POWER PLANTS

Preparing for Long Life
or the Afterlife

THE STORY IN BRIEF

With changing generation economics and the adoption of new environmental regulations, many power companies are facing tough choices about what to do with their aging coal-fired power plants. EPRI is conducting new research to help electric utilities make these complex decisions.

In January, Ohio-based power producer FirstEnergy announced that it would shutter six aging coal-fired power plants. The company said that bringing the plants into compliance with new environmental regulations, such as the U.S. Environmental Protection Agency's recently finalized mercury and air pollution rules, would be too costly.

FirstEnergy isn't alone. In the coming decade, many utilities will make tough decisions regarding their aging coal plants. "Power companies are facing pressures to consider the viability of these older plants," said Jeffrey Clock, a senior project manager in EPRI's Environment Sector. "Coal prices keep going up and gas prices keep coming down." What's more, new emission control requirements will drive up costs.

For a power plant, the lifespan is not always easy to foresee, and some plants may even have an "afterlife." The Pratt Street Power Plant, constructed in the early 1900s to run Baltimore's rail system, now houses restaurants, bars, and a bookstore. The building is a Baltimore tourist attraction, bringing new energy to the city's much-visited Inner Harbor.

Beyond bookstores or bars, the possibilities are many. Some plants will be torn down, while others may enter the afterlife to be sold, temporarily mothballed, or repowered. EPRI research is providing information that can be used to evaluate options and navigate the technical challenges that arise when a plant must be demolished or retooled.

Tough Choices

Revis James heads EPRI's Fleet Transition Initiative, launched in 2011 to provide members with insights and tools to help them decide how best to manage their generation fleets. A director in EPRI's Generation Sector, he has thought a lot about the factors that affect the viability of coal-fired power plants. Although EPRI has a great deal of experience addressing technology questions, research addressing fleet management is "a new area for us," James said.

For any business, economics is the driving factor. But determining a plant's economic viability is a complex calculation with many variables. For example, utilities need to examine the cost of coal compared with other fuels. "Because the world is electrifying quite quickly, there've been more and more exports of coal from the United States to other places," James said. That drives coal costs up. Natural gas, however, has remained relatively cheap.

Company executives also have to consider a plant's capabilities. Many older coal plants were designed to operate more or less continuously as "baseload" power generators. But with growing reliance on renewable energy sources such as wind, systems are having to become more flexible. When the wind stops blowing, power producers need to ramp up other generation units quickly to meet demand. Many older coal plants aren't able to respond rapidly. Those that can might require more maintenance than they would if they were run continuously, and such "cycling" operation can reduce a plant's efficiency.

Power companies must think beyond whether a plant is economically viable in today's market, factoring in future electricity demand and fuel costs as well. For example, if natural gas prices are projected to remain low, a coal plant that is only sporadically competitive may not be worth saving. However, if gas prices are expected to rise, a company may decide to mothball a plant, bringing it back on line when fuel prices warrant. Similarly, if future regulations are likely to make it more difficult to site, build, or finance new power plants, holding on to existing plants may be the more attractive option.

While mothballing a plant for years or even a decade can be costly, it may be less expensive than demolishing the existing structure and building a new plant in the future. "The mothballing costs have to be measured against future economic conditions and against the alternative of replacing the plant," James said.

Capability and balance across the fleet is another consideration. Electricity demand fluctuates by time of day and season, with daily peaks and valleys. If a company expects higher peaks or lower valleys, that could affect which plants are—or will be—economically viable. Just as hardware stores stock up on snow shovels in the winter, power companies may want to stock certain assets so they can provide solid baseload capacity but also serve peak demand in particular seasons. They can't close too many plant because they need to be able to keep up with demand. "Any decision has to take into account what is happening to the rest of the fleet," James said.

When is the right time to retire a coal plant? "You could get a lot of different answers, depending on when you ask that question and where you are in the United States," James said. The equation is complex and involves many uncertainties. Power producers will want to adopt a "least regrets" strategy, he added.

Upgrade Solutions

For older coal plants that can't meet new

air pollution regulations, demolition may seem like an obvious choice. Older plants can't handle as much heat and pressure as new, advanced supercritical plants, so they are less efficient. But some plant components, such as the steam turbine, the cooling system, and the ash handling system, still may have value. For some utilities, retrofitting a plant may be a better choice than starting from scratch.

One way to increase the efficiency of a subcritical plant is to replace the boiler with one made of nickel alloys that can withstand higher temperatures and pressures. Rather than replacing the existing turbine, a supercritical "topping turbine" could be added. The topping turbine would lower the pressure to a level that the older turbine can handle, allowing its continued use. EPRI showed in a 2010 report (1019676) that this is theoretically possible. Although purchasing and installing a supercritical boiler and turbine isn't cheap, this option would make the plant more efficient and lower its emissions because less fuel would be burned and it would be possible to add emissions controls. "For some power plants, this could be a pretty good choice," said Jeffrey Phillips, a senior program manager in EPRI's Generation Sector.

A more radical retrofit would replace the entire plant with a higher-efficiency design; this could be a more attractive option than building a new plant on another site. The original site retains significant value. "A lot of assets that you would look for are already there," Phillips said, including transmission lines, cooling towers, coal delivery systems, and a trained workforce. What's more, the existing site already is licensed and permitted for power generation, and surrounding communities are used to having a power plant nearby, moderating the concern over community impacts that typically accompanies new sitings.

If natural gas prices stay low, however, replacing an existing coal plant with a natural gas combined-cycle plant may make more sense. This would involve replacing the coal boiler with a gas turbine and a heat recovery steam generator. Not every component would need to be replaced. The steam generator could feed into the existing steam turbine, and the plant could, of course, use the existing cooling towers and transmission lines.

End of the Line

Some power companies will decide, as FirstEnergy did, that a plant has reached the end of its usefulness. Clock pointed out that "nowadays, plant closure is not a straightforward demolition project." Significant technical and logistical challenges must be met, including environmental assessments, engineering challenges, health and safety issues, community outreach, and planning for the plant's workforce.

In 2010, EPRI formed the Power Plant Decommissioning and Site Closure Interest Group to provide a clearinghouse of information for power companies that may have to navigate these tricky waters. During the group's annual workshop and regular webcasts, members can discuss with experts and each other a variety of concerns. "Plant closings have been relatively rare, and there isn't a whole lot of experience in the industry," said Clock. "While there is a lot of experience with construction practices, there is much less that relates to demolition."

One group participant, Hawaiian Electric Company (HECO), has faced a particularly steep learning curve. "We had not dismantled and removed any generating units from our system in the last 40 years, and now we're dealing with four retired units," said Gary Hashiro, a project manager in HECO's power supply engineering department. "We're a small utility in the middle of the Pacific Ocean. The interest group has helped us use our limited funds effectively, increasing the likelihood of success in our generation removal projects."

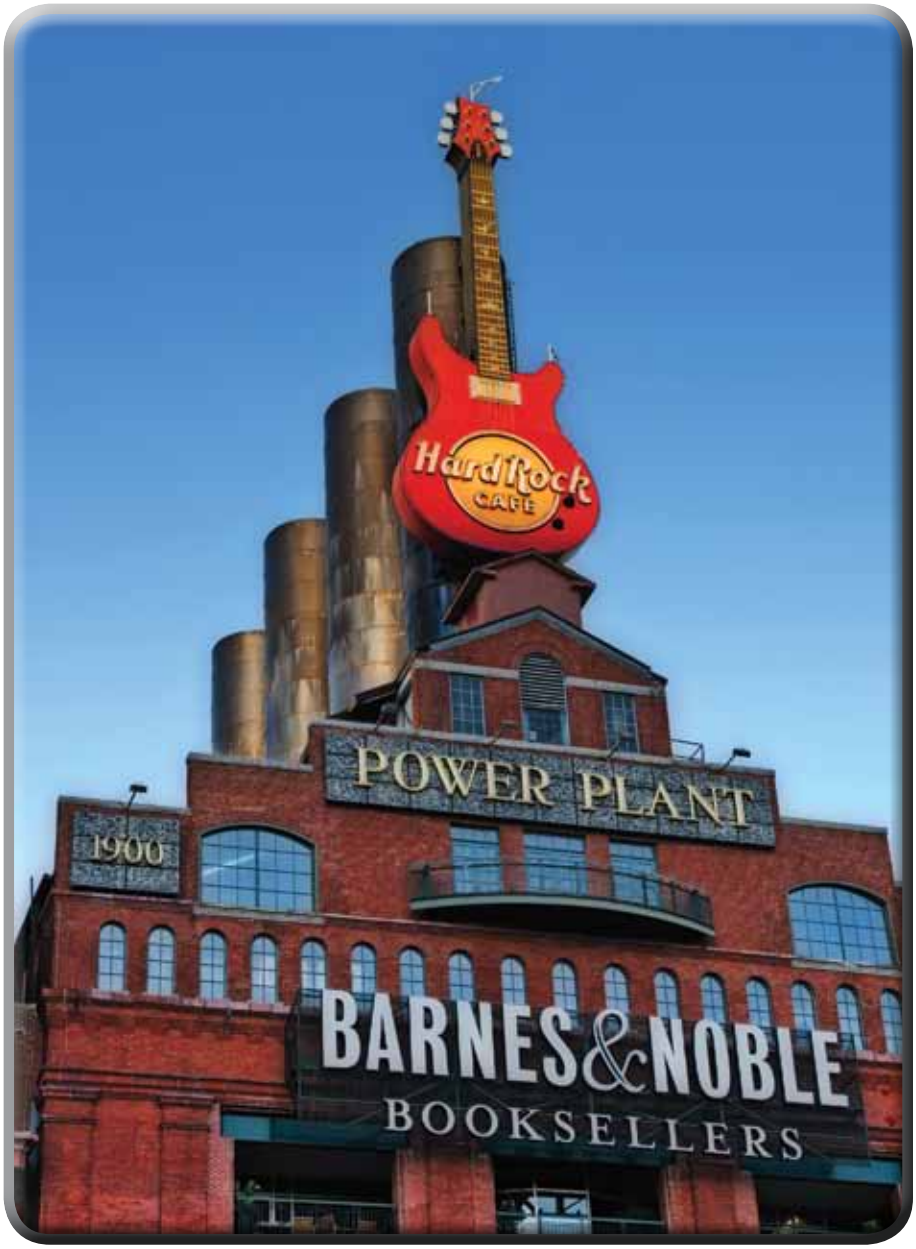
In 2010, Clock and his colleagues published a guidebook (1022263) that includes an annotated checklist of topics and issues that need to be addressed when closing a plant. While each project is unique, the report details common concerns and possible solutions regarding decommissioning. Because many coal plants are decades old, finding information on the plant's design and operation may prove challenging. "The people who built and operated these plants may not be around anymore," Clock said, "so engineers need to budget significant time to recreate plant construction, design, and operation information that may not have been retained within the corporate memory."

Employees' knowledge and familiarity with the plant are crucial, but keeping workers engaged also can prove challenging. "How do you continue to get productivity out of employees who know the plant is going to be shut down in a year or two? Will they start to jump ship, looking for other jobs or taking early retirement packages?" Clock asked. Another important issue is community outreach. "Community concerns are key, and it's not always easy to identify those up front," he said

Some decommissioning issues are less obvious. For example, a guest at a recent workshop discussed issues related to PCBs in solids—in everything from fiberglass insulation to paint—subjecting familiar compounds to fresh scrutiny. "Addressing PCBs in insulating oils has been accomplished by many members. But solid sources represent a new area of potential concern," Clock said.

Even a volatile scrap metals market can have a dramatic impact. "It turns out there's a lot of valuable material in these plants," Clock said. In some cases, the value of the scrap may nearly cover the demolition cost, but rushing a project or disposing of scrap metals at the wrong time can drastically reduce their value. "It's not unusual for a project to cost $15 million to $20 million," he said. "If you can offset a significant portion out of scrap metal, you really want to do it right."

"The future use of a site is really a key driver in how you go about the closure process," Clock said. For example, if a power company plans to construct a new power plant, less remediation and demolition will



Baltimore's Pratt Street Power Plant has a most unusual "afterlife." Built in the early 1900s to run the city's rail systems, the plant now houses restaurants, bars, and a bookstore.

be required than if it plans to sell the land for residential use. But deciding how to repurpose the site can be difficult. "It's the most significant issue that companies struggle with," Clock added. The decision can involve so many factors that a complete teardown often seems like the easiest option.

Clock's next project involves creating a database of plant closure projects that includes information from engineers and managers who have conducted decommissioning projects. Users will be able to reference plants similar to their own to get a better sense of what they should expect in terms of costs, regulatory issues, engineering concerns, and more.

As a result, while engineers and operators will face many decisions, the new forums, the growing banks of data, and the shared experiences can all be used to see more clearly how life can go on for some plants, how some plants will go away, and how some may live on in an afterlife their builders may never have imagined.

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Jeffrey Phillips is a senior program manager in the Generation Sector, specializing in advanced generation research, including the CoalFleet for Tomorrow® program. Before joining EPRI in 2004, he worked on gasification plants for the Royal Dutch/Shell group, on hazardous waste gasification at Molten Metal Technology, and on combined-cycle plants at Fern Engineering. Phillips holds a B.A. in mathematics from Austin College, a B.S. in mechanical engineering from Washington University, and M.S. and Ph.D. degrees in mechanical engineering from Stanford University.

Jeffrey Clock is a senior project manager in the Environment Sector, focusing on investigation, remediation, and management of former manufactured gas plant (MGP) sites and on transmission and distribution environmental issues. He joined EPRI in 2008 after a 24-year career at Central Hudson Gas & Electric Corporation in environmental compliance, licensing, and site assessment and remediation. Clock received a B.S. degree in natural sciences from Bard College, an M.S. in biology from New York University, and an M.B.A. from Rensselaer Polytechnic Institute.