

**Federal Energy Regulatory Commission**

**Denver Regional Technical Conference on  
Environmental Regulations and Electric Reliability,  
Wholesale Electricity Markets, and Energy Infrastructure**

**February 25, 2015**

**Docket No. AD15-4-000**

**Western Interconnection Regional Advisory Body Staff  
Observations on the Reliability Implications of the EPA's Proposed  
Clean Power Plan**

The Federal Energy Regulatory Commission seeks comments on the implications of EPA's proposed Clean Power Plan rule on grid reliability, wholesale markets and operations, and energy infrastructure.

Together with the Western State-Provincial Steering Committee and the Committee for Regional Electricity Power Cooperation, the Western Interconnection Regional Advisory Body (WIRAB)<sup>1</sup> have been deeply involved in analyzing and promoting solutions to the reliability and operational challenges and opportunities posed by the changing mix of generating resources in the West towards more variable renewable generation, more natural gas-fired generation, and fewer coal-fired power plants.<sup>2</sup>

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<sup>1</sup> The Western Interconnection Regional Advisory Body (WIRAB) was created by Western Governors under Section 215 of the Federal Power Act. Members of WIRAB represent the Governors of 14 Western states, the Canadian provinces of Alberta and British Columbia, and Mexico. WIRAB is charged to advise FERC, WECC, and NERC on reliability standards; the governance and budgets of WECC and NERC; and related reliability issues.

<sup>2</sup> Examples of our activities in these areas include: efforts to improve wind and solar forecasting; efforts to evaluate and foster energy imbalance markets; work to evaluate natural gas and electric system interdependencies and to assess the ability of the gas delivery infrastructure in the West to meet future demands; and work with WECC to develop modelling tools to evaluate the ramping requirements associated with high penetrations of variable energy resources and to evaluate the impact of coal-plant retirements on system frequency response and transient stability.

Our observations are from an interconnection-wide perspective. Several Western states (e.g., Arizona and Montana) have indicated that coal plant retirements can result in local frequency and transient stability concerns. WIRAB staff encourages WECC and the Order 1000 Regional Planning Groups in the West to conduct rigorous and transparent studies of potential local reliability issues. FERC should encourage these entities to work with Western states to quickly complete thorough and transparent analyses of these concerns. Similarly, we encourage these entities to consider in their studies the time available under the rule for expansion of natural gas infrastructure.

WIRAB staff offers the following observations on the impact of the proposed 111(d) rule on resource adequacy and grid reliability in the West:<sup>3</sup>

1. The timing of the emission reductions required to meet the EPA's proposed interim goals raise concerns about the pace of infrastructure expansion in the West. As long as EPA allows sufficient time for capacity expansion and the resource pathways for states and utilities are viable, 111(d) does not pose a significant risk to the ability of electric systems in the West to maintain reasonable capacity reserve margins that exceed expected peak demands.

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<sup>3</sup> The views expressed herein in many instances do not reflect the position of the Arizona Corporation Commission with respect to the proposed rule's impact on reliability and other related issues in Arizona.

Many of the general concerns about the draft rule have been about the adequacy of resource supply – such as the loss of generating power plants without adequate time to develop replacement resources.

In the West, resource development is largely driven by utility integrated resource planning rather than markets. Virtually all Western utilities prepare long-term resource plans for meeting their customer's needs. These plans guide when and what kinds of generating and transmission resources are developed to meet customer demand. The goal is to identify the portfolio of resource additions that provide the best combination of cost and risk for ratepayers. The risks considered in these plans include electricity and natural gas price risk, fuel supply risk, and the risk of generation outages. For regulated utilities, these plans are overseen by Western utility commissions.

Western states have offered many specific comments on the EPA's draft rule and the EPA has acknowledged that it will likely adjust its final rule in response to stakeholder comments. For example, EPA in its Notice of Data Availability sought comments on multiple ways to give states more flexibility and make it easier to comply with emission reduction targets for 2020 through 2029 and move toward addressing state concerns about the timing of resource actions. Potential approaches include gradual phase-in of the redispatch of power, credit for early action before 2020, and flexibility on when states can meet the average of targets over the 2020 to 2029 period.

Under the current proposed rule, not all of the states in the West have sufficient time to plan for and develop new generating resources. The experience in the West, however, is that as long as the resource pathways are viable and utilities have sufficient time to plan for and develop necessary replacement resources, the West should experience no traditional resource adequacy problems. Western utilities and state regulators will be able to more accurately evaluate resource adequacy once the final rule is in place. Further resource adequacy analysis by EPA or WECC would be of little or no use because it would not be conducted at a utility level – where resource adequacy decisions are made in the West.

WIRAB staff believes that compliance with the rule could be achieved more reliably and at lower cost through multi-state collaboration. To that end, we are bringing together Western air regulators, commissioners, energy office directors, and Governor’s aides to explore opportunities for multi-state solutions to comply with carbon emission targets.

2. Continued growth of natural gas pipeline infrastructure will be needed in order to meet the incremental demand for natural gas created from retiring or converting coal plants. As long as the EPA allows sufficient time for pipeline expansion, the natural gas infrastructure in the West should be able to meet both the demands of new natural gas-fired electric generators and residential, commercial, and industrial end-users of natural gas.

The Western states and provinces recently commissioned a study on the adequacy of natural gas infrastructure in the Western Interconnection from the perspective of the electric system.<sup>4</sup>

Using a limited number of major contingencies, the study sought answers to such questions as:

- Will there be adequate natural gas infrastructure to meet the needs of the electricity industry in the West over the next 10 years?
- Do current market arrangements provide appropriate signals for expansion?
- Will the gas delivery infrastructure be adequate to meet future demands assuming significant coal plant retirements and significantly more variable generation?

Because of the breadth of scope – both in the geography it addresses and in the questions it seeks to answer – the study used a screening level approach focused on identifying potential vulnerabilities. As such the results are not forecasts, but rather are illustrative of relative and directional impacts.

The consultants developed a High Coal Retirement Case to investigate whether a large and sudden increase in the total volume of natural gas demand by the electric sector will strain the physical capability of the existing pipeline systems in the West. The case modeled the retirement of 22,976 MW of coal plant capacity in the Western Interconnection; a 58% reduction relative to installed capacity in 2010. All of the retired coal capacity was assumed to be replaced with an equivalent amount of natural gas capacity at the same location. To test the vulnerability of the

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<sup>4</sup> “Natural Gas Infrastructure Adequacy in the Western Interconnection: An Electric System Perspective”, Phase 1 Report, provided to the State and Provincial Steering Committee by Energy and Environmental Economics and DNV GL, March 2014.

existing system, no additional natural gas pipeline transportation was assumed to serve this demand. The consultants then assessed natural gas generator curtailment risk and electric system capacity shortfall under 1-in-10 and 1-in-35 extreme winter weather conditions.

As would be expected under these test assumptions, in regions with substantial coal plant retirements, there would be a clear need for continued expansion of natural gas pipeline infrastructure. After calculating the amount of needed pipeline expansion and comparing the rate at which natural gas generating capacity was built out over the past decade to the amount needed to replace the retiring coal generators in this scenario, the consultants concluded that the infrastructure build-out is relatively modest.<sup>5</sup> As long as the EPA allows sufficient time for pipeline expansion, the natural gas infrastructure in the West should be able to meet both the demands of new natural gas generators and residential, commercial, and industrial end-users of natural gas under scenarios with high levels of coal plant retirement.

The report also finds that regional coordination will play a key role in avoiding potential curtailment of gas generation in certain areas. Nowhere is this more clearly illustrated than in the relationship between the Desert Southwest and California. The report found potential curtailment of gas generation in the Desert Southwest under the scenario of a regional heat wave across the entire west (similar to one that occurred in July 2006). The consultants added that coordination with California (e.g., to increase imports from other regions or increase non-gas generation) could relieve the identified constraint.

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<sup>5</sup> The need for additional firm pipeline capacity under the High Coal Retirement Case is 565 MMcf/day in the Desert Southwest, 1,075 MMcf/day in the Great Basin, 236 MMcf/day in the Pacific Northwest-West, and 328 MMcf/day in the Rocky Mountains.

3. Regional coordination between electric system balancing authorities is leading to better use of the flexibility of existing generating resources to meet the ramping and balancing requirements associated with the addition of renewable energy resources. A recent study indicates that it is technically feasible for natural gas pipelines to meet the variable gas demands needed to integrate high penetrations of renewable resources under extreme winter load conditions. The study encourages FERC to continue to explore refinements to the nominations and scheduling process to facilitate gas system operations and to establish reliable communications between gas and electric system operators.

Resource planning in the West is expanding beyond simply addressing whether the installed generating capacity is sufficient to meet expected peak demand plus a reasonable reserve margin and is beginning to address whether the existing generating capacity is sufficiently flexible to meet the expected ramping needs and balancing requirements associated with the large amounts of variable renewable resources being added to the system.

Regional planners and policymakers have learned that the flexible capacity needed to integrate renewable resources is not always located where it is needed the most, and have begun to use Energy Imbalance Markets and coordinated regional dispatch to better use the flexibility inherent in the existing system. The California ISO – PacifiCorp energy imbalance market, the Colorado Front Range joint dispatch agreement, and the on-going consideration in the Northwest of a security constrained economic dispatch agreement are examples of efforts to improve the

operational flexibility of regional power systems by expanding the geographic footprint and resource diversity of the regions.

In some areas of the West, additional quick start natural gas generating capacity may be needed to meet the ramping and balancing requirements associated with high penetrations of renewable resources. The Western states are looking to WECC for analyses of the reliability impacts of high penetrations of renewable resources. WECC needs to quickly develop its analytical abilities to undertake the needed studies.

The Western states and provinces recently commissioned a study of whether the natural gas system will have adequate short-term operational flexibility to meet increased volatility in electric industry natural gas demand due to higher penetrations of variable energy resources in the West.<sup>6</sup> A group of Western pipeline companies and natural gas utilities provided hydraulic modeling and worked closely with the contractors.

The study sought answers to such questions as:

- During which times of the year are pipelines most likely to encounter challenges related to variability in demand?
- Will the intraday variability of electric sector demand for natural gas exceed the physical capability of pipeline systems?

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<sup>6</sup> “Natural Gas Infrastructure Adequacy in the Western Interconnection: An Electric System Perspective”, Phase 2 Report, provided to the State and Provincial Steering Committee by Energy and Environmental Economics and DNV GL, July 2014.



- Is the Western gas system physically capable of operating in such a manner to accommodate large hourly ramps in the demand for natural gas?

The consultants developed a High Renewables Case to investigate these questions. Generation from renewable resources reaches 26% of total WECC-wide generation. Hourly profiles of demand for natural gas from the electric sector were selected from production cost simulations. Winter days that exhibited large ramps in net load were selected. Hourly profiles of demand for natural gas from residential, commercial and industrial customers were based on historical and/or forecast information provided by the participating pipelines. The combined demand profile produced large ramping events in the power sector that occur during the most challenging high demand period in the natural gas sector. The participating pipelines used hydraulic modeling of system operations to test whether their systems could be successfully operated to meet all loads under these extreme conditions.<sup>7</sup>

A key conclusion of the study is that it is technically feasible for natural gas pipelines to meet the variable gas demands needed to integrate high penetrations of renewable resources under extreme winter load conditions. An important lesson learned is that while the addition of renewable resources in the electric sector increases the variability of natural gas demand, it also reduces the overall level of demand. The results of the hydraulic modeling of pipeline system operation indicates that the operational flexibility gained from the decrease in gas demand outweighs the impact of the increased variability.

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<sup>7</sup> Criteria for successful operation included: full recovery of system linepack; all facilities operating with the limits of their capabilities; and no violations of minimum or maximum operating pressures.

4. Our understanding of whether the Western grid will remain reliable as we move to more renewables and natural gas plants and fewer coal-fired plants is incomplete. Recent studies show we should be able to maintain the frequency and transient stability of the system if the resource mix in the West changes significantly but more analysis is needed.

The move to more variable renewable generation and fewer coal plants poses reliability and operational challenges for Western grid operators. For example:

- Will the shutdown of coal-fired generators and the reduction in system inertia create interconnection-wide frequency response problems in the West?
- Will the shutdown of coal-fired generators cause reductions in transmission path transfer capability and congestion on the transmission system?

There have been a few studies to date that have examined these issues. In September, WECC released a white paper that provided a preliminary analysis of the potential impacts of the 111(d) rule. WECC looked at frequency stability under its 2024 “Common Case” – WECC’s forecast of expected loads, generation, and transmission in the Western Interconnection in 2024.

Independent of the 111(d) rule, the WECC common case assumes retirement of about 7,000 megawatts of coal plants in the West by 2024. This business-as-usual load and resource scenario yields sufficient reductions in average emission rates to comply with the EPA’s overall interim emission rate targets for the West as a whole. One of WECC’s preliminary findings was that “removing 7,000 megawatts of coal and replacing it with “non-responsive generation does not compromise system frequency response” in response to a large contingency. At the same time, the WECC study did not look into local frequency response issues nor does its resource mix

necessarily reflect what individual Western states would do to meet the interim emission rate targets for each state.

In December 2014, the National Renewable Energy Laboratory (“NREL”) released Phase 3 of its Western Wind and Solar Integration Study, titled “Western Frequency Response and Transient Stability Study.” The study looked at the large-scale frequency response and transient stability of the Western Interconnection under high wind and solar resource penetrations and reduced coal generation. The study found that “System-wide transient stability can be maintained with high levels of wind and solar if local issues are addressed with traditional transmission system reinforcements. Then, an 80 percent reduction in coal plant commitments results in acceptable transient stability performance.” The study drew similar conclusions for frequency response. At the same time, the report cautioned that good system planning and power system engineering practices must be followed and that more analysis is needed.

WIRAB staff believes that more analysis is needed to confirm these findings. The Western states are looking to WECC for analyses of the reliability impacts of potential 111(d) compliance strategies. WECC needs to develop its analytical abilities quickly to undertake such studies. The Western states and provinces are partially funding the development of a tool to evaluate what capability is necessary to handle large ramps caused by high penetrations of variable generation to avoid violating NERC control performance standards. In addition, WECC needs to develop tools to analyze system frequency response and transient voltage stability under high renewable/low coal scenarios. Further, WECC needs to provide timely integrated production and powerflow analyses (“roundtrip” analyses). FERC should urge WECC, in collaboration with

Order 1000 Regional Planning Groups, to develop the tools it needs and expeditiously conduct necessary reliability analyses.

Until WECC and NERC have completed thorough and transparent analyses, FERC should draw no conclusion regarding the system reliability implications of the Clean Power Plan.

5. Regardless of the 111(d) rule, the resource mix in the West is changing. The changing mix poses both reliability and operational challenges and opportunities that should be thoroughly studied and acted upon.

The West is moving to an energy landscape that features far more variable renewable energy generation, more distribution generation, more storage and demand response, more natural gas generation, and less coal-fired generation.<sup>8</sup> Regardless of the 111(d) rule, we must continue to pursue and enact reforms to increase system flexibility at the lowest cost, maximize the capacity and capacity utilization of the grid, and invest in technologies and mitigation measures that will enhance the reliability of the Western grid.

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<sup>8</sup> Note that WECC's 2024 Common Case load and resource expectations for the region would comply with EPA's emission rate targets for the West as a whole.

Submitted on February 20, 2015.

A handwritten signature in black ink, appearing to read "Maury Galbraith", with a long horizontal flourish extending to the right.

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