SPP 101
Our Mission

Helping our members work together to keep the lights on ... today and in the future.
Our Beginning

• Founded 1941 with 11 members
  – Utilities pooled electricity to power Arkansas aluminum plant needed for critical defense

• Maintained after WWII to continue benefits of regional coordination
The SPP Difference

• Relationship-based
• Member-driven
• Independence Through Diversity
• Evolutionary vs. Revolutionary
• Reliability and Economics Inseparable
Milestones

1968  Became NERC Regional Council
1980  Implemented telecommunications network
1991  Implemented operating reserve sharing
1994  Incorporated as nonprofit
1997  Implemented reliability coordination
1998  Implemented tariff administration
2004  Became FERC-approved Regional Transmission Organization
2007  Launched EIS market; became NERC Regional Entity
2009  Integrated Nebraska utilities
2010  FERC approved Highway/Byway cost allocation methodology and Integrated Transmission Planning Process
2012  Moved to new Corporate Center
2014  Launched Integrated Marketplace
2014  Became regional Balancing Authority
2015  Integrated System joins SPP (expected in October)
SPP’s Corporate Center
SPP at a Glance

• Located in Little Rock

• About 570 employees

• Primary jobs: IT electrical engineering, operations, settlements, IT

• 24x7 operation

• Full redundancy and backup site
Community Involvement and Recognition

- Best Companies to Work for in Arkansas: Benchmark Award Winner (2014)
- Best Companies to Work for in Arkansas: Finalist (2013)
- Principal Financial Group “Top 10”
- Employee involvement, including:
  - Arkansas Foodbank
  - Girls of Promise
  - Race for the Cure
  - Relay for Life
  - United Way
  - Youth Home
Regulatory Environment

• Incorporated in Arkansas as 501(c)(6) nonprofit corporation

• FERC (Federal Energy Regulatory Commission)
  – Regulated public utility
  – Regional Transmission Organization

• NERC (North American Electric Reliability Corporation)
  – Founding member
  – Regional Entity
3 Electric Interconnections/8 NERC Regions

NERC INTERCONNECTIONS

Western Interconnection

ERCOT Interconnection

TRE

SERC

FRCC

RFC

NPCC

MRO

WECC

Québec Interconnection

Eastern Interconnection
Members in 14 States

- Arkansas
- Kansas
- Iowa
- Louisiana
- Minnesota
- Missouri
- Montana
- Nebraska
- New Mexico
- North Dakota
- Oklahoma
- South Dakota
- Texas
- Wyoming
Operating Region

- 370,000 miles of service territory
- More than 15 million people
- 586 generating plants
- 4,229 substations
- 48,537 miles transmission:
  - 69 kV – 12,497 miles
  - 115 kV – 10,063 miles
  - 138 kV – 9,023 miles
  - 161 kV – 4,973 miles
  - 230 kV – 3,362 miles
  - 345 kV – 8,526 miles
  - 500 kV – 93 miles
2014 Energy Consumption (MWh)

- Gas: 18.9%
- Coal: 58.8%
- Other: 0.1%
- Hydro: 2.5%
- Wind: 11.8%
- Nuclear: 7.9%
2014 Energy Capacity (MWh)

- Gas: 46.50%
- Coal: 35.40%
- Hydro: 1.10%
- Wind: 11.45%
- Biomass: 0.02%
- Nuclear: 3.43%
- Fuel Oil: 2.03%
- Solar: 0.07%

12% annual planning capacity requirement
Market Facts

• 134 participants
• 586 generating resources
• 2014 Integrated Marketplace = $3.26 billion  
  (Went live March 1, 2014)
• 47.0 GW coincident peak load
• 48 MW wholesale demand response
Transmission Facts

• In 2014, SPP members completed 148 transmission projects totaling more than $1.9 billion

• More than $8.8 billion in transmission grid upgrades were planned and approved in the 2000-14 planning cycles

• 48,537 miles of transmission lines in SPP’s footprint would circle the earth — almost twice!
IT Facts

• 135,000+ data points updated every 4-30 seconds
• Operations model solves $25,906 \times 59,403$ matrix every two minutes
• More than 1,800 servers
• More than 1.8 terabytes of storage
Growth in Responsibilities

- Energy Imbalance Market Transactions ($MM)
- Transmission Customer Transactions ($MM)
- Number of Employees

Bar chart showing the growth in responsibilities from 2004 to 2014.
SPP Expenses: 2001-2014

Operating Expenses (in millions)

SPP Tariff Rate ($/MWh)

0.15 0.16 0.16 0.19 0.19 0.17 0.195 0.21 0.255 0.315 0.381 0.39 0.37
Interregional Coordination

- ISO-RTO Council
- Interregional planning efforts, including Eastern Interconnection Planning Collaborative
- North American Energy Standards Board
- National Association of Regulatory Utility Commissioners
Contract Services

• Alternative to RTO membership for Transmission Owners

• Oversight of Transmission Owners’ system operations:
  – Reliability Coordination
  – Transmission Planning
  – Tariff Administration
  – Interregional Coordination

• Provides process for assigning cost responsibility for transmission upgrades
Our Strategy

- Reliability Assuranc
- Enhance Member Value and Affordability
- Optimize Interdependent Systems
- Maintain an Economical, Optimized Transmission System
Consumer Value

- SPP services lower ratepayer’s costs
- A typical residential customer bill of $100 per month would be $106.61.
Our Major Services

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

Our Approach

- Regional
- Independent
- Cost-Effective
- Focus on Reliability
Reliability Coordination

- Monitor grid 24 x 365
- Anticipate problems
- Take preemptive action
- Coordinate regional response
- Independent

As “air traffic controllers,” our operators comply with ... 

... more than 3,800 pages of reliability standards and criteria
Training

- 2014 Training program awarded more than 13,120 continuing education hours to 31 member companies
- SPP offers:
  - Regional System restoration drills
  - Integrated Marketplace training
  - Regional Emergency Operations sessions
  - Train-the-Trainer classes
SPP Regional Entity

- Independent and functionally separate from SPP RTO
- Monitors and enforces Registered Entities' compliance with reliability standards
- Assesses and evaluates grid reliability
- Provides regional outreach on compliance issues
- Analyzes system events and develops lessons learned
Services

TRANSMISSION MARKET
Finding Balance

Minimum for Reliable Delivery to Customers

More Transmission Needed

Expand Transmission

Customer Energy Cost

No Limits to Low Cost Delivery
Transmission Market

• Provides “one-stop shopping” for use of regional transmission lines
• Consistent rates, terms, conditions for all users
• Independent
• Process almost 5,000 transactions per month
• 2014 transmission customer transactions = $1.5 billion

As “Sales agents,” we administer ...

... 3,000+ page transmission tariff on behalf of members and customers
Transmission Service

Without SPP

To get from a generator in Utility A to a customer in Utility C, electricity must flow through lines owned by Utilities A, B, and C, each with its own set of operating rules and associated costs.

$30

$4

$6

$5

$15 transmission service + $30 energy = $45
Transmission Service

With SPP

SPP moves electricity across Utilities A, B, and C in one transaction for a single service fee, then shares revenues with each party.

$30

A

SPP

B

C

$5 transmission service + $30 energy = $35
How Transmission Service Works

• Reserving transmission service
  – Like buying e-ticket to reserve seat on plane
  – Customer specifies priority, time, source/sink, capacity
  – Tariff administrator approves if capacity exists

• NERC Tag is issued
  – Like receiving boarding pass for plane
  – Won’t be approved if improper use of reservation

• Schedule is created from Tag. When approved:
  – Like sitting on the plane
  – Generators ramp to provide energy for transaction
  – May be curtailed if transmission system overloaded
Services

WHOLESALE ENERGY MARKET
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.
Market Concepts: What is a Market?

General Concepts:

- Buyers/Sellers OR Producers/Consumers
- Prices driven by Supply and Demand
- Products
## Market Concepts: What is a Market? (cont’d.)

### Wholesale Energy Market:

<table>
<thead>
<tr>
<th>Sellers/Producers</th>
<th>Buyers/Consumers</th>
<th>Locational Prices</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Utilities</td>
<td>• Utilities</td>
<td>• Driven by</td>
<td>• Energy</td>
</tr>
<tr>
<td>• Municipals</td>
<td>• Municipals</td>
<td>Supply and Demand</td>
<td>• Operating</td>
</tr>
<tr>
<td>• Independent</td>
<td>• Load Serving</td>
<td>at defined</td>
<td>• Congestion</td>
</tr>
<tr>
<td>Power</td>
<td>Entities (LSEs)</td>
<td>locations</td>
<td>Rights</td>
</tr>
<tr>
<td>Producers</td>
<td>• Power</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Generators</td>
<td>Marketers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Power Marketers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Locational Prices: Driven by Supply and Demand at defined locations.
SPP’s Energy Market: Integrated Marketplace

1. SPP facilitates the Marketplace

✓ Provides the infrastructure and systems

✓ Maintains and follows 800+ pages of Marketplace protocols

✓ 24/7 market operations
SPP’s Energy Market: Integrated Marketplace (cont’d.)

2. SPP financially settles the Marketplace
   - Calculates prices
   - Captures wholesale energy production and consumption
   - Collects from market participants (MPs) who owe the market
   - Pays MPs who are owed by the market
   - Remains revenue neutral

3. SPP has an independent Market Monitor
MMU Ensures Markets Reliability, Effectiveness

- SPP’s internal Market Monitoring Unit (MMU) reports directly to the Board and Oversight Committee
  - Independent from SPP RTO
- FERC Order 719 allows ISO/RTO markets to be overseen by internal, external, or hybrid monitor
  - 2 ISOs/RTOs have external, 2 have internal, 2 have hybrid
  - SPP’s use of internal MMU brings cost savings and allows easy access to real-time operations
- MMU reviews real-time/historic data and reports any issues to FERC for investigation
Integrated Marketplace Overview

Key Components
- Day-Ahead (DA) Market
- Real-Time Balancing Market (RTBM)
- Transmission Congestion Rights (TCR) Market

Products
- Energy
- Operating Reserve (Regulation Up, Regulation Down, Spinning, Supplemental)
- Congestion Rights
Integrated Marketplace Benefits

- Net benefits estimated at approximately $100 million/year based on Ventyx study
- Reduce total energy costs through centralized unit commitment while maintaining reliable operations
- Day-Ahead Market allows additional price assurance capability prior to real-time
- Operating Reserve products support implementation of the SPP Balancing Authority and facilitate reserve sharing
Day-Ahead Market

• Determines least-cost solution to meet energy bids and reserve requirements

• Participants submit offers and bids to purchase and/or sell energy and operating reserve:
  – Energy
  – Regulation-Up
  – Regulation-Down
  – Spinning Reserve
  – Supplemental Reserve
Real-Time Balancing Market

• Balances real-time load and generation committed by the Day-Ahead Market and Reliability Commitment processes

• Operates on continuous 5-minute basis
  – Calculates dispatch instructions for energy and clears operating reserve by resource

• Energy and operating reserve are co-optimized

• Settlements based on difference between results of RTBM process and Day-Ahead Market clearing

• Charges imposed on market participants for failure to deploy energy and operating reserve as instructed
Transmission Congestion Rights (TCR) Market

• In the DA Market, price separation of MP’s resource to load may occur due to congestion leaving the MP exposed to high prices

• A TCR can be used as hedge against congestion that allows MPs to reduce their exposure to high market prices and potentially receive lower priced deliverable energy

• TCR Market has Annual and Monthly Auction processes related to two products:
  – Auction Revenue Rights (ARRs)
  – Transmission Congestion Rights (TCRs)
GRID CONGESTION
Impacts markets and transmission planning
What is Congestion?

• Congestion or “bottlenecks” happen when you can’t get energy to customers along a certain path
  – Desired electricity flows exceed physical capability

• Congestion caused by:
  – Lack of transmission, often due to load growth
  – Line and generator maintenance outages
  – Unplanned outages such as storms or trees on lines
  – Too much generation pushed to grid in a particular location
  – Preferred energy source located far from customers

• Results in inability to use least-cost electricity to meet demand
Congestion Prevents Access to Generation
Congestion’s Impact on Market Prices

OSGCANBUSDEA – Osage Switch - Canyon East 115kV ftlo Bushland - Deaf Smith 230kv

North -> South flow in Texas Panhandle
SMP = $25.26 / MWh

North of constraint = $10.87 / MWh
South of constraint = $59.43 / MWh
TRANSMISSION PLANNING: BASIC CONCEPTS
Primary Energy Consumption by Source and Sector, 2012
(Quadrillion Btu)

Source:
- Petroleum: 34.6 (36%)
- Natural Gas: 26.1 (27%)
- Coal: 17.3 (18%)
- Renewable Energy: 8.8 (9%)
- Nuclear Electric Power: 8.1 (8%)

Percent of Sources: Total = 95.0
- Transportation: 26.7 (28%)
- Industrial: 20.6 (22%)
- Residential & Commercial: 9.6 (10%)
- Electric Power: 38.1 (40%)

Percent of Sectors:
- Transportation: 26.7
- Industrial: 20.6
- Residential & Commercial: 9.6
- Electric Power: 38.1

Energy Consumed when Generated
Other Ways Electric Industry is Unique

• Location of “manufacturing” plants is limited
  - Wind farms must be in areas of high wind, solar farms in areas with strong sun, hydroelectric plants on a river
  - Coal and natural gas can only be extracted where fuel is
    ▪ Coal mine may be far from coal-fired power plants – Expensive to transport coal long distances
    ▪ Location of coal and gas plants have limitations

• Manufacturing plants may be far from people, and “roads” may not exist to deliver product to consumers

• Some products are only available at certain times
Transmission Planning Considerations

• What parts of grid need strengthening to “keep the lights on?”
  – Redundancies necessary to account for a line being out
• Where are current and future generations located?
• Where are electricity consumers located?
• Where on the grid do we frequently see congestion (more traffic than roads can accommodate)?
• Will laws mandating more renewable energy or a carbon tax impact traffic?
• How do coal/gas prices impact traffic?
  – People will use more coal if gas prices rise, and vice versa
• How do regional temperatures impact traffic?
  – If temperature differs across region, one area may need more energy
Without transmission, we can’t deliver this capital-intensive generation to where it’s needed across the region.
Transmission = 10% Retail Electricity Rates

Transmission enables optimal use of our region’s diverse generating resources, including coal, natural gas, hydroelectric, nuclear and wind energy.
Larger Transmission Reduces Right of Way
TRANSMISSION PLANNING AT SPP
Why do We need more Transmission?

- In the past, built least-cost transmission to meet local needs
- Today, proactively building “highways” to benefit region

Improves access to lower-cost generation by reducing grid “bottlenecks”

May reduce electricity reserves, allowing more generation into regional energy market

Building “bigger” can be more cost-effective than building to meet minimum requirements

Helps add renewable wind and solar energy to grid

Improved reliability reduces high-cost of brown and blackouts

More efficient use of existing resources may reduce need for new generation

High voltage transmission “superhighways” would move more power more efficiently over long distances at lower costs

New economic opportunities

Diverse fuel usage increases reliability and flexibility

Lower voltage transmission “byways” still needed to move power to smaller distribution lines

Environmental and land use benefits

More efficient electricity delivery
How SPP Makes Transmission Decisions

- Integrated Transmission Planning process
- Generation Interconnection Studies
  - Determines transmission upgrades needed to connect new generation to electric grid
- Aggregate Transmission Service Studies
  - Determines transmission upgrades needed to transmit energy from new generation to load
  - Shares costs of studies and new transmission
- Specific transmission studies
ITP: Economics and Reliability Analysis

- Annual Near-Term plan
  - Reliability is primary focus
  - Identifies potential problems and needed upgrades
  - Coordinates with ITP10, ITP20, Aggregate and Generation Interconnection study processes

ITP20
- Develops 345 kV+ backbone for 20-year horizon
- Studies broad range of possible futures

ITP10
- Analyzes transmission system for 10-year horizon
- Establishes timing of ITP20 projects
Who Pays for These 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 300 kV</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>100 kV and below</td>
<td>0%</td>
<td>100%</td>
</tr>
</tbody>
</table>
Transmission Owner Selection: Order 1000

• SPP developed the Transmission Owner Selection Process (TOSP) to allow competitive bidding on certain transmission projects.

• Transmission Facilities that meet the criteria in the SPP Tariff and are approved for construction (or are endorsed by the SPP Board of Directors) after Jan. 1, 2015, are known as Competitive Upgrades.

• SPP will solicit proposals for Competitive Upgrades from Qualified RFP Participants (QRP) utilizing the TOSP.
State Regulators’ Role

• Regional State Committee — Retail regulatory commissioners from:
  Arkansas    Nebraska    Oklahoma
  Kansas      New Mexico   Texas
  Missouri
  *Louisiana maintains active observer status*

• Primary responsibility for:
  – Cost allocation for transmission upgrades
  – Approach for regional resource adequacy
  – Allocation of transmission rights in SPP’s markets
Services

TRANSMISSION PLANNING MAPS
Projects Constructed 2005-2014

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Approved Balanced Portfolio

(Map as of February 2015)

Completed 345 kV
Portfolio 3-E
- Completed Substation
- Southwest Power Pool
- Woodward District EHV

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Priority Projects

Priority Projects (February 2015)

All SPP Transmission Expansion Plans are subject to change.

- Transformer Upgrade
- Completed Substations
- Double Circuit PP
- Single Circuit PP
- 230 kV
- 345 kV
- 500 kV

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230kV-plus Planned Expansion

(as of February 2015)

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Proposed Expansion

Proposed Transmission Expansion In and Around SPP (345kV +) (February 2015)

All SPP Transmission Expansion Plans are subject to change.

- Approved Double Circuit 345 kV
- Approved Single Circuit 345 kV
- Draft EHV Overlay
- Ozark Study 345 kV
- Ozark Study 500 kV
- EWITS 345 kV HVDC
- EWITS 800 kV HVDC
- 345 kV Quanta/SPS
- 765 kV Quanta/SPS
- HPX
- CREZ Single Circuit
- CREZ Double Circuit
- Clean Line HVDC

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Conceptual and Approved Expansion In and Around SPP

(February 2015)

All SPP Transmission Expansion Plans are subject to change.

Upgrade Type
- Completed 345 kV
- Double Circuit 345 kV NTC's
- Single Circuit 345 kV NTC's

Other Expansion
- Clean Line
- HPX Expansion
- CREZ
- SGL Ckt/Dbl Ckt Towers
- Double Ckt

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Generating Resources

Distribution of Generation in SPP
(February 2015)

Generation Type
- Fossil
- Hydro
- Nuclear
- Wind

Voltage
- 230 kV
- 345 kV
- 500 kV

Southwest Power Pool
WIND ENERGY
Wind Energy Development

- Wind “Saudi Arabia”: Kansas, Oklahoma, Nebraska, Texas Panhandle, New Mexico
  - 60,000-90,000 MW potential
  - More wind energy than SPP uses during peak demand
- 8,583 MW capacity of in-service wind
- 25,614 MW wind in-service and being developed
  - Includes wind in Generation Interconnection queue and with executed Interconnection Agreements
Annual Average Wind Speeds

Solar in the U.S.

PV Solar Radiation (Flat Plate, Facing South, Latitude Tilt)

This data represents annual average solar resource potential for 48 Contiguous United States and Hawaii, in High Resolution. The data for Hawaii and the 48 contiguous states is a 10 km, satellite modeled dataset (SUNY/NREL, 2007) representing data from 1998-2005.

Source: National Renewable Energy Laboratory (NREL), U.S. Department of Energy
Wind-Energy Development Challenges

- Intermittent
  - Must be supplemented with constant generating sources
- Wind in remote areas
  - Expensive new transmission needed
- “Not in my backyard” siting issues
- Seams agreements
- Renewable Energy Standards
Renewable Portfolio Standards

NPPD, OPPD, LES goal
20% - 2020

KS RPS
10% - 2011
15% - 2016
20% - 2020

NM RPS
6% - current
10% - 2011

OK goal
15% - 2015

MO RPS
2% - 2011
5% - 2014
10% - 2018
15% - 2021+

TX RPS
3,272 MW - 2009
4,264 MW - 2011
5,880 MW - 2015
10,000MW - 2025
Wind In Service

Wind Generation
In Service
(February 2015)

All SPP Transmission Expansion Plans are subject to change.

Size of GI Request (MW)
- 1 - 60
- 61 - 140
- 141 - 250
- 251 - 550
- 551 - 1000

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Generation Interconnection Requests

GI Requests (Wind)
(As of February 2015)

Status of GI Request
- Signed IA/In Service
- Signed IA/On Schedule
- Signed IA/On Suspension
- Under Study

Size of GI Request (MW)
- 1 - 60
- 61 - 140
- 141 - 250
- 251 - 550
- 551 - 1000