June 18, 2018

Honorable Steven E. Winberg
Assistant Secretary
Office of Fossil Energy
U.S. Department of Energy
1000 Independence Avenue SW
Washington, DC 20585

Attn: Request for Information DE-FOA-0001937

Re: Improving Efficiency, Reliability, and Flexibility of Existing Coal-Based Power Plants

Comments submitted electronically to DE-FOA-0001937@netl.doe.gov

The American Coal Council ("ACC") appreciates the opportunity to respond to the request for information ("RFI") issued on May 23, 2018 by the U.S Department of Energy's ("DOE") Office of Fossil Energy ("FE") regarding "Improving Efficiency, Reliability, and Flexibility of Existing Coal-Based Power Plants".

Interests of the American Coal Council

The American Coal Council has been in existence for 36 years and represents the collective business interests of the American coal industry. Our members include mining companies and suppliers, transportation companies and terminals, electric utilities and independent power producers, industrial coal consumers, and many industry support services providers. ACC's member companies touch every aspect of turning one of America's most abundant resources into reliable and affordable electricity for the United States economy. Our diverse membership base encompasses the entire coal supply chain, and it is from this broad perspective that we assess the impacts of new initiatives, programs, policies, and regulations impacting coal supply and use. The continued use of coal as part of an "all of the above" energy policy and strategy is important to our members and to America's energy, economic, and national security.

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ACC commends the Office of Fossil Energy for issuing this RFI to solicit stakeholder input to support DOE's research and technology development objectives including the advancement of coal-fired power plants that provide stable power generation with operational flexibility, high efficiency, and low emissions.

This is particularly relevant because of the continuing evolution of the electricity business which is occurring as a result of many factors. Among them are energy efficiency programs and changes in end-use customer behavior; a changing mix of generation sources with more natural gas plants and an increase in less efficient, intermittent wind and solar resources enabled by federal subsidies and state renewables mandates; and the burdens of additional regulations that have increased the cost of coal for electricity generation and industrial use, made coal less competitive against other fuels, and resulted in the closure of a large number of coal plants.

Preserving coal as a key element of power sector resource diversity protects U.S. consumers, provides energy security, and safeguards national security. Continued adaptation of coal power plants to the operating characteristics of other generation resources will have benefits including enhancing the future reliability and resilience of the bulk power system.

ACC's stakeholder input is intended to underscore the importance of DOE's efforts in this research and development area. The sections below provide context and background information and a brief discussion of technology aspects.

Coal Plant Closures; Increasingly Important Reliability & Resilience Attributes

In the RFI background section, FE describes the increased integration of variable energy resources (VER) into the bulk power system and the need for other assets to accommodate their intermittent, non-dispatchable characteristics. Assets that were traditionally run in baseload mode are now being operated for load-following purposes or to back up such resources. Thus, coal plants are encountering "sub-optimal" operating conditions that are leading to decreased overall efficiency, and per FE are

expected to become less reliable with increased risk of unplanned outages if subjected to "prolonged and rapid cycling".

FE notes operational flexibility is becoming increasingly important. ACC in turn notes that adapting the existing coal fleet is becoming increasingly important, especially considering the shrinking size of the U.S. coal fleet and the important objectives of maintaining energy diversity and security.

Announced power sector coal retirements in the U.S. currently total nearly 115,000 MW (628 generating units).[1] Approximately 68,000 MW of coal capacity has already retired and another 25,000 MW is expected to be shut down between 2018 and 2020.[2] Much of this is attributable to previously-enacted regulations and prior environmental policies. Coal generation is also pressured by current low natural gas prices and the continued building and use of less-efficient wind and solar sources due to the extension of federal subsidies.

There is abundant and increasing evidence of coal's importance to grid resilience and reliability.

Most recently, in late May the North American Electric Reliability Corporation ("NERC") released its summer reliability assessment. This highlighted operational challenges and reliability concerns NERC foresees this summer for California and Texas.[3] The 2015 Aliso Canyon gas storage leak and ongoing storage constraints there continue to affect availability of natural gas in southern California. NERC's Texas analysis looked at typical maintenance or forced outages, extreme forced outages, extreme weather, and a low-wind scenario and found with any one of these situations the state would fall below its operating reserve margin this summer.[4] ACC notes that California's move away from coal and increasing use of natural gas and renewables has reduced fuel diversity and options for electricity providers. In Texas, over 4,000 MW of coal generating capacity was shut down earlier this year.

A report this spring by the DOE's National Energy Technology Laboratory ("NETL") on this winter's "Bomb Cyclone" showed that coal was the most resilient form of power generation across six electricity market regions during this severe weather period. Of the contributions by various assets to meet the surge in demand, coal accounted for more than 55% of the incremental daily generation needed to keep the lights on and avoid electricity shortages. Availability of coal plants in reserve and their on-site fuel inventories made this response possible.

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[1] American Coalition of Clean Coal Electricity, "Retirement of U.S. Coal-Fired Electric Generating Units", May 1, 2018.
[2] *Ibid.*
[3] North American Electric Reliability Corporation, "2018 Summer Reliability Assessment, May 30, 2018.
[4] *Ibid.*

In PJM, which serves 65 million people including in the mid-Atlantic and Midwest, the value of resilience during the Bomb Cyclone was estimated at $3.5 billion by NETL.

Aging Coal Plant Considerations

The DOE NETL report assessed the impact of an aging coal fleet and oncoming retirements. NETL reported announced U.S. coal retirements at 31 GW through 2025 and EIA-projected retirements at 41 GW by 2025. However, NETL suggested EIA's assumed coal capacity factor at 72 percent is unrealistically high due to the age of the fleet, detrimental impacts of running plants more in cycling mode, and New Source Review barriers to investments in the fleet. NETL cautioned the actual coal retirements might be far higher, perhaps as much as 76 GW by 2025.

New Source Review Reform Needed

Developing technologies for improving coal plants will hold more promise if the New Source Review ("NSR") barrier can be overcome. If an equipment modification or upgrade project is considered likely to trigger NSR under the existing Environmental Protection Agency program and enforcement, such a project would unlikely even be considered for investment due to the associated time, cost, and uncertainly of the outcome of the NSR review. Reform of the NSR program must occur so that the electric power sector can confidently plan for installation and implementation of projects or measures to improve efficiency and emissions. ACC is encouraged by the attention being given to NSR program reform by EPA and Congress and requests DOE's involvement to overcome this longstanding barrier.

Technology Considerations for Coal Plant Efficiency Improvements

At the request of Secretary of Energy Ernest Moniz in 2014, the National Coal Council ("NCC") undertook a study of the U.S. coal generating fleet to assess measures that could enhance its capacity, efficiency, and emissions profile through the application of new technology. The "Polar Vortex" occurred in early 2014 and the NCC report and many others discussed the critical role of coal in meeting electricity demand and mitigating problems that occurred with natural gas availability, deliverability, and spiking prices. The NCC report discussed technology challenges and opportunities, most of which are the same today because the fleet is virtually the same – except that many more coal units have been retired. As the Polar Vortex did in 2014, the Bomb Cyclone of 2018 showed the contributions and resilience of the coal fleet. The continuing and accelerating pace of retirements is cause for even greater concern now, and that concern is cause for action. We commend Energy Secretary Perry's efforts to address grid reliability and resilience.

The potential efficiency improvements identified in the NCC 2014 report[5] include:

- Moisture reduction in low-rank coals using waste heat
- Boiler and steam conditions
- Steam turbine and condenser upgrades
- Process instrumentation and controls
- Enhanced boiler tube coatings
- Low temperature heat recovery
- Auxiliary power consumption
- Cooling system design improvements
- Changing plant thermodynamics
- Topping and bottoming cycles
- Alkali injection to reduce fouling

The NCC's 2014 report recommendations for efficiency improvements[6] were:

- The private sector should work to develop improved fuel drying heat exchangers for use with high moisture fuels, such as PRB subbituminous coal and lignite.
- The private sector should continue work to develop tube coatings to enhance heat transfer, use alkali injection to reduce SO3 in flue gas and enable greater heat recovery from air heaters, develop non-metallic heat exchangers for recovering low temperature heat, and extend neural network technologies into next-generation sensors and software. An R&D campaign needs to be undertaken to demonstrate the effectiveness and reliability of deploying these actions into commercial plants.
- DOE should lead a collaborative effort with industry to design next-generation steam condensers, using state-of-art materials that resist fouling and corrosion; develop advanced, enhanced heat transfer materials and material coatings; develop improved cooling tower pack materials; and revisit chemical coal cleaning processes developed in the 1980s (in light of multiple benefits to efficiency, reliability, and emission control).
- DOE should lead a long-term (10 year) collaborative effort with industry to integrate topping and bottoming cycles with existing power plant designs in order to substantially increase the efficiency of existing power plants.
- DOE should work with EPA to find a way to deploy changes at existing coal-fired power plants that would result in higher fleet efficiency, including adding heat

[5] National Coal Council, "Reliable & Resilient: The Value of Our Existing Coal Fleet", Fact Sheet on Enhancing Efficiency of Power Generation from the Existing Coal Fleet, May 2014.

[6] National Coal Council, "Reliable & Resilient: The Value of Our Existing Coal Fleet", May 2014, p. 72.

exchanger surface in the boiler, improving steam paths, providing better heat rejection, and in the long-term the use of topping and bottoming cycles, without imposing new emission reduction requirements due to the change.

ACC appreciates that some of these recommendations are beginning to be addressed, including with this RFI.

Technology Considerations for Coal Plant Reliability and Flexibility

Operating coal plants with more flexibility than their original design presents challenges to managing costs, efficiency, emissions, and reliability. Increased startups, shutdowns, and ramping add operational stress and can increase the risk of outages.

The recommendations of the NCC 2014 report for improving coal plant reliability[7] under these increasingly common flexible operating conditions include:

- DOE should lead a collaborative effort with industry to develop improved assessment tools in several areas, including: damage mechanisms, costs and reliability changes associated with cycling and fuel changes; remaining life assessment for cycled units; and asset management tools.
- DOE should lead collaborative efforts in the areas of materials development (higher strength alloys allowing thinner components), fabrication (powdered metallurgy), welding techniques and evaluation of remaining life.
- DOE should lead collaborative efforts to develop improved sensors and control systems to automate flexible operation, detect maintenance issues associated with flexible operation, evaluate extreme environments and measure trace concentrations of toxic pollutants. Improved non-destructive evaluation techniques to test components should also be developed.
- DOE should lead collaborative efforts to develop improved “best practices” approaches to operating coal-fired power plants under cycling conditions and ramping conditions, including steam pressure management and maintaining proper water chemistry. Workforce training is needed in these new techniques.
- DOE should lead collaborative R&D regarding the impact of cycling and use of off-specification coals on environmental control systems, including cooling systems, SCRs operating at low load (improved catalysts), treatment of FGD effluent, wastewater treatment, landfill operation and leachate collection/treatment and HAPs controls.

[7] National Coal Council, “Reliable & Resilient: The Value of Our Existing Coal Fleet”, May 2014, p. 55.

- DOE should lead a collaborative effort with industry to investigate the potential for coal pre-treatment to improve operating flexibility and efficiency, as well as to reduce emissions.

Conclusion

The American Coal Council appreciates the opportunity to offer this stakeholder input to DOE's Office of Fossil Energy. With about one-third of the U.S. coal fleet that existed less than ten years ago planned to retire by 2020, it is critical to retain and maintain our remaining coal plants to support bulk power system reliability and resilience. Cost-effective technology solutions are needed for the continued adaptation of the coal fleet to the changing mix of generation resources brought about by the combination of electricity policies, regulations and markets. Preserving coal as a key element of power sector resource diversity protects U.S. consumers, provides energy security, and safeguards national security.