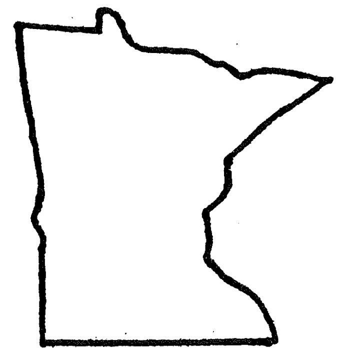

CONSIDERATIONS IN ELECTRIC POWER PLANT SITING

Plant Size

POWER PLANT SITING PROGRAM

MINNESOTA ENVIRONMENTAL QUALITY BOARD

7 DECEMBER 1979

The Minnesota Environmental Quality Board has the responsibility for locating electric power generating plants and routing electric transmission lines. The law that established the Board states, "The Board shall choose locations that minimize adverse human and environmental impact while insuring continued electric power system reliability..." This brochure discusses how the size of individual power plants can affect both electric system reliability and human and environmental impact.

Over the past several decades newly constructed power plants have increased in size as utilities sought to realize economies of large scale production. For example, if several generating units are located together at one plant site, some common facilities such as coal handling and ash disposal can be shared, making the operation more economical. Also, large pieces of equipment, such as boilers, and turbine generators are generally designed to be more efficient in larger sizes. Although there is nothing inherently more efficient about large boilers or turbines, the economic evaluations generally used by utilities allow proportionally greater capital expenditure as size increases.

The traditional process that led to larger and larger plant sizes was based largely upon an economics evaluation of a single plant rather than on the entire system. Some recent studies, however, indicate that a broader, system evaluation might show that smaller plants are most economical. Also, as land for plant sites becomes scarce, as awareness of environmental effects and the need to conserve energy increases, plant size can no longer be determined by economics alone. Power plants have expected lives of approximately 40 years and require approximately 10 years to design, license, and construct. Decisions made today will have environmental and energy effects for almost a half century into the future. It is imperative, therefore, that future considerations also be a part of today's decisions on power plant siting.

WASTE HEAT UTILIZATION

One increasingly important consideration in sizing a power plant is the question of how to utilize the energy that conventional plants waste. Generally coal-fired power plants discharge about 40 percent of the energy originally contained in the fuel into the condenser cooling system. The theromodynamics of power plants are such that not much can be done to reduce the amount of heat rejected to the condenser, however, much can be done to use rather than waste that heat.

For example, in urban areas or in industrial parks that waste heat could be used to heat office buildings, schools, or factories. Or, with proper planning, that heat could be used in industrial processes. Associated with the reduced need to burn oil to heat those offices, schools, or factories there could be an approximate reduction in sulfur dioxide pollution by about 1.7 million pounds per year from a single 200 megawatt power plant supplying district heating. Consider again that a power plant, sited today, will be around for approximately 50 years. Even if there are no immediate plans to utilize the waste heat, it may be wise to keep that option available for the future.

Another possibility for using waste heat should be particularly interesting to rural Minnesotans. The possibility exists to use power plant waste heat in the production of ethanol from agricultural wastes. The ethanol could, in turn, be used by the utility as a fuel to generate electricity, thus providing both a market for agricultural wastes and an alternative fuel for electricity generation.

If waste heat is to be utilized, it seems likely that smaller power plants offer greater potential than larger plants. The amount of heat rejected by an 800 megawatt plant is probably greater than the amount that can be effectively utilized at one location. Also, if agricultural wastes are to be used in ethanol production, several smaller plants distributed over a region will probably allow more efficient collection of those wastes than one large, centrally located plant.

ELECTRIC SYSTEM RELIABILITY

The size of a power plant also affects the reliability of the power system, the amount of capital investments by the utility, and the ability of the electric utlity to accurately match their electric load with their generating capabilities.

It apears that smaller generating units are more reliable than larger ones. Smaller plants are generally less complicated and have fewer components to break down. When a smaller plant does break down, the disruption to the power system is less than if a larger plant had failed. Also it is unlikely that several smaller plants would break down at the same time causing a large reduction in generation equivalent to the loss of a single larger unit.

Because of the increased reliability of smaller plants and the unlikely chance that several smaller plants will fail at the same time, utilities with a preponderance of smaller plants may require less reserve capacity than utilities with larger plants. For example, one study*, comparing a system with all large generators to another system with all small generators, concluded that the system with smaller generators was most economical and required less total generating capacity that the system with larger generators.

LAND REQUIREMENTS

Obviously larger power plants require more land than smaller plants. But larger plants do make more efficient use of land. On a basis of acres of land required per megawatt of electricity generated, larger plants require less land than small plants. Following is a tabulation of the land requirements for various sizes of power plants.

		PLANT SIZE (MW)			
PLANT SYSTEM	50	200	400	800	2400
Boiler-Turbine	1.5	1.8	2.0	4.0	10.0
Fuel Supply	5.0	15.0	26.0	28.0	140.0
Cooling System	8.0	15.0	20.0	25.0	60.0
Water Quality	1.0	1.5	2.0	4.0	10.0
Solid Waste-20 ft.Deep	63.0	165.0	315.0	610.0	1760.0
Buffer Zone	35.0	90.0	160.0	326.0	970.0
Trans. Switchyard	1.5	2.0	3.0	7.0	18.0
Total Plant (Acres)	115.0	290.3	528.0	1024.0	2968.0
(Acres/MW)	2.3	1.45	1.32	1.28	1.24

Considering all of Minnesota then, more land is required if our electricity is generated in many smaller plants rather than fewer larger plants. However, the number of locations where large plants could be sited with acceptable impacts is very limited.

*The study will be made available on request to the MEQB.

SOCIAL EQUITY

Most people can imagine the burdens of having a power plant for a neighbor - noise, pollution problems, unpleasant appearance to name a few. But there are also benefits. An 800 megawatt plant requires a peak construction work force of approximately 1000 workers. After being completed, such a plant would employ approximately 200 people. Additionally, a power plant substantially increases the local tax base. If measures are taken to utilize the waste heat from power plants the locality could become attractive to small industrial parks Further benefits in the form of jobs and increased tax base, could accrue to the neighbors of the power plant.

If fewer, larger plants are built, the burdens and benefits are shared by relatively few people. However, if smaller, more dispersed plants are built, the benefits and burdens of generating electricity are more evently distributed among the people who use the power.

SUMMARY

The considerations involved in sizing and siting power plants involve many different issues. Some are complex technological or economic. But many are subjective involving social, esthetic or predictions of the future. You are urged to make your feelings known and to participate in the process.

To communicate your ideas or to receive a copy of a report entitled "Definition of Model Coal-Fired Electric Generating Stations in the 50 MW to 2400 MW Range please write:

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