WATER TRANSPORTATION OF ENERGY MATERIALS

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The nation's recognized navigation system is composed of 26,700 miles of inland and intracoastal waterways, the Great Lakes-St. Lawrence Seaway system and the ports and harbors serving these waterways. Providing direct access to 131 of the nation's largest cities and to almost all of the contiguous states, transporting energy resources along these waterways involves innumerable issues and problems.

The following discussion will focus primarily on the movement of coal on the Mississippi River system and the Great Lakes--the current picture, future developments and the industries' ability to respond to expanded use. The need for deep water ports on the West Coast to accommodate super tankers hauling petroleum from Alaska's North Slope will also be briefly discussed.

Although this encompasses only a small part of the total picture, the issues surrounding these areas are the ones that must be addressed and resolved now, as they are the ones most crucial to the nation's immediate energy needs.

Recent changes in oil prices and President Carter's energy message point to some important shifts in the use of coal and oil in the U.S. Carter's ceiling of 8.5 million barrels per day for imported petroleum will likely result in a substantial shortfall between increasing demand and decreasing supply. Potential increased domestic oil production will probably only partially compensate for reduced imports.

Carter also called on utilities to reduce by 50 percent the amount of oil used to generate electricity. Although he did stress the need to have nuclear-fired generating capacity in the U.S., his message implied a go slow policy until safety questions are resolved.

All of these changes point to an increased demand for coal--coal for electrical generation, coal for the development of synthetic liquid fuels, and coal to replace oil in industrial processes. Substantial deposits of domestic coal are available in Appalachia, the Illinois basin and the western states of Montana, Wyoming and North Dakota. The inland waterway system and the Great Lakes are expected to play an important role in transporting this increasing volume of coal.

Transportation on the Mississippi River System

The Mississippi River, its tributaries and the Gulf Intracoastal waterway network are essentially one inland waterway system that carries most of the nation's waterborne cargo. This system comprises about 55 percent of the length, 70 percent of the ton-mileage, and 85 percent of the total tonnage of waterborne traffic in the U.S.

The Mississippi River system is the largest and most improved component of the inland waterways. Barges move approximately 123 million tons of coal per year as well as significant amounts of petroleum along the 9,000 miles of navigable channels. In total, coal and petroleum account for about 60 percent of all transportation on the river.

The Lower Mississippi system, between the mouth of the Ohio River and Baton Rouge, has the largest amount of traffic, transporting more than 90 million tons of cargo per year. In the Upper Mississippi system, barges transport 56 percent of the Upper Midwest's grain exports, 41 percent of the area's fertilizer, and 28 percent of its refined petroleum products. In addition, electricity derived from barge-transported coal serves about one of every three persons residing in the Upper Mississippi River Basin.

Currently, shipment of coal to Florida via the inland waterway system is being considered as a possible alternative to more costly rail shipments. Because the rail line grades from the Appalachian coal mines are designed for northbound traffic, it is extremely expensive to ship coal south to Florida. It is estimated that ten thousand tons of coal can be transported north for every thousand tons transported south. In fact, it is actually cheaper for Florida to import coal from South Africa or Australia.

A preliminary study of the cost figures shows that moving western coal to the Mississippi via unit train, transferring it by river barge to New Orleans and then by ocean barge to Florida, would definitely be less expensive than rail shipment from Appalachia and may also be cheaper than importing African or Australian coal.

With the exception of lake carriers, transport on inland waterways has generally been found to be

more fuel-efficient than other modes of transportation. The Department of Transportation has estimated that one gallon of fuel will move 300 ton-miles of freight by water, 180 ton-miles by rail, and 50 ton-miles by truck.

For this reason, barge rates are generally lower than rail rates (0.4 to 0.7 cents per ton-mile). However, if river transportation is used only for a short distance, or if the river route increases the total distance the coal is shipped, an all rail movement may be cheaper.

According to a 1976 study by the Electric Power Research Institute (EPRI), there are four constraints that limit the annual throughput of the inland waterways system: operating season, channel depth, channel width and locks.

Operating Season

The Upper Mississippi River and the Missouri River are the only two waterways that have restricted operating seasons. The former operates 8.5 months a year; the latter, 7.5 months.

Channel Depth

The typical river barge and towboat can operate on all rivers with a channel depth of 9 feet. In the Lower Mississippi system, channel depth generally exceeds 9 feet, while in the Upper Mississippi system, dredging operations are often required to maintain a 9 foot depth.

Channel Width

Although some narrow sections of the river limit the number of barges that can be moved at one time, there is generally no practical capacity limit in the open stretches of the waterway system. Most barges are about 200 feet long and 35 feet wide. Unless restricted by physical characteristics of channel width or river velocity, one towboat can handle up to 30 barges.

Locks

The major constraint to current inland waterway traffic is lock capacity. The length of a tow, including towboat, can be almost equal to lock length (or double the lock width). The longer the tow, the more time is required for it to traverse a lock, which can result in traffic congestion.

River operators consider that a lock is reaching capacity when average delays reach six hours per tow. Currently, delays of six hours or more are occuring at several locations in the Upper Mississippi system, especially at Lock and Dam 26 at Alton, Illinois.

River traffic is growing at an annual rate of three to four percent per year. The barge industry has the capacity to double the number of barges and towboats in a relatively short period of time and should be able to respond to increased demands very quickly. This assumes that congested locks such as Lock and Dam 26 are improved and other handling facilities are built.

Another potential problem is the threat of increased transportation costs due to user charges such as a fuel tax or toll. The Federal Government is currently considering the user charge as a means to offset maintenance costs.

At this time, the Mississippi River enjoys the lowest operation and maintenance cost per ton-mile (less than half the system average) of any segment of the inland waterway system. It is estimated that the impacts of a user charge on the Upper Mississippi River system would increase barge rates about 15 to 20 percent on the average. A recent study by the University of Minnesota Department of Agricultural and Applied Economics suggests that user charges may increase the barge traffic on the Upper Mississippi by diverting it from higher cost segments of the inland navigation system such as the Missouri.

In any case, the user charge is a controversial issue which has raised such questions as: how will it affect the competitiveness of water transportation relative to other transportation modes?; would it cause major shifts in traffic patterns?; and how much would a "viable" water transportation system cost the taxpayer?

If user charges greatly increase total transportation costs, some traffic would no doubt be diverted to trucks and railroads. This potential result must be seriously considered, both in terms of overall transportation needs and, because barges are more fuel-efficient, in terms of the nation's overall energy situation.

Transportation on the Great Lakes

In 1977, the Great Lakes carried approximately 40 million tons of coal and lignite and about 9.5 million tons of crude oil and petroleum products. By 1978, total U.S. tonnage moved on the Lakes was 169 million net tons; a 21 percent increase over 1977, in spite of the iron ore miner's strike during the fall.

The Great Lakes have a surface area of 95,000 square miles and 1,700 miles of navigable water connecting the system to the Atlantic Ocean. In the past, a large volume of coal was moved from the east to the west via the Great Lakes. Today that system is being reversed, due primarily to environmental and economic concerns.

Eastern coal has a higher sulfur content compared to western coal. Also, according to a 1976 estimate by the Bureau of Mines, approximately 80 percent of our nation's demonstrated reserve base of 438 billion net tons of coal is located west of the Mississippi River. Montana and Wyoming contain over 40 percent of our demonstrated reserve base and about 80 percent of our country's low sulfur coal.

Because of its abundance, low sulfur content, and inherent economic advantages western coal is being relied upon to provide a major portion of the nation's energy needs. This is particularly true for the energy-poor Eastern and New England states.

Over the next 25 years, the Great Lakes is expected to play a vital transportation role in the tremendous resurgence of coal usage. The major growth will be in the intermodal movement of western coal to the Eastern areas of the country.

Unit coal trains leaving the western mines are typically 100 to 110 cars long. Equipped with automated loading and unloading functions, they can be unloaded at modern transshipment facilities in less than four hours using automated single or double car dumpers.

The coal transshipment facility at Superior, Wisconsin is representative of state-of-the-art facilities today. Constructed by the Detroit Edison Company, the automated unloading process at Superior is completed in just over two hours on the average. The coal is reloaded into a 105 foot by 1,000 foot collier at the rate of 10,000 tons per hour.

The Superior facility also includes such environmental and safety features as dust suppression and

collection systems, water treatment and spark-free motors.

Aside from another transloading facility at Thunderbay which has a loop track to facilitate train movement, there are very few, if any, facilities on the Lakes designed to receive and handle coal in the same way.

The economic advantages of high volume, low water transportation freight rates combined with low unit train rates are readily evident. A modern intermodal transportation system could deliver western coal to Buffalo, New York, today at a lower price, on a Btu basis, than the FOB price TVA recently paid for 15 million tons of high Btu, low-sulfur eastern coal.

In addition to lower transportation costs per ton-mile and greater fuel efficiency, the water transportation mode via the Great Lakes eliminates the major environmental problems of unit trains hauling western coal eastwards. A 1,000 foot collier with a capacity in excess of 68,000 net tons can carry the contents of six 110-car unit trains. Bypassing all metropolitan areas, transporting coal via the Great Lakes eliminates noise pollution and community disruption.

The main obstacles to navigation on the Great Lakes are the narrow and shallow connecting channels between lakes. The Illinois Waterway that joins Lake Michigan with the Mississippi River and the channel in Oswego, New York, where the Hudson River Waterway enters the Great Lakes, are typical examples.

Constraints to expanded shipment of coal on the Lakes include limited availability of equipment, the need for up-to-date facilities and the capital expenditure needed to remedy these problems.

According to the EPRI study previously mentioned, the existing Great Lakes fleet is already committed and the number of ships that could be made available for hauling coal is limited to new vessels currently under construction. There are three new ships under construction for hauling coal in the Great Lakes. These ships will be able to carry 50,000 tons per trip, 40 trips per year; or 2,000,000 tons per year. Approximately ten new ships could be constructed per year. Thus, 20 million tons of annual capacity could be added.

A related issue is that of tanker sizes and lock capacities. To efficiently transport increased volumes of coal, larger vessels will probably be required. Current studies on tanker size suggest that the optimum size for lake vessels is 140 feet by 1,200 to 1,300 feet. Although 1,500 foot vessels have been studied, it is estimated that fuel efficiency would decrease significantly.

To accommodate vessels of this size, locks would have to be modified or replaced. Of the four Sault Ste. Marie locks, only one--the Poe Lock--is long enough to accommodate even 1,000 foot vessels. Given the increased tonnage anticipated from western coal and iron ore pellets in the super colliers, the U.S. Senate has authorized a study by the U.S. Corps of Engineers on the need for and feasibility of a second, modern lock to replace the Sabin or Davis Lock, or perhaps both.

In addition to the cost of updating or replacing these locks, the fixed cost for a super collier is high. A new self-unloading vessel belonging to the American Steamship Corporation cost about $53 million.

With these high costs, it would be desirable to extend the navigation season on the Great Lakes to more than the current eight months. The U.S. Corps of Engineers has already demonstrated its ability to keep the Sault Ste. Marie locks open 10 to 12 months during the year. However, this extended navigation period has required the stepped-up replacement of some of the Coast Guard's obsolete ice breaking vessels, resulting in yet another expense.

Given the current limited navigation season on the Great Lakes, adequate stockpiling capacity should be incorporated into transshipment facilities. The underground feed-reclaim system developed for the Superior terminal is an excellent prototype for future storage and reclaim systems.

The need for modern, efficient transshipment facilities such as the one at Superior has already been alluded to. However, this again raises the cost factor. The Superior facility cost in the range of $45-50 million when it was built in 1976.

To achieve optimum operating efficiency in terms of invested capital, such a facility should ideally handle one large vessel per day. However, many potential western coal users will not have the need for 68,000 net tons of coal. Thus, the concept of multiple users should be explored and developed.

However, since 85 percent of the coal currently being burned is used by electric utilities, their demand requirements justify the development of a modern infrastructure for the distribution of coal. Once that infrastructure is in place, other small volume industrial and commercial customers should be able to make use of the distribution network and derive the economic advantages of unit train and super collier rates.

The capital investments outlined above are indeed significant and raise the question of whether an all-rail system would be more feasible. Although railroads will also play an important role in transporting the increasing volumes of coal, water transport via the Great Lakes will continue to provide an economic, as well as environmental, advantage.

First of all, the costs involved in upgrading and maintaining a rail system to haul the projected amount of coal could prove prohibitive. The railroads are expected to move about 799 million tons of coal in 1985. This projected coal movement would require a total capital investment of $6.1 billion. This estimate includes $2.4 billion for freight cars, $1.5 billion for locomotives and $2.2 billion for fixed plant additions and expansions. The country may not be able to afford the capital investment required to make an all-rail system work.

Secondly, the environmental and social costs, especially in the more populated areas east of the Mississippi, could be larger than the problems faced in using the Great Lakes where vessels move silently away from the metropolitan complexes and population. Thus, expanding the Great Lakes coal transportation system seems to be a very viable alternative.

Alaskan Oil and the Need for West Coast Oil Ports

Vital to the nation's energy goals will be the increased production of domestic oil resources. Although it is unlikely that domestic production can totally compensate for reduced imports, the potential does exist to increase production on Alaska's North Slope up to two million barrels per day. An important link in moving this oil from the North Slope to the existing pipeline system will be new deep water oil ports on the West Coast to accommodate the super tankers hauling the oil. There have been several proposals for oil ports in Washington State, in southern California and in Canada.

Kitimat

One proposal for transporting Alaskan oil into

the Northern Tier states of the U.S., was the recently withdrawn Kitimat proposal. This proposal would have required a deep water port on Canada's west coast at Kitimat. A pipeline would have been built to connect with existing pipeline systems at Edmonton. Oil from the Alberta oil fields is already being shipped into Minnesota from Edmonton on the Interprovincial pipeline. But with a drop in Canadian imports the extra capacity on this pipeline could be used to transport Alaskan oil.

Sohio

Another proposal, which has also been withdrawn, was the Sohio project. This proposal called for a new port at San Diego, California, and construction of a pipeline across the southern states into Texas where it would connect with the existing system.

Foothills

A third proposal, the Foothills or Skagway system, would bring the oil around the horn of Alaska and then follow the McKenzie River down to the Edmonton area refineries.

Trans Mountain

A fourth proposal, the Trans Mountain project, would come through Washington's Puget Sound up to the existing Trans Mountain pipeline which would be reversed to take crude up to the Edmonton area and then back into the Interprovincial pipeline. Under this proposal, Alaskan crude oil would be shipped into an expanded port facility in Washington State. Because the Marine Protection Act of 1977 was amended to prohibit any new tanker ports in Puget Sound, a modified Trans Mountain proposal with the construction of a new port at, or west of, Port Angeles, has been suggested.

Northern Tier

A fifth proposal, Northern Tier pipeline, would also require a new port facility at or near Port Angeles, Washington. From there, the crude oil would be transported through a pipeline to be constructed across the states of Washington, Wyoming, North Dakota and into Minnesota to connect with existing systems.

One of these proposals will probably be selected. At any rate, development of a West Coast oil port in the near future must be planned for. President Carter has pointed to the need to expedite the building of such a port in his recent messages on energy. To this end, he has suggested the creation of a new arm of the Federal Government to work through a number of often conflicting state, local and national regulations on the siting of such a facility.

Before production of Alaska's oil can be increased however, a way to use the gas that caps the oil deposits must be found. One way is to simply flare it, but such a method is obviously wasteful of precious energy resources. On the other hand, if a natural gas pipeline system such as the AlCan can be built, production of Alaskan petroleum can increase without flaring the gas.

President Carter has talked about strengthening cooperative efforts with Canada, specifically to bring natural gas from the North Slope through Canada on the AlCan system. The importance of such cooperative efforts cannot be overemphasized.

In conclusion, the subject of transporting energy materials by water raises a multitude of complex issues and problems, a few of which have been discussed here. To answer all the questions would involve a major study. It seems obvious, however, that the use of domestic oil and coal resources will, of necessity, increase; that water transportation of these resources will also increase significantly; and that if this nation is going to meet some of its energy goals, these increases must occur rapidly.

With the expanded use of any resource, there are problems--economic, environmental and social--that require conscientious and comprehensive solutions. An influx of capital will be needed to build the necessary facilities and to resolve the tough environmental, safety and security questions. Is the nation willing to invest the large sum of money that will be required? This question must be answered soon.