WIRES University
Overview of ISO/RTOs

Mike Ross
Senior Vice President
Government Affairs and Public Relations
Southwest Power Pool
OUR MISSION
Helping our members work together to keep the lights on ... today and in the future.
Northeast Blackout of 1965

5:28 P.M., NOV. 9th
THE LIGHTS WENT OUT

POWER FAILURE BLACKS OUT NEW YORK;
THOUSANDS TRAPPED IN THE SUBWAYS;
LOOTERS AND VANDALS HIT SOME AREAS

State Troopers Sent Into City As Crime Rises
Some Civilians Assist Police in Blackout Fight

Westchester Is Also Darkened After Lightning Hits Line

Some Led Others by Flashlight, Lightning Bolt
Some Knocked on Doors to Help Fight Struck
Northeast Blackout of 1965

- Tuesday, November 9, 1965
- Affected parts of Ontario in Canada and Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont in the United States
- Over 30 million people and 80,000 square miles without electricity for up to 13 hours
Northeast Blackout of 2003

- 50 million lose power
- City swelters to a halt
- Rush-hour chaos today
Led to the Energy Policy Act of 2005
Our Major Services

- Reliability Coordination
- Market Operation
- Transmission Planning
- Transmission Service/Tariff Administration
- Balancing Authority
- Facilitation
- Standards Setting
- Compliance Enforcement
- Training

**OUR APPROACH:**
Regional, Independent, Cost-Effective and Focused on Reliability
Some Activities Outside of SPP’s Responsibility

- Transmission Siting
- Generation Planning/Siting
- Transmission/Generation Construction
- Transmission/Generation Permitting
- Credit/Allowance Trading Oversight
The SPP Footprint: Members in 14 States

- Arkansas
- Kansas
- Iowa
- Louisiana
- Minnesota
- Missouri
- Montana
- Nebraska
- New Mexico
- North Dakota
- Oklahoma
- South Dakota
- Texas
- Wyoming
United States Electric Grid

United States transmission grid
Source: FEMA
Operating Region

- Miles of service territory: 575,000
- Population served: 18M
- Generating Plants: 703
- Substations: 4,757
- Miles of transmission: 60,944
  - 69 kV  13,532
  - 115 kV  14,269
  - 138 kV  9,117
  - 161 kV  5,647
  - 230 kV  7,608
  - 345 kV  10,772
SPP’s 94 Members: Independence Through Diversity

As of August 11, 2016

- Cooperatives (20)
- Investor-Owned Utilities (16)
- Independent Power Producers/Wholesale Generation (13)
- Power Marketers (12)
- Municipal Systems (14)
- Independent Transmission Companies (10)
- State Agencies (8)
- Federal Agencies (1)
REGULATORY ENVIRONMENT

- Incorporated in Arkansas as 501(c)(6) nonprofit corporation
- Federal Energy Regulatory Commission (FERC)
  - Regulated public utility
  - Regional Transmission Organization
- North American Electric Reliability Corporation (NERC)
  - Founding member
  - Regional Entity
GOVERNANCE

• Independent Board of Directors
• Members Committee
• Regional State Committee
• Working Groups
Reliability Coordination: air traffic controllers of the bulk power grid

- Monitor grid 24 x 365
- Anticipate problems
- Take preemptive action
- Coordinate regional response
- Independent
- Comply with more than 5,500 pages of reliability standards and criteria
2015 Energy Capacity* by Fuel Type

- Gas (42.58%)
- Coal (33.25%)
- Hydro (4.11%)
- Wind (14.86%)
- Nuclear (3.16%)
- Other (0.15%)
- Fuel Oil (1.89%)

* Figures refer to nameplate capacity
2015 Energy Consumption by Fuel Type

- Gas (21.63%)
- Coal (55.06%)
- Hydro (1.54%)
- Wind (13.52%)
- Nuclear (8.11%)
- Other (0.14%)
What Kind of Markets Does SPP Operate?

- **Transmission Service**: Participants buy and sell use of regional transmission lines that are owned by different parties.

- **Integrated Marketplace**: Participants buy and sell wholesale electricity in day-ahead and real-time.
  - **Day-Ahead Market** commits the most cost-effective and reliable mix of generation for the region.
  - **Real-Time Balancing Market** economically dispatches generation to balance real-time generation and load, while ensuring system reliability.
Integrated Marketplace Savings

• Market continues to provide savings even with extremely low natural gas prices

• First year net savings calculated to be $380 million

• 2015 annual net savings calculated to be $422 million

• At the end of September, 2016 the savings amount was over $1 Billion from the Integrated Marketplace
Transmission Planning

- Reliability
- Economics
- Public Policy
Integrated Transmission Planning (ITP)

Conceptual

- Develop EHV “highway” vision
- Develop “highway/byway” system
- Develop “byway” & “local” system

20-Year Assessment

10-Year Assessment

Near-Term Assessment

Implementation

- Reliability, economic and public policy needs are evaluated in the 20 and 10-year assessments
- Reliability needs are evaluated in the near-term assessment
Transmission Build Cycle in SPP

Planning Study (12-18 mo.)

TO Selection (3-12 mo.)

Design, ROW Acquisition, & Construction (2-6 yr.)

Responsible Party
- SPP
- Transmission Owner
Generation Expansion in SPP Over the Last Decade

GI Requests In Commercial Operation
(as of 1/11/2017)

<table>
<thead>
<tr>
<th>Generation Type</th>
<th>Size (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil Fuel</td>
<td>1 - 50</td>
</tr>
<tr>
<td>Wind</td>
<td>50 - 131</td>
</tr>
<tr>
<td>Nuclear</td>
<td>131 - 225</td>
</tr>
<tr>
<td>Hydro</td>
<td>225 - 370</td>
</tr>
<tr>
<td></td>
<td>370 - 850</td>
</tr>
</tbody>
</table>

This map contains the intellectual property of SPP and may not be used, copied or disseminated by third parties without the express permission of SPP. All rights reserved.
Transmission Expansion in SPP Over the Last Decade

Projects Constructed or with NTCs
(2005 - 2016)

- 115 kV
- 138 kV
- 161 kV
- 230 kV
- 345 kV

This map contains the intellectual property of SPP and may not be used, copied or disseminated by third parties without the express permission of SPP. All rights reserved.

Map Created: March 2016
Transmission Investment Directed By SPP

Annual Transmission Investment Directed By SPP

- **Completed ($6.9 B)**
- **Scheduled ($3.0 B)**

Bar chart showing annual transmission investment directed by SPP from 2006 to 2023.
Who Pays for Transmission Projects?

- **Sponsored**: Project owner builds and receives credit for use of transmission lines

- **Directly-assigned**: Project owner builds and is responsible for cost recovery and receives credit for use of transmission lines

- **Highway/Byway**: Most SPP projects paid for under this methodology

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Region Pays</th>
<th>Local Zone Pays</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 kV and above</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>above 100 kV and below</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>300 kV</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>100 kV and below</td>
<td>0%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Renewables in SPP
The highest wind speed in the country is within SPP Balancing Authority.
Wind Energy Development

• SPP’s “Saudi Arabia” of wind: Kansas, Oklahoma, Nebraska, Texas Panhandle, and New Mexico
  • 60,000-90,000 MW potential
  • More wind energy than SPP uses during peak demand

• 15,782 MW capacity of in-service wind*

• 34,730 MW wind in all stages of development*
  • Includes Generation Interconnection queue and executed Interconnection Agreements

* December 2016
Wind Capacity has grown significantly
Wind units are concentrated in the middle of the footprint.
Renewables impacts to SPP

• Peak Wind Penetration level: 49.17% April 2016

• Peak instantaneous Wind generation: 12,336 MW December 2016

• High impact on congestion and loading of the transmission system

• Wind can cause capacity issues by
  • Not showing up during times of high demand, contributing to capacity shortages
  • Showing up too high during times of low demand, contributing to “Min Gen” issues
  • Uncertainty complicating unit commitments

• Short-term, intra-hour changes in wind also require reserves to maintain balance between generation and obligations

• Wind forecast is crucial for SPP to have the right generation online at the right time, while maintaining the reliability and economic efficiency of the regional transmission grid.
MODERNIZING THE GRID

THE VALUE OF TRANSMISSION

www.SPP.org/value-of-transmission
SPP’s Value of Transmission Study

- Evaluated 348 projects from 2012-14, representing $3.4B of transmission investment

- Evaluated benefit metrics
  - Adjusted Production Cost (APC) Savings
  - Reliability and Resource Adequacy Benefits
  - Generation Capacity Cost Savings
  - Market Benefits
  - Other industry and SPP-accepted metrics

- APC Savings alone calculated at more than $660k/day, or $240M/year.

- Overall NPV of all benefits for considered projects are expected to exceed $16.6B over 40 years.

For every $1 of transmission investment made in 2012-2014, SPP expects at least $3.50 of benefit to be provided to rate-payers