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New Technologies in the Generation of Electricity

The electric utilities are in the later phases of a horrendous experience resulting from their choices and scheduling decisions about generating capacity that were made during the 1970s. They chose to build huge plants and were overly optimistic about growth in demand. Their trauma was exacerbated by problems with nuclear reactors and high interest rates during construction and by the need to curtail acid emissions from coal-fired plants. The time required for design, obtaining permits, and construction of 1000-megawatt (MW) and larger units was 8 to 15 years. During 1987 and 1988 most of the plants now under construction will be completed, and with time, excess capacity will disappear, probably to be followed by shortages.

The capacity requirements of the next decade are uncertain, but new technologies have the potential to forestall many future problems, by providing flexibility in the adding of capacity and freedom from pollution. In the new approach, units of the order of 100-MW capacity will be added in times on the order of 2 or 3 years.

A key technological development is a series of combustion turbines that can run reliably for long periods at high temperatures. One version being tested by General Electric can operate at 1260°C. The heat from the turbine can be used to make steam to drive another turbine.

The combustion turbines can employ natural gas, fuel oil, or CO + H_2 derived from gasification of coal. The utilities see an opportunity for phased addition of increased generating capacity. The first phase would be the installation of 100-MW gas turbine capacity that would use natural gas and serve for peaking purposes. Later the heat recovery and steam turbine would be added to yield another 100 MW. Finally, were natural gas to become too expensive, coal gasifiers could be installed, leading to a total output of 300 MW. One version of the gasification step has been operated successfully for about 3 years at the Cool Water plant in California. Emissions from the plant are pollution-free. The Cool Water unit employs a Texaco gasifier. Both Dow Chemical and Shell have developed their own versions of gasifiers, and other companies have also been active.

A panel discussion at the 2 April annual meeting of the Gas Research Institute in Chicago cited some of the advantages of the use of natural gas in the generation of electricity. Generating facilities can be constructed rapidly. Capital costs of equipment are small. Siting problems are minimal. The generators can be located close to loads, thus cutting transmission losses. There are no emissions of SO_2. These advantages justify use of a fuel whose cost is greater than coal. A major uncertainty is the longer term price of gas after the gas bubble disappears.

The use of co-generation is a growing phenomenon that may come to have a considerable role. At the panel discussion, William T. McCormick of Consumers Power told of a project being developed at Midland, Michigan. There, gas turbines will be used to generate 1300 MW of electricity. Low-temperature heat will be delivered to Dow Chemical to be used in chemical processing. Vendors have guaranteed on-line availability of 85 to 90 percent, which is much better than that of the usual power plant. Overall thermal efficiency will be 43 percent. Were new turbines available that are currently being tested the efficiency would be 47 percent. Many coal-fired power plants operate in the low 30s. Co-generation is likely to have increasing applications in commercial establishments where both electricity and heat are required. Again, high thermal efficiencies can be attained. As an alternative to turbines, electricity can be generated and heat recovered from natural gas by means of fuel cells. This is a technology recently developed under sponsorship of the Gas Research Institute.

There is no question about the versatility of natural gas as an energy source and its potential role in the generation of electricity, the principal question for the future is its price and the quantities available. Present spot prices of about $1.50 per million BTUs discourage exploration and drilling.

In any event, the electric utilities are embarked on a new and flexible course in their choice of generating equipment.—PHILIP H. ABELSON