

# SPP Market Clearing Engine Enhancements and Performance Improvements

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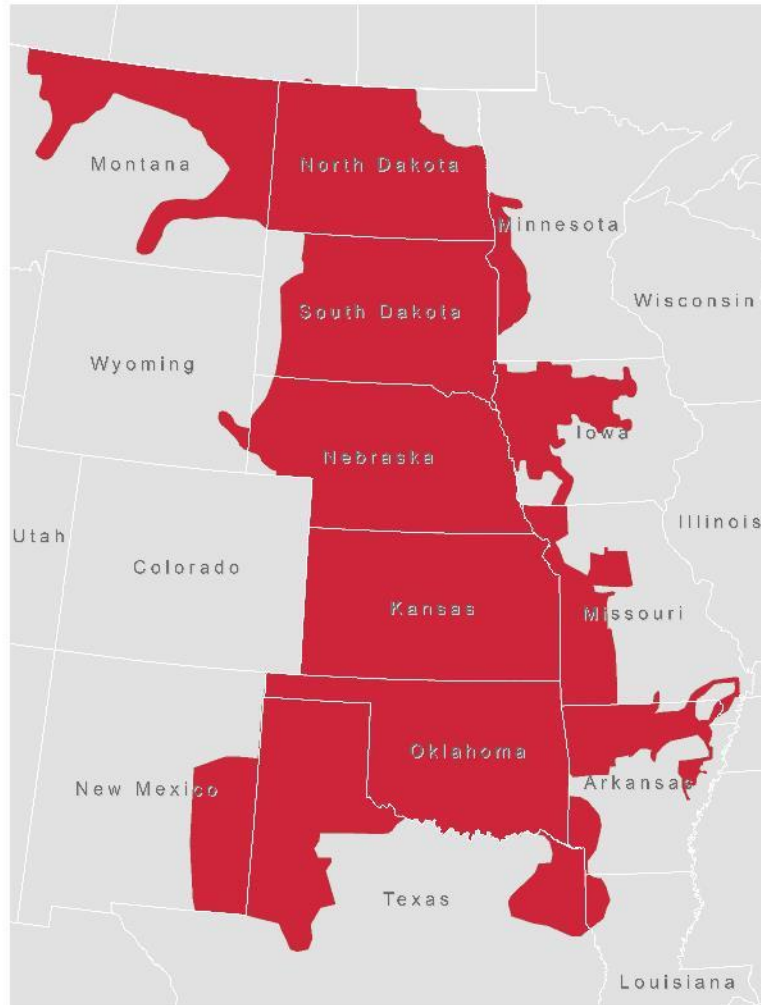
Southwest Power Pool

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HELPING OUR MEMBERS WORK TOGETHER  
TO KEEP THE LIGHTS ON... TODAY AND IN THE FUTURE.

# THE SPP FOOTPRINT: MEMBERS IN 14 STATES



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

# SPP Market Clearing Engine (MCE) Overview

- Single Engine for SCUC and SCED for all studies
  - DAMKT, DA-RUC, ID-RUC, ST-RUC, PA-RUC
- Large, complicated SCUC model
  - Regulation Up separate from Regulation Down
  - Mitigation integrated into engine
    - Necessitates additional solve in process
  - Scarcity and Emergency condition detection with corrective actions
    - Different procedure in DAMKT vs RUCs
  - Different Optimization goals depending on case type
    - DAMKT optimize based on production cost
    - RUCs optimize based on commitment cost
- System Conditions
  - Large Number of Transmission Constraints
  - High Renewable Penetration

# MCE Enhancements Implemented in Last Year

- **Gas-Day Harmonization – 10/1/2016**
  - Reduces DAMKT solve window from 5 hours to 4.5 hours
  - Reduced DA-RUC solve window from 3 hours to 2.5 hours
- **Enhanced Combined Cycle Logic – 3/1/2017**
  - Allows Registration of Multi-Configuration Combined Cycle Resource (MCR)
    - up to 3 configuration per MCR
  - DAMKT and RUC processes optimize:
    - Commitment of MCR configurations
    - Transitions between MCR configuration

# Challenges Faced

- Both enhancements required performance improvements
  - Gas Day effort started after ECC effort originally scoped
- Overlapping and condensed project timelines
  - ECC (10/2015 – 03/2017)
  - Gas Day (07/2015 – 10/2016)
- Clearing Engine performance limitations primary hurdle for mutual success

# MCE Performance Challenges

- MCE and overall market design not really implemented to have something more granular than a Resource
  - Fundamental pillar of design through all areas of marketplace
- Two Options:
  - Fundamentally change everything
  - Fit ECC logic into existing structure
    - Configurations = Resource in MCE
      - Introduces new group-type constraints in formulation for UC
        - Bigger Matrix

# MCE PERFORMANCE IMPROVEMENTS CONSIDERED

- Hardware Upgrades
- Software Upgrades
  - CPLEX
  - AIMMS
- Different Solver Settings
  - Parallel MIP
- Change to Solver Process
  - Interval lengths
  - HotStart SCED
- Formulation Tweaks
- Multi-Stage SCUC



# FINAL PERFORMANCE IMPROVEMENTS

- Hardware Upgrades
- Software Upgrades
  - CPLEX
  - AIMMS
- ~~• Different Solver Settings~~
  - ~~• Parallel MIP~~
- Change to Solver Process
  - Interval lengths
  - HotStart SCED
- Formulation Tweaks
- ~~• Multi-Stage SCUC~~

# FUTURE MCE PERFORMANCE NEEDS

- Decrease DAMKT runtime to further align to gas day
- Increase MCR Configurations
- Expand some of the MCR-like logic to Resources other than Combined Cycle
  - Staggered Start Resources
  - Resources with multiple fuel sources
- Multi-Day Economic Commitment
- Price formation enhancements
  - Ramp Optimization
  - Fast-Start Resource Pricing
- Near-AC Market Solution

# MCE CERTIFICATION PROCESS

- Original Method
  - ~550 test cases executed on full-size model
    - Dozen engineers and analysts 3 weeks to complete
    - Ties up testing environments
    - Requires SMEs to perform many tests
- With all the possible options to close performance gap, we could not maintain:
  - Quality
  - Project Timelines
  - Prevent Staff Burnout
- New method needs to be:
  - Somewhat Automated
  - Easily repeatable
  - Fast
  - Adaptable to also perform performance benchmarking

# MCE CERTIFICATION IMPROVEMENT

- SPP SMEs worked with Vendor to develop certification tool
  - Comparison functionality
  - Batch-running Functionality
  - Standalone
- Small Model
- SPP SMEs reworked entire certification test case library
  - Used Governing Language, Design Documentation, Defects etc.
  - 634 test cases and growing
    - 12,000 + case solutions
- Use same hardware as production

# MCE CERTIFICATION IMPROVEMENT BENEFITS

## Measurable Benefits

- Takes One or Two engineers ~2 days to certify
  - Runs all test cases over an evening on standalone server

## Qualitative Benefits

- Vendor performs same effort prior to sending patch
  - Reduced defects/ better unit testing
- Frees up SMEs that used to perform most of testing
- Small model cases easier to identify root-cause of defects

# Questions?

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