Legal and Environmental Concerns Affecting Electric Utility Involvement in Cogeneration

Hallaron, Shirley A., Environmental Scientist, Sargent & Lundy Engineers, 55 E. Monroe, Chicago, Illinois 60603, USA

Abstract: The National Energy Act of 1978 included cogeneration as one of the leading strategies to help solve the nation's energy problems. As a result, many new regulations have been formulated to encourage the development of industrial cogeneration facilities. These regulations are aimed at reducing oil imports, conserving nonrenewable resources, and preserving air quality. The electric utilities are uncertain whether the regulations will accomplish these goals. They are concerned that the regulations will lead to the proliferation of small industrial cogeneration facilities giving rise to increased air pollution and other adverse environmental impacts. The utilities are also concerned that, because of the way the regulations are written, they will discourage the electric utilities from fully participating in the cogeneration process.

Cogeneration is the combined production of electric energy and some form of useful thermal energy (such as heat or steam) by the sequential use of energy from one fuel source: the reject heat from one process becomes the energy input to a subsequent process. The two basically different thermodynamic cycles used for cogeneration application, topping and bottoming, are differentiated on the basis of whether electrical or thermal energy is produced first. A topping-cycle cogeneration facility is one in which the energy input to the system is first used to generate electricity, with the reject heat then used to provide useful thermal energy. A bottoming-cycle cogeneration facility is one in which the energy input to the system is first applied to a useful thermal energy process, with the reject heat then used to generate electricity. Although the process of combined generation of electricity and thermal energy is not new, the term "cogeneration" is a new legislative one coined by congress to facilitate new regulations governing an old engineering practice.

The purpose of this paper is to examine current and emerging laws and regulations that affect cogeneration, and to show what effect the regulations might have on the interactions between electric utilities and industrial cogenerators. The paper will also highlight areas of environmental concerns associated with the cogeneration process as its use becomes more popular in the United States. The popularity of cogeneration is expected to increase since the Department of Energy is advancing the technique as one of the leading strategies in solving the nation's energy problems. This emphasis is placed on cogeneration because of its potential for turning waste heat into useful energy products, thereby serving the dual purpose of producing useful energy without the additional use of scarce fuels, and reducing thermal discharge to the nation's rivers and lakes.

The subject of cogeneration is of interest to the spacial scientist as one of the various energy alternatives having impact on the human environment. The search for ways to make the United States more self-sufficient in energy resources is as much of concern to the spacial as well as the physical scientist. This paper deals with cogeneration as one of the proposed methods to deal with the nation's energy problems. Other energy strategies such as solar, wind, geothermal, small-scale hydropower, and biomass are also being researched by spacial scientists.
Historical Background

Cogeneration has been in use in the United States since the early 1900's when most industrial plants cogenerated their own electricity and steam. Interest in cogeneration re-emerged in the 1970's along with the serious energy problems as one of the numerous strategies aimed at decreasing dependence on foreign oil, increasing domestic energy supplies, and increasing energy efficiency. The technique received more serious consideration than other strategies, from the regulators, because of its high potential to increase energy efficiency and its use of existing technology and facilities. Other energy alternatives require construction of new facilities and extensive research into new technologies. This renewed interest in cogeneration is expected to increase in popularity in the 1980's, spurred by continued rise in energy prices and increased incentives granted to industrial cogeneration facilities by regulatory agencies.

During the 1920's approximately 30% of the electrical energy requirements of the United States was satisfied by industrial cogeneration. Most industries at that time supplied their steam requirements for industrial processes and generated their own electricity in bottoming-cycle cogeneration facilities. By the late 1960's, electrical energy cogenerated by industry had declined to less than 20%. According to the Federal Energy Regulatory Commission (FERC), the amount of cogenerated electrical energy currently consumed in the United States has dropped to 4% of total power production (FERC, April 1980). This steady decline resulted from the relatively low rates commonly charged by electric utilities during this period coupled with what appeared for many years to be a limitless supply of cheap energy sources. Technical progress during this period encouraged the introduction of large generating units with the associated economies of scale that favored large central generating stations. Onsite industrial facilities could not compete effectively with the central generating stations, which could absorb the high capital costs of construction and enjoy lower operating expenses.

Since the oil embargo of 1973-1974, however, increasing oil prices, public concern for the environment and the availability of scarce fuels, and increasing costs for electricity have all combined to renew interest in industrial cogeneration. Another factor contributing to the renewed interest is the enactment of laws that grant incentives to qualifying cogeneration facilities. In 1978 Congress drafted the National Energy Act (NEA) in response to former President Carter's proposed energy policies. The NEA comprises five acts, three of which directly affect cogeneration activities. The major impacts of the three acts, which will be discussed in more detail later, were to require electric utilities to purchase excess power from, and supply backup power to, industrial cogenerators; exempt industrial cogenerators from restrictions on the use of oil and natural gas; and allow an additional energy tax credit to small industrial cogenerators.

The FERC, in keeping with the NEA, is promoting cogeneration as one means of achieving the goal of conservation of energy through more efficient use of energy resources. The FERC (June 1980) projects that by 1995 cogeneration could provide approximately 10% of America's electrical production, compared to 18% for nuclear and 3% for other combined sources (such as geothermal, solar, wind, and municipal waste). The FERC further estimates that the added capacity provided by industrial cogenerators and small power producers could allow electric utilities to differ the construction of about 12 large power plants.

Recent months have seen many orders for new electric generating stations cancelled or deferred for substantial periods of time; orders for nuclear power plants have been especially hard hit. Annual demand for electricity has been increasing at a decreasing rate. The US Department of Energy (1980) shows that demand for electricity increased by 6% during the 1970-1971 record-keeping year and by only 2% during the 1978-1979 year. Projections are for the average annual increase to level off at about 2%. With the demand for electricity leveling off, the electric utilities are not proposing the construction of many new facilities. Consideration is being given to the purchase of excess electricity cogenerated by industrial cogenerators as one means of meeting the small increase in demand. In addition, many utilities currently are making plans for new cogeneration facilities or retrofitting existing facilities for cogeneration. Engineering, economic, and operating considerations are generally recognized as important factors during planning stages. In addition, legal and environmental considerations must be evaluated early in the planning process because they may affect design and operating requirements. Potential regulatory problems often are relegated to the end of the planning process and thus are not fully addressed. This paper examines some of these regulatory considerations as they apply to electric utilities.

Waste Heat Utilization

Thermal power plants discharge wastewater, which has been used to cool the plant's condensers and heat exchangers, to the nation's rivers and lakes. This cooling water, being higher in temperature than the ambient water temperature, creates a thermal plume at the point of discharge. Waste heat discharged in a power plant's thermal plume is often considered a danger to the aquatic environment. It is argued that the use of this waste heat in industrial processes and space heating will significantly reduce the problem of thermal pollution. A general misconception about this waste heat is that power plants discharge boiling water. Waste heat from thermal power plants is in fact low-grade energy, approximately 38°C, and has a limited number of uses.