SPP Market Clearing Engine Enhancements and Performance Improvements

James Gonzalez, jgonzalez@spp.org

Southwest Power Pool

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

Jim Gonzalez
Supervisor, Real Time Markets
Southwest Power Pool
jgonzalez@spp.org