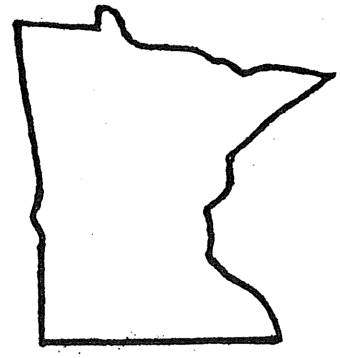

CONSIDERATIONS IN ELECTRIC POWER PLANT SITING

Coal Transport versus Electric Transmission

POWER PLANT SITING PROGRAM

MINNESOTA ENVIRONMENTAL QUALITY BOARD

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Two somewhat alternative considerations exist when siting a coal-fired power plant: site the plant near the electrical load and deliver coal to the plant or; site the plant near the source of coal and deliver electricity to the load by transmission lines. This brochure outlines some of the power plant siting considerations that relate to coal transportation and electrical power transmission.

To put the issue in perspective, consider that over 80 percent of the nation's coal is burned to produce electricity. A typical 800 megawatt plant operating at full load consumes approximately 475 tons of coal per hour. If that typical plant is located in Minnesota and burns low sulfur western coal, the transportation cost of the coal will be about ¼ the total electrical power cost. So the cost of coal transportation is a significant part of the cost of electricity. But transmission lines have their own problems. Depending upon land use practices in the region crossed, transmission line effects can range from an adverse esthetic impact to a complete elimination of a strip of land from particular uses. The costs of transmission lines will vary, depending upon the amount of power transmitted, terrain crossed, and existing land use. And, depending upon the voltage, controversies exist on the environmental and human health effects of transmission lines.

Coal Transportation

For the quantities of coal involved in electrical power generation, railroads or barges are the currently practical methods of transportation. Barges can serve Minnesota from Lake Superior or from the Mississippi, Minnesota, or St. Croix Rivers as far upstream as the Twin Cities, Shakopee, or Stillwater respectively. Assuming though that a power plant is not located on the shores of one of those waters, a rail system would still be required to get the coal from the barge unloading point to the power plant. To avoid the repetitious handling of coal at a barge-railroad transfer point, and because Minnesota power plants generally burn low-sulfur western coal, coal transport in Minnesota probably means railroads.

Most utilities use "unit trains" to transport coal. Unit trains generally have 100 cars--each with 100 ton capacity--and operate only between a coal mine and the power plant without being uncoupled or mixed with other freight. They carry coal from the mine to the power plant and then return, empty, to the mine. Although only little of Minnesota's existing rail facilities are now capable of handling unit trains, most could be upgraded to do so. Because greater than 80 percent of Minnesota lies within 12 miles of existing railroad tracks, coal transport by railroad will probably require relatively little new construction to serve any new power plant site.

However, a potential for adverse impacts from increased rail traffic on existing tracks still exists. Such potential impacts include: delays at road crossings; environmental problems due to noise and air pollution; and community development problems such as inhibition of residential or commercial development due to reduced community attractiveness. And coal transport requires diesel fuel, derived from oil which may become increasingly limited or expensive in the future.

Electric Transmission Lines

Electric transmission lines serve three principal functions: "outlet lines" connect an electrical generator to the utility's system; "system lines" connect all the utility's generators and loads, and provide alternate paths between various loads and generators to increase system reliability;" interconnection lines" connect the systems of various utilities, allowing them to share generating capacity and help each other during emergencies.

The power that can be transmitted by a transmission line is proportional to the voltage multiplied by the current. To transmit a given amount of power then, if voltage is reduced current must be increased, or vice versa. To accomodate higher voltages, higher towers are required to keep the conductors further from the ground. Also, greater space is required between the conductors so a larger right-of-way is required. To accomodate higher values of current larger conductors are required. This adds weight to the transmission line, so more towers, spaced more closely together are required. And higher transmission line losses generally result from higher current values. It's a difficult situation. Many people are opposed to increasingly high voltage levels but increasing the voltage is probably the most efficient way to increase the power that can be transmitted, and that decreases the total number of transmission lines required.

Several alternatives to establishing new rights-of-way exist when routing transmission lines. One alternative is to make use of existing rights-of-way, either with a separate set of towers for the new line or by increasing the capacity of the existing line. In some cases, particularly where advanced planning is practiced, transmission line towers can be constructed with the capability for two circuits. That way, when additional capacity is required, a new circuit can be added to the existing towers. Another alternative is to follow existing highways or railways. Following existing routes such as these minimizes the new impacts of a transmission line, but it means that areas, or people, already bearing a burden have an additional burden. Also, reliability may be reduced if transmission lines share towers or rights-of-way.

Shared rights-of-way also can reduce the amount of land required for transmission lines. And design variations exist, such as using different types of towers or insulators, that affect the amount of right-of-way. Depending upon these variations, land required for a transmission line right-of-way ranges from about 7.2 acres per mile at 138,000 volts to 24.2 acres per mile at 500,000 volts. But right-of-way land is not necessarily lost to all other forms of production. In agricultural areas, farming can generally be carried on under the transmission line, however, at the higher voltage levels special safety precautions may be required and controversies exist over the effects of transmission lines on agricultural and human health. In forested regions, the right-of-way must be kept clear of trees that would eventually grow to interfere with the conductors. In regions where mature forest habitat predominates, transmission line right-of-way can be maintained in a shrub or grassland habitat to provide habitat diversity which may increase wildlife diversity. Where transmission lines pass through public lands, recreational trails can follow the right-of-way.

Another alternative for electrical transmission is the use of underground systems. Insulating materials, rated up to about 345 kV are now available but such systems are very new, and very expensive. The reliability of such systems has not been determined through extensive operating experience. But the possibility for underground transmission in sensitive areas exists.

The Minnesota Environmental Quality Board is eager to hear from you regarding your thoughts on coal transport versus electric transmission. If you have any ideas or wish a more detailed report on electric power systems entitled: "Definition of Model Coal-Fired Electric Generating Stations in the 50 MW to 2400 MW Range, please contact:

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