Independent System Operators: Keeping the Power Under Control

Spurred by deregulation, the wholesale electricity marketplace has rapidly developed over the past three years. Unlike other commodity markets, such as those for wheat, corn, and gold, electricity transactions are characterized by unique reliability-based considerations. At the core of electricity markets is the reliable operation of the bulk power system that is responsible for keeping the lights on. For electricity transactions, the complex task of maintaining the reliability of the electric transmission grid is the overriding consideration, while market-related influences seemingly assume a secondary status. How do Independent System Operators (ISOs) contribute to keeping the power flowing? Is the ISO concept a viable model for continued development of bulk power markets?

Although ISOs are not the only means by which these needs could be addressed, ISOs are the dominant mechanism currently in place. Across the country, ISOs are in various stages of formation and development. PJM Interconnection, L.L.C. (PJM), the California ISO (CAISO), ISO New England, Inc. (ISO-NE), and the New York ISO (NYISO) are functioning today. Others, like the Midwest ISO (MISO), have been approved and are in the process of implementation.

Today’s ISOs have been evolutionary agents to facilitate the development of the bulk power markets and open grid access. These organizations have accepted responsibility for a monumental task with access to limited tools and resources. The ISO concept has been successful as a viable model for continued development of bulk power markets.

Current State
Each of the existing ISOs has a different structure and role necessitated by differences in the market rules for each entity. Regardless of the market structure, all ISOs perform certain necessary core functions:

Estimation of system load
System load or electricity demand is an ever-changing value that needs to be estimated for each hour of the day. Accurate estimates of load are essential to ensuring the adequacy of generation while guarding against reliability issues related to over-committing generation. In addition, accurate load estimates facilitate cost (or clearing price) minimization by permitting cheaper, slow moving generation to be called into service in advance. Load estimates are driven by a variety of factors, the most important of which is weather.

Estimation of system supply (including energy and reserves) both operable in the short-term and capacity available in the long term
System supply estimates involve accumulating information on the generating resources available to supply the energy and reserve markets in two different time horizons, short-term and long-term. In the near term, the availability of the unit including physical operating parameters and bid prices are accumulated. In the long term, the ISO must make projections to ensure that the installed capability in a control area is sufficient to meet anticipated load growth.

Scheduling generation and transmission equipment outages, as well as approving requests for new resources
Since equipment outages impact the reliability of the power systems, requests to schedule outages must be reviewed by the ISO. Outages can be requested for many reasons including routine maintenance and upgrades. During the outage, operators must maintain contact with the resource to understand any unexpected delays in the return to service.

Scheduling generating resources to meet load including operating reserve requirements
Once estimates of load and system supply are created, the ISO then endeavors to schedule

http://niehaus.UtilitiesProject.com
resources to provide energy and reserve to reliably satisfy load at the lowest possible production cost.

Directing the minute-by-minute operation of the bulk power system in accordance with operating and market regulations

Real-time direction of the power system entails the minute-by-minute balancing of system load and generation within reliable and safe operating limits. Systems operations rely heavily upon telemetry information and complex linear algorithms which provide generation targets for resources given the conditions that currently exist on the system.

Continuously evaluating the state of the system and using operator judgment to identify and address reliability considerations

Real-time system operation entails reacting to deviations between estimated and actual conditions including addressing unexpected contingencies. Unexpected contingencies can arise from a variety of factors including unplanned transmission line or generating resource outages.

Participant billing and clearinghouse services

In addition to the complex task of operating the power system, ISOs capture transaction details and calculate monthly billing statements. Complex calculations for everything from clearing prices and congestion related charges and credits, to transmission service fees and other assessments, are performed and billed to market participants. As the servicing organization, the ISO implements the charges and credits that are set forth in the respective open access transmission tariff and other governing control area agreements. These involve in many cases, sophisticated linear algorithms, mathematical modeling tools, and computer systems to produce solved solutions. The ISO also facilitates settlement among the parties acting as a sort of clearinghouse for the monthly billing distributions.

Although many power market stakeholders argue for absolute certainty of all aspects of the transactions they want to complete, these core functions amply demonstrate the need for flexibility in real-time operational matters, which ultimately affect the market. The structure, governance and roles performed by the ISO, or other organization responsible for the above activities, will never be able to eliminate the need for this flexibility.

The maturity of mechanisms to control and limit the use of judgment varies among today’s operational ISOs. Any organization ceded responsibility for the grid and the markets would need to spend enormous amounts of time and resources to reach a high level of maturity.

Alternating Currents

At present, the various markets administered by ISOs differ significantly in terms of the market rules governing transactions. Not only do they functionally differ, but even the theoretical foundation of the markets are unique. This inconsistency, particularly between adjacent control areas creates both operational and market-based issues for the ISO. Differences in the market rules potentially create arbitrage opportunities for participants while presenting operational uncertainties and contingencies from a system reliability perspective. This situation creates significant issues for the ISO to address and creates friction with participants who may not necessarily appreciate the reliability related considerations associated with scheduling a high volume of short-notice transactions. These differences also:

- Hamper the development and interpretation of market signals between adjacent control areas particularly in extreme system conditions
- Hinder market efficiency by forcing participants to learn numerous complex rules and procedures governing the same types of transactions
- Prohibit the direct comparison of statistics between the ISOs and the identification and sharing of best practices.

The sharing of best practices among these entities would likely provide benefits to all parties. Unfortunately, while the ISOs do communicate and share ideas, much of the best practices experience is difficult to translate into different market structures. Aligning the market rules for the various control areas could mitigate some of these issues.

Each ISO has developed its own operating policies and procedures to carryout its role in controlling the operation of the transmission grid and administering the markets. Not only do these policies and procedures differ amongst ISOs, but they also differ to a certain degree within each ISO. While methodologies and guidance exist to assist operators in performing these tasks, human judgment, along with its potential for error, is an essential element of each of these functions. The soundness of this judgment is, in turn, predicated on the knowledge, training and experience of the individual operators and shift crew management.

Often power marketers and other observers argue that absolute certainties should replace these areas of operator judgment and discretion. Unfortunately, in a real-time system environment characterized by a great deal of uncertainty and the dire consequences of system failure, operator judgment will always be a necessary aspect of the operating processes. However, that is not to say that operator judgment should be boundless or unconstrained. Strong decision-making frameworks and evaluative precepts should be in place to promote consistent and sound operating decisions when addressing uncertainties.

Legacy power systems did not provide the outside world with a great deal of transparency with respect to their operations and did not receive a great deal of attention from the marketplace. Reliability-based judgments went relatively unquestioned by the market participants. Operators felt accountable to regulators with successful operation of the power system judged primarily by reliability measures. Now, however, ISOs operate in a fishbowl garnering attention from a host of stakeholders. Market participants scrutinize every decision made by operators.
while judging successful system operations primarily on the basis of price and cost considerations. While market participants readily accept the tenets of reliable operations in theory, a difference of opinion exists in practice as to when reliability needs to trump the market. Market participants generally have a higher tolerance for stressing the system before moving outside the markets for a reliability-based solution. On the contrary, operators are primarily concerned with maintaining safe and reliable operations and are understandably more hesitant to take the system to extremes before intervening.

Sensitive Information
As contentious as the struggle between reliability and markets is, the sufficiency of information distributed to the marketplace is just as important. Codes of conduct, Federal Energy Regulatory Commission (FERC) Orders and information policies govern the distribution of information to market participants. Once again, a difference of opinion often arises between participants who want unlimited access to operational information, and the ISO which must guard and filter market sensitive information for public consumption.

Although the type and extent of information to be shared is debatable, the need to bring transparency to the markets is incontrovertible. Improvement in the transparency of operational processes and system operating conditions is a necessary step in the development of the power markets. Participants need to understand the rules of the game in order to be a player. Similarly, participants must understand how the ISO makes operational decisions to understand how to react in the various markets.

Need for Transparency
Over the past decade, the rate of change in the electricity markets has been staggering. Not only are new markets being formed, changes to existing market rules and structures are continuously debated and approved. These changes do not represent minor fine-tuning; rather, these changes are generally fundamental alterations to the operation and structure of the market. Migrating from existing congestion pricing mechanisms to location-based marginal pricing, transitioning from single settlement to multi-settlement markets, and redefining reserve markets are but a few of the evolutionary changes adopted by the existing markets. In looking ahead to the future, this rapid evolutionary pace is not expected to decelerate. With the existing changes approved by FERC awaiting implementation and still other new proposals expected on the near term horizon, there is no relief in sight.

Similar to companies early in their life cycle, ISOs must be flexible organizations that readily adapt to change. ISOs need an innovative culture and entrepreneurial spirit married with strong change management skills. Reacting to change by quickly and soundly implementing new policies and procedures is a cornerstone to success for the ISO. This environment makes documentation, training and process ownership that much more important.

As apparent by the current operating environment, ISOs can be structured in a variety of ways. Roles can be separated between the ISO and a power exchange as is the case in California, or both roles can be executed by the same entity as at PJM. Other types of regional transmission organizations could also be introduced to provide similar or other services to the market. Regardless of the form, any organization playing this role in the market will confront the challenges facing ISOs today. From the market scrutiny to the state of continuous change to the exercise of judgment and concentration of knowledge capital, these issues are not unique to the organizational form. These issues are borne of the role this type of entity plays in directing the operation of the power system and administering the wholesale electric markets.

Similarly, any form of the entity executing the roles of the ISO will face the significant start-up costs and formation issues that ISOs experienced. The complexity of the operations of the bulk power system necessitate huge investments in computer systems and infrastructure costs. These infrastructure costs span a wide range including communication, telemetering and related data links as well as other general and administrative expenditures. Because the reliability of the power system is managed by this operating equipment, significant investments in state-of-the-art technology are required. In addition, the magnitude of change to the markets necessitates constant updates to and replacement of underlying operating systems and procedures. These updates represent a significant recurring expenditure to be borne by any entity serving the ISO’s purpose.

Maturity Comes With Time
Many market participants are vocal in their criticism of ISOs and try to develop a groundswell of support to influence future decision-making practices. These lobbying efforts are made directly to the respective ISO through formal and informal communications. In addition, participants seek relief through various committees and advisory structures formed to air grievances and address market design issues. In extreme cases, participants contact regulators including the FERC with complaints and alternative filings to change current policies, procedures and market rules.

Questions and complaints from participants are a common attribute of any market, particularly one so early in its life cycle. Although the wholesale purchase and sale of electricity is not a new concept, the existence of sophisticated electricity commodity markets is a new development. With time and experience, all of the participants in the market including the ISOs will learn and grow. Market design issues will be identified as only actual experience and market stresses can illuminate. Operators and ISO management will gain hands-on knowledge and experience improving their ability to operate the system reliably through the markets. Unfortunately, the key to this learning and market maturity is time – a commodity not easily transferred in the marketplace.