SPP'S RELIABILITY IMPACT ASSESSMENT
OF THE EPA'S PROPOSED CLEAN POWER PLAN

Background[1]

In its recently released proposed Clean Power Plan (CPP) rule, the U.S. Environmental Protection Agency (EPA) proposes to cut existing power plant carbon emissions 30% by the year 2030, from 2005 levels. As currently proposed, the CPP will be implemented through state-developed plans that meet state-specific carbon reduction goals set by the EPA. The CPP offers flexibility for states to rely on a number of options to meet those goals, including generator efficiency improvements, redispatch from coal to gas fueled generation, increased reliance on renewable resources, and increased energy efficiency. State plans will be required as early as 2016 but may be deferred until 2018 subject to collaborative approaches and regional solutions. The EPA's state-specific carbon reduction goals are proposed to be effective beginning in 2020. Based on its modeling and assessment of the proposed CPP, the EPA has projected generator retirements; Figure 1 shows projected generation retirements in the Southwest Power Pool (SPP) region and adjacent systems according to EPA's Integrated Planning Model (IPM) Option 1 simulation.

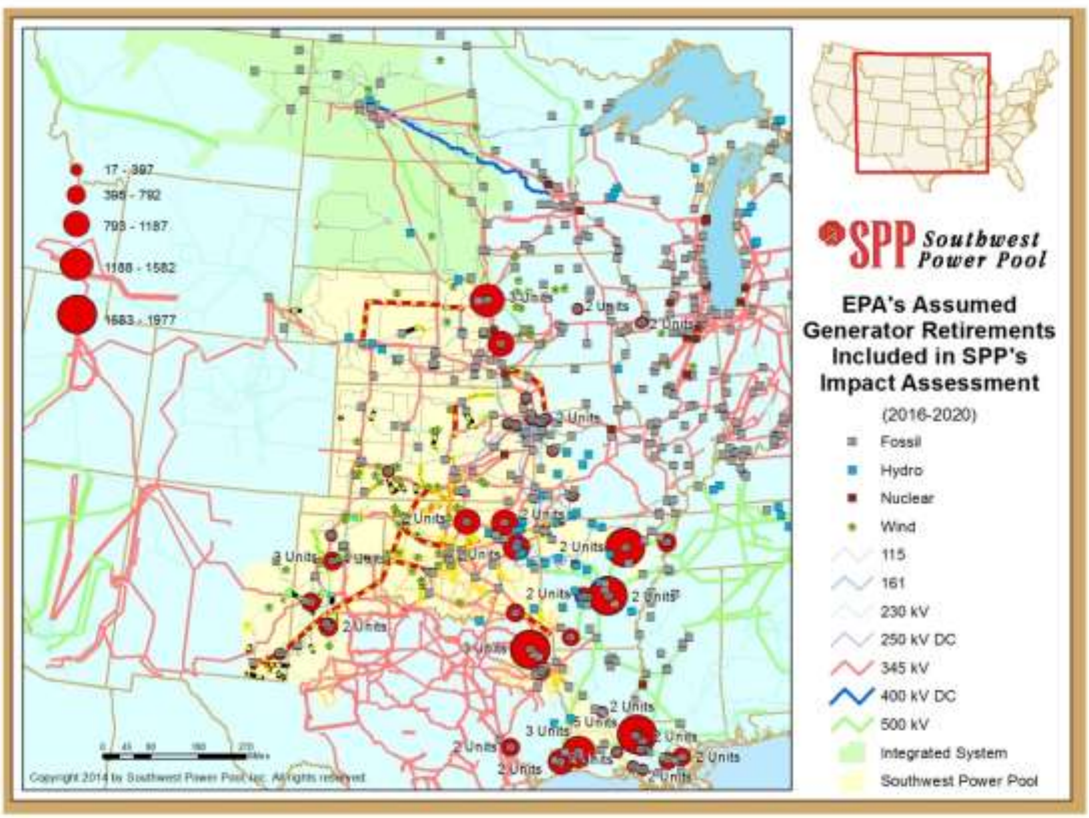

Figure 1: EPA's Projected EGU Retirements by 2020 in the SPP Region and Adjacent Systems

[1] For purposes of this assessment, SPP has included the Integrated Systems utilities, which are in the process of joining the organization.

The EPA IPM assumptions for SPP includes retirements of approximately 9,000 MW of capacity associated with existing coal and gas-fired units currently relied upon to serve load obligations in the SPP region. EPA's projected Electric Generating Unit (EGU) retirements represent approximately 6,000 MW of additional capacity being retired in the SPP region beyond that currently expected by 2020. The EPA projections represent approximately a 200% increase in retired generating capacity compared to SPP's current expectations.

Scope of Work

The scope of this reliability impact assessment (Assessment) reflects input from member representatives under the guidance of SPP's Strategic Planning Committee and other stakeholders. This is a cursory analysis to help inform comments that are to be submitted to the EPA on the draft rule by December 1, 2014.

This Assessment evaluates the impacts of the EPA's projected EGU retirements within SPP and adjacent areas on reliability of the bulk power system within the SPP region. Reliability impacts were evaluated by identifying bulk power system equipment overloads and low voltages both during system intact conditions and during loss of a single element (Transmission System Impact Analysis) and by determining impacts to SPP's reserve margin (Resource Adequacy Analysis). SPP evaluated the impacts of the EGU retirements projected by the EPA that result from implementation of the carbon emission reduction goals proposed in CPP, but due to time constraints did not evaluate the viability or reliability impacts of any of the building blocks used to establish those proposed goals.

Transmission System Impact Analysis (TSIA)

Method

SPP staff developed power grid models to assess how compliance with the proposed CPP would impact reliability in the SPP region. The TSIA incorporated the retirements reflected by EPA in their IPM models based on the Option 1 State simulation for 2020.

Part 1 of the TSIA assumed the retired capacity would be replaced by existing unused capacity remaining within the SPP footprint and surrounding areas. Part 2 of the TSIA assumed the retired capacity would be replaced by a combination of existing unused capacity and new gas-fired and wind resources in the SPP footprint as needed to address capacity deficiencies. Both parts include performance of steady-state power flow analyses using models developed as described below to evaluate transmission system performance when all transmission elements are in service ("system intact") and during conditions after which any single transmission element, including a generator, is taken out of service ("first contingency" or "N-1").

Assumptions

Part 1 of the TSIA was performed using a current 10-year-out summer peak model modified to reflect EPA's projected retirements in the SPP region and surrounding areas. Reactive power limits on remaining generators were increased as necessary to enable a minimally solvable power flow model under system intact conditions and to account for reactive power shortfalls within SPP.

Part 2 of the TSIA was performed using an updated 10-year-out summer peak model modified to reflect EPA's projected retirements in the SPP region and surrounding areas. Additionally, new gas-fired and wind generators (see Figure 2) were added within SPP's region and dispatched to offset the majority of the EPA retirements. The generators added to the model were placed in locations based on resource plans developed to support SPP's 10-year transmission planning evaluation. New gas generators, including combined cycle (CC) and combustion turbine (CT), were dispatched at approximately 5,600 MW and new wind generators were dispatched at approximately 300 MW in SPP's model. Wind generation levels at existing plants in SPP were increased by approximately 3000 MW to serve load in SPP and support 2000 MW of transfers from SPP to adjacent areas in Arkansas and Louisiana that would be capacity deficient based on the EPA projected retirements. Additionally, wind resources in MISO were increased to provide 2000 MW of transfers from MISO to these same deficient regions in Arkansas and Louisiana.

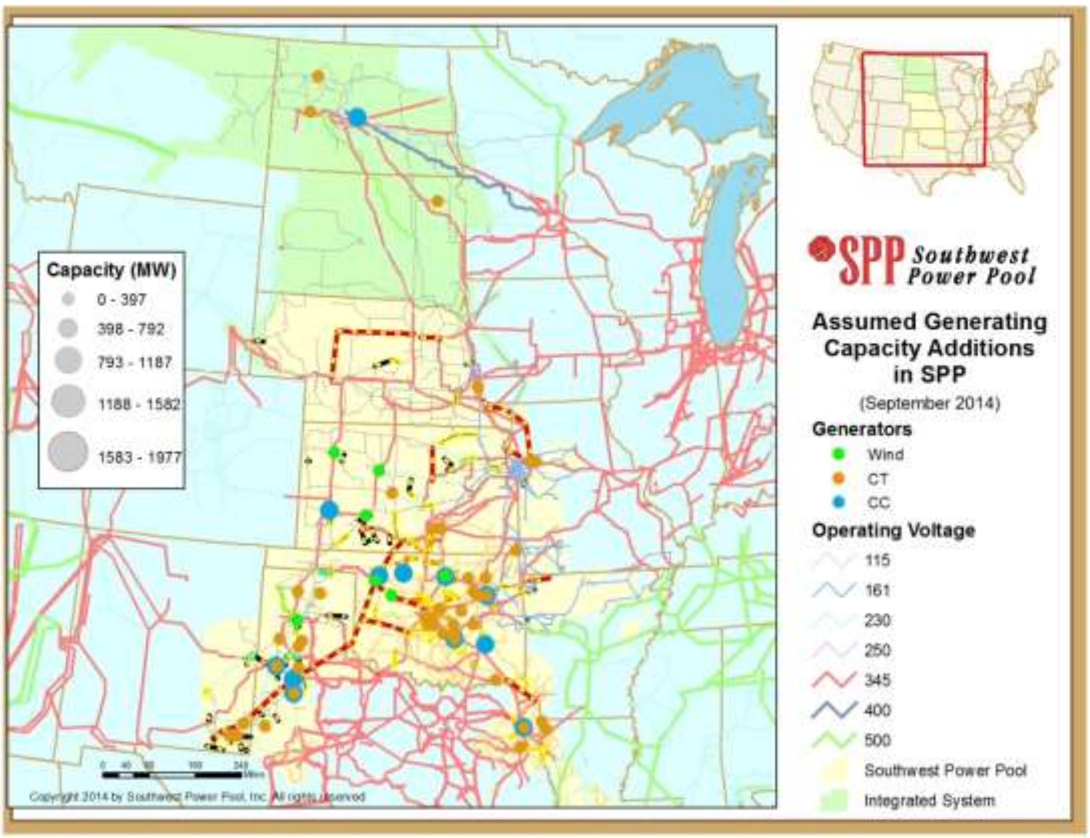

Figure 2: New Generation Capacity Included in Part 2 of the TSIA

TSIA Reliability Findings

Both parts of the TSIA identified significant reliability issues. The issues were not mitigated, but actually increased, despite the optimal generation expansion and conservative assumptions used in Part 2 to address EPA retirements.

TSIA Part 1

Results from the power flow analysis performed in Part 1 of the TSIA were initially indeterminate under both system intact and first contingency conditions. As a result of the assumed EPA retirements with no resource additions, the SPP network was so severely stressed by large reactive deficiencies that the software used in the analysis was unable to produce meaningful results, which is generally indicative of voltage collapse and blackout conditions. In order to enable analytical results, SPP modeled increased reactive limits at remaining generators on the system and was eventually able to achieve analytical results by adding approximately 5,200 MVAR of reactive production to the model during system intact conditions. Because of the arbitrary nature of artificially increasing reactive limits of generators, reliability indicators such as equipment loadings and voltage levels are not accurate and are not presented in this Report. However, this analysis indicates approximately 5,200 MVAR of reactive deficiencies in the SPP footprint during system intact conditions resulting from the modeled EPA generator retirements. Figure 3 shows the reactive power deficiencies within SPP identified by this analysis. The most notable deficiencies were found in Texas and eastern Oklahoma.

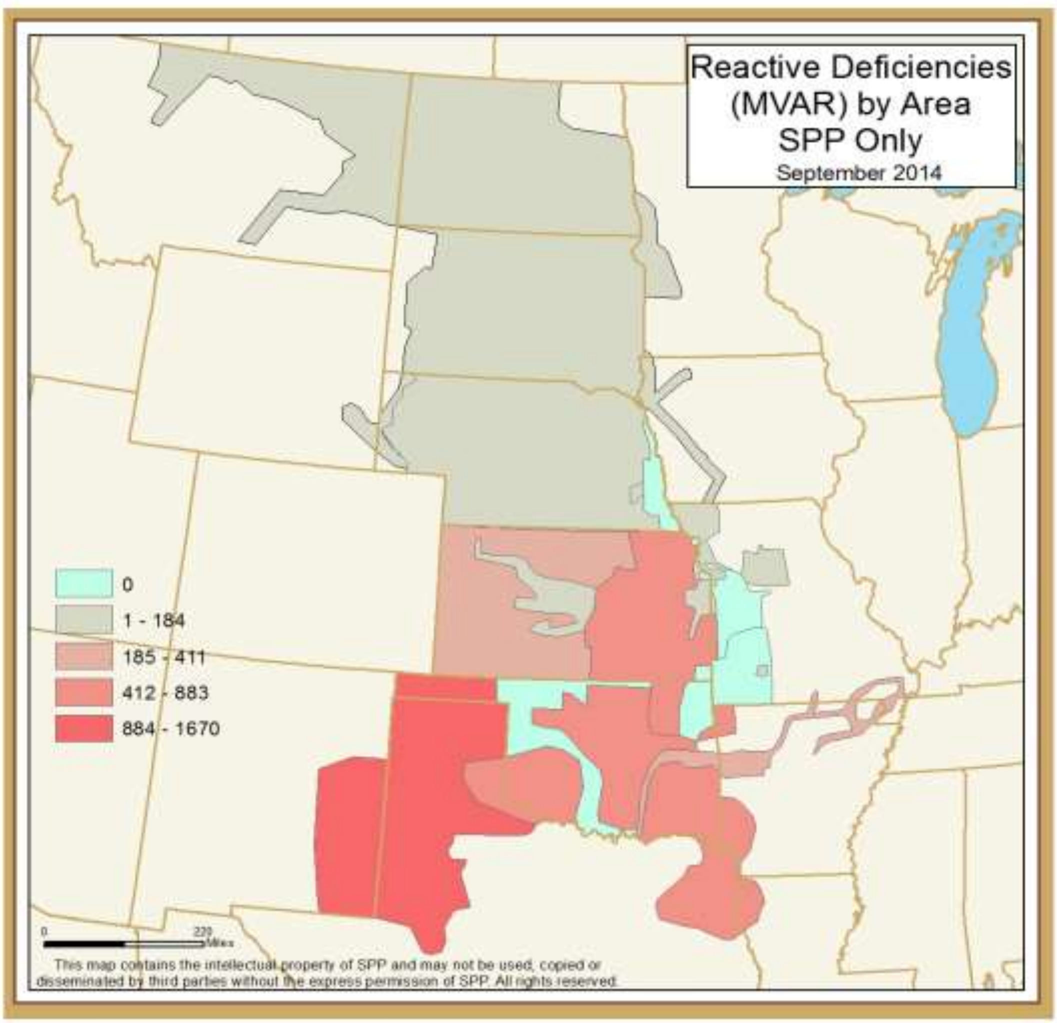

Figure 3: Transmission System Impact Analysis Part 1 - Reactive Deficiencies (MVAR)

TSIA Part 2

Part 2 of the TSIA utilized the latest optimal generation resource plans available to SPP as well as existing wind resources to mitigate generation shortfalls within SPP. Existing wind generation in SPP and the northern part of MISO were increased to serve shortfalls in the southern part of MISO. An N-1 assessment revealed 38 overloaded elements. These overloaded elements were identified in the portions of six states – Arkansas, Kansas, Louisiana, Missouri, Oklahoma, and Texas – that operate within the SPP region. Portions of the system in the Texas panhandle, western Kansas, and northern Arkansas were so severely overloaded that cascading outages and voltage collapse would occur. The following graph (Figure 4) shows the number of overloaded elements and significance of loading expected given the EPA retirements from the proposed CPP and substantial new gas-fired and wind generation additions:

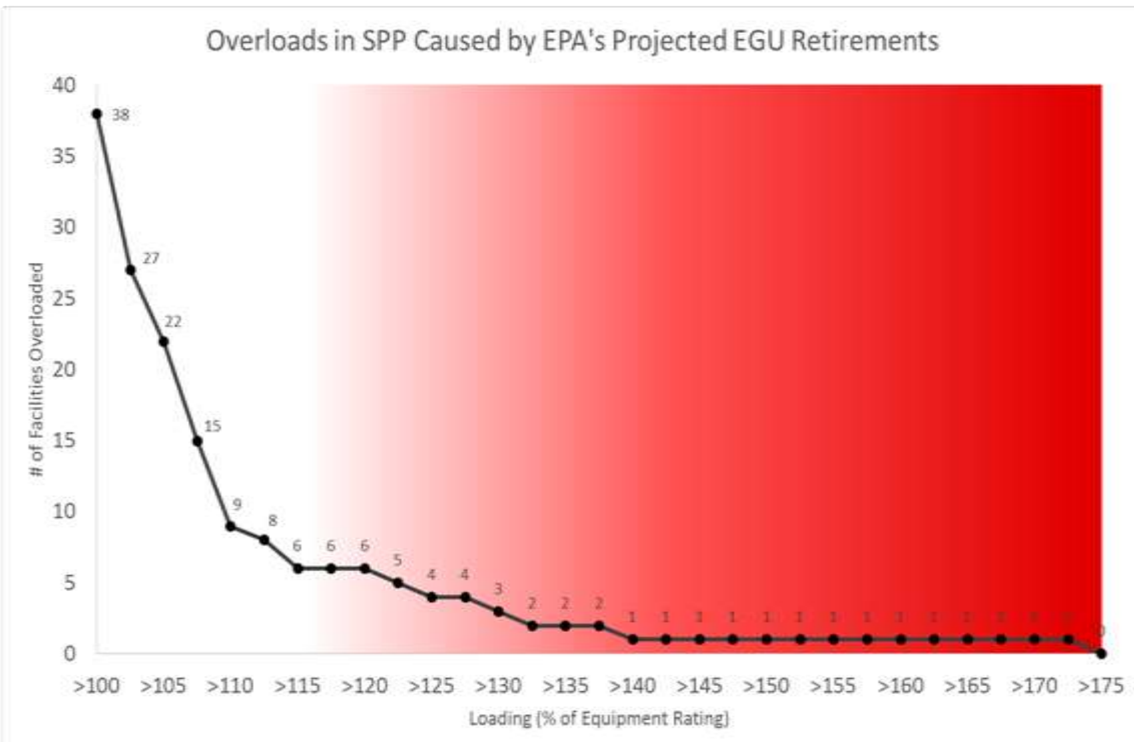

Figure 4: Number of Incremental Overloads in Part 2 of the TSIA

Both parts of the assessment assumed that electric transmission expansion currently planned to meet previously identified needs would be available. It is important to note that the transmission expansion currently planned in SPP does not consider EGU retirements expected as a result of the CPP.

Resource Adequacy Analysis

Resource adequacy is a fundamental requirement for a secure power system and is often measured in terms of reserve margin. The Assessment evaluated the impacts of the projected EGU retirements on SPP's reserve margin. SPP has a minimum reserve margin requirement of 13.6% that every SPP member with load serving responsibilities must plan to meet with appropriate generation capacity. In evaluating the impacts of the projected EGU retirements on SPP's reserve margin, SPP utilized current load forecasts, currently planned generator retirements and additions, as well as the retirements projected by the EPA. The Assessment showed that by 2020, SPP's reserve margin would fall to 4.7%, which is 8.9% below our minimum reserve margin requirement. Out of SPP's fourteen load-serving members impacted by the EPA's projected retirements, nine would be deficient in 2020. Furthermore, SPP found that its anticipated reserve margin would fall to -4.0% in 2024, increasing the number of deficient load serving entities to ten. These anticipated reserve margins represent a generation capacity deficiency of approximately 4.6 GW in 2020 and 10.1 GW in 2024.

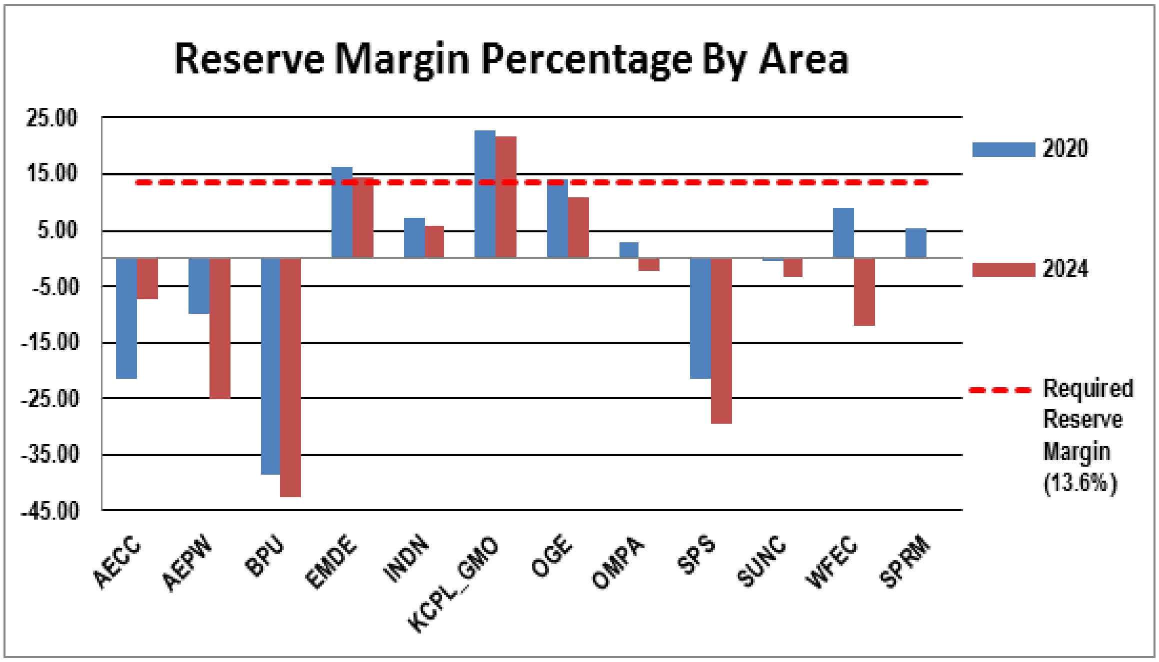

Figure 5: Reserve Margin Percentage by Area

Conclusions

Development of a stable, secure, efficient and effective bulk electric power system takes time. Disruptive changes such as retirements, retrofits and/or changes in the operating characteristics of base load resources, must be considered carefully and communicated clearly in a transparent and open process.

The findings in this Assessment make it very clear that new generation and transmission expansion will be necessary to maintain reliability during summer peak conditions if EPA's projected generator retirements occur. Even the scenario that assumes optimal resource expansion using new natural gas fired resources could be problematic during extreme winter load conditions with gas supply and delivery challenges. This Assessment does not consider outages to accommodate retrofits/cut-ins, time and efforts to get new replacement thermal capacity approved, and in service to offset capacity losses or transmission upgrades to maintain system reliability. More comprehensive planning efforts with stakeholders and new tools/metrics will be required. Unprecedented coordination and cooperation beyond regional planning efforts will be necessary, but may not be timely given significant challenges with interregional planning and necessary system expansion. In addition, broader system assessments of the bulk power system, and natural gas pipeline and storage systems based on environmental constraints will be required.

Implementation of approved state plans will take time, as will potential mitigation measures to address unacceptable system conditions to accommodate retirements, and/or retrofits to existing plants, which are the major resources that drove the design of the current bulk power system. Outages to accommodate cut-ins of new equipment, as well as shifts in the operating characteristics of existing base load units to more seasonal dispatch could have a profound impact on system reliability.