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EDITORIAL

A Changing Electric Power Industry

Karl Stahlkopf* recently pointed out that the U.S. electric power industry is undergoing its most profound changes in a century. This movement is in response to the growing role of competitive wholesale power transfers, to regulatory pressures, and to the demands of users of power-sensitive equipment, such as microprocessors.

Scientists and engineers using computers and computer-aided equipment need reliable electricity, and many industrial customers are employing sensitive electronic devices to control their machines. A one-cycle interruption in ac supply can cause serious losses of production and information. The total cost of interruptions and voltage sags has been estimated to be \$3 billion to \$5 billion per year.

Providing completely reliable electric power is not easy. Generating plants have thousands of parts, and the failure of a component can cause a sudden shutdown. To increase the overall reliability of electric power, many generating plants are connected in regional transmission systems. The 60-cycle frequency of all the generators in a system must be synchronized, even if those generators are a thousand miles apart. Such a network, with its varying power sources and loads, has complex behaviors. Electric current destined for a consumer often does not flow by the shortest path but proceeds in a loop hundreds of miles long. On occasion, lines have been subjected to excessive currents, causing them to overheat, expand, and sag. A power failure in the eastern United States was greatly magnified when overheated sagging lines touched trees.

Applications of new technology are leading to greater reliability and lower maintenance costs of electric power systems. Sensors that can detect and warn of imminent failures are being installed at crucial points. One example is an instrument that detects gases produced by overheated transformers. Another device is programmed to monitor the sine wave in a distributing line. When the line is struck by lightning, the sensor detects a deviation in the shape of the voltage cycle, and thyristors can quickly remedy the voltage deviation. Thyristors are large solid-state devices that consist mainly of elemental silicon doped to create positively or negatively charged regions. Because they can respond in a fraction of a cycle, they will increasingly be used to switch large electrical currents. In computer-controlled industrial processes, problems can be avoided when thyristors quickly switch from a failed feeder to another power source.

Electric utilities are under competitive and regulatory pressures to reduce the price of power. In earlier times, most were sole providers of electricity in specific regions. They were regulated by state and local authorities that enabled them to earn a profit and recapture the costs of capital investments. They owned their generating stations, the transmission lines, and the distribution system. Some made costly investments in generating stations that now seem ill-advised. Other utilities were urged by regulators to make long-term commitments to purchase expensive power, some of it from then-fashionable renewable energy sources. Costs to U.S. consumers of electric power now range from about 3 to 16 cents per kilowatt-hour.

Large-scale consumers have responded to high costs by building their own generating facilities and by purchasing electricity from unregulated power producers. This search for lower costs has been facilitated by the existence of the large-scale power grids and by regulatory pressure to make the transmission line capabilities of utilities available to competitors. An important result has been the creation of an expanding market for wholesale electric power. For example, Consolidated Edison, which distributes electricity in New York, purchases some electricity from Quebec Hydro and some from Georgia Power. Sources often change hourly, depending on the price quoted by each. Already, 40 percent of the power generated in the United States is sold by a producing company on the wholesale market. New, more efficient generating plants—most notably those using gas-fired combustion turbines—have production costs that are considerably lower than those of many existing plants. Federally mandated open access to transmission networks is expected to further accelerate the growth of bulk power sales. Moreover, as Stahlkopf states, "Deregulation is rapidly making electricity as much of a commodity as pork bellies—complete with an evolving futures market and a variety of sophisticated trading options."

Philip H. Abelson

*Karl Stahlkopf, *Powering the Future* (Electric Power Research Institute, Palo Alto, CA, 1995).