours generated by each fuel used by the utility on its existing system, for the latest year for which such information is available;
– (13) a summary of back-up fuel capabilities and options.

EPE Local Generation

Newman Power Plant

- Unit 1 – Steam Turbine – 80 MW 1960
- Unit 2 – Steam Turbine – 80 MW 1963
- Unit 3 – Steam Turbine – 100MW 1966
- Unit 4 2x1 CC configuration – 220MW
  - Unit 4 GT1 – Gas Turbine – 70 MW 1975
  - Unit 4 GT2 – Gas Turbine – 70 MW 1975
  - Unit 4 STM – Steam Turbine – 80 MW 1975
  - Unit 4 1x1 CC configuration – 110 MW
- Unit 5 2x1 CC configuration – 282 MW
  - Unit 5 GT3 – Gas Turbine – 70 MW 2009
  - Unit 5 GT4 – Gas Turbine – 70 MW 2009
  - Unit 5 STM – Steam Turbine – 142 MW 2011
  - Unit 5 1x1 CC configuration – 141 MW

Rio Grande Power Plant

- Unit 6 – Steam Turbine – 50 MW 1957
- Unit 7 – Steam Turbine – 50 MW 1958
- Unit 8 – Steam Turbine – 150 MW 1972
- Unit 9 LMS 100 – Gas Turbine – 88 MW 2013

Montana Power Plant

- Unit 1 LMS 100 – Gas Turbine – 89 MW 2015
- Unit 2 LMS 100 – Gas Turbine – 89 MW 2015
- Unit 3 LMS 100 – Gas Turbine – 89 MW 2016
- Unit 4 LMS 100 – Gas Turbine – 89 MW 2016

Copper Power Plant

- Unit 1 – Gas Turbine – 64 MW 1980

EPE Generation

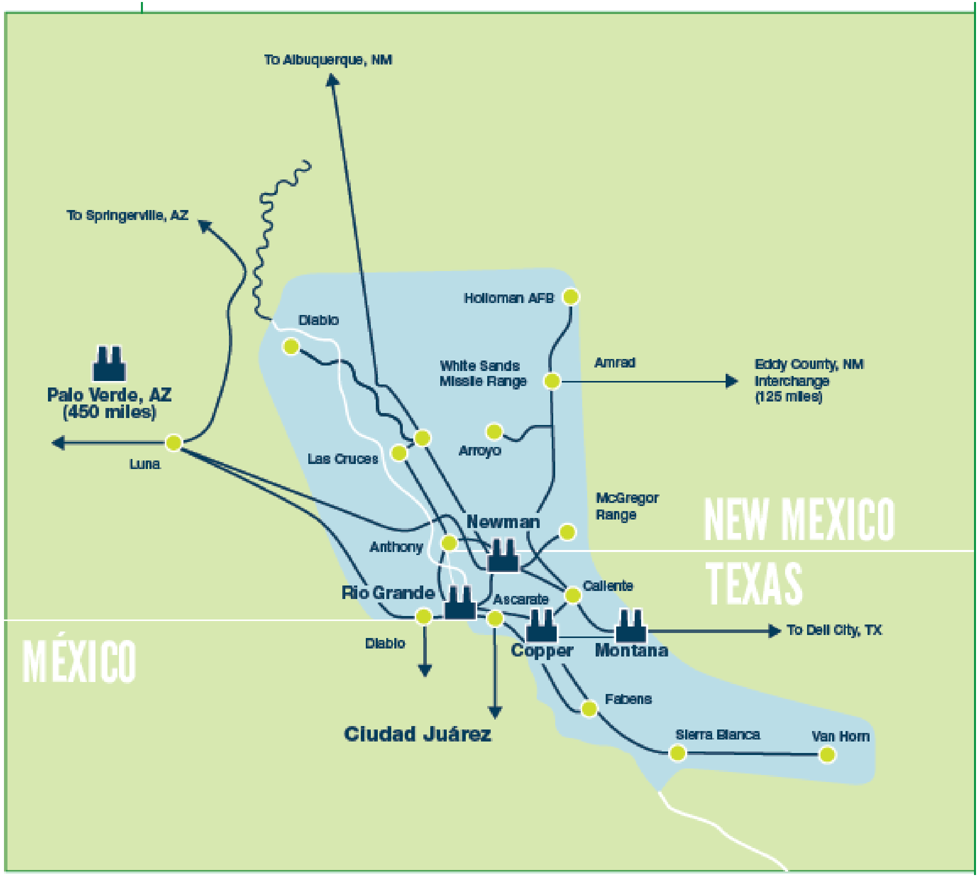
Remote Generation

- Palo Verde, AZ-Nuclear – 633 MW

Local Generation

- Newman, TX-Gas/Oil – 762 MW
- Copper, TX-Gas – 64 MW
- Rio Grande, NM-Gas – 338 MW
- Montana Power, TX-Gas/Oil – 356 MW

Total EPE – 2153 MW



The Electric Company
El Paso Electric

EPE Generation

Baseload – Nuclear (633 MW)

- Generator online at full load 24x7
- Generators and reactors not designed for cycling on/off
- Generators and reactors not designed for ramping output up/down

Baseload – Conventional Steamer (481 MW)

- Boiler produce high-pressure steam to turn/drive turbine for generator
- Operations result in mechanical stresses and strains due to pressures and temperature
- Establish operating boundaries for minimum downtime and minimum runtime to mitigate mechanical impact of stresses and potential fatigue due to cycling
- Generators brought online for continuous run days (typically weeks at time)
- Lower ramp rates (lag time for boiler to change steam pressure to ramp)

EPE Generation

Intermediate – Combined Cycle (505 MW)

- Combustion Turbine ("CT") and Steam Turbine ("ST")
- CT – gas combustion drives turbine
- Exhaust heat from CT is utilized to create steam to turn Steam Turbine (supplemented by gas)
- Most efficient of gas-fired generation
- May be cycled more often, newer designs maybe cycled daily (however, it comes with impacts)
- Faster ramp rates than Boiler Steamers

Peaking – Combustion Turbine (506 MW)

- Gas combustion drives turbine
- No steam – makes for quicker start times
- Fastest ramp rates in "gas-fired" category
- No high-pressure steam components
- Maybe cycled daily and even multiple times per day

EPE Generation

Current Plan for Upcoming Retirements

Unit Name	Fuel Type	Gen Type	Category	Commission Year	Age	Current Planned Retirement	Age at Retirement
Rio Grande 7	Gas	Conventional Steam	Baseload	1958	59	2022	64
Newman 1	Gas	Conventional Steam	Baseload	1960	57	2022	62
Newman 2	Gas	Conventional Steam	Baseload	1963	54	2022	59
Newman 3	Gas	Conventional Steam	Baseload	1966	51	2026	60
Newman 4	Gas	Combined Cycle	Intermediate	1975	42	2026	51
Copper	Gas	Combustion Turbine	Peaking	1980	37	2030	50
Rio Grande 8	Gas	Conventional Steam	Baseload	1972	45	2033	61

7F.05 GAS TURBINE (60 Hz)

Next Generation, F-Class Flexibility and Efficiency

GE understands the challenges of today's power generation industry: lower cost of electricity, dispatch and fuel volatility, as well as increased efficiency, reliability, and asset availability. GE created the 7F.05 gas turbine to be highly efficient, agile, and simple to maintain. With combined cycle efficiency greater than 59.9%, and a 40 MW per minute ramp rate, the 7F.05 helps operators capture more ancillary revenue. In simple cycle the 7F.05 gas turbine is extremely responsive with a start capacity of 200 megawatts in ten minutes, 5 ppm NO_X and grid stability logic, making the 7F.05 ideal for supporting renewable energy growth.

Reliable and Efficient

- Combustion systems accommodate a wide range of fuels, including natural gas, distillate oil, lean methane, pure ethane, hydrogen, syngas, and light crude oils. They also enable low NO_X emissions, as low as 5 ppm, at rated output levels.
- 98.5% reliability leads F-class offerings.[1]
- Maintainability features support increased availability:
  - Field replaceable compressor airfoils reduce downtime.
  - Superfinish 3D airfoils reduce degradation.
  - 100% borescope inspection reduces overall inspection time.
- Performance packages support most customer demands across the ambient spectrum, including wet compression for enhanced hot day performance.
- The 7F.05 is now available with an air cooled generator for simplified installation and maintainability.

[1] Source: ORAP Simple cycle equipment, 12 month average, April '13 through March '14.

224-231 MW Simple Cycle Output

>59% COMBINED CYCLE EFFICIENCY

	7F.05 @ 5 ppm NO_X	7F.05 @ 9 ppm NO_X
Frequency	60	60
SC Net Output (MW)	224	231
SC Net Heat Rate (Btu/kWh, LHV)	8,670	8,640
SC Net Heat Rate (kJ/kWh, LHV)	9,147	9,116
SC Net Efficiency (%, LHV)	39.4%	39.5%
Exhaust Energy (MM Btu/hr)	1,176	1,207
Exhaust Energy (MM kJ/hr)	1,241	1,273
GT Turndown Minimum Load (%)	38%	38%
GT Ramp Rate (MW/min)	40	40
NO_X (ppmvd) at Baseload (@15% O_2)	5	9
CO (ppm) at Min. Turndown w/o Abatement	9	9
Wobbe Variation (%)	+/-7.5%	+/-7.5%

Power Plant Configuration	1x1 MS 7F.05 @ 12 ppm NO_X
CC Net Output (MW)	359
CC Net Heat Rate (Btu/kWh, LHV)	5,740
CC Net Heat Rate (kJ/kWh, LHV)	6,056
CC Net Efficiency (%, LHV)	59.4%
Bottoming Cycle Type	3PRH
Plant Turndown – Minimum Load (%)	48%
Ramp Rate (MW/min)	40
Startup Time (Hot, Minutes)	25

Power Plant Configuration	2x1 MS 7F.05 @ 12 ppm NO_X
CC Net Output (MW)	723
CC Net Heat Rate (Btu/kWh, LHV)	5,700
CC Net Heat Rate (kJ/kWh, LHV)	6,014
CC Net Efficiency (%, LHV)	59.9%
Bottoming Cycle Type	3PRH
Plant Turndown – Minimum Load (%)	24%
Ramp Rate (MW/min)	80
Startup Time (Hot, Minutes)	25

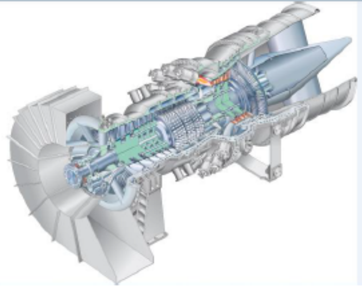
Customer Success Story

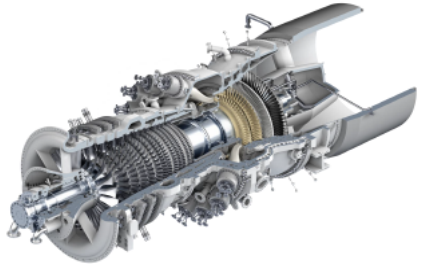
الشركة السعودية للكهرباء
Saudi Electricity Company

With a partnership that spans over four decades and 40 Saudi Electricity Company (SEC) power plants, GE assists in the generation of over half of Saudi Arabia's power supply. The company has more than 500 gas turbines installed in the Kingdom, and that number will grow when SEC's Riyadh Power Plant 12 (PP12) enters commercial operation in early 2015. PP12 utilizes 8 GE 7F.05 gas turbines and is the first installation of the new product in the region; it will add nearly 2,000 megawatts of power, helping SEC meet future electricity demands. The 7F.05 gas turbines provide SEC with significant fuel savings and lower emissions, along with the operating flexibility needed to respond to a wide range of generation conditions, from base load to cyclic duty. Fuel flexibility is also a significant advantage. The 7F.05 turbines can operate on natural gas, distillate fuel or Arabian Super Light (ASL) crude. GE's F-class gas turbines are the first to offer customers the ability to operate on crude oil.

SIEMENS

SGT6-5000F Capabilities - 2005 vs 2015





First Unit Commercial Operation	2005	2015
ISO GT Gross Power	198 MW	250 MW
ISO GT Gross Efficiency	37.7%	39.3%
ISO 1x1 Combined Cycle Net Power	300 MW	375 MW
ISO x1x Combined Cycle Net Efficiency	57%	59%
GT Fast Start Ramp Rate	30 MW/min	40 MW/min
Output in 10 mins	150 MW	200 MW
Minimum Turndown	50%	30%
Minimum NOx Emission achievable	9 ppm	5 ppm
EBH (hours) to HGPI	25,000	33,000*
ES (starts) to HGPI	900	1200*

* With Siemens long term service agreement

Conclusion

- **How adding renewable affects existing system**
  - Intermittent resources – new CC & new CT’s
- **Peaking/Nonpeaking Units**
- **Baseload – then vs now**
- **Idling generation units**
- **Fuel Costs**

Questions?

Integrated Resource Plan

Transmission and Distribution Systems
Overview and Projects

Clay Doyle

Vice President – Transmission and Distribution
and System Planning

Outline - Transmission and Distribution

- **Overview – Transmission & Distribution**
  - The “Big Picture”
    - Generation –> Transmission –> Distribution -> Service
  - “The Grid” and EPE’s place in the Grid

- **The IRP Rule Requirements**

- **System Planning – T&D**
  - Planning studies and methodologies per NERC reliability standards
  - T&D System Expansion Plan
  - Distribution System Expansion Plan

- **Metering & Metering Systems**
  - Automated Meter Reading (AMR) System – EPE’s System
  - Advanced Metering Infrastructure (AMI) / Advanced Metering Systems (AMS)
  - AMI/AMS vs. AMR functionality /cost/benefits

IRP Rule Requirements
17.7.3 NMAC

17.7.3.9

(11) existing transmission capabilities:

(a) the utility shall report its existing, and under-construction, transmission facilities of 115 kV and above, including associated switching stations and terminal facilities; the utility shall specifically identify the location and extent of transfer capability limitations on its transmission network that may affect the future siting of supply-side resources;

(b) the utility shall describe all transmission planning or coordination groups to which it is a party, including state and regional transmission groups, transmission companies, and coordinating councils with which the utility may be associated;

Overview – Transmission & Distribution

The BIG PICTURE: From the Generator to your home

Palo Verde
Phoenix, AZ

Clay's Casita
Mesilla, NM

Overview – Transmission & Distribution

The BIG PICTURE: From the Generator to your home

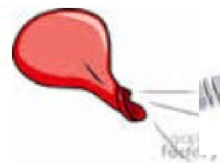
In 30 seconds or less

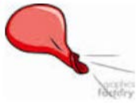
1. We Generate

3. We Transport

7. We Hook you up

5. We distribute





2. We Inflate

4. We deflate

6. We deflate again

Overview – Transmission & Distribution

The BIG PICTURE: From the Generator to your home

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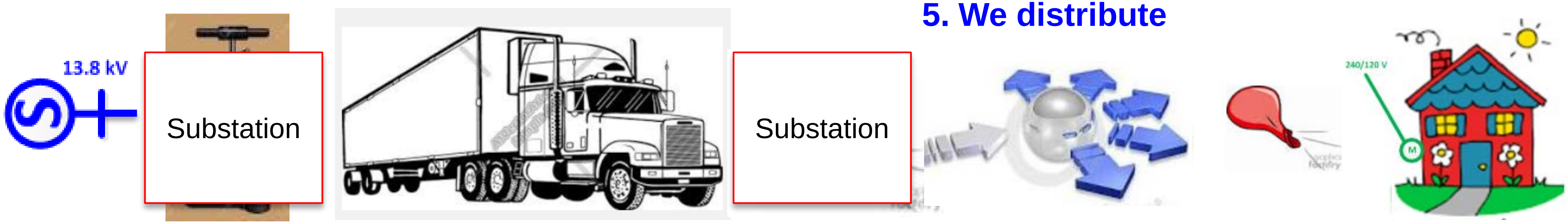


2. We Inflate

4. We deflate

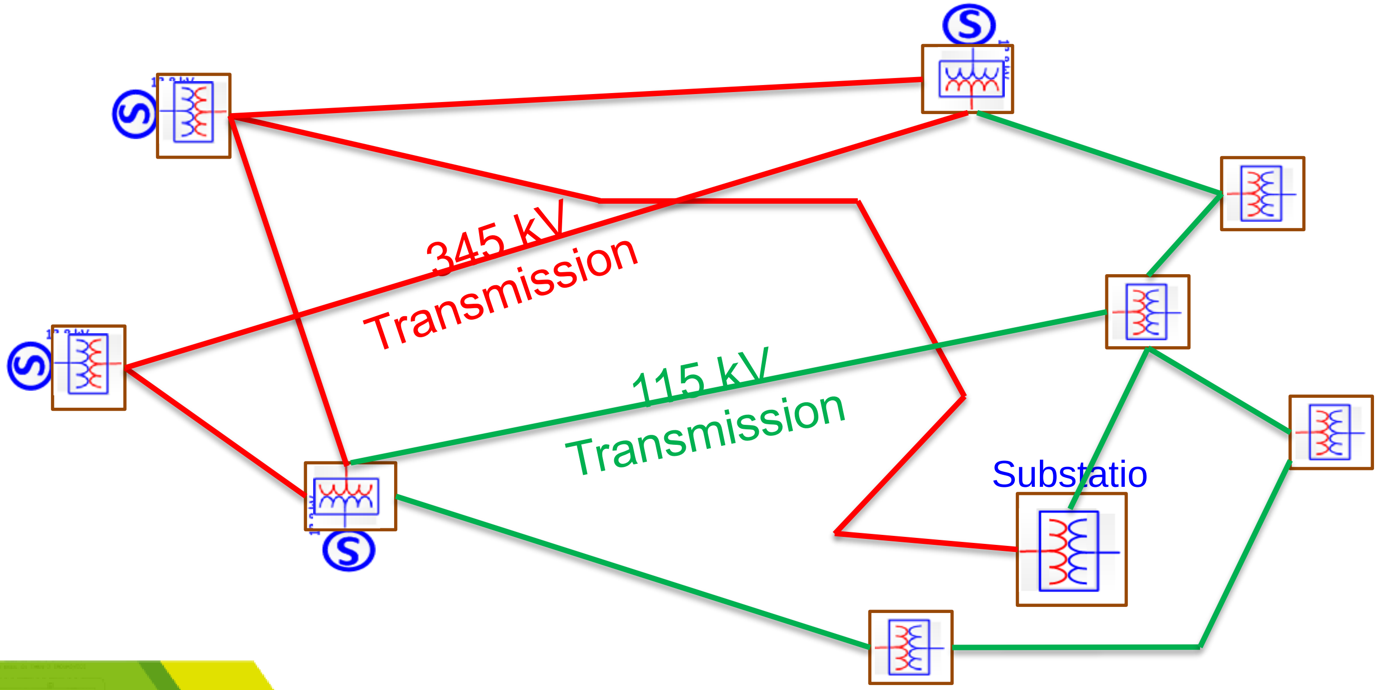
6. We deflate again

TRANSMISSION SYSTEM

DISTRIBUTION SYSTEM

Overview – Transmission

The BIG PICTURE: From the Generator to your home



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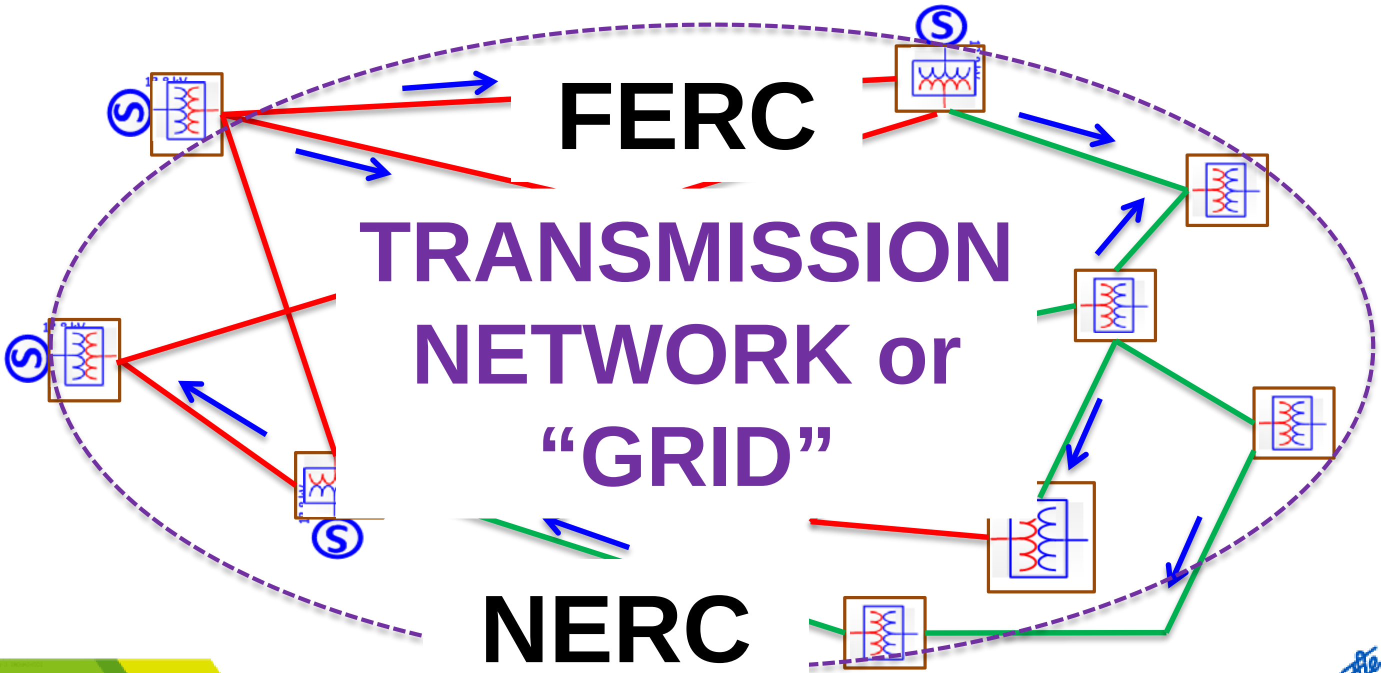
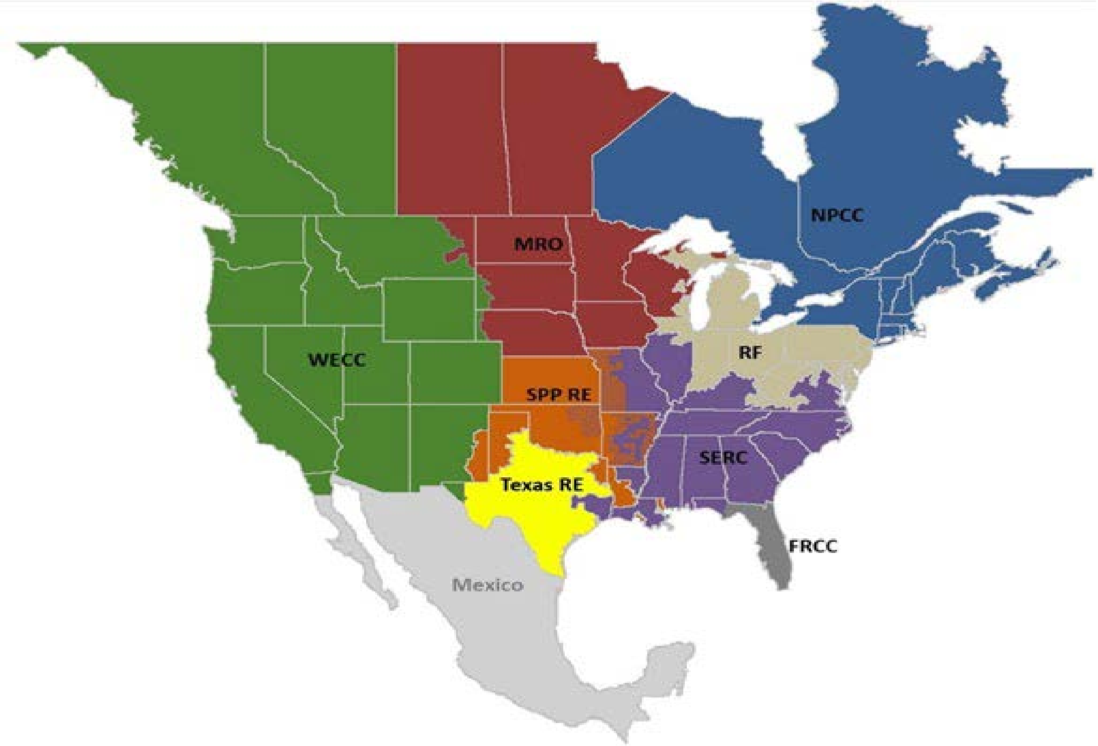
Overview – Transmission

The BIG PICTURE: From the Generator to your home



Reliability Of The Bulk Power System



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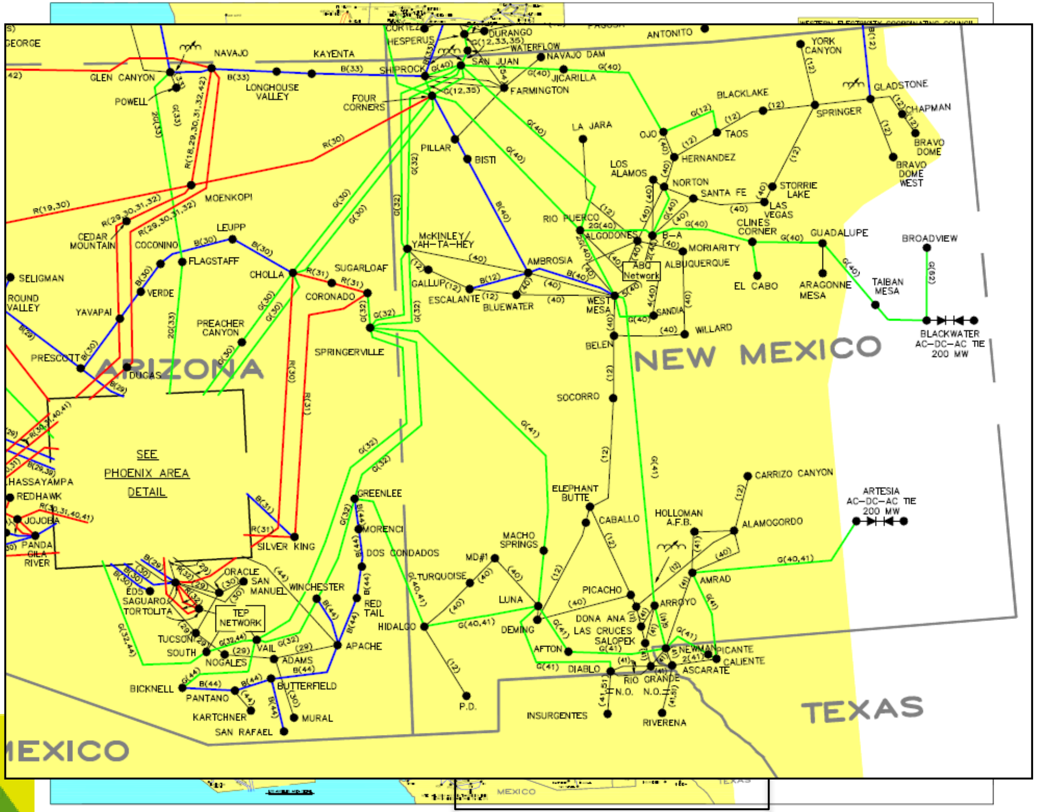
Overview – Transmission

EPE – How We're Connected

- **El Paso Electric (EPE)** is a member of the **Western Electricity Coordinating Council (WECC)**
- **WECC Interconnections (Dynamic)**
  - Public Service of New Mexico (PNM) – 345 kV & 115 kV
  - Tri-State Generation and Transmission - 115 kV
  - Tucson Electric Power (TEP)- 345 kV
- **Southwest Power Pool (SPP) – (Non Dynamic)**
  - Excel Energy (SPS) – 345 kV

Western Electricity Coordinating Council

(the “Western Grid”)



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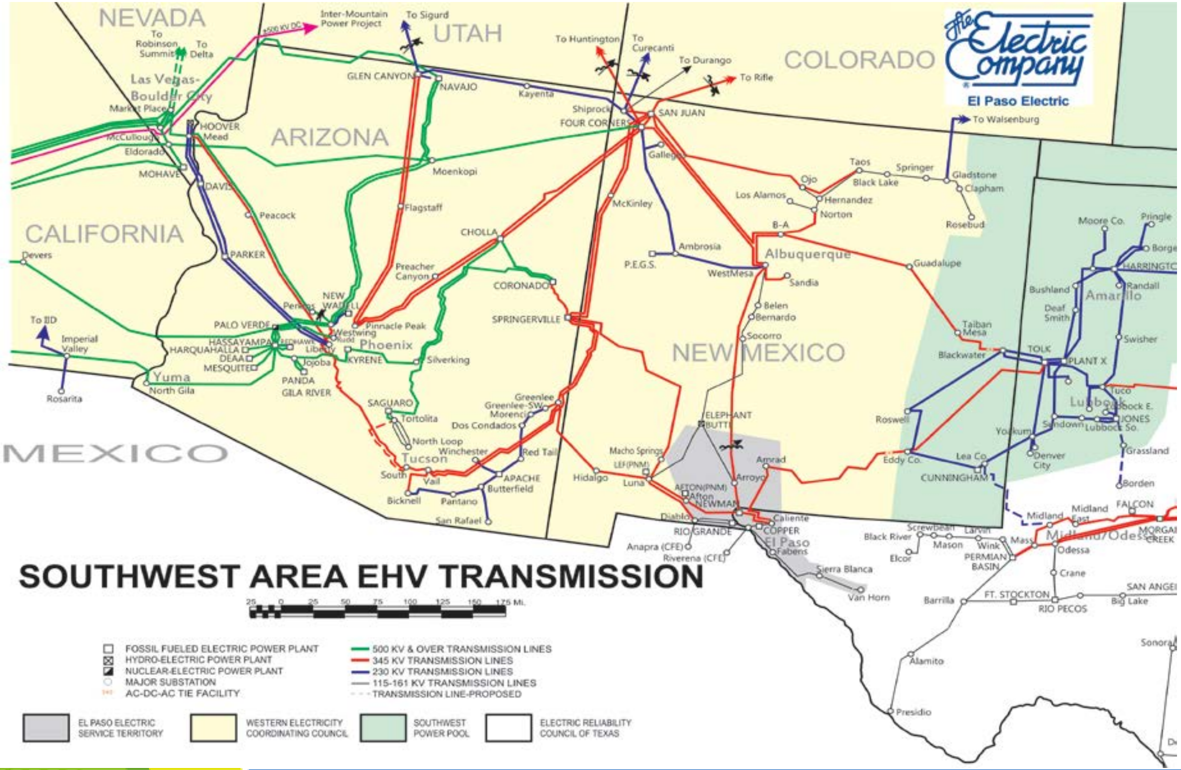
Overview

SW Area EHV Transmission



Overview

EPE Service Territory (Control Area)

EPE Proprietary Material

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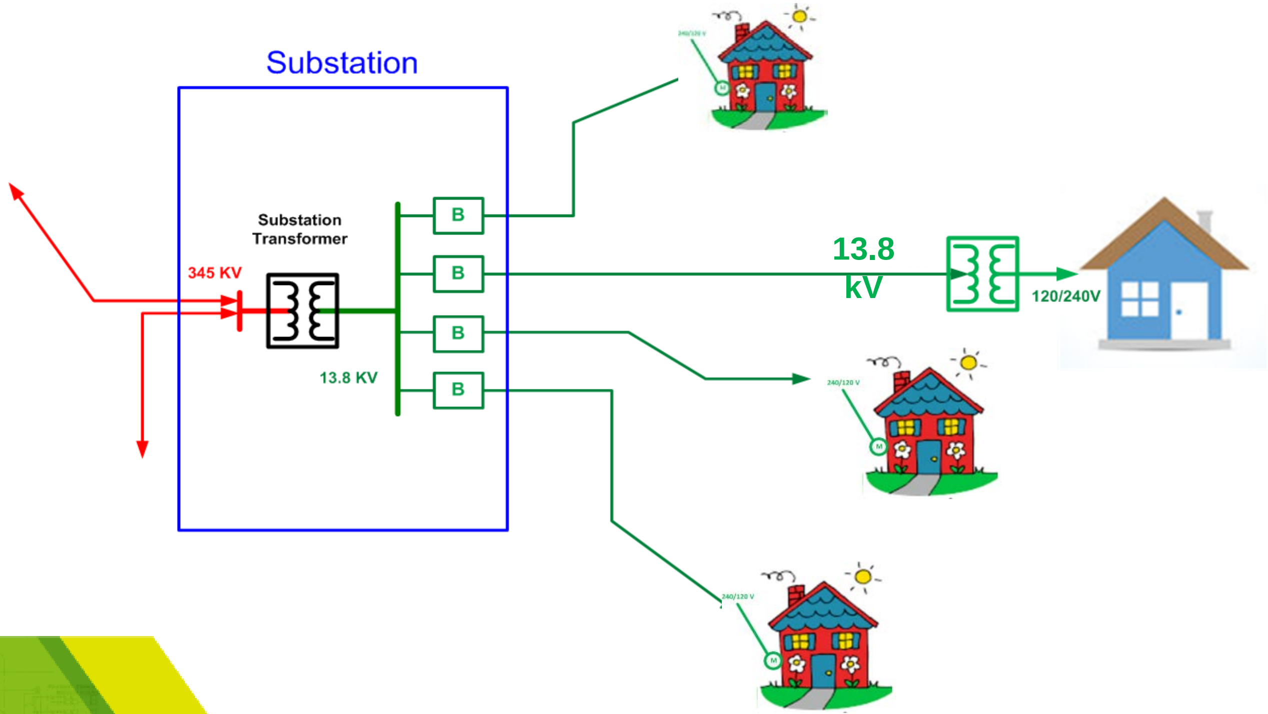
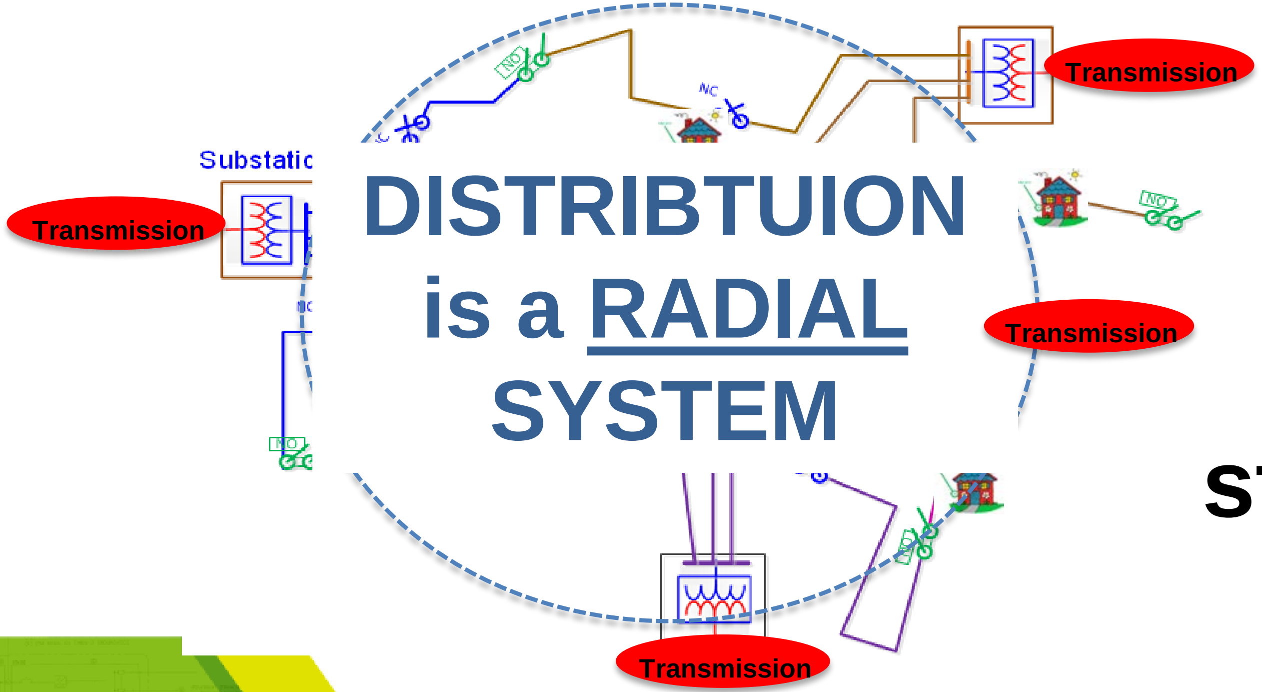
Overview – Distribution

EPE – From the Substation to your home



Overview – Distribution

EPE – From the Substation to your home



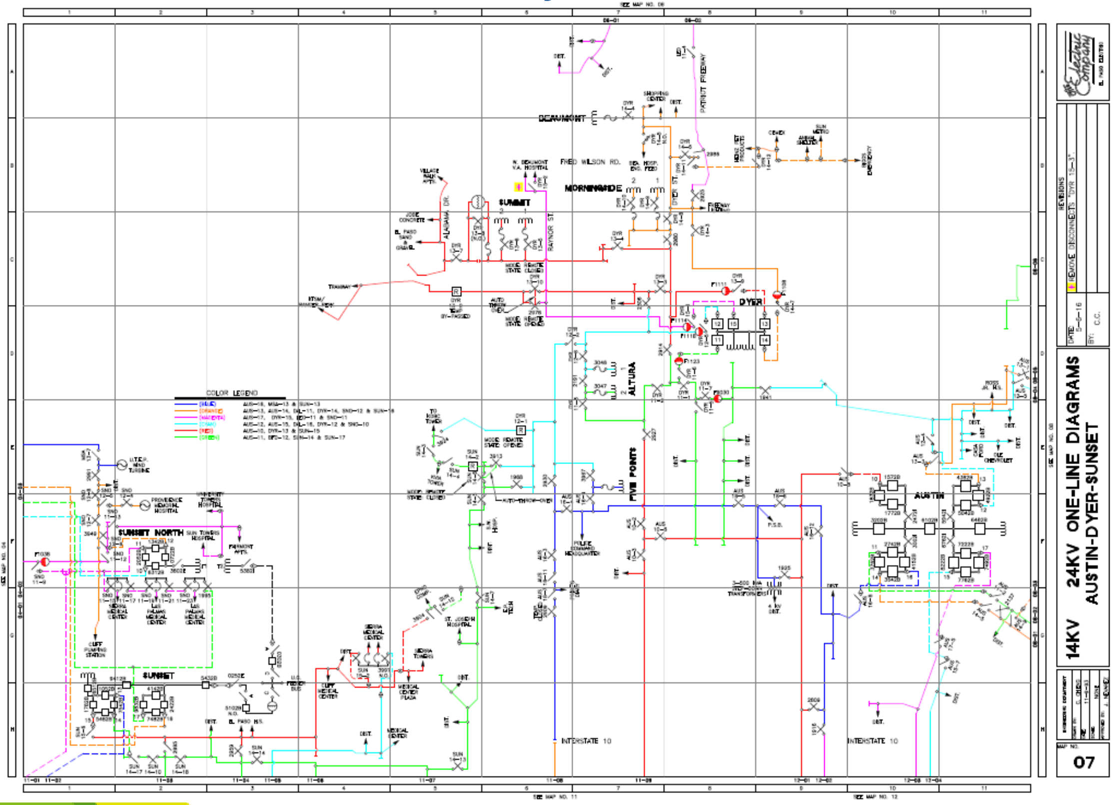
PRC

PUCT

NEC standards

Overview – Distribution

EPE – From the Substation to your home



fidential

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System Planning (Transmission)

FERC Requirements

- **Order No. 888** (1996) Requires open access to transmission facilities for third parties to address undue discrimination and to bring more efficient, lower cost power to the Nation's electricity consumers – OPEN ACCESS

- **Order No. 890** (2007) Requires coordinated, open and transparent transmission planning processes to address undue discrimination – COORIDNATED & OPEN PLANNING

- **Order No. 1000** (2011) Requires transmission planning at the regional level adhere to the precepts of Order 890, to consider and evaluate possible transmission alternatives by third parties and produce a regional transmission plan requires the cost of transmission solutions chosen to meet regional transmission needs to be allocated to beneficiaries. – REGIONAL PLANNING WITH COST/BENEFIT ALLOCATION

System Planning (Transmission)

FERC Requirements

<u>**Order No. 890**</u> (2007)

- **EPE modified its Open Access Transmission Tariff (OATT) in 2008 to reflect the principals in Order 890:**
  - coordination, openness, transparency, information exchange, comparability, dispute resolution, and economic planning

- **EPE holds bi-annual Stakeholder meetings to:**
  - Discuss upcoming Plans
  - Discuss results of Plans
  - Obtain input from Stakeholders

System Planning (Transmission)

FERC Requirements

Order No. 1000 (2011)

- **Requires EPE to a participate in regional planning process and a regional Plan**
- **Requires a methodology for cost allocation be developed for regional projects that request and meet the standards for cost allocation**
- **EPE amended its OATT and filed it at FERC to incorporate FERC Order 1000 requirements**
- **Since the original filing, EPE has made additional compliance filings incorporating additional FERC Orders**

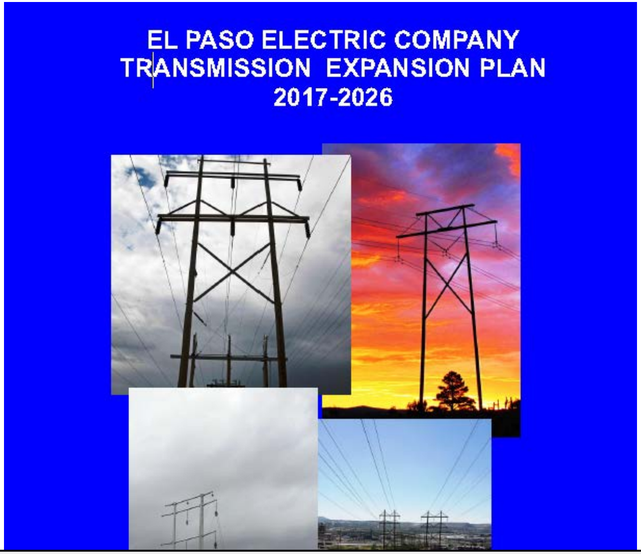
System Planning (Transmission)

FERC Requirements

Cost Allocation Principals (FERC Order 1000)

- Costs allocated “roughly commensurate” with estimated benefits
- Those who do not benefit from the transmission project are not allocated any costs
- Benefit-to-cost thresholds must not exclude projects with significant net benefits
- Cost allocation methods and identification of beneficiaries must be transparent
- Different allocation methods could apply to different types of transmission facilities

System Planning (10yr System Expansion Plan – T&D)



System Expansion Plan - Drivers

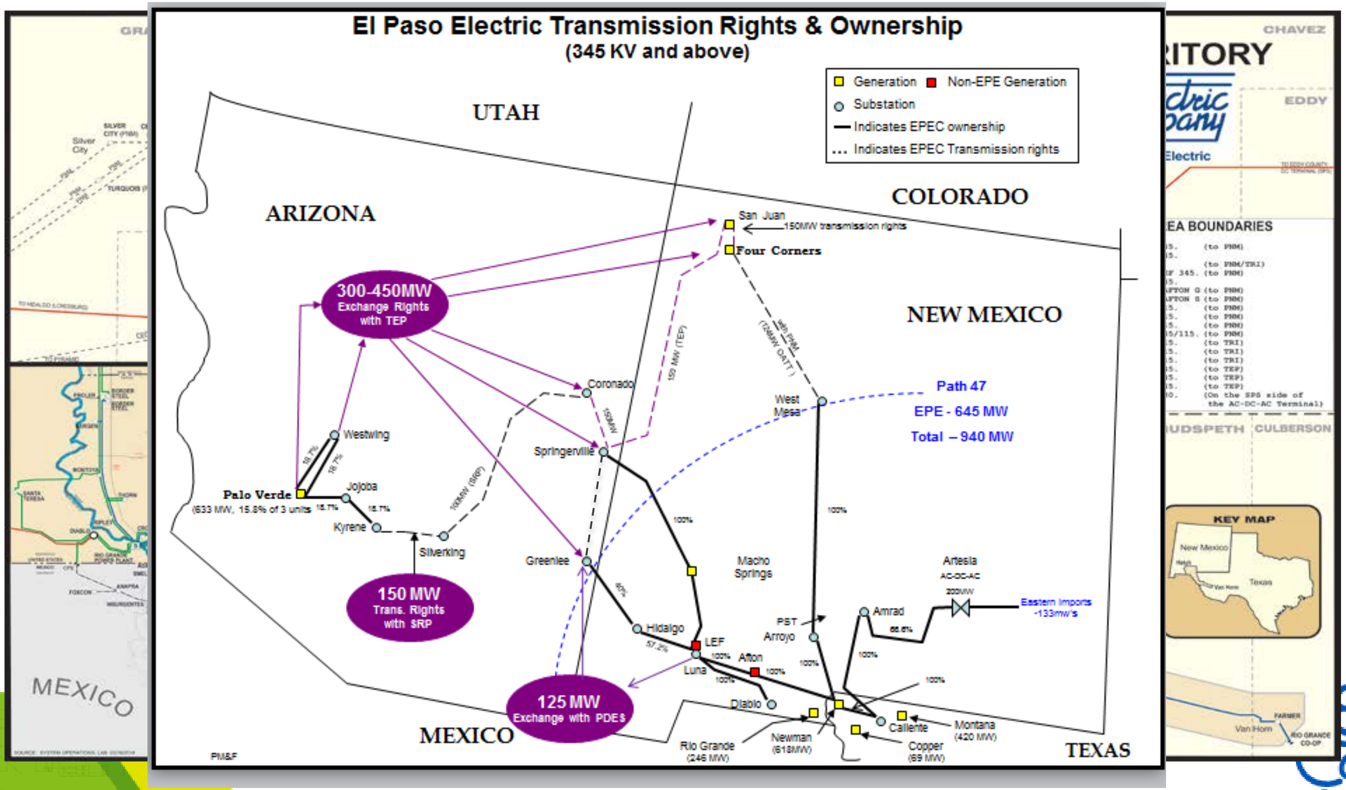
- ✓ Bi-Annual with material changes annually
- ✓ Load Forecast
- ✓ Distribution Expansion Plan
- ✓ Loads & Resources Report
- ✓ Operational constraints and contingencies
- ✓ **FERC/NERC/WECC P&O requirements**

Distribution Expansion Plan - Drivers

- ✓ Annual
- ✓ Customer load growth/projections
- ✓ System maintenance & reliability
- ✓ Maintain/Improve Operational capabilities

System Planning (Transmission)

Interconnections, Ownership, and Limitations



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System Planning (Transmission)

EPE Service Territory (Control Area)

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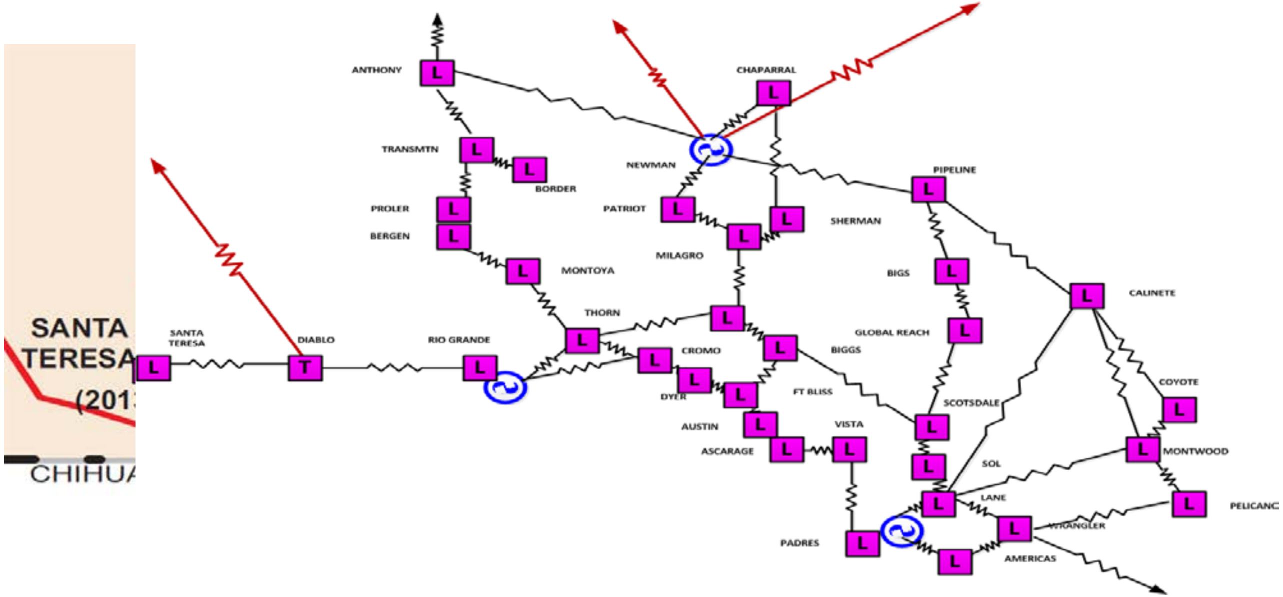
Transmission System Planning

1. Power Flow Model

System is modeled to Substation level (not to Distribution level)

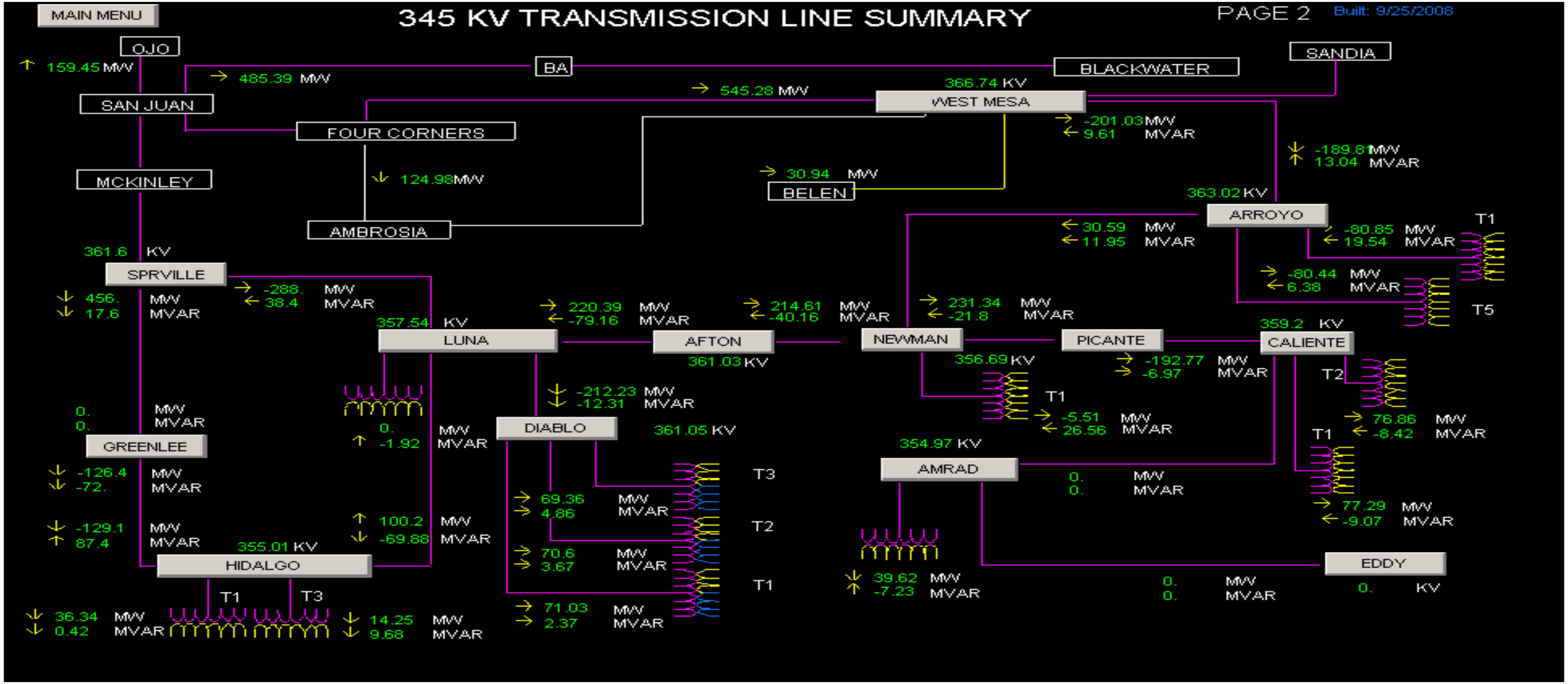


Validation
Using known EMS Data

- ✓ Voltages & Currents
- ✓ Substation load
- ✓ Line loading
- ✓ Line status
- ✓ Generation - local
- ✓ Generation - Import
- ✓ Generator capacity

System Planning

EMS, Power Flow Modeling, Validation, Contingencies



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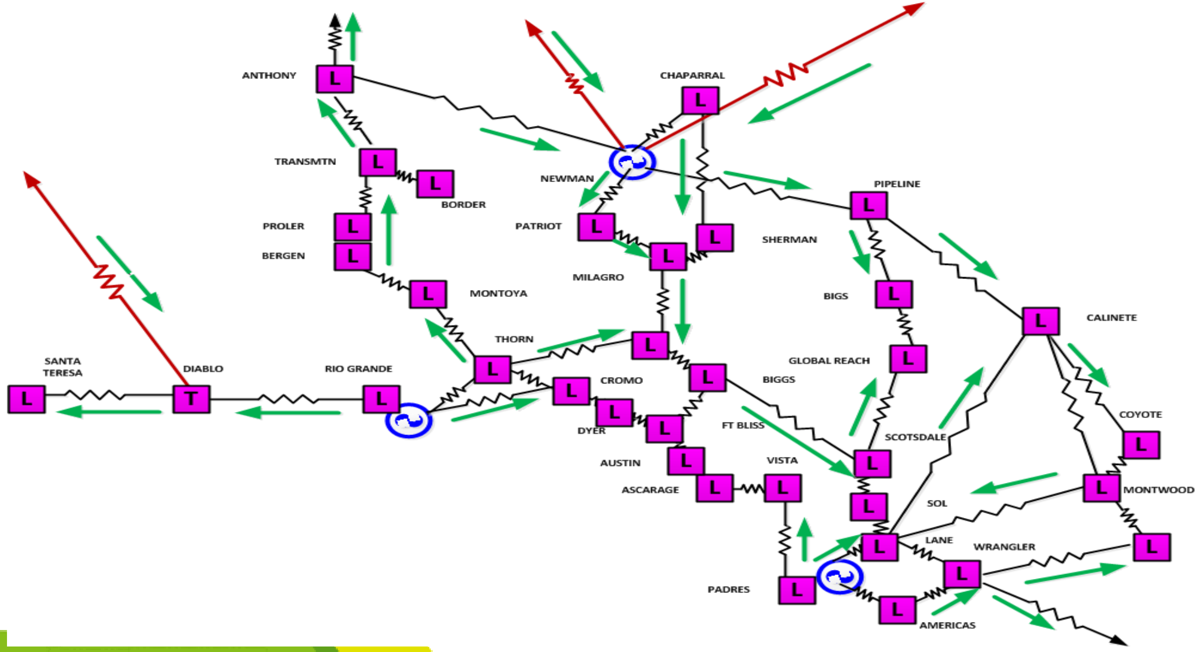
Transmission System Planning

2. Power Flow Model Validation

Does the model truly represent the physical system?



Validation

Using known EMS Data

- ✓ Voltages & Currents
- ✓ Substation load
- ✓ Line loading
- ✓ Line status
- ✓ Generation - local
- ✓ Generation - Import
- ✓ Generator capacity

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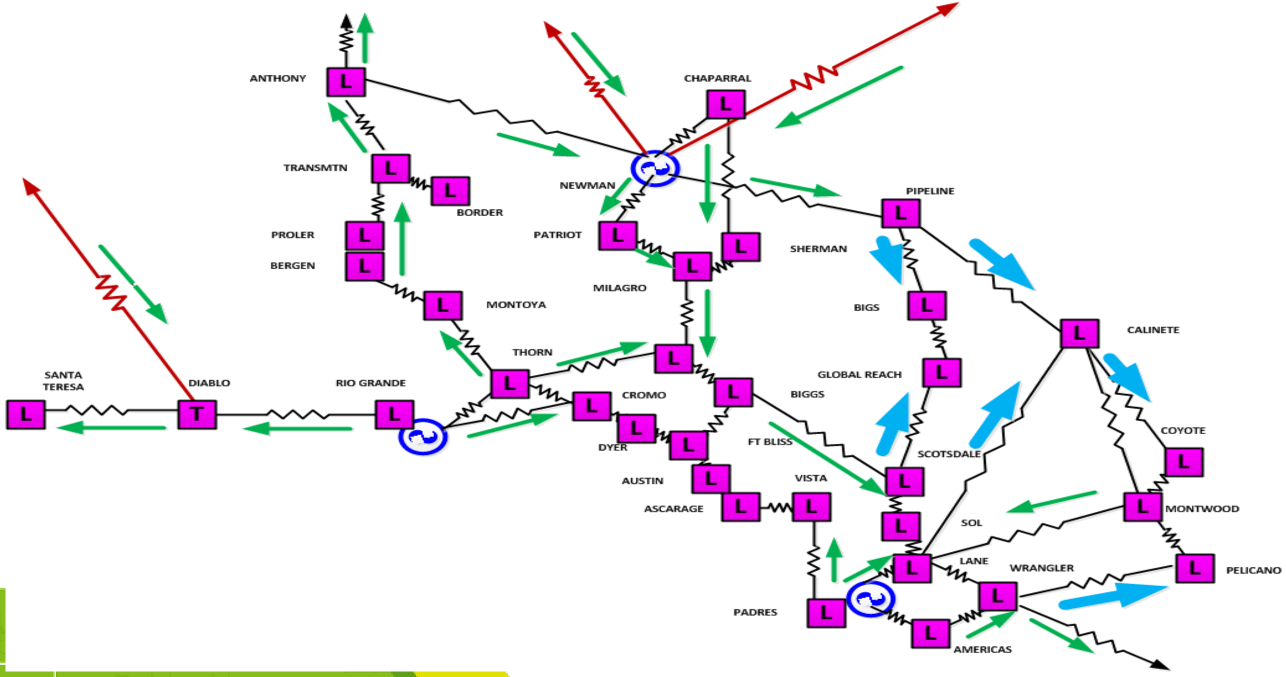
Transmission System Planning

3. Power System Analysis

Both “Real Time” with EMS Data, or Planning Studies using worst case loading



PLANNING ANALYSIS

(The Game of “What if?”)

Utilizing the WECC powerflow models for the Heavy Summer seasons (EPE worst case) for each year of the 10 Year Planning Horizon, EPE models:

- Newest Load Forecast from EPE Load Forecast Department
- Newest Loads & Resources from EPE Resource Development Department

EPE produces a 10 Year Transmission Plan on an Annual Basis

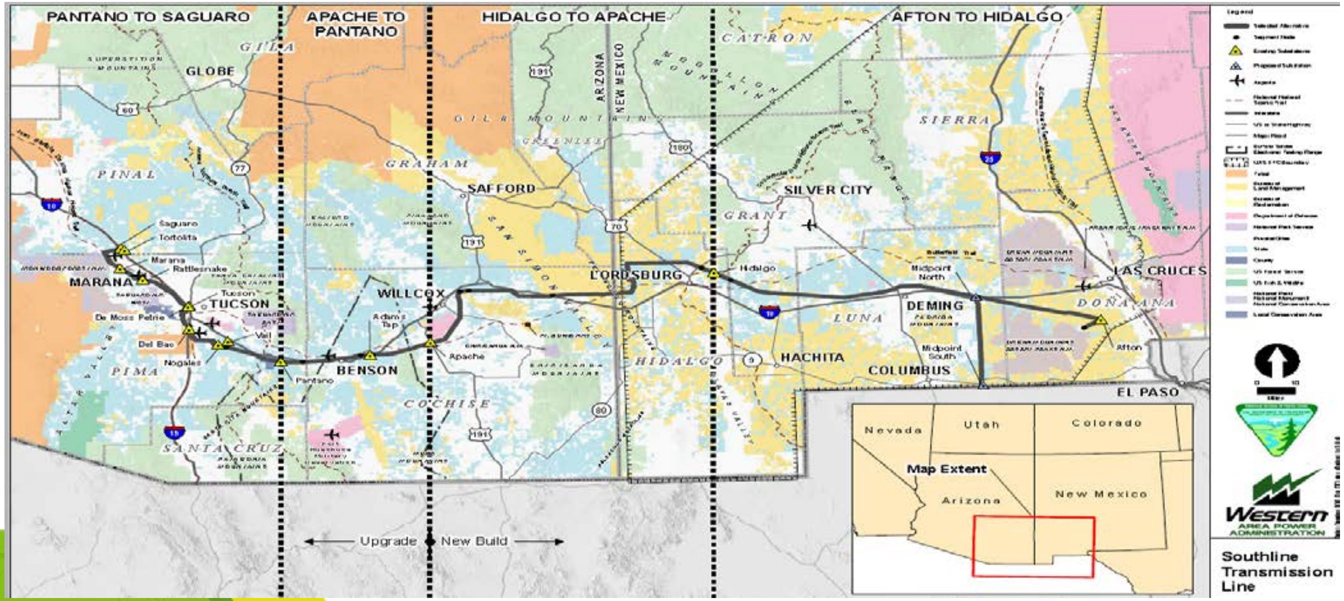
- Plan calls for Facilities required to maintain EPE system operation within WECC/NERC Criteria

Transmission System Planning

3a. Power System Analysis – Interconnection Studies

How will new generation and/or new transmission impact the system?

SOUTHLINE TRANSMISSION PROJECT



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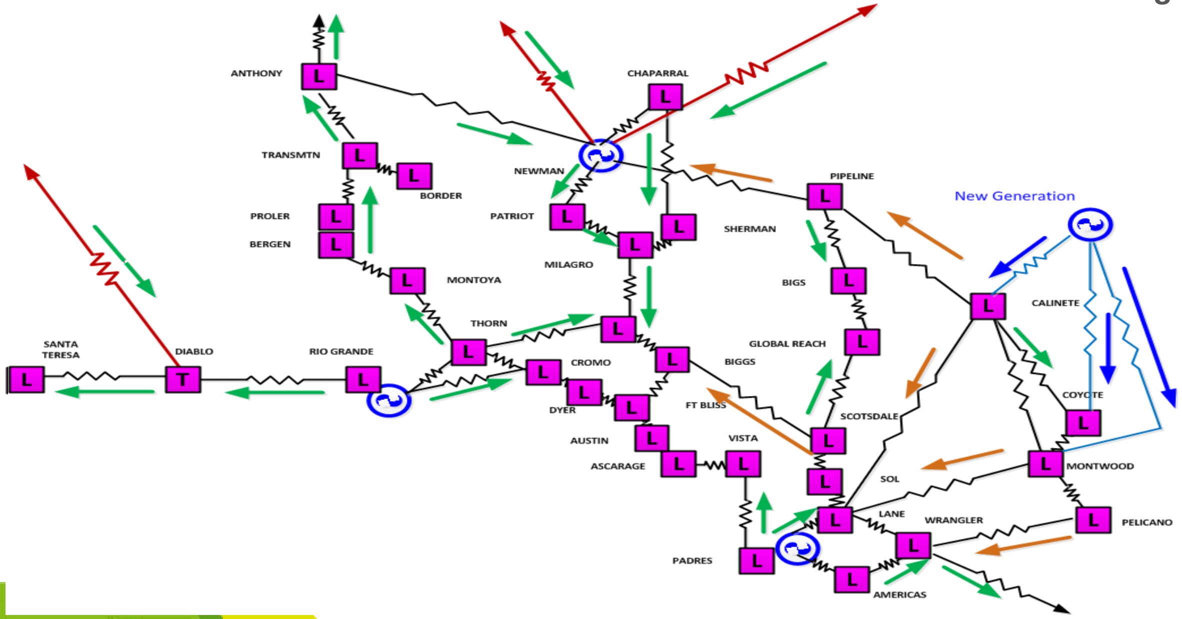
Transmission System Planning

3a. Power System Analysis – Interconnection Studies

How will it impact the system?

System Planners propose solutions for contingencies



- **New Generation**
- **New Transmission**

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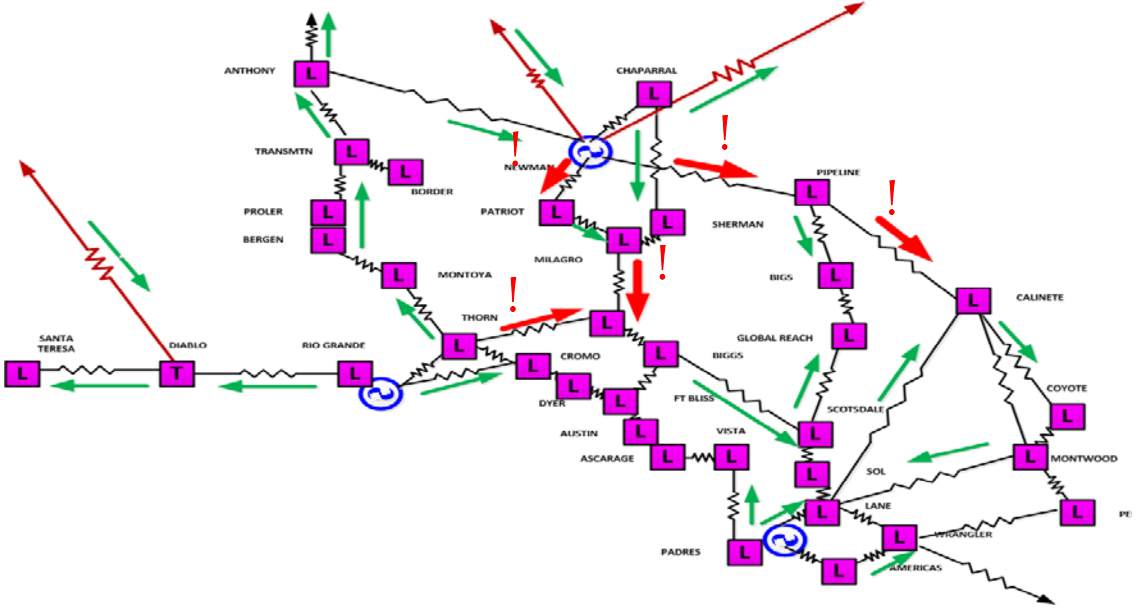
Transmission System Planning

4. Power System Analysis – Compliance to Standards

System Contingency Analysis – What will happen in N-0, N-1, N-2?



NERC Standards
(Your system must be able to do this)

TPL-001: N-0 (All Facilities in Service): All voltages and conductor loadings must be within normal limits

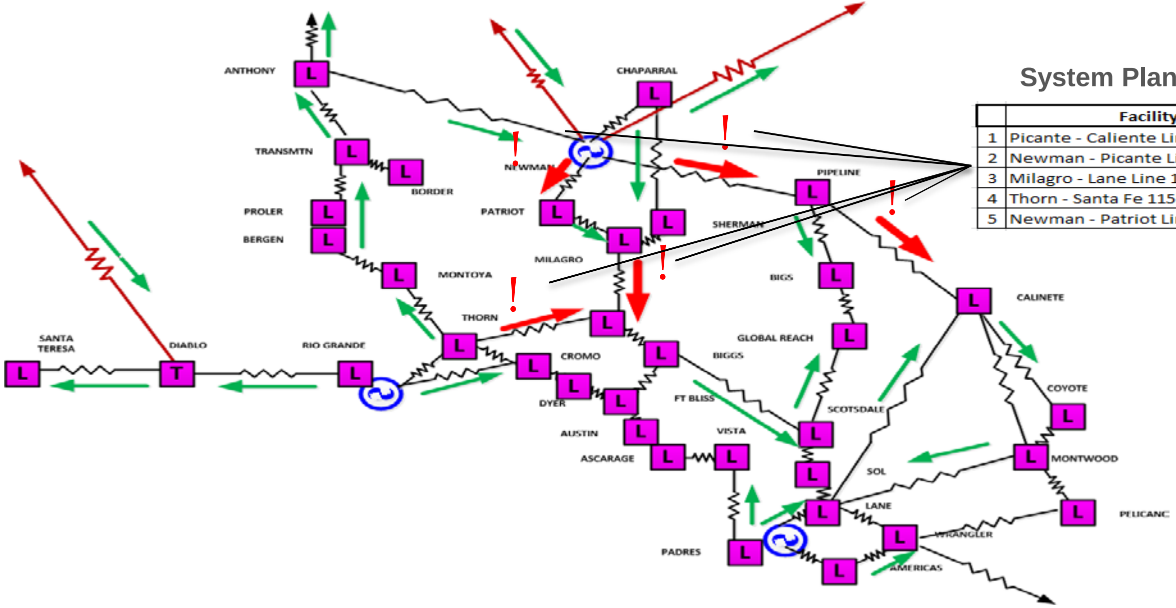
TPL-002: N-1 (Loss of Facility Line): All voltages and conductor loadings must be within emergency limits and the system shall remain stable with no cascading or uncontrolled loss of load

TPL-003: N-2 (Loss of Multiple Facilities): All voltages and conductor loadings must be within emergency limits and the system shall remain stable with no cascading or uncontrolled loss of load

Transmission System Planning

5. Power System Analysis – Resolution/Recommendations

Stress Testing the Existing System – How do you plan to fix it?



System Planners propose solutions for contingencies

	Facility	Issue	Resolution
1	Picante - Caliente Line 345kV	Line Over-load, N-1 Condition	Reconductor line
2	Newman - Picante Line 345kV	Line Over-load, N-1 Condition	Reconductor line
3	Milagro - Lane Line 115kV	Line Clearance violation	Re-structure (raise line)
4	Thorn - Santa Fe 115kV	Line Over-load, N-1 Condition	Reconductor line
5	Newman - Patriot Line 115kV	Line Over-load, N-1 Condition	Reconductor line

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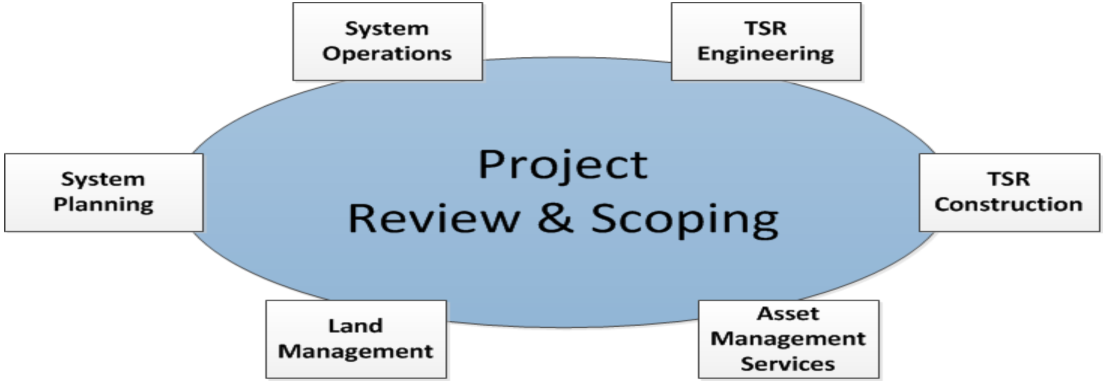
Transmission System Planning

4. Project Review and Scoping



System Planning prepares the description and motivation of each Transmission level project

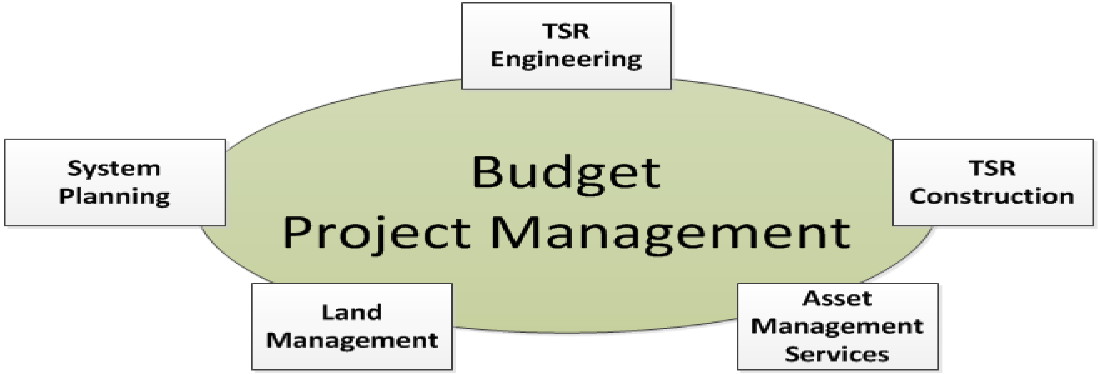
- EPE driven Compliance, Reliability, Load Growth projects
- Power Generation interconnection driven projects
- Externally driven projects (TX-DOT, UP-Railroad, etc.)
- Planned Maintenance projects

Stakeholders considers each project:

Purpose, Priority, Time-line, Feasibility, Options & Alternatives, Land/Permit Acquisition, Resource Availability, Material Acquisition, System Access Availability, Cost Estimates, etc.

Transmission System Planning

5. Projects List, Resource Allocation, Budgeting, Project Management



System Planning project list based on Stakeholder Scoping Meeting Results

- EPE driven Compliance, Reliability, Load Growth, Maintenance projects
- Power Generation interconnection driven projects
- Externally driven (TX-DOT, UP-Railroad, etc.)
- Break-In projects (AMRAD-Eddy Line, Arroyo PST)

Stakeholders considers each project:

Resource Allocation/Assignment, Budget Prep, Project Plan, etc.

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System Planning

EPE’s 10yr T&D System Expansion Plan

- **Updated annually**
- **Complies with requirements of, and supports, all FERC Orders**
- **Defines near-term and future system changes**
    - Accommodate new generation interconnections
    - Meet future load growth
    - Meet/maintain/improve operational capabilities
    - Meet/maintain/improve reliability requirements

System Planning

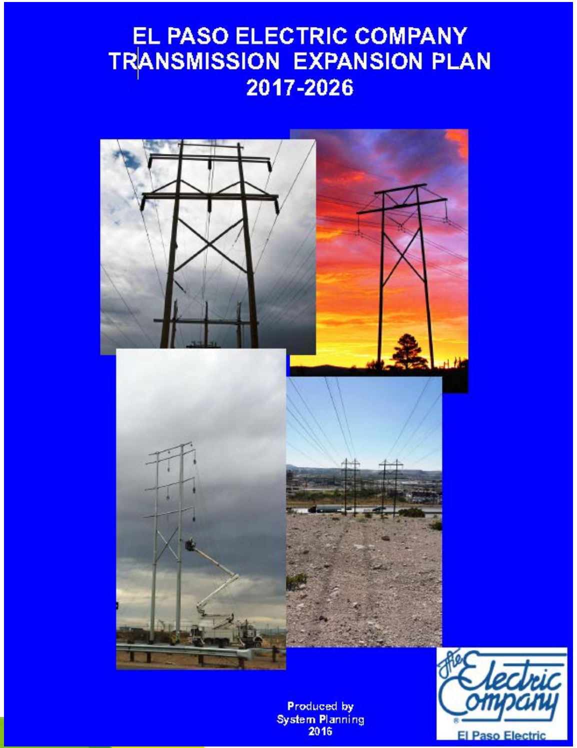
EPE's 10yr T&D System Expansion Plan - Projects

Table 5A. Project Schedule & Cost Summary (2018 - 2021)
EPE 2018-2027 System Expansion Plan (1)

Tab #	Project #	Project Descriptions	Recommended Completion Dates Month-Year (2)	Estimated Project Cost (3)
	TL174	Re-conductor 4.4 miles of Copper -To Pendale 115kV line from 556 ACSR to 954 ACSR	May-18	$617,107
	TL174	Re-conductor 0.85 miles of Pendale to Lane 115kV line from 556 ACSR to 954 ACSR	May-18	$60,090
	TL240	Sunset N.-Durazno 115kV line. Upgrade 3.3 mi of line to increase capacity to 170 MVA minimum.	May-18	$1,172,071
	TH015	Tap In-And-Out to Picante 345, from Caliente - Amrad 345 KV Transmission Line	May-18	$2,500,000
			2018 Total	$3,732,161
	DT359	Transmountain 115 KV, 2-15 MVAR capacitor banks	May-19	$650,000
	TH171	New Afton North substation with 345/115 KV 224 MVA Autotransformer	May-19	$10,388,617
	TH173	Afton - Afton North 345 KV Transmission Line (1 mile of double-bundled 954 ACSR)	May-19	$1,385,152
	TL178	Afton North - Airport 115 KV Transmission Line	May-19	$10,743,070
	TL239	Durazno- Ascarate 115kV line. Upgrade 3.3 mi of line to increase capacity to 170 MVA minimum.	May-19	$1,864,188
			2019 Total	$25,031,028
	TS119	East side loop expansion, Add new 115 KV substation E1, 7.33 miles east of Coyote substation	May-20	$5,018,000
	TL242	Re-conductor 7.33 miles of Coyote to E1 115 KV from 4/0 ACSR to 954 ACSR wire	May-20	$3,604,281
	TS120	East side loop expansion, Add new 115 KV substation E2, 18 miles south of E1 substation	May-20	$5,044,830
	TL244	New 954 ACSR transmission line from E1 to E2 115 KV, approximately 18 miles long	May-20	$4,794,849
	TL243	New 954 ACSR transmission line from E2 to Horizon 115 KV, approximately 4.3 miles long	May-20	$4,254,755
			2020 Total	$22,716,715
	TL245	New 954 ACSR transmission line from E2 to Felipe 115 KV, approximately 12 miles long	May-21	$8,510,011
	TL116	Re-conductor Sparks to Felipe 69 KV line, 12.87 miles, to 115 KV 954 ACSR wire	May-21	$1,333,494
	PT348	Upgrade Felipe substation to include a 115 KV bus	May-21	$6,882,000
			2021 Total	$16,725,505

System Planning

EPE’s 10yr System Expansion Plan – T&D


EL PASO ELECTRIC COMPANY
TRANSMISSION EXPANSION PLAN
2017-2026

Produced by
System Planning
2016

The Electric Company
El Paso Electric


The Electric Company
El Paso Electric

Distribution Expansion Plan

Distribution Projects for 2017 – 2026

Distribution Systems Section
May 2017

El Paso Electric Company
Distribution Expansion Plan
- Page 1 -
May 2017
Version 1

Metering & Metering Systems

- **Automated Meter Reading**
- **Advanced (Smart) Meters**
  - Advanced Meter Reading (AMR)
  - Advanced Metering Infrastructure (AMI)
  - Advanced Metering System (AMS)

Metering & Metering Systems

Metering – EPE’s AMR Metering System

Automated Meter Reading - AMR

Residential

- ✓ Itron – Automated Meter Reading system (AMR)
- ✓ AMR Deployment 95% complete
- ✓ Meters are one way radio frequency (RF) communication close proximity reading
- ✓ One reading, kWh residential, per month, up to three register values with polyphase (maximum).
- Cost
  - ✓ Meter cost $35/meter, approximately $70/meter installed
- Benefits
  - ✓ Improved accuracy
  - ✓ Improved read efficiency (personnel, vehicles, etc.)
  - ✓ Improved safety

Metering & Metering Systems

Advanced Metering Systems

Public Utility Commission of Texas (PUCT)

2007

AMI/AMS Requirements:

- Automated or Remote Meter Reading
- Two-Way Communications
- Remote Disconnection & Connection for meters
- Capability to Time-Stamp Meter Data
- Real-Time Access to Customer Usage Data
- Means for Providing Price Signals to Customers
- Interval Data – 15 Minutes or Shorter
- On-Board Storage of Meter Data
- Communication Capability Beyond Meter (load control)
- Must Comply with Open Standards and ANSI C12.22

Metering & Metering Systems

Advanced Metering Systems

MDMS (back office stuff) Requirements:

- Data Security
- Data Validation & Storage
- Data Communication - Customer/Web Access
- Pricing Translation/Signals
- Billing Interface
- Customer Service Interface
- Data Volume Capability

Metering & Metering Systems

AMI/AMS – Development Cost/Benefit

AMI/AMS Costs Estimates

- Metering (Itron): $165 - $197 per meter, $20/meter installed
- Comm., It, Interface, MDMS cost allocation per meter $?? (hosted)
- 390,000 meters
- Expected Cost Range Estimate
  - ($197 + $20) /meter x 390,000 meters = $84.6 MM + plus hosting

AMI/AMS Benefits (Cost Mitigation)

- Service Order Reductions (Disconnects & Reconnects)
- Energy Diversion (Theft) Reduction
- Outage Management
- Demand Control
- Other

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Metering & Metering Systems

Functionality: AMR vs. AMI/AMS

Functionality AMR vs. AMS

AMR		AMS
✓	Electronic Reading Accuracy	✓
X	Time of Use (TOU) Metering	✓
X	2 Way Communication	✓
X	15 Minute Interval Data	✓
X	Remote Connect / Disconnect	✓
X	On Demand Readings	✓
X	Load Monitoring Capability	✓
X	Hourly/Daily Load Profiling	✓
X	Load Control Capability	✓
X	Critical Peak Pricing Capability	✓
X	Distribution System Control & Engineering	✓
X	Outage Management Support	✓
$29 MM No Comm., No MDMS required		**$84.6 MM plus hosting cost**

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Conclusion

- **Big Picture:**
  - Generation -> Transmission -> Distribution -> Home
- **Transmission is Networked System, defines the “GRID”**
- **Distribution is Radial System, between Sub and your home**
- **System Planning (Transmission)**
  - Power Flow Modeling, Validating, What if’s, FERC/NERC rules, Contingency Analysis, Issues & resolution, etc.
  - Project list and priorities
- **Transmission Line Construction**
  - Right of Way acquisition time
- **Metering & Metering System**
  - AMR vs. AMI/AMS functionality & cost
  - AMR meters are not AMI/AMS meters!

QUESTIONS

Discussion

Please return feedback form to Facilitator before you leave or email to NMIRP@epelectric.com

For More Information

- EPE's IRP website https://www.epelectric.com/community/2017-18-public-advisory-group-meetings
- E-mail NMIRP@epelectric.com to be added to the Public Advisory Group e-mail distribution list. You will receive updates on available presentation material and future meetings. Questions can also be submitted to this e-mail.

Acronyms

AC	-	Alternating Current	MW	-	MegaWatts (1,000 kW)
ACE	-	Area Control Error	NERC	-	North American Reliability Council
AMI	-	Advanced Metering Infrastructure	NMAC	-	New Mexico Administrative Code
AMR	-	Automated Meter Reading	NMPRC	-	New Mexico Public Regulation Commission
CC	-	Combined Cycle	OATT	-	Open Access Transmission Tariff
CCN	-	certificate of convenience and necessity	PDES	-	Phelps Dodge Energy Services
CT	-	Combustion Turbine	PNM	-	Public Service Company of New Mexico
DC	-	Direct Current	ROW	-	Right of Way
EPE	-	El paso Electric Company, or "EPEC"	SNMIC	-	Southern New Mexico Import Capability
EPIC	-	El Paso Import Capability	SOL	-	System Operating Limit
FERC	-	Federal Energy Regulation Commission	SRP	-	Salt River Project
FM	-	Freeport McMoRan	SPP	-	Southwest Power Pool
Gen	-	Generation	ST	-	Steam Turbine
IRP	-	Integrated Resource Plan	TEP	-	Tucscon Electric Power Company
KV	-	Kilovolt (1,000 volts)	WECC	-	Western Electricity Coordinating Council

NERC Glossary of Terms

Automatic Generation Control - Equipment that automatically adjusts generation in a Balancing Authority Area from a central location to maintain the Balancing Authority’s interchange schedule plus Frequency Bias. AGC may also accommodate automatic inadvertent payback and time error correction.

Area Control Error - The instantaneous difference between a Balancing Authority’s net actual and scheduled interchange, taking into account the effects of Frequency Bias, correction for meter error, and Automatic Time Error Correction (ATEC), if operating in the ATEC mode. ATEC is only applicable to Balancing Authorities in the Western Interconnection.

Balancing Authority - The responsible entity that integrates resource plans ahead of time, maintains load-interchange-generation balance within a Balancing Authority Area, and supports Interconnection frequency in real time.

Balancing Area - The collection of generation, transmission, and loads within the metered boundaries of the Balancing Authority. The Balancing Authority maintains load-resource balance within this area.

Bulk Power System - (A) facilities and control systems necessary for operating an interconnected electric energy transmission network (or any portion thereof); and (B) electric energy from generation facilities needed to maintain transmission system reliability.

NERC Glossary of Terms

Cascading - The uncontrolled successive loss of System Elements triggered by an incident at any location. Cascading results in widespread electric service interruption that cannot be restrained from sequentially spreading beyond an area predetermined by studies

Contingency Reserves - The provision of capacity deployed by the Balancing Authority to meet the Disturbance Control Standard (DCS) and other NERC and Regional Reliability Organization contingency requirements.

Direct Control Load Management - Demand-Side Management that is under the direct control of the system operator. DCLM may control the electric supply to individual appliances or equipment on customer premises. DCLM as defined here does not include Interruptible Demand.

Frequency Response - The ability of a system or elements of the system to react or respond to a change in system frequency.

NERC Glossary of Terms

Interconnection - A geographic area in which the operation of Bulk Power System components is synchronized such that the failure of one or more of such components may adversely affect the ability of the operators of other components within the system to maintain Reliable Operation of the Facilities within their control.

Net Actual Interchange - The algebraic sum of all metered interchange over all interconnections between two physically Adjacent Balancing Authority Areas.

Net Scheduled Interchange - The algebraic sum of all Interchange Schedules across a given path or between Balancing Authorities for a given period or instant in time.

Non-Spinning Reserve - 1. That generating reserve not connected to the system but capable of serving demand within a specified time.2. Interruptible load that can be removed from the system in a specified time.

Operating Reserve - That capability above firm system demand required to provide for regulation, load forecasting error, equipment forced and scheduled outages and local area protection. It consists of spinning and non-spinning reserve.

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Operating Reserve - Spinning The portion of Operating Reserve consisting of: Generation synchronized to the system and fully available to serve load within the Disturbance Recovery Period following the contingency event; or Load fully removable from the system within the Disturbance Recovery Period following the contingency event.

Ramp Rate – The rate, expressed in megawatts per minute, that a generator changes its output.

Regulating Reserve - An amount of reserve responsive to Automatic Generation Control, which is sufficient to provide normal regulating margin.

Reportable Disturbance - Any event that causes an ACE change greater than or equal to 80% of a Balancing Authority’s or reserve sharing group’s most severe contingency.

System Operating Limit - The value (such as MW, Mvar, amperes, frequency or volts) that satisfies the most limiting of the prescribed operating criteria for a specified system configuration to ensure operation within acceptable reliability criteria.