From *wellhead* to *wall socket*

A holistic approach to managing merchant plant operations—from fuel procurement to power delivery—is needed to profit in deregulated electricity markets. Total Btu Management is one such approach, and it is designed to achieve business objectives from start to finish

BY CHAL BARNWELL

Deregulation has done more than bring competition to U.S. retail electricity markets. It has also made wholesale power prices more volatile. That volatility is most evident when there are short-term dislocations of supply. The resulting price spikes lead to substantial "risk premiums" in forward power markets.

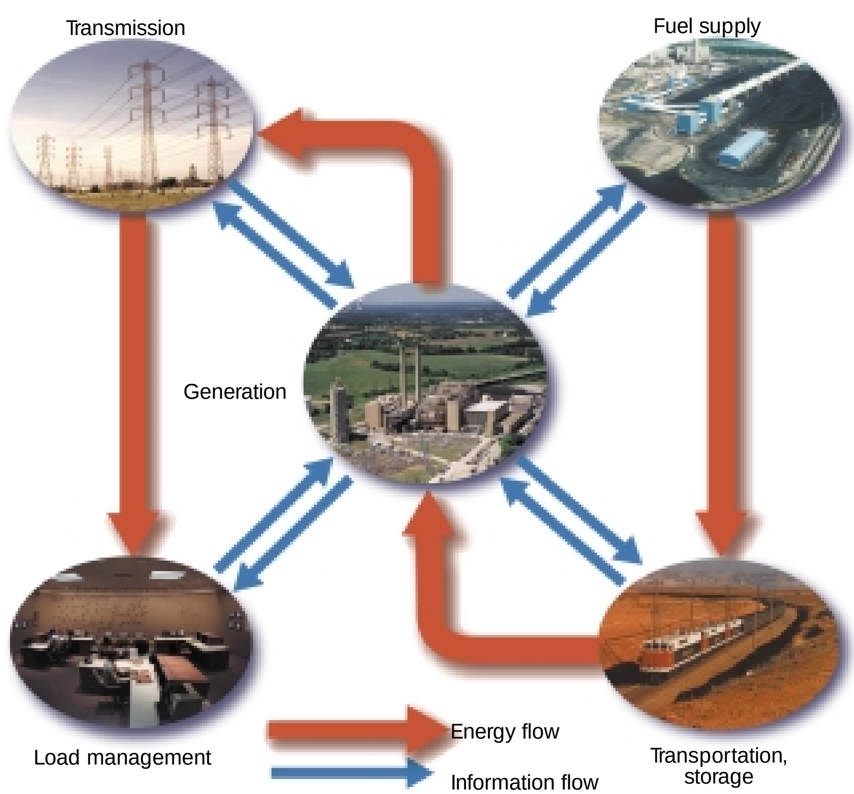
In the past, traditional utilities typically considered their power plants mere collections of brick and mortar. But today, a merchant plant operator increasingly views his facility as a stack of conversion options or options on the available spark spread (see box, p. 41). But whether the merchant plant operator is a utility or an independent power producer (IPP), competition requires that it make every possible effort to extract maximum value from the generation portfolio, and that means using sophisticated tools to manage market risk (GLOBAL ENERGY BUSINESS, May/June 2001, p. 12).

These risk-management tools are designed to cope with the uncertainties of the new business model that deregulation has ushered in—the Forward Risk Premiums model. As was the case under the old Economic Dispatch model, some portion of forward power prices is still determined by marginal generation economics. Now, however, whenever one or more links in the electricity delivery chain are stressed, the market adds a risk premium to power prices to reflect the uncertainties of forward delivery. Exploiting the existence of that risk premium is the objective of a new concept for managing merchant plant operations called Total Btu Management.

The components of generation value

The base values that accrue to electricity generation and the effect that these value components have on wholesale power prices are a subject that requires a modified mind set to understand. In

The five elements of Total Btu Management



the traditional paradigm, where generation and transmission were merely guarantors of reliable service, these value components were largely ignored or not understood at all. In the competitive marketplace, electricity generation has three main components of value: commodity, optionality, and deliverability (see box).

Generally speaking, the commodity aspect is the only value that is attached to generation in a regulated environment. The commodity component refers to the ability of a power plant to convert one form of energy—be it fossil or nuclear fuel, wind, water, or sunlight—to another: electricity. The value of this conversion capability is embedded in the economics.

With the introduction of competition, the optionality that accrues to a form of electricity generation has become a significant value component. The economies of scale that were the rage in the 1970s and early 1980s have yielded the premium value perch to the generating capacity that has the most opportunity to run at peak periods, and not run at periods of low demand. Rapid ramp rates, complete turndown capability, storage capacity, and other forms of enhanced optionality add tremendous value to the generation proposition.

The third component—deliverability—is in some ways another form of optionality. The value of the deliverability of power depends on its ability to be packaged in intermittent delivery blocks and for very short periods of time. The other aspect of deliverability is its flexibility in reaching multiple transmission points and multiple markets with equal ease. Plants with easy access to multiple markets are more valuable because they are capable of delivering their output to premium markets on short notice as market conditions change.

Components of electricity generation value

Commodity
- Conversion of fuel to electricity
- Principal value in regulated environment

Optionality
- Electricity values vary by time and duration of delivery
- Operating characteristics: ramp rates, turndown capability, fuel switching, peaking

Deliverability
- Greater value by packaging, time, flexibility
- Major feature in deregulated markets
- Not important in regulated environment as market is known

Steps towards Total Btu Management

The process of optimizing the financial performance of a merchant power plant—or a portfolio of them—is an ongoing process that takes place in a dynamic environment. The success of this process depends largely on the ability of senior management to correctly and constantly identify the strategic elements of merchant plant operations that their company's personnel are equipped to deal with.

Another prerequisite for success is a centralized desk for pricing, structuring, and analysis. All decisions that must be made during this process require a thorough understanding of the fundamental risk elements that influence prices and delivery costs. It is a monumental undertaking to continuously evaluate fuel-price fluctuations, weather conditions, unit availability, transmission constraints, emissions credits costs, and all other factors that bear on prudent decision-making. Upon developing a well-conceived forward market opinion, the role of senior management is to orchestrate the execution of a tactical business optimization plan.

Elements of Total Btu Management

The remainder of this article examines the theory and practice of Total Btu Management as it applies to gas-fired merchant power plants, which are increasingly the type of marginal generation available. The discussion is based on two assumptions: that the units are designed for load following, and that there is considerable flexibility in the fuel supply delivery mechanism.

The variables in the Total Btu Management equation can be put into five broad classes (figure, p. 39):

- Commodity fuel supply is that portion of the fuel-purchasing decision that deals with the base cost of gas at a trading liquidity center.
- The transportation element deals with the physical delivery requirements of that fuel to the facility in a fashion that matches its consumption patterns.
- The generation element deals with all operating decisions involving the generator itself. This includes establishing base operating levels, options pricing for load-following contracts, allowing for emissions credits coverage, and ancillary services offerings. This portion of the optimization process addresses decisions about spot activity, the duration of power purchase contracts, and daily/hourly sales activity.
- Transmission priorities are becoming a make or break decision for merchant generators. The significant expense of maintaining a broad and substantial transmission priority portfolio must be weighed against the desire to access premium market values routinely.
- Load management has—somewhat ironically—found its way back to the forefront. As the ownership of generation portfolios moves from utilities to IPPs, the desire of smaller load-serving entities to have risk-free supply contracts that provide all their swing requirements in one place represents a large profit opportunity for merchant generators. This element of the supply chain requires perhaps the most sophisticated analytical capability to accurately measure risks of delivery, price the instant optionality required, and construct a pricing mechanism that is satisfactory to both buyer and seller.

Commodity fuel supply

The management of the commodity fuel-cost element of power generation is the first step that most utili-

Glossary

Risk premium is a portion of the forward price that is attributed to the risk associated with the potential for unknown events to occur. This portion of the forward price is set by the market forces exerted by buyers and sellers. As a rule, the greater the risk that unknown events will occur, the greater their impact will be. Another rule of thumb: the further out in time a forward price is, the greater risk premium it will generate.

An option is the right—as opposed to the obligation—to receive or deliver (call or put) a given commodity at a specified price, location, and time.

A conversion option is an option to convert one form of energy to another. In this article, the conversion option refers to the option to convert one form of hydrocarbon to electricity.

A spread option is an option to receive an established spread between two commodities. This article discusses it as the relationship between the input (natural gas) and output (electricity) of a generation process.

The spark spread relates the price of electricity to the price of fuel used to generate it. Spark spreads vary by location, fuel source, output configurations, and timing.

Swing is the underlying optionality associated with delivering or receiving either natural gas or electricity at intermittent rates and durations. It is used to vary the delivery of energy to the specific consumption characteristics of the consumption unit. The concept of swing can also refer to the ability to vary the amount of energy consumed or delivered.

ties made to become competitive. This is the most visible portion of gas trading—and often the most misunderstood.

The range of sophistication in commodity fuel supply management is quite broad. At its simplest, a generator may limit its participation in gas trading to simply hedging fuel-cost risks when locking in a generation margin. At the other end of the spectrum, a generator may be actively involved in all 20 liquidity centers in North America with a substantial open position limit in each. The most sophisticated traders may maintain substantial futures, options, and over-the-counter (OTC) portfolios.

The price of natural gas fuel is likely to be the most volatile number—next to power prices—to which a merchant generator will be exposed. Therefore, it is critical that IPPs keep close tabs on the prevailing market price of gas, in addition to performing rigorous fundamental supply/demand balance analyses for informing their fuel-purchase decisions. The level of analytical sophistication and trading acumen should be a function of the company's desired trading activity levels.

Transportation

This is the portion of the fuel supply chain that is involved in transporting fuel from a liquidity center to the power plant. Not unlike the electricity grid, the natural gas transportation system has been stretched further toward capacity constraints. This element of the portfolio provides for all the delivery flexibility that is necessary to operate one or more plants.

The group responsible for managing the transportation element makes decisions about maintaining more expensive firm transportation or making delivery via interruptible agreements. The location of the plant and its peak times of use are key variables here. Will swing optionality be purchased, or will the organization maintain storage space to facilitate demand swings? If storage is to be part of the supply chain, where should that storage be located?

Another responsibility of the transportation group is management of the basis trades that are necessary to run the generating capacity. For example, in areas that are particularly stressed for supply—such as California today—the basis relationship and physical firm transportation exposure may easily outweigh the commodity fuel price itself. Generation facilities that are located close to multiple pipelines with ample access to liquidity centers are less likely to require a firm transportation arrangement than those located far from supply lines. Individual plant requirements, the overall portfolio of gas management, the geographic scope of activity of power and gas, and the regional supply dynamics collectively govern the decisions made to support the transportation element. If the company manages this element well, large profits could result.

The generating facility

Decisions about the generating facility itself are crucial to the success of Total Btu Management. The facility's or facilities' unit characteristics, individually or as a portfolio, determine the embedded optionality and bear heavily on the best type of marketing plan. The financial arrangements and loan covenants surrounding newly built merchant plants must be considered. Tradeoffs between long-term earnings stability and flexibility of operations must also be considered. All aspects of the IPP's operations must be considered in designing a power marketing plan that fits the physical characteristics of the units, as well as the financial concerns of the organization.

Gas-fired generation falls into one of three broad categories: existing, mid-merit, simple-cycle generation; high-efficiency combined-cycle; and peaking plants. Plant characteristics—such as heat rate curves, ramp rates, turndown maximums, startup costs, location, and market load shape—must be considered here. In many

Decisions about the generating facility itself are crucial to the success of Total Btu Management cases, existing, long-dated transactions must also be taken into account. Decisions about long-term indexed transactions or short-term spot activity should be largely influenced by the financial requirements of earnings levels and variability control. In many cases, financing arrangements require that some portion of a facility be committed to long-term agreements. Upon determining the mix of transaction terms that is appropriate, the facility marketing plan must take into account trade construction.

Virtually all gas-fired plants have some level of load-following optionality that is accompanied by substantial short-term price premiums. The IPP must accurately quantify the options value and be compensated for it accordingly. This can be done either by entering into contracts with sizable options premiums embedded in the price formula or by keeping a portion of the unit's output uncommitted and then selling it hourly as market prices dictate. Where a portfolio of different generation types is involved, a total portfolio approach is adopted to take advantage of the combined flexibility of the generation fleet.

Within this element, decisions to run or not run a plant are made. When natural gas prices are extremely volatile, very often shutting down a facility and selling its fuel into the market makes better economic sense than keeping the plant running. During the spring and fall, when generating plant economics are marginal, intermittent operation of facilities based upon daily swings in profitability are most crucial. In addition, basis and pipeline economics of natural gas delivery may dictate operating a less efficient facility to exploit fuel economics on the front end of generation. For example, an older, less efficient facility that is located near a liquidity hub might be substituted for a more efficient plant located up the distribution chain to resell the transportation for a profit.

Transmission

Going forward, the most stressed segment of the power delivery chain is likely to be power transmission. For a variety of reasons, the construction and interconnection of high-voltage transmission grids is not likely to keep pace with demand movement. Exacerbating the problem, the balance of generation ownership and load-serving requirements is shifting to reflect the effect of competition. Consequently, decisions regarding the location of new generation may or may not ideally suit load mobility.

The price spikes that have become increasingly common in power markets of late have spawned the need for power plants to have "dual deliverability"—access to two or more markets all the time, and the flexibility to serve the one with the highest prices. The objective of transmission has also broadened from that of just delivering power to getting the best price for it. Today, with power prices topping several hundred dollars per kilowatt-hour in the summer, transmission flexibility plays a more important role than ever in a company's overall economic performance.

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Load management

In the mid-nineties, as support for deregulation began to grow, so did support for demand-side management programs. By and large, however, the timing of such undertakings by utilities was premature. Today, however, haunted by the possibilities of rolling blackouts and outrageous electric bills, demand-side management is back in vogue. With prices for "super peak" power (that is, power delivered for only four or eight hours) reaching into the multiple hundred dollar per kilowatt-hour level, the ability to vary load and charge a premium for emergency supply represents a huge opportunity for profit.

Another application of load management is in the restructuring of long-dated transactions. With many years left on several load-following agreements, there is a lot of opportunity to restructure these arrangements to better achieve the mutual goals of the contracting entities. Traditional arrangements that involve a fixed cost for infrastructure, a reservation fee for committing generation, a capacity charge to pay for energy conversion, and a commodity fee for fuel adjustments are prime targets for restructuring.

In many cases, contractual covenants entered into under vastly different circumstances hardly represent the intentions of the parties today. It can be in everyone's best interest to reconstruct these power-purchase agreements to add or remove time, and/or add or remove an option value to match current needs and current conditions.

Systems requirements

By considering its portfolio of generation and load as an exercise in Total Btu Management, a completely new and vastly different set of analytical systems requirements emerges for merchant-plant operators. To accommodate the technique, their enterprise systems must be able to capture all elements of the portfolio simultaneously and conduct ongoing financial evaluations of the individual components as well as of the entire portfolio. This systems exercise includes traditional volumetric analyses and sophisticated financial, options pricing, and volumetric modeling. ■

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