Resilience Finally Debuts in Electricity Markets and Raises 2018 Questions

By Thomas Russo

Back in May 2015, I presented a paper[1] in Houston on the resilience of natural gas and oil pipelines and their relationship to the power sector. The audience was polite, but few people were interested in resilience. How things have changed!

Secretary of Energy Rick Perry's use of the term "resilience" has created havoc and dismay over compensating coal- and nuclear-fired power plants to participate in energy markets. The resilience genie is out of the bottle and it remains to be seen whether coal, nuclear, or other power plants will be compensated as proposed by the secretary. Nevertheless, future discussions in electricity circles are sure to go beyond electric reliability and include robust discussions of resilience.

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MEANING OF RESILIENCY

My view was that sooner or later, energy projects would be attacked or go down for a variety of reasons. That was a given, but what really matters is how resilient they are or how quickly they would be able to resume operations.

While the Federal Energy Regulatory Commission (FERC) staff has asked for definitions of resilience from stakeholders, the United States and the United Kingdom already defined it pretty well years ago (Exhibit 1). I prefer the definition in the UK document "Keeping the Country Running", more for its simplicity and getting past all the noise of a notice and comment hearing at FERC.

It's better to spend time determining if resilience has value to begin with. If it does, then we should be determining which power plants, be they coal, nuclear, or other power facilities and technologies, can provide resilience for the grid, and how much to compensate owners for it.

RELIABILITY RELATED TO RESILIENCE, BUT NOT SAME THING

The North American Electric Reliability Corporation (NERC) defines a reliable bulk-power system as one that is able to meet the electricity needs of end-use customers even when unexpected equipment failures or other factors reduce the amount of available electricity. NERC divides reliability into two categories:

1. Adequacy: Adequacy means having sufficient resources to provide customers with a continuous supply of electricity at the proper voltage and frequency, virtually all of the time. Resources refer to a combination of electricity-generating and transmission facilities that produce and deliver electricity and demand-response programs that reduce customer demand for electricity. Maintaining adequacy requires that system operators and planners take into account scheduled and reasonably expected unscheduled outages of equipment while maintaining a constant balance between supply and demand.

2. Security: For decades, NERC and the bulk power industry defined system security as the ability of the bulk power system to withstand sudden, unexpected disturbances, such as short circuits or unanticipated loss of system elements due to natural causes. In today's world, the security focus of NERC and the industry has expanded to include withstanding disturbances caused by manmade physical or cyber attacks. The bulk power system must be planned, designed, built, and operated in a manner that takes into account these modern threats, as well as more traditional risks to security.

- "To withstand and recover rapidly from disruptions— including from deliberate attacks or naturally occurring threats or incidents." U.S. Presidential Policy Directive 21 February 12, 2013 (DHS.gov: Homeland Security Presidential Directive 7: Critical Infrastructure Identification, Prioritization, and Protection).
- "The ability of assets, networks and systems to anticipate, absorb, adapt to and/or rapidly recover from a disruptive event" (Cabinet Office, UK, "Keeping the Country Running: Natural Hazards & Infrastructure," October 21, 2011).
- "Resilience—the ability of a nation, system or institution to adapt to changing contexts, to withstand shocks, and to quickly recover or adapt to a desired level of stability, while preserving the continuity of critical infrastructure" ("Digitalization and Energy," http:// www.iea.org/digital/).

Exhibit 1. Definitions of Resilience

MEASURING RESILIENCE

NERC's definitions are good starting points for distinguishing resilience from reliability.

But I believe that the significant difference is how quickly a power plant or system can recover and provide those services that electric customers are depending on, as opposed to withstanding an outage.

Looking at actual operating histories of coal and nuclear plants and other plants should shed a great deal of light on their resilience. In the interim, we can look at the operating characteristics of various dispatchable power technologies. This approach is not perfect, but at least it provides insight on how long different types of power plants need to resume full operations from a hot, warm, and cold start-up mode (Exhibit 2).

	Nuclear power plant[a]	New coal-fired plant[b]	Combined cycle plant Siemens F-class	Siemens H-class
Hot start-up (time taken to start-up following shut-down lasting <8 h)	60-120 min[c]	80-150 min	30-60 min (potential for <30 min depending on customer)	
Warm start-up (time taken to start-up following shut-down lasting <48 h)	2-3 h[c]	3-5 h	1-1.5 h (potential for <50 min depending on customer requirements/ configuration)	
Cold start-up (time taken to start-up following shut-down lasting <120 h)	15-20 h	5-10 h	2-3 h depending on customer requirements/configuration	
Start-up reliability (%)	Not relevant[d]	87-93% depending on supplier/configuration	95-99% depending on supplier/configuration	

Notes and sources:
a. AREVA corporate communication 2010.
b. Experience feedback from start-up of coal fired power plants (Paiton, Kogan Creek).
c. In the event of planned shutdown and subsequent restart from the hot subcritical condition, otherwise restrictions due to need to adjust reactivity control to account for xenon concentration
d. Not relevant since usually only a few start-ups per year.

Source: Balling, L. (2010, December). Flexible future for combined cycle. *Modern Power Systems, 30*, 61–63.

Exhibit 2. Start-up Characteristics of Nuclear- and Fossil-Fired Power Plants

Coal and nuclear do not respond as quickly as gas-fired combined-cycle plants based on Exhibit 2 data. However, the data in Exhibit 2 may not reflect advances made during the last seven years by Siemens and other power equipment vendors.

IS RESILIENCE CODE FOR ENERGY SECURITY?

The International Energy Agency (IEA) uses a tool called the Model of Short-Term Energy Security (MOSES) to take a systematic look at a country's energy security. MOSES looks at threats, vulnerabilities, and risk and also at resilience—a country's capacity to deal with different types of disruptions. MOSES is well-developed for oil, natural gas, and other fuels, and relies quite a bit on infrastructure and the number of fuel suppliers to mitigate threats to fuel security. Unfortunately, analyses of power generation and electricity are still under development at the IEA.2 (See Exhibit 3.)

Nevertheless, MOSES could shed some light on coal and natural gas, which are currently competing fuels in the electric sector.

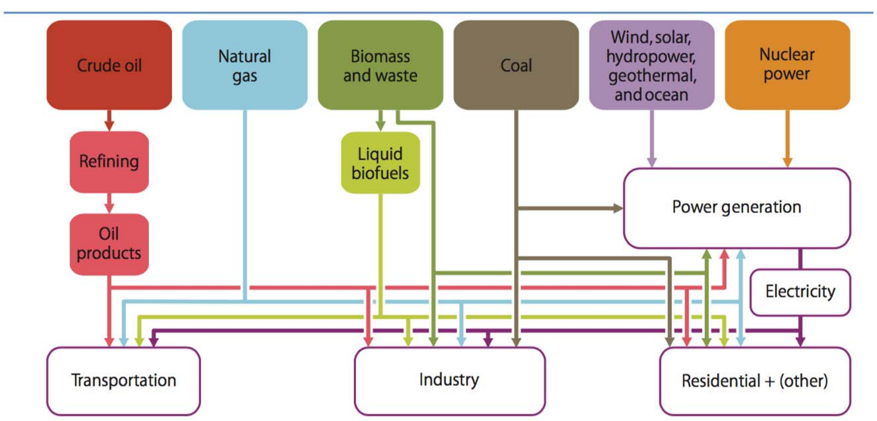

Exhibit 3. MOSES Uses and Energy Systems Approach in Evaluating Energy Security

DO THE STATES HAVE A ROLE TO PLAY?

Thirty-eight states have mandatory renewable energy portfolio standards (RPSs), which, together with the renewable energy production tax credit and other incentives, have seen wind and solar project growth rates climb.

As FERC and the organized electricity markets analyze the secretary's proposal, perhaps more states may want to have a say in matters of resilience and want to incent or require electric utilities to promote resilience in the form of mandatory resiliency standards. There are many reasons for this desire, and all are somewhat related to the cost of natural gas and how states with growing levels of renewables are dealing with increased evening ramp.

Abundant and low-cost natural gas has allowed the states, regions, and organized electricity markets to respond to steep evening ramp-ups with gas-fired power generators and peaking hydropower plants. The cost of doing this has been minimal to electric customers given the low cost of natural gas. However, increased exports of pipeline natural gas to Mexico and greater demand for liquefied natural gas (LNG) from global markets may see prices increase.

Demand for natural gas will increase as the Cove Point LNG export terminal begins operation by year-end and as Freeport, Corpus Christi, and the Cameron LNG export terminal begin operations in 2018.

COAL AND NATURAL GAS PRICE COMPETITION

Coal has had a difficult time competing with natural gas as power plant fuel. However, the rates charged to transport coal and natural gas have to be taken into account when power plant operators compare the delivered costs of each fuel to a power plant.

Natural gas pipeline companies and the gas industry openly acknowledge that the power sector is an important to the growth of natural gas. As such, FERC ensures that natural gas pipeline rates are just and reasonable and that transportation of natural gas is priced accordingly. The same cannot be said of coal transportation.

Coal transportation by railroad is competing with intermodal container shipments. The latter is an important growth area for the railroads. In 2014, agricultural and coal producers were complaining about excessive delays in moving coal and agricultural goods to market. Back then, the rails were doing a brisk business in moving crude oil from North Dakota and responding to increased domestic intermodal container growth. Bad weather also played a part in the delays of agricultural and coal shipments. The latter caused the Surface Transportation Board to take action, and FERC held a hearing as well.

By one published report,3 the railroads are responsible for more of the delivered coal costs than coal producers. Despite efficient coal production from the mines, the higher rates to transport steam coal from the Powder River Basin to the Southwest and Midwest have made it very difficult for coal to compete with natural gas in those areas.

The railroads' response to the severe decline in coal production and consumption during the 2008–2016 time period has also been surprising and instructive. The four major railroads that originate U.S. coal are Burlington Northern Santa Fe (BNSF) and Union Pacific (UP) in the West and CSX Transportation (CSX) and Norfolk Southern (NS) in the East and Midwest.

In the West, UP and BNSF both originate Powder River Basin coals. Most of these coals move long distances at rates that are high relative to the cost of the coals. While mine prices may range from $8–$12 per ton, the rail rates can easily run $25–30 per ton for movements to the Southwest and Midwest. It's also important to note that the railroads did cut rates on coking coal, which is used to produce steel, but despite problems with steam coal and natural gas competition, the rails chose to maintain their profit margins and not reduce rates. Had there been some rate relief, coal-fired generation may have been better able to compete despite the effects of the Environmental Protection Agency's Mercury and Air Toxics regulations and the Clean Power Plan.

Nevertheless, it is not too late for the Surface Transportation Board, which regulates railroads and rates, to take a hard look at coal freight rates and determine if they are just and reasonable.

PROPOSED RULE MAY TRIGGER THE NATIONAL ENVIRONMENTAL POLICY ACT

I believe that the proposed rule envisioned by the secretary of energy and any temporary action approved by FERC to compensate coal-fired power plants to operate would constitute a major federal action affecting the human environment. FERC would have to prepare an environmental impact statement (EIS) that addresses carbon dioxide emission of the anticipated retirements of coal and nuclear plants as well as replacement generation. DOE's staff4 report anticipates that approximately 12,700 megawatts of coal generation will retire through 2020. While the EIA reports that eight reactors representing 7,167 megawatts of nuclear capacity that have announced retirement plans since 20165 before making such a decision. I base my conclusion on the following.

Richard J. Pierce Jr., the Lyle T. Alverson Professor of Law at The George Washington University and a well-known figure in the electric industry, asserted in comments to FERC that the rule would increase dramatically the emissions of carbon dioxide.6 Professor Pierce points out that the Supreme Court has held that carbon dioxide is a pollutant in Massachusetts v. EPA7 and that subsequent courts have upheld that decision.

He also cites a recent decision on three proposed interstate natural gas pipelines collectively known as the Southeast Markets Pipelines pending before FERC. The U.S. District Court decision required FERC to do a greenhouse gas (GHG) analysis and calculation on emissions at the existing and new Florida power plants receiving natural gas from the Southeast Markets Pipeline-Sabal Trail, Hilabee Expansion, and NextEra's Florida Southeast Connection in Sierra Club v. FERC.8 FERC recently complied with the court by analyzing the carbon dioxide emissions. Professor Pierce concludes that the secretary of energy's proposal would have far greater effects on emissions of carbon dioxide than would the authorization to construct three natural gas pipelines and that FERC can take no action of the type urged by the secretary without first preparing an EIS.

FERC normally does not prepare National Environmental Policy Act (NEPA) documents on proposed rulemakings that affect tariff changes. The commission usually concludes in rulemaking orders that neither an environmental assessment nor an environmental impact statement is required under Section 380.4(a)(15) of the commission's regulations. FERC relies on a categorical exemption for approval of actions under Sections 205 and 206 of the Federal Power Act relating to the filing of schedules containing all rates and charges for the transmission or sale subject to the commission's jurisdiction. This includes the classification, practices, contracts, and regulations that affect rates, charges, classifications, and services.[9]

I think that FERC's argument may not be persuasive when challenged in court. Any rule issued by FERC would be targeting coal plants with a 90-day supply of fuel. Also, any temporary compensatory measures to keep coal power plants running while FERC works on a long-term rule will be problematic. In each scenario, the names and locations of the coal plants would be known, and FERC would have no problem assessing the impacts on carbon dioxide emissions from allowing these plants to continue to operate.

Such a NEPA review required by a court might have consequences well beyond the secretary of energy's proposed rule. It may open Pandora's Box and subject FERC's natural gas and hydropower programs to broader NEPA reviews. For example, the courts might find it necessary to require FERC to conduct an upstream analysis that would factor in the drilling and fracking of source gas for proposed natural gas pipelines.

Footnotes

[1] Russo, T. (2015, May 13–15). *Oil and gas infrastructure resiliency*. Presented at the North America Oil & Gas Cybersecurity Conference.

[2] Jewell, J. (2011). *The IEA model of short-term energy security* (MOSES). Paris: OECD/IEA.

[3] Repsher, M., Heller, J., Mann, C., & Gaalaas, T. (2017). *The future of coal versus gas competition*. Retrieved from http://www.paconsulting. com/insights/the-future-of-coal-versus-gas-competition/.

[4] U.S. Department of Energy. (2017, August). *Staff report to the secretary on electricity markets and reliability.* DOE staff report. Washington, DC: Author.

[5] U.S. Energy Information Administration (EIA). (2017, June). *Monthly update to the annual electric generator report.* Form EIA- 860m. Washington, DC: Author.

[6] See Richard J. Pierce Jr. comment on secretary of energy proposal in Docket no. RM18-1-000. Retrieved from https://elibrary. ferc.gov/idmws/common/opennat.asp?fileID=14702680.

[7] 549 U.S. 497 (2007).

[8] 867 F.3d 1357 (D.C. Cir. 2017).

[9] *Regulations Implementing the National Environmental Policy Act,* Order No. 486, 52 FR 47897 (Dec. 17, 1987), FERC Stats. & Regs. ¶ 30,783 (1987).