

Revisiting The Complex World Of Power Generation

Written by William C. Livoti, Baldor Electric Company
Friday, 01 May 2009 08:55



According to this author, the picture he painted of the state of power last year hasn't grown much brighter. We still have a long way to go and an even shorter time to get there.

Rantings or Realities?

It's been 12 months since the May 2008 issue of Maintenance Technology published my article entitled "The Complex World of Power Generation." Based on activity in that arena over the past year, I thought it would be an interesting exercise to revisit some of the statements I made in my 2008 article and compare them to what has transpired since. You may be very surprised by what you learn. □ ...Bill Livoti

Wouldn't you know it? Following publication of my May 2008 article in this magazine, I received a number of e-mails— *several of them voicing some very strong opinions*. Among other things, I was told that coal will never be replaced ... that public sentiment will never allow nuclear to replace our current fleet of fossil plants ... that coal is the least expensive form of power generation (this has been confirmed by an engineering firm) ... that natural gas is far too expensive. As for my assertion that wind energy would come on strong, well, I was informed that I was crazy!

Each of these comments will be addressed in this follow-up article. What generated them, however, are the following assertions I made in the 2008 piece:

- The power industry is at a crossroads, faced with environmental requirements from the federal government, unprecedented power demands from the consumer, an aging fleet of power plants and the all-important antiquated transmission system.
- The way in which the power industry responds to this "crisis" will impact every person in

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the United States. The profitability of industry will depend on how the industrial sector's management responds to the inevitable rising energy cost necessary to support the massive plant and transmission construction.

- Once the fuel of choice, coal is becoming a point of contention.
- New energy-efficient power plants are necessary to meet additional consumer demands.

Expand and update transmission lines and industry infrastructure and meet new environmental regulations.

- The only way we can control the impact on our economy and way of life is to conserve energy.
- Electric bills will continue to rise in order to subsidize construction.
- New plants and transmission lines must be approved and constructed at a rapid pace. The industry should move to non-polluting, efficient power generation, including wind, solar and nuclear. The power industry and our country can no longer afford inefficient power plants. The days of the 35%-efficient coal plant and 65%-efficient gas plant are over.

Are these ideas the ravings of a madman? Did I miss the mark? Let's look back at 2008 and the first quarter of 2009.

Where we were/where we are

Unless you've been living on a desert island, you can't avoid the debates over environmental requirements. They're in every newspaper and all the networks every day. The issue is only going to get more intense as the federal government presses for tougher pollution limits.

In fact, as I began writing this article, a new release from the Associated Press caught my attention in a big way. It stated: *Cars, power plants and factories could all soon face much tougher pollution limits. The government took a major step in that direction Friday, concluding that carbon dioxide and five other greenhouse gases "endanger public health and welfare" under federal clean air laws, that they help cause climate change or global warming and pose an enormous threat "in both magnitude and probability."*

The AP release went on to say that this was the first time that the federal government had said it was ready to use the Clean Air Act to require power plants, cars and trucks to curtail their release of climate-changing pollution—*especially carbon dioxide from the burning of fossil fuels.*

“So what has changed from 2008 to 2009? As far as I can tell, only the economy. As for the state of power, we're just in the lull before the storm.”

The DOE is working to keep coal in America's electricity future. The key challenge is to remove

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the environmental objections to the use of coal in tomorrow's power plants as well as existing plants. Community opposition, legal challenges and financial uncertainty over future carbon costs are prompting companies to rethink their plans for coal. Since early 2007, a total of 95 proposed coal-fired power plants have been cancelled or postponed in the United States—*59 in 2007, 24 in 2008 and at least 12 in the first three months of 2009*

. That being said, new technologies are being developed to drive fossil power generation. Such technologies could virtually eliminate the sulfur, nitrogen and mercury pollutants released when coal is burned. With ongoing investment in new technology, it may eventually be possible to capture greenhouse gases emitted from coal-fired power plants and prevent them from contributing to global warming.

At long last, research is underway in the United States to increase the fuel efficiency of coal-fueled power plants. Today's plants convert only a third of coal's energy potential to electricity. The remaining two-thirds go to cooling and up the smoke stack. Amazingly, this efficiency hasn't changed since the mid-1950s.

Power utilities—and *engineering firms*—should make every effort possible to improve the efficiency of both existing fleet and future construction. The overall life cycle cost benefits will far outweigh the "first cost" investment.

A few suggestions

Although they are under-utilized, variable frequency drives (VFDs) have been around for a number of years. By incorporating VFD technology on boiler feed and condensate pumps, heater drain pumps, induced draft fans and forced draft fans, we can provide precise speed and load/process control with potential increased efficiency of up to 2% at reduced loads. The actual auxiliary load savings will vary with plant load and duration. This load savings means increased net efficiency for the plant at a time when fuel utilization may not be optimum. In addition, the pump and fans will operate continually at their optimum design point—*thus improving equipment reliability, uptime and availability*

Better cooling capability will help reduce auxiliary power. Efficient use of the circulating water pumps, state of the art cooling towers and process control could add a few percentage points in efficiency to the power cycle.

Why haven't these upgrades been implemented? It's all about the bottom line (i.e. protecting the

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stockholders' interest). While fuel prices have driven a number of utilities to look at efficiency improvements, it appears that economic incentives will be required to really get things done. Utilities offer incentives to their customers for energy reduction—*why shouldn't there be such a program for generation?* (The average fossil power plant consumes roughly 5% of the gross megawatts it generates, and we haven't even begun to talk about the associated thermal inefficiencies.)

While coal is the nation's major fuel for electric power, natural gas is the fastest growing for base load. More than 90% of the power plants to be built in the next 20 years will likely be fueled by natural gas. Why? Primarily due to public perception and special interest groups, natural gas is the path of least resistance for a power utility charged with meeting increased consumer demand.

The status of environmental compliance

The utilities are waiting for the federal government to decide on the new emission standards. In his testimony before the House Energy and Commerce Committee this past January, Duke Energy CEO James E. Rogers said that he believed energy companies could meet a goal of reducing carbon emissions by 80% by 2050—*a timetable set in a climate change bill by House Democrats*. However, Rogers also noted that the federal government would need to take greater control of an industry regulated by individual states to leverage incentives to companies that cut down on electricity use. "I believe we can set those kinds of goals and reach those goals, but we can't do them without technology... If the Pentagon can say a vision without resources is a hallucination, I'm going to tell you that a carbon policy without technology is a hallucination."

If the federal government uses the Clean Air Act to meet new pollution standards, we will see a significant amount of push-back from the industry, as the cost of such upgrades could put some small utilities in financial distress. Regardless of a utility's size or financial stability, its compliance to the new standard (whatever it may be) will cost a great deal of money with zero return on the bottom line. This is not a pretty picture for the power generators-nor for the consumer. At the end of the day, we will all pay for the new emission standards. The question is: "how much?"

Reducing demand-side consumption

Power companies have stepped up to the plate in record numbers in an effort to reduce energy consumption on the demand side. There is a simple and compelling business case for investment in energy efficiency:

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- Build new fossil plant (capital cost) \$2100 per kW/hr
- Renewable (capital cost) \$3000 per kW/hr
- Energy efficiency @ 2.4 cents per kW/hr

Utilities are working hard to defer capital investments—*and rightfully so*. Until the federal government decides on the new emission standards, investing in a technology that may not meet future regulation would be very risky.



Energy-efficiency initiatives that reward consumers and businesses for reducing electricity and gas usage could result in utility-bill savings of \$168.6 billion, according to a recent report from the American Council for an Energy-Efficient Economy (ACEEE). That number is 16% higher than ACEEE's previous savings estimate of \$144 billion and is based on updated data. This

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organization released its new economic analysis as business leaders, industry groups and environmental advocates launched the Campaign for an Energy-Efficient America, a coalition calling on Congress to enact a federal energy-efficiency target.

As for just how we will be able to transmit enough electricity to meet increasing demand in the future, the federal government has come forth with money in the recently passed stimulus package to assist in upgrading the national grid—*something that MUST be done as soon as possible*. While there may be some debate over federal government intervention, I see no other solution to this national crisis. By the way, don't expect this issue to be resolved overnight. It will take a number of years—*and billions of dollars*—to complete the upgrade.

Energy conservation

Electric utility bills continue to increase nationwide. It's a fact of life that as the power companies build plants to meet consumer demand, our rates will go up to cover the capital costs. In fact, some utility CEOs project rates to double over the next five years.

This brings up the next topic: energy conservation. What has changed over the past year? As a nation, we have treated electric service as a right rather than a privilege. This attitude is about to change. Over the past year, various industries have taken a hard look at their energy consumption and made a concerted effort to reduce same. Many state and local governments have implemented new building standards to reduce energy. The federal government also has joined in by requiring energy-conservation measures (HVAC, lighting, etc.) to reduce energy consumption in its facilities. We aren't there yet. I believe it is going to take a major upset on the grid, such as rolling blackouts, before the nation as a whole gets the message. It's a sad testament to the American people when a disaster must occur (economic or physical) before we take action. Whatever happened to being proactive? For those willing to jump on the energy-conservation bandwagon, [Pump Systems Matter](#) and [Database of State Incentives for Renewables & Efficiency](#) are excellent resources on incentive programs.

Alternative energy sources

For it to survive-and for our country to achieve sustainability-the power industry needs to embrace new technology and build energy efficient plants while upgrading its existing operations. In addition, the industry should diversify its generation. Green energy is a hot topic—*everybody wants to go green*. Many state governments have mandated 20% renewable energy over the next 10 to 20 years. However, renewables come at a price.

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Oregon's biggest electric companies, PacifiCorp and Portland General Electric, filed for rate increases recently with state utility regulators. Both cited renewable energy projects as the reason. Costs associated with renewables, primarily wind, are high, said Michael Early, executive director of Industrial Customers of Northwest Utilities, a group representing those tagged with some of the steepest hikes. "We have a renewable energy portfolio, but it doesn't come without a cost." Under PacifiCorp's request, industrial customers would get some of the biggest rate jumps at 13.7%.

Wind generation has grown over the past year, even with the economy down. According to the U.S. Interior Secretary, Ken Salazar, if wind power were fully developed off the East Coast, windmills could generate enough electricity to replace most, if not all, the coal-fired power plants in the United States. While this is a bold statement, it does provide promise as a viable alternative energy source.

The United States is undergoing renewed interest in nuclear power as it seeks alternatives to traditional coal-fired power plants, which scientists have tied to greenhouse-gas emissions. The U.S. Nuclear Regulatory Commission has received 17 applications to construct 26 new nuclear reactors, according to the chairman of the agency. The NRC has added nearly 1000 more employees in the past six years to review plans for the next generation of nuclear reactors and the fuel-enrichment plants that will supply the additional units. In early March 2009, a Gallup Poll found 59% favored nuclear power "as one of the ways to provide electricity for the U.S."

Driven by state mandates, utilities are seeking large solar installations. A year ago, a 10 MW power-purchase agreement was considered large. Now the average size is 25 to 50 MW. Some solar companies are bidding for tenders that are orders of magnitude larger, 100 to 150 MW, and even one that's 500 MW. A new report by the Geothermal Energy Association (GEA) shows strong growth in new geothermal power projects continuing into 2009. "There has been a 25% increase in new geothermal projects from August 2008, when the last GEA report was released. There is also an increase in overall production potential by 35%," noted Kara Slack, the report's author.

The report also notes that the number of states producing geothermal power has increased from 7 to 8 with the addition of Wyoming. "Geothermal power projects continue to move forward, with new projects being added at an increasing rate," according to Karl Gawell, executive director of GEA.

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The GEA report identifies a total of 126 projects under development with the potential to put 5500 MW of new geothermal power on line, equivalent to 15,000 MW - 20,000 MW from wind turbines or enough power for 5.5 million California homes, according to GEA. New geothermal power projects were identified in Alaska, Arizona, California, Colorado, Florida, Hawaii, Idaho, Nevada, New Mexico, Oregon, Utah and Washington.

Will we have enough power in the future?

So what has changed from 2008 to 2009? As far as I can tell, only the economy. As for the state of power, we're just in the lull before the storm—*and a very frightening storm at that!*

Keep in mind that the U.S. continues to lag behind other nations in energy efficiency, alternative-energy sources and new fossil-fuel technology. We seem to be a nation resistant to change. I fear this resistance will result in extending our exit from our current recession (look at South Africa). How can we recover? More precisely, how can we ever increase manufacturing and grow without sufficient power generation? **MT**

Bill Livoti is a fluid power and power industry engineer with the Baldor/Dodge/Reliance divisions of Baldor Electric Company, based in Greenville, SC. His professional background includes many years working in the power gen industry. Today, among other things, he is strongly involved with the Pump Systems Matter initiative focusing on the optimization of pumping systems throughout industry. Telephone: (864) 281-2118; e-mail: wclivoti@baldor.com

For more information on pumping system optimization and life cycle costing, visit the [Hydraulic Institute \(HI\)](#)
and/or
[Pump Systems Matter \(PSM\)](#)

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[The Associated Press](#)

[Wall Street Journal](#)

[Edison Electric Institute](#)

[Electric Power Research Institute \(EPRI\)](#)

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