MARKET DEVELOPMENT POTENTIAL
for the
COMMODITY CARGO TRANSPORT
between
ALASKA, CANADA AND THE NORTHERN TIER

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INTRODUCTION

There is renewed interest in the connection of the Alaska Railroad with the rest of the North American rail network (Ref. 1). The economy of Alaska is becoming increasingly intertwined with the rest of the United States as a north-south orientation. In addition, the Canadian provinces are becoming more interconnected to their southern neighbors in the United States and Mexico as north-south interlinkages become greater. The completion of the railway link between Alaska and British Columbia is the one major element in the completion of the North American rail network, as shown in Figure 1.

There are several reasons why the completion of the railway from Canada to Alaska would be beneficial for all of the affected regions. The completion of the railway line from Canada to Alaska would reduce the transportation costs of goods hauled to Alaska. The result would be a reduction in the cost of living to Alaska residents. It would then become easier and cheaper to export raw materials from Alaska to Canada and the Lower 48 States of the United States. Fuel and mineral resources produced in Alaska would then become more competitive from a price standpoint in the lower 48 states as compared to alternative sources.

The completion of the construction of the railway from Canada to Alaska can also influence trade patterns in North America and throughout the World. The recent passage of the North American Free Trade Agreement (NAFTA) between Mexico and the United States in 1993 has led to a major expansion in north-south trade between the three countries. It has been estimated that the volume of north-south trade in North America has increased by 5.0 percent per year from 1993 to 1999. The total volume of the east-west trade in North America during the same period has only increased by 1.5 to 2.0 percent per year.

There is the potential for extending the North American railway network to the south from Mexico to South America by way of Central America (Ref. 2). There have been roposals advanced to develop a unified rail, road, air and marine transportation system among all of the nations of North and South America. The Western Hemisphere Transportation Ministers' conference held in New Orleans in December 1998 agreed to begin the planning for such a unified transportation system as a part of a future trade area of the Americas (Ref. 3). The route layout for a proposed Western Hemisphere rail network is illustrated in Figure 2.

There is also the possibility of increases in east-west trade by way of Alaska to Asia and Europe. A recent article by Gillespie (Ref. 4) in 1998 in the Alaska Business Journal described the possibility of completing an underground railroad tunnel beneath the Bering Strait. There have been a number of proposals made to build a railroad tunnel under the Bering Strait, but have so far been unrealized (Refs. 5,6,7,8). The construction of a railroad tunnel under the Bering Strait would allow a Worldwide railroad network to be developed as shown in Figure 3. Alaska and neighbor Chukotka would then become the American and Asian World trade centers for a future worldwide rail network connecting all continents.

BACKGROUND

The earliest efforts to develop a railway line between Alaska and Canada with the Lower 48 States were actually a part of early proposals to develop a Worldwide railroad network. There were reported but unsubstantiated reports of a proposed as early as the late 1860's after the-Civil War to build a railway line from Denver to Paris by way of Alaska and Russia (Ref. 9). This railway project was to be a part of the efforts to construct the Trans-Siberian Railway being constructed under the direction of Count Sergei Witte (Ref. 10). However, these efforts never came to fruition because other railroads needed to be built in more populated areas.

The completion of the Trans-Siberian Railway from Moscow to Port Arthur in 1903 and to Vladivostok in 1908 led to the formation of a company in the State of New Jersey in 1906 (Ref. 6). The purpose of this railway was to connect Paris and Moscow with New York plus Fort Nelson and Edmonton in Canada to Chicago and New York. This company was incorporated with $6 million U.S. in equity capital with French, Russian and American investors with the purpose of operating both freight and passenger service. This project was halted by the onset of World War I (Ref. 11) and was not restarted.

After World War II, there were extensive surveys of railway line development under the direction of Joseph Stalin in Russia. These efforts led to the surveying and grading of the entire Northern Arctic railway along the Arctic Ocean from Vorkuta to Egvekinot over 4,000 miles. In addition, route surveys and engineering designs were conducted of the 2,500 mile long rail corridor from Yakutsk in the Sakha Republic to the Bering Strait (Ref. 12). These efforts were suspended upon Stalin's death but reappeared in a book by Chersakov in Russia in 1993 to build a railway from Moscow to New York, as shown in Figure 4 (Ref. 13). In the United States there were also efforts made by the Czech engineer George Koumal, who proposed building a tunnel under the Bering Strait (Ref. 5).

The concern about the possibility of constructing a railway line to Alaska began with the purchase of Alaska and the Aleutian Islands from Russia in 1867. Russia at that time sold Alaska to the United States in part because it lacked the transport infrastructure to maintain these remote regions. The initial development of Alaska began in the 1890's with the discovery of gold, but did not become significant until the onset of World War II in 1941.

A number of military facilities were built in Alaska during World War II to begin the development of its infrastructure. One of the major projects was to connect Alaska with Canada by either a highway or rail line. The roadway was built as an alternative to the railway because of its lower initial cost and shorter construction time. In addition, the initial street shortage during World War II resulted in a greater priority being given to tanks and artillery than a railway at that time (Ref. 34).

The Alaska Railroad was originally chartered as an initial part of this infrastructure by the United States Congress in 1912 through the establishment of the Alaska Railroad Commission. The authorization of $35 million U.S. for railroad construction by the U.S. Congress in 1912 was approved by President Wilson in 1914 to make it possible to begin layout, design and construction. The legislation approved called for the construction of 1,000 miles (1,600 km) of railroad lines in Alaska from the interior to an ice-free port along the Pacific Ocean at the Southern end of the Kenai Peninsula.

It was originally decided to build the Alaska Railroad from the ice-free Port of Seward at the South of the Kenai Peninsula to the Fairbanks area via Anchorage with a total length of 515 miles (825 km). This original section of the Alaska Railroad was finally completed in 1923 at a cost of $60 million and was dedicated by then President Warren Harding.

The Alaska Railroad was extended for an additional 20 miles (38 km) to Eielson during the 1950's as a part of its rebuilding and expansion to serve Eielson Air Force Base as a new facility with a total length of 535 miles (860 km). As a result, there are 465 miles (745 km) of railroad line, which remain unbuilt by the Federal Government in Alaska under the terms of this originating legislation passed in 1912 (Ref. 14), which could be constructed in the future.

The Alaska Railroad as an operating railroad line was owned by the Federal Government, but had relatively little traffic upon its initial completion so that it required an annual Congressional appropriation until 1938. The line's traffic greatly increased during World War II and thereafter so as to never again require an operating subsidy. The line was rebuilt during the early 1950's at a cost of $100 million U.S. so as to be able to handle the increasing traffic demands associated with the Korean War and then the Cold War.

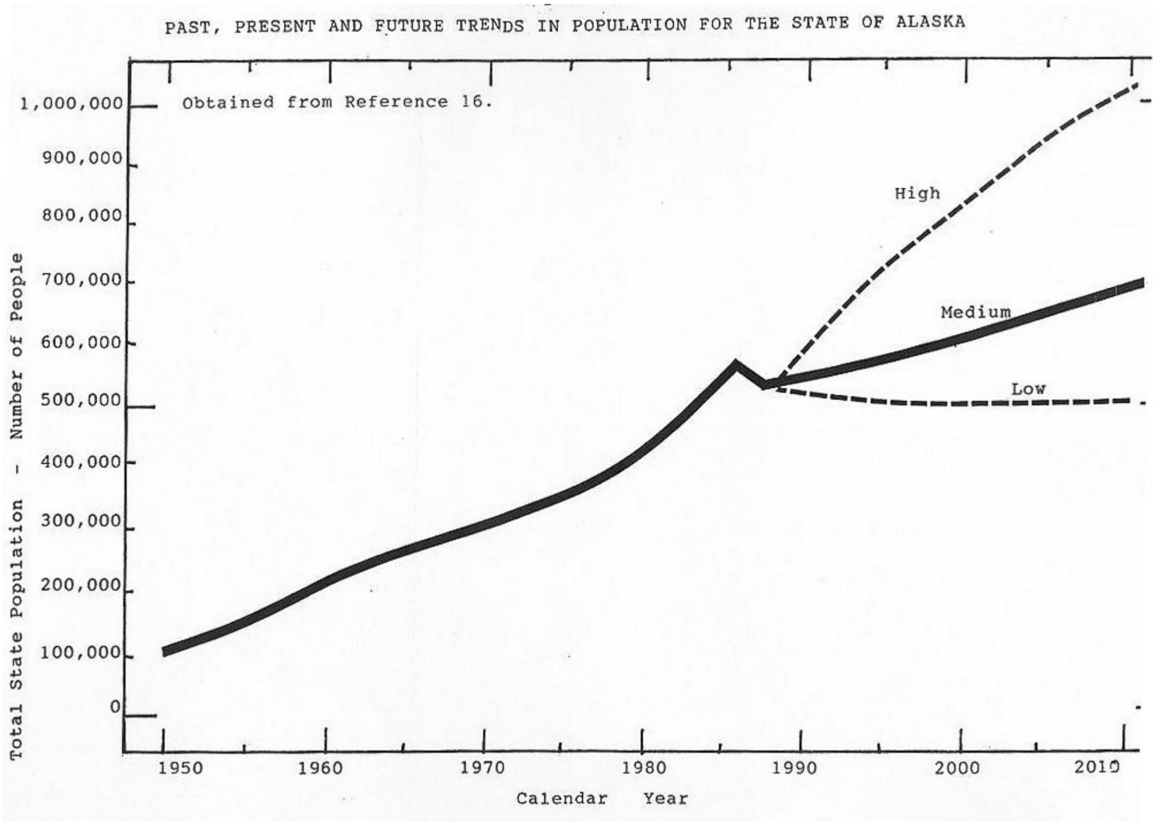
The Alaska Railroad was finally sold by the Federal Government to the State of Alaska in 1984 for $23 million U.S. and continues to be under the present ownership by the State of Alaska under profitable operation today.

One of the main reasons for the development of the military infrastructure in Alaska was to allow for supplies to be transported to Russia to assist in its war effort with Germany during World War II. The development of the civilian infrastructure of Alaska began in earnest after the end of World War II. The economic growth of Alaska greatly accelerated following the development of the Prudhoe Bay oil field on the North Slope after 1975 with the construction of the pipeline to Valdez to facilitate crude oil shipments to the West Coast of the United States.

As a result, the population of Alaska has grown from 100,000 in 1950 to 500,000 in 1990 and to an estimated 600,000 in 2000. The population of Alaska could reach 700,000 to 1,000,000 by 2010, as shown in Figure 5 (Ref. 15). The population growth of Alaska appears to be closely following the medium scenario for development at an estimated rate of increase of 1.4 to 1.5 percent per year. In excess of 70 percent of the total population of Alaska lies within the so-called "Rail Belt" between Seward, Anchorage, Denali and Fairbanks.

INFRASTRUCTURE

There is a parallel need to develop the railroad infrastructure of the Northwestern part of North America in order to provide a suitable degree of economic integration with the railroad systems of Canada, the United States and Mexico and eventually to Asia. Railroads generally provide the most suitable means for land-based transportation of large quantities of freight and even passengers in the far northern climates of Canada and Alaska. These superior characteristics of railroads over highways occur because of their relative ease of maintenance with respect to frost heaves in permafrost, their greater resistance of materials to extremely cold temperatures, and their inherently greater energy efficiencies and lower land use requirements.



The railroad network in Alaska is relatively minimal at the present time with only a single North-South corridor in the South-Central part of the state known as the "Rail Belt". There is a 535 mile long railroad line from Seward at the Southern end of the Kenai Peninsula through Anchorage on the Cook Inlet to the North as far as Fairbanks in the central interior of Alaska and then East to Eielson Air Force Base, as shown in Figure 6. There is also a branch line from Portage to Whittier, which allows access to boat traffic to Southeastern Alaska. A rail-barge service connects from Whittier to Prince Rupert in British Columbia and to Seattle, Washington in the Northwest comer of the Lower 48 States to and from the Port of Whittier. There are also several small branch lines to specific industries and mining operations on the route to the coal mine at Healy, the gravel mine at Palmer and others.

These railroad operations in Alaska are all owned and operated by the Alaska Railroad Corporation. The Alaska Railroad Corporation is owned by the State of Alaska with its headquarters in Anchorage. The Alaska Railroad hauls considerable amounts of petroleum products, coals, gravel, wood, chemicals and intermodal freight. The overall freight traffic level on the Alaska Railroad was 5.1 million short toms (4.6 million metric tons) hauled in 1991, as shown in Table 1. This level of railroad freight traffic is expected to grow significantly in the future, as illustrated in Figure 7 (Ref. 16).

The total revenue produced from the hauling of this 5.1 million short tons of freight in 1991 was $48.0 million U.S. The Alaska Railroad also hauled 471,217 passengers in 1991, which has divided between the regular coach and tour business, to produce a revenue of $16.4 million. The total revenue on the Alaska Railroad in 1991 from the combined freight and passenger services was $68.3 million U.S. as compared to expenses of $63.9 million U.S. to result in a net profit of $4.4 million U.S. as shown in Table 2 (Refs. 17,18,19).

The total freight traffic on the Alaska Railroad was estimated as approximately 9.5 million short tons (8.6 million metric tons) in 1998 and 11.5 million short tons in 1999(10.4 million metric tons) based on data reported in the Alaska Business Journal (Ref. 20). Railroad passenger traffic was estimated as 550,000 per year in 1998 and 600,000 per year in 1999 with the continuing growth of Alaska's tourist trade. The total revenues for the Alaska Railroad were expected to have exceeded $95 million U.S. in 1999 with $75 million U.S. from freight and $20 million from passengers with a net income of $8 million U.S.

The other railroad is the White Pass and Yukon Railroad in the extreme Southeastern comer of Alaska from Skagway to Whitehorse in the Yukon Territory of Canada. This railroad is a 111-mile long narrow gauge line as compared to the standard gauge Alaska Railroad. This railroad formerly hauled copper, lead and ore concentrates from mines in the interior to the coast for shipment by boat to smelters located elsewhere. This rail line now operates exclusively as a primarily Summer passenger tourist operation with little if any freight service (Ref. 21).

There are also railroad lines in the adjacent provinces of Alberta and British Columbia, which would be important as the connecting links to the proposed Alaska-Canada connector railroad project. In British Columbia, the British Columbia Railway presently operates a 460-mile (740-km) line from Vancouver in the Lower Mainland to Prince George in the interior. Branch lines extend from Prince George to the North to Fort Nelson and to the Northwest at Jackson near Dease Lake, as shown in Figure 8. There is also a branch line to the coal mine at Tumbler Ridge, British Columbia which is electrified, and handles 5 million tons per year of coal.

There is a connection from the British Columbia Railway to the Canadian National Railway at Prince George with a line to Prince Rupert. There are also connections to both the Canadian Pacific and Canadian National Railways at Edmonton in Alberta from which connections to the Midwestern and North Central United States can be made by way of Montana, North Dakota and Minnesota. There is a recently privatized branch line from Peace River in northern Alberta to Fort Resolution in the Northwest Territories and from Edmonton to McMun-ay in the Athabasca tar sands region from north of Edmonton.

The British Columbia Railway carried 17.9 million net short tons (16.2 million metric tons of cargo in 1997, a 6.15 percent increase over 1996 with an average haul of 300 miles (480 km). The total revenues of the British Columbia Railway were approximately $275 million U.S. in 1997, a 1.91 percent increase over 1996. The net income of the British Columbia Railway was $50 million U.S. in 1997, a 10.7 percent increase over 1996 (Ref. 22).

The British Columbia Railway operates two lines, which may serve as useful interconnections to the Alaska Railroad. The 450-mile (720-km) long single-track line from Chetwynd to near Dawson Creek to Fort Nelson would serve as the access line to Edmonton and the Midwestern and Eastern United States. The 500-mile line (800-km) from Prince George to Summit Lake and Fort St. James along Takia Lake has a single track for 300 miles (480 km) to Chipmunk. The rail line has only bridges and grades with no tracks for the final 200 miles (320-km) to Dease Lake.

The Fort Nelson branch line through the Peace River Valley presently hauls grain, wood, oil, other minerals and foods and equipment with 2 to 4 trains per day. The Dease Lake line typically has one to two trains per day and handles almost exclusively logs for the pulp and paper mills at Prince George. The Fort Nelson line handles an estimated annual traffic flow of 3.5 to 7.5 million short tons (3.2 to 6.8 million metric tons) per year while the Dease Lake line handles 1.5 to 2.5 million short tons (1.35 to 2.25 million metric tons) per year of freight. The total freight traffic flow on the two lines is between 5.0 and 10.0 million short tons (4.5 to 9.0 million metric tons) per year, which approximates that of the Alaska Railroad.

The connection of the Alaska Railroad and the British Columbia Railway will require the construction of 880 miles (1,410 km) from Eielson to Dease Lake at a minimum. The connection of the two railroads between Eielson and Fort Nelson will require the construction of a total of 1,180 miles (1,895 km) of trackage. The connection of the Alaska Railroad at Eielson with the British Columbia Railway at both Dease Lake and Fort Nelson will require the construction of 1,360 miles (2,185 km) of track. The total estimated capital cost of constructing the entire railway connections is between $6.9 and $4.7 billion U.S. (Ref. 23).

The estimated route distances for the various railway line segments to connect the Alaskan and Canadian railway systems are listed in Table 3. The illustrations of the individual route distances for the interconnection of the Alaskan, Canadian and American railway networks is illustrated in Figure 9. It will then be possible to have trains running between Alaska and the United Statesthrough Canada in an uninterrupted way. The commodities which could be hauled on this extension of the North American railway network, is the subject of the remainder of this paper.

Figure 9

ROUTE DISTANCES BETWEEN CITIES FOR THE ALASKA CANADA CONNECTOR RAILWAY

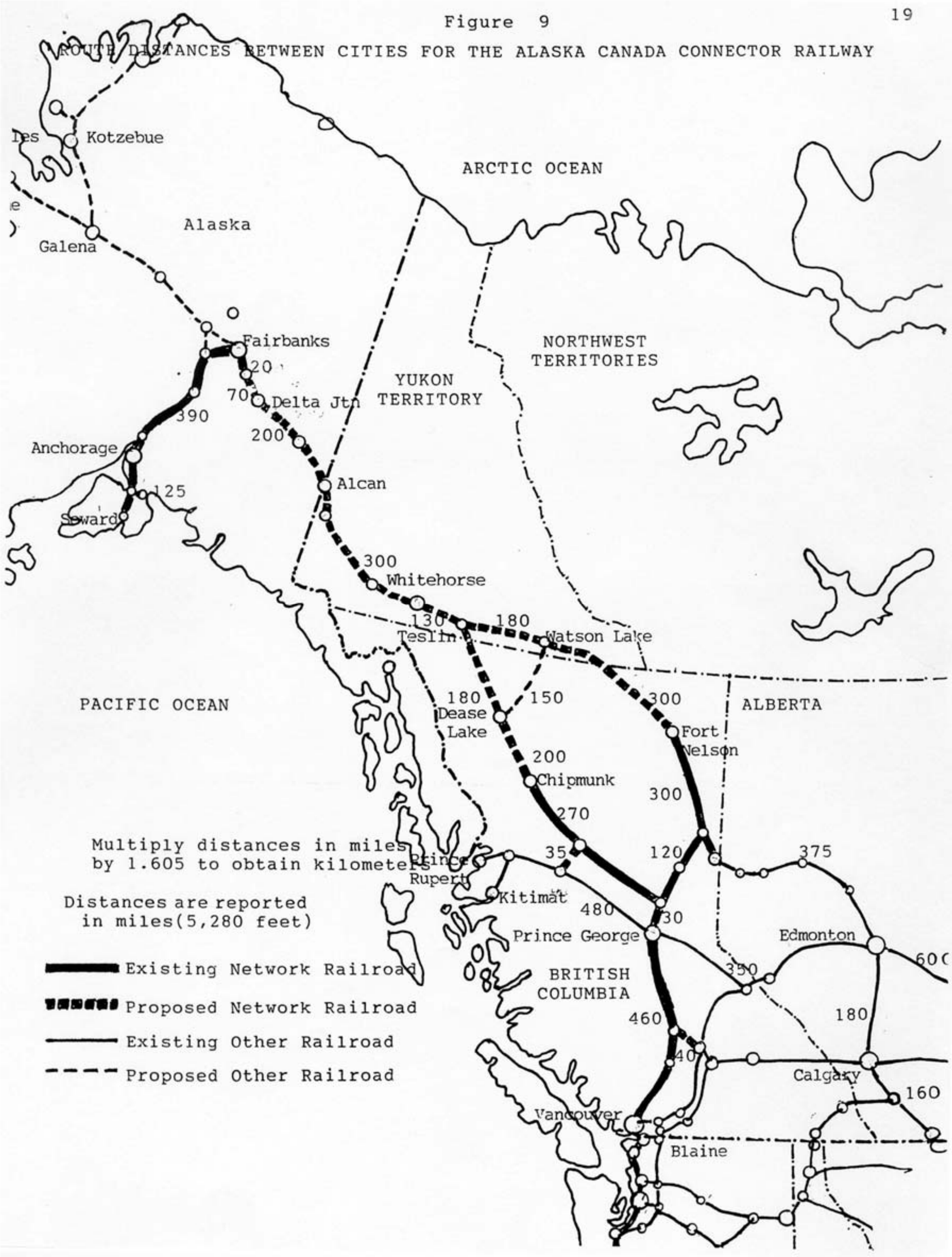
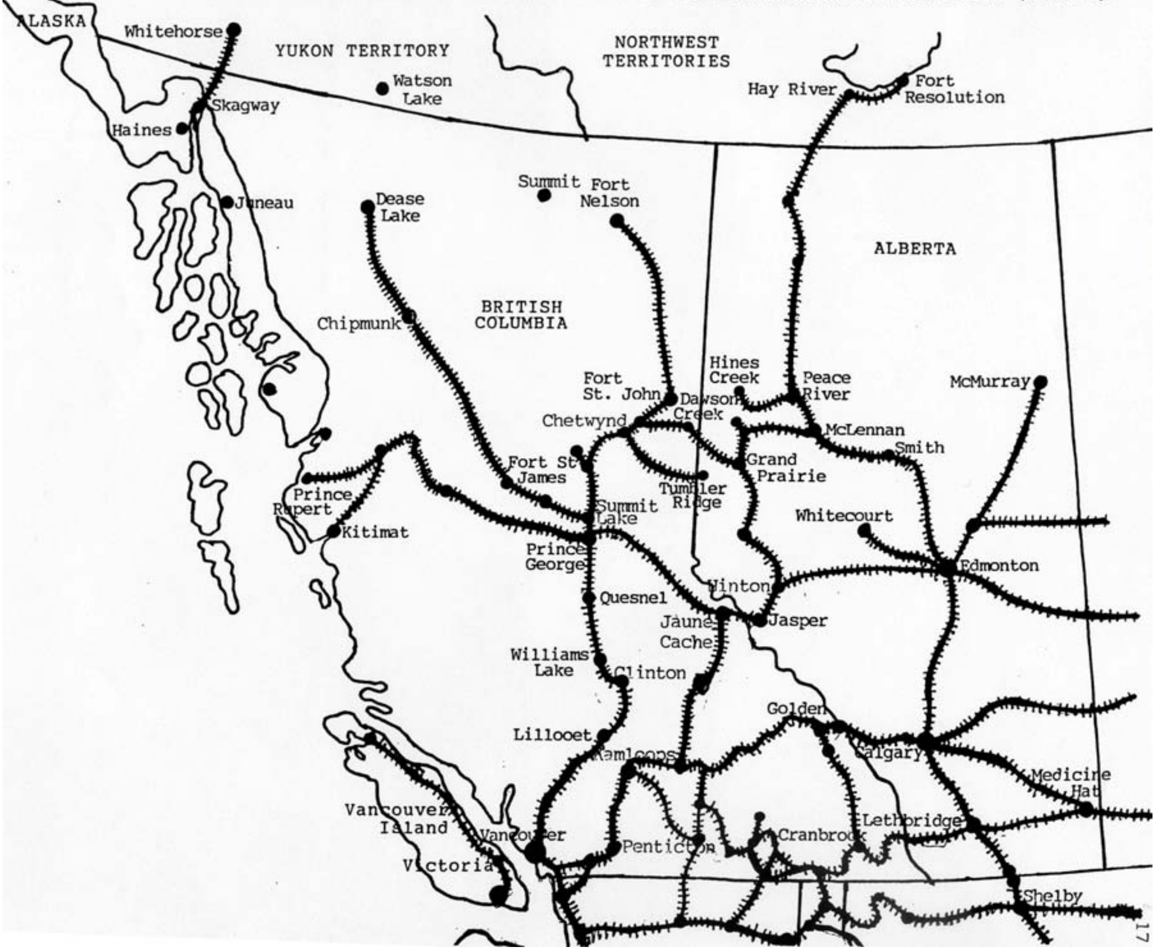


Figure 8

NETWORK CONFIGURATION OF EXISTING RAILROAD LINES IN ALBERTA AND BRITISH COLUMBIA (Ref. 16).



ENERGY

Energy is a matter of critical concern with regard to the construction of the proposed railroad between Alaska, Canada and the Lower 48 States for several reasons. The United States is the world's largest consumer of energy, where Alaska has the nation's largest untapped reserves of energy. The hauling of crude oil, petroleum products, natural gas or gas liquids and coal can be done either by the railroad itself or by parallel gas or oil pipelines. The future development of energy resources in either Alaska or northwestern Canada will require the transport of large amounts of equipment and materials for the energy production facilities and the required pipelines plus the provisions for workers at the production sites.

One of the main products being shipped by railroad in Alaska at the present time over the Alaska Railroad is either crude oil or petroleum products. The North Slop oil field at Prudhoe Bay has been the major oil producing field in Alaska since the late 1970s, which has taken up the slack in oil production in Texas by increasing oil production in Alaska, at least until recently. However, even the large Prudhoe Bay field in Alaska is now beginning to decline as well, as shown in Figure 10. The production out of the Prudhoe Bay field has declined from 2.1 million barrels per day (111 million metric tons per year) at its peak to 1.9 million barrels per day (101 million metric tons per year) in 1990 to 1.8 million barrels per day (95 million metric tons per year) in 1993.

There is also approximately 100,000 barrels per day produced from other oil fields in Alaska as well, which are located on the Kenai Peninsula of far southern Alaska for approximately 5.3 million metric tons per year. There is a large oil field adjacent to the Southwest of the existing Prudhoe Bay field of approximately equivalent size in the National Strategic Petroleum Reserve. There is also a large oil field within the Arctic National Wildlife Refuge (ANWR) to the East of the existing Prudhoe Bay field. The field to the Southwest of Prudhoe Bay could be developed under present conditions. However, it would probably be very difficult to develop the ANWR field to the East of Prudhoe because of environmental restrictions in a wildlife refuge area. The total untapped oil reserves in Alaska are in the range of 10 to 20 billion barrels or more or between 1.3 and 2.5 billion metric tons per year.

The limiting constraint to the future development of both petroleum and natural gas from the Prudhoe Bay area of the North Slope of Alaska may well be transportation in addition to environmental restrictions. The existing crude oil pipeline from Prudhoe Bay to Valdez is beginning to suffer from increasing maintenance problems because of electrolysis requiring greater cathodic protection. The Alyeska crude oil pipeline is also suffering increasing maintenance problems resulting from greater pump and pipe wear. The result is the necessity to periodically curtail oil throughout or to build bypasses in certain sections to correct these problems. There has also been a large oil spill on Prince William Sound in 1989 as well as smaller oil spills in recent years. These problems are expected to continue into the foreseeable future to at least some extent.

The result is that the existing Prudhoe Bay pipeline may not be able to handle the future crude oil flow requirements if the other field is developed from the area. As a result, there may be a need to develop additional transportation facilities for bringing crude oil out of the Prudhoe Bay field. The construction of a railroad line from Prudhoe Bay to Fairbanks to connect with the proposed Bering Straits connecting railroad would make it possible to transport crude oil to Washington, Montana and Minnesota over land without any pipeline maintenance problems. The needs for crude oil by refineries in the Midwestern and Eastern United States could then be readily met without any possibility of the reoccurrence of marine oil spills at Valdez on Prince William Sound, at Femdale or Anacortes on Puget Sound or elsewhere.

There is also the need to build a natural gas pipeline out of the Prudhoe Bay area. The previous idea was to build the pipeline to Valdez and load liquefied natural gas onto ships for transport to major use points. However, the loading and unloading of liquefied natural gas may present some added safety risks and certainly adds some increased costs. A better alternative may be to build a natural gas pipeline from Prudhoe Bay to Fairbanks and then parallel to the proposed connecting railroad from Alaska through Canada to the Lower 48 States, as has been previously discussed. The need for developing natural gas resources in Alaska and transporting them to the Lower 48 States is made especially great because of the expected growth in its use. Natural gas has been designated as the "environmental fuel of choice" by the Clinton Administration, and as a result its use is expected to grow by at least five percent per year over the next few years. Natural gas consumption has increased from 20 trillion cubic feet per year (565 billion cubic meters per year) in 1990 to 23 trillion cubic feet per year (650 billion cubic meters per year) in 1993 and is expected to reach 30 trillion cubic feet in 2000 as shown in Figure 11.

Natural gas consumption is expected to increase to 32 trillion cubic feet per year (905 billion cubic meters per year) by 2000 and 41 trillion cubic feet per year (1,160 billion cubic meters per year) in 2010 if present trends continue. Unfortunately, domestic natural gas production from the Lower 48 States is estimated to only increase from 18 trillion cubic feet per year (510 billion cubic meters per year) in 1990 to 25 trillion cubic feet per year in 2010. The result is that the amount of natural gas, which will need to be imported from outside of the Lower 48 States or from new fields is expected to increase from one trillion cubic feet per year (28 billion cubic meters per year) in 2000 to 20 trillion cubic feet per year (565 billion cubic meters per year) in 2010.

The potential sources for importing natural gas from other countries are more limited than for crude oil because of the need for cryogenic cooling, the safety concerns of storing and transporting liquefied natural gas, and the additional expense involved. As a result, the practical options for large-scale importation of natural gas are limited to pipeline transport from Mexico or Canada at the present time. The location of a natural gas pipeline parallel to the proposed Alaska connecting railroad would make it possible to transport natural gas from Alaska to the Lower 48 States or even from Canada on an enhanced economical basis.

The United States is the World's greatest energy consumer and is also the World's greatest energy importer. The United States consumes large amounts of petroleum, which is primarily used for transportation. The United States imported more than half of its total petroleum consumed this past year. The petroleum production in the United States is expected to continue to decline while its consumption is expected to continue to increase, as shown in Figure 12 (Refs. 26,27). Alaska has the greatest known reserves of untapped domestic petroleum in the United States, which reason and logic say need to be developed in order to reduce imports.

The United States has very limited amounts of oil and gas resources, but very large reserves of coal, as listed in Table 4 (Ref. 26) and illustrated in Figure 13 (Ref. 27) There are very large coal reserves located in Alaska, as shown in Table 5 (Ref. 28). There is a large coal field at Beluga on the Kenai Peninsula in Southern Alaska, which could be utilized, plus the Nenana field near Fairbanks in Central Alaska. There is another large coal field in the Colville Valley of Northwestern Alaska with a high heating value, which could also be developed in the future. The Arctic Slope low sulfur coal reserves of 20 billion metric tons or more are one of the World's largest deposits, but is limited in terms of development by transportation (Ref. 28). The coal reserves in Alaska constitute 20 to 25 percent of the total for the entire Nation and are between 500 billion and one trillion metric tons in magnitude (Ref. 29).

The Alaska coals tend to be of the bituminous and subbituminous grades with some lignites. The coal in Alaska tends to be very low in sulfur content with a minimal air pollution potential. The coal in the Colville Valley is high in heating value to make it desirable as either a utility or industrial fuel. Some of this coal has properties, which make it suitable for metallurgical coking as well as for utility steam coal. The coals from Alaska would have a particularly suitable market in Japan and Korea for steelmaking, as well as those from British Columbia, where these countries tend to have very little coal reserves of their own.

The expected coal use in Japan, Korea and Taiwan alone is expected to increase from 80 million metric tons per year in 1990 to 200 million tons per year by 2010. Some of this coal could be provided from Alaska and Siberia in the future. However, a considerable amount would still be expected to come from Australia, as it is generally the price leader for the Pacific region in terms of the present export market. There are presently about 700,000 short tons (600,000 metric tons) of coal shipped from the Usibelli mine near Healy to Seward over the Alaska Railroad and then by ship to Korea for use in electric power generation. There is also approximately 4.3 million short tons (3.9 million metric tons) of high grade bituminous coal shipped from the Tumbler Ridge mine in northeastern British Columbia by the British Columbia Railway to Vancouver for export to Japan and elsewhere in Asia.

One solid bulk energy fuel, which could be hauled on the connecting Alaska-Canada railroad is coal. As previously noted, Alaska has very large available resources of both utility steam coal and metallurgical coking coal. The State of Alaska is presently exporting approximately 0.75 million short tons per year of low sulfur coal to Korea to the Korean Electric Power Company. This coal is mined at the Usibelli mine near Healy to the South of Fairbanks and then transported on the Alaska Railroad to Seward. The coal is then loaded onto ships and taken to Korea for electric power generation. There is also another 0.75 million short tons per year hauled on the Alaska Railroad to local power plants in Alaska, which operated by local electric utilities, private industries, native corporations, and by the U.S. military bases.

The present coal hauling on the British Columbia Railway is 5.3 million short tons per year (4.8 million metric tons) from the Tumbler Ridge mine near Dawson Creek to Vancouver for export to Japan, Taiwan and Korea. This amount of coal hauled is expected to decrease to 3.3 million short tons per year in 2000 (3.0 million metric tons) with a reduction in purchases for metallurgical coking coal for steel production in Asia. Other uses need to be found for this coal.

There is a good possibility that coal exports from Alaska could significantly increase in the future, as shown in Table 6 (Ref. 29). Coal exports from Alaska were projected to increase from 0.8 million tons in 1990 to 2.0 million tons after 1995 and to 5.5 million tons after 2000. This coal could be transported by means of the Alaskan and Canadian rail lines to Asia for use in Japan, Korea, Taiwan and elsewhere in Asia. It is possible that coal could be shipped by rail from Alaska or Northwest Canada to the Lower 48 States, but it is unlikely in the near term because of the large coal reserves available in the Rocky Mountain States. The amount of coal which could be shipped over the connecting Alaska-Canada railroad lines is estimated as 5 to 15 million tons per year which represents approximately 5 to 15 percent of the present U.S. coal exports to other countries, as shown in Table 7.

Crude oil is another bulk commodity that could be shipped in large quantities from Alaska or Canada via the connecting Alaska-Canada railroad project to the Lower 48 States of the United States for processing. The development of the new oil fields adjacent to the existing Prudhoe Bay field could yield a production of at least 1.5 million barrels per day (80 million metric tons per year) of crude oil. At least some of this crude oil could be hauled by rail to the Lower 48 States of the United States from Alaska by way of the new railroad line from Prudhoe Bay to Fairbanks.

The shipments of crude oil could be made by means of tanker unit trains from the producing fields to the refining centers. The development of oil fields near Prudhoe Bay and in the Peace River Basin and elsewhere in Alberta could lend themselves to long distance shipments of crude oil by tank car to the Lower 48 States if the United States. It might also be possible to ship refined products in the reverse direction or even petroleum products from the refineries in Alaska to online communities along the railroad line.

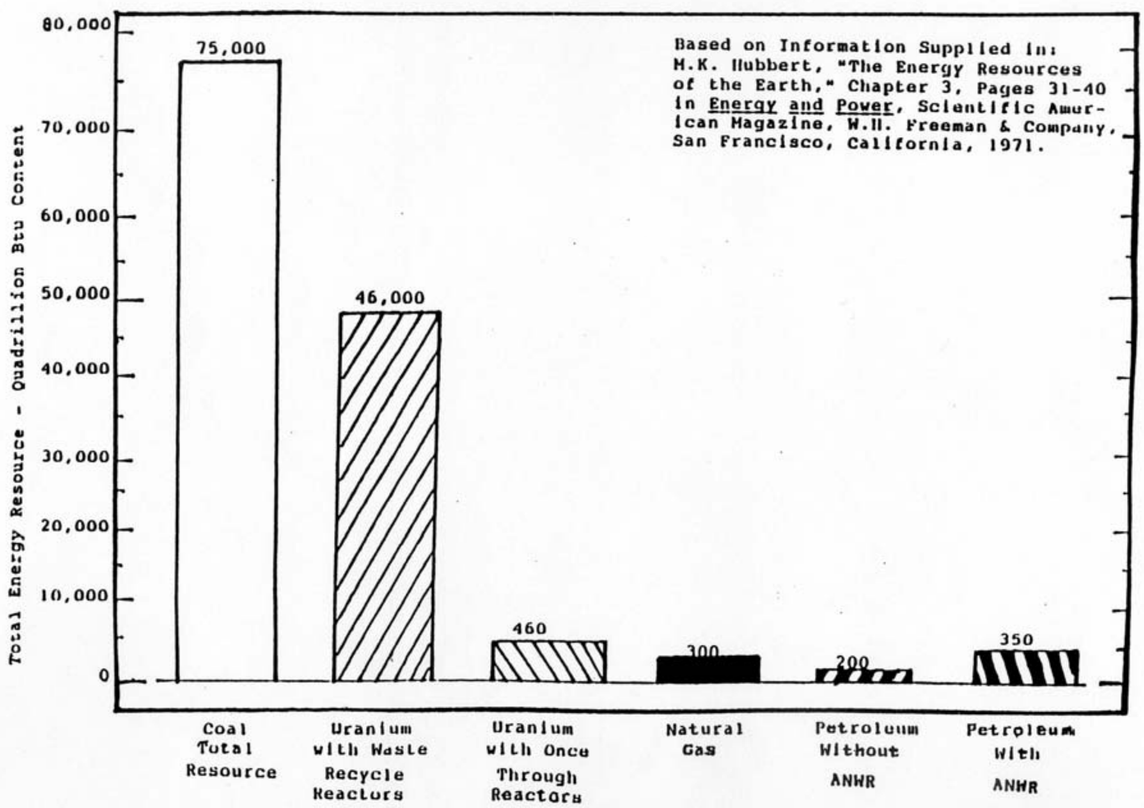
Oil shales and tar sands could even be shipped by rail from deposits to refineries in Alberta, but are generally processed at the local mine sites. The present level of petroleum-related shipments along the British Columbia Railway and the Alaska Railroad is approximately 4 to 5 million short tons per year for both crude oil and petroleum products in combination. It is estimated that the potential market for petroleum shipments is 5 to 10 million short tons per year using conservative growth projections. It is possible that as much as 10 to 15 million short tons per year of crude oil and petroleum products could be shipped over the connecting Alaska Canada railroad upon its completion if a higher growth rate assumption is employed as the basis for making estimates.

Another commodity which could be shipped by rail along the Alaska-Canada connecting rail line is natural gas. The natural gas could be liquefied at elevated pressures and very low temperatures and placed in tank cars for long distance shipment while avoiding the need for additional pipeline construction. There is a potential safety hazard in passing through the tunnel because of the possibility, however remote, of a leak and explosion. An alternative form of natural gas transport would be as a methane-hydrate complex where water and methane have been found to produce solid snow-like matrices at supercooled temperatures and very high pressures such as occurs in permafrost zones (Ref. 30).

Pipelines are the more likely means of natural gas transport. There have been no estimates made of natural gas shipments along the proposed Alaska-Canada connecting railroad line. However, it is possible that the magnitude of these natural gas shipments could become equivalent to those of petroleum if it were to become economical to ship methanehydrate supercooled solid materials in the future. Once a more realistic basis, the need for equipment for natural gas gathering systems with processing plants at the wellheads plus pipeline transmission could be substantially benefited by having access to transport by the proposed Alaska-Canada connecting railroad with parallel pipelines. The recovery of seam gas from coal fields is a logical part of coal development.

Figure 13

KNOWN TOTAL ENERGY RESERVES BY FUEL TYPE IN THE UNITED STATES IN QUADRILLION BTU.



COMMODITIES

There are a large number of commodities which are or can be moved over the Alaska Railroad and the British Columbia Railway. The previous Alaska Transportation Systems Planning Study (Ref. 31) by the University of Alaska divided rail cargo movements into the six categories of bulk liquids, bulk solids, machinery and metal products, forest products, food products and general cargo. The major commodities moved over the Alaska Railroad were reported to be rock, sand and gravel plus coal and petroleum products, intermodal trailers and containers, and others. The major commodities moved over the British Columbia Railway include forest products, grain, petroleum products, food and machinery to provide a frame of reference.

The ultimate economic viability of the proposed Alaska connecting railroad project will be determined by its ability to move goods between Alaska and Canada and the Lower 48 States in a cost competitive and time efficient manner. The traffic levels for cargo movements into and our of the various marine ports in Alaska have been presented in Table 8 (Ref. 32). The movement of these commodities through these ports gives an indication of the types of movements of materials, which could be expected to be hauled on the Alaska to Canada connecting railroad line.

The major commodities noted include petroleum, metals, fish, chemicals and forest products. The commodities, which can be moved, are separately categorized as bulk commodities and specialty materials. The major commodities moved by the Alaska Railroad include petroleum, coal, gravel and intermodal freight.

A study was previously conducted in 1979 by the University of Alaska to determine commodity movements if a railroad link were constructed from Alaska through Canada to the Lower 48 States (Ref. 30). The major commodities identified which could be transported included petroleum, coal, machinery, forest products, food products and general cargo, as shown in Table 9. The amounts of material, which could be hauled by means of this railroad link, were listed as being only on the order of one million tons per year, which alone would mot be able to justify the cost of construction. However, the cargo traffic volumes reported in this study of approximately 1.2 million short tons per year (1.1 million metric tons) were well below the 5.1 million short tons per year in 1991 (4.6 Million metric tons per year).

This study also made a determination of the impact of building a railroad link from Alaska to the Lower 48 States upon road and rail traffic in Alaska upon its existing infrastructure. Without a rail link to the Lower 48 States, the rail traffic would increase from 435 million met ton-miles per year to 483 million net ton miles per year between 1992 and 2000, as shown in Table 10. The highway traffic would increase from 406 million net ton miles per year to 451 million net ton miles per year between 1992 and 2000 without this rail link. If the rail link were constructed the rail traffic would greatly increase from 877 to 974 million net ton miles per year between 1992 while the highway traffic would remain the same.

These results are based on information developed in 1979. In the meantime, the growth in traffic has raised the total shipments on the Alaska Railroad to above one billion met ton-miles per year in 1991. These values are well above the projected traffic figures even without a rail link to the Lower 48 States being completed. A major reason for this increase in traffic has been the growth in population of Alaska since the completion of the Alaska crude oil pipeline from Prudhoe Bay to Valdez. This population growth has resulted in an increase in economic activity with a resultant increase in freight traffic on the Alaska Railroad. There has also been a considerable growth in freight traffic on the British Columbia Railway over the past 10 years.

Forest products are one bulk commodity, which could be hauled by rail to the Lower 48 States from Alaska or Canada as either wood, pulp or paper. The amount of timber harvested in Alaska has been presented in Table 12, with values ranging from 5 to 22 million board feet per year (Ref. 33). The amount of timber harvested in Alaska could increase in the future to between 25 and 144 million board feet per year, as shown in Table 13.

There has been a need for timber by lumber mills in Japan and Korea for many years because of their lack of available domestic resources. In addition, the decline of forest resources in the Pacific Northwest of the United States has given impetus to the need for importing outside timber from both Alaska and Canada by ship or rail to the Lower 48 States of the United States, especially to California and Texas.

The amount of forest products which could be shipped at least some segments of the connecting Alaskan and Canadian railroad system is estimated as much as 5 to 15 million tons per year. Alaskan or Canadian timber and partially finished lumber could be shipped to either the Lower 48 States by an all rail haul or to Japan and Korea in Asia from Seward or Prince Rupert. Timber or partially finished lumber from Alaska and

Canada could be shipped to Japan, Korea, China and other countries in Asia and perhaps in limited quantities to the United States.

There will also be large quantities of chips and wood wastes generated, which could be processed into pulp or used as fuel. The use of waste wood or even municipal refuse as fuel with rail shipments is also feasible, including burning in combination with coal in rural areas to provide electricity for local residences, businesses, and industries.
The problem with forest products in Alaska is that the proposed rail line would go through the northern interior while the main forests are located near the southeastern coast. The inland forests tend to be more slow growing and sparse in the colder drier climate, which could be readily harvested near the railroad. In British Columbia, the entire rail network is near forests, which tend to be faster growing in the more moist wanner climate. It is therefore suggested that the main emphasis on hauling forest products with the proposed new connecting railway line would be in Canada and not Alaska.

Mineral mining activities are a major concern for the construction of the proposed railway line between Alaska, Canada and the Lower 48 States. Gold mining is a matter of immediate interest, especially in the Pogo mining region near Delta Junction in Alaska. The amount of gold to be transported is not large, but chemicals are required for processing, equipment and materials are required for mining, and provisions of food and other items are required for mining. It is also possible that gold mined from deposits adjacent to the proposed railway line could be used as a form of security collaterization for project financing of its construction. The estimated amounts of materials, which could be hauled along the railway line for gold mining, are between one and three million short tons per year.

Other mineral ores and products can be shipped along at least portions of the proposed Alaska Canada connecting rail route. Cements can be shipped as a construction material along with sand, rock and gravel and limestone, although generally only for short distances. There will be a need for hauling a number of metal and mineral ores from mines to processing plants as these resources become developed in the future. The magnitude of this market is estimated as being from 2 to 6 million short tons per year for bulk mineral ore transport.

One specific mineral, which might have considerable interest along the proposed Alaska Canada connecting railroad line, is that large iron ore deposits exist in the Yukon Territory and the Northwest Territories. The iron ore could be mined and taken to a future small steel mill to be located along the railway line. The coal required for coking and the limestone for fluxing could also be transported by the railroad from mine to mill, and the steel products transported, also by rail to customers. One possible application for such a steel mill could be to produce railroad rails and construction beams to support future economic development along the railroad line corridor in Alaska and Canada (Ref. 23). The expected total iron and steel traffic on the railway would be one to three million short tons per year.

The hauling of metals on the Bering Strait railroad line is another specialty material, which can be transported. Fabricated steel products and steel products can be shipped in both directions from Seward to Alaska or from the Lower 48 to States to Canada as the needs develop. Construction steel can be shipped over intermediate distances or over the entire route depending on the specific need. Metallic ores can also be shipped along the railroad line over shorter distances for processing in smelting plants and others such as the Red Dog zinc mine. It is expected that much of this traffic will originate in the mineral-rich zones of the Yukon and Northwest Territories.

It is estimated that the shipment of metal products and ores will comprise 2 to 5 million tons per year. Equipment and materials will need to be hauled along the railroad line in order to foster mineral mining and other economic development. The possibility that new oil and gas development could occur within a reasonable time frame would necessitate the movement of large amounts of piping, pumps, compressors and other machinery. The possible development of natural gas production with coal bed gas recovery could occur separately from oil development would require large amounts of piping and equipment. The equipment and machinery hauling could generate 2 to 5 million short tons per year of rail traffic for the Alaska-Canada connecting railroad.

Grain is a bulk commodity, which can be shipped, in large quantities from the United States and Canada to China, India, Russia and other countries in Asia. The grains, which could be shipped, include corn, barley and wheat, depending upon the use desired. The grain could be shipped from the Peace River area of northeastern British Columbia or from Alberta to the west through Prince Rupert or Seward and then to the points of use. Existing markets and cars could be utilized in an extension of existing services to primarily interior market locations. The amount of grain which would be expected to be shipped via the Alaska-Canada connecting railroad is 3 to 8 million tons per year. This amount represents 3 to 8 percent of the present U.S. grain exports of almost 100 million short tons per year, and could be greatly increased if the Bering Strait tunnel were to be built.

Other agricultural crops could be shipped by rail such as potatoes or hydroponically grown vegetables or farm fish. Such facilities could be located at periodic intervals along the line with greenhouses and used for enhanced crop growing with carbon dioxide enrichment. The hauling of these specialty crops could add one to two million tons per year to the railroad traffic on the Alaska Canada connector line in both directions, and would be useful for small villages.

Food products can be shipped in both directions along the Alaska-Canada connecting railroad route. A particular market in at least the immediate term is from the Lower 48 States of the United States to Alaska, where much of it must be refrigerated due to perishability concerns. Fruits and vegetables and meats can be shipped by means of these refrigerated cars to Alaska or Canada from the United States. Dried food products can also be shipped by means of the Alaska-Canada connector railroad line from the United States to Alaska, Alberta, British Columbia and elsewhere in northwest Canada.

This market is estimated as being from 2 to 6 million tons per year in magnitude for food products shipments in a northbound direction. One specific type of agricultural operation, which may become increasingly common in Alaska and Northwestern Canada in the future are hog farms for pork production. The States of Colorado and South Dakota have recently passed ballot initiatives to restrict hog farm operations in their states because of nitrate water pollution and odorous air pollution. The location of these hog farms in remote areas of the Far North would act to minimize adverse environmental impacts as to create employment opportunities in depressed regions.

Hog farms need to have extensive grain feed shipments plus chemical supplies. They also have the need to process and remove wastes as well as to ship the pork product to distant markets. It is estimated that 10 to 15 hog farms could be located in these remote communities along the Alaska-Canada connector railway line. These hog farms could create as much as 3 to 7 million short tons per year of freight traffic, and would generate large amounts of wastes for recovery.

A number of chemicals can be hauled along the Alaska-Canada connecting railroad line. These chemicals include basic industrial inorganics such as sulfuric acid, nitric acid and caustic soda in the liquid form as well as dry bulk chemicals such as sodium carbonate, limestone and titanium oxide pigments. There are a number of organic chemicals which could be hauled along the Alaska-Canada connecting railroad line in either direction which include ethylene from the plant in Red Deer, Alberta. There will be a need for these chemicals to be shipped to support the mining and mineral processing industries plus other industries to be located in Northwest Canada and to a lesser extent elsewhere in Alaska. The estimated magnitude of this market is 2 to 5 million tons per year for chemical shipments of organic and inorganic materials.

A related material to chemicals is fertilizers, which are needed to assist agriculture in East Asia and elsewhere. Potash is one fertilizer material, which can be shipped in bulk from Saskatchewan along with potassium sulfate and potassium nitrate. The economics of shipping these materials depends on the haul distance involved and their value at the point of use. It is expected that these fertilizers shipments would be primary from America to Asia, and that the magnitude of the materials shipped would be from 1 to 5 million tons per year for fertilizer shipments. A particular route would be potash shipments from Saskatoon, Saskatchewan to Edmonton, Alberta and Prince George to Prince Rupert British Columbia by rail for export to Asia by ship.

Intermodal freight traffic has been a major component of the growth in railroad freight traffic over the past few years in the United States. Intermodal freight traffic includes truck trailers as well as single stack or double stack containers. Intermodal freight traffic is bi-directional in nature as it can move from the Lower 48 States to Alaska or from Alaska and Canada to the Lower 48. There is no specific description of the contents ofintermodal freight except that it is material, which is time-sensitive in terms of equipment or goods where speed of shipment is a necessity.

The Alaska-Canada connector railway route may make it possible to ship cargoes between the various inland destinations entirely by land routing without having to offload or onload containers at the marine ports or Seward or Prince Rupert or Haines to reduce overall transport costs.

The rail intermodal shipments in the United States now exceed 10 million trailer and container units per year for a net weight exceeding 200 million tons and is increasing at more than 5.0 percent per year. The level of cargo shipments at the various ports on the West Coast of the United States now exceeds 200 million tons per year exclusive of crude oil, and is increasing at a rate of greater than 3.0 percent per year. The Pacific Rim trade is now the most rapidly growing in the World. Intermodal freight traffic could go between the United States, Canada, Mexico and Latin America in the Western Hemisphere to Japan, Korea, Taiwan, China, Southeast Asia, Russia, the Newly Independent States plus Western and Eastern Europe in the Eastern Hemisphere.

The growth ofintermodal freight traffic along the proposed Alaska-Canada connector railway would become especially great if the Bering Strait, railroad tunnel between Alaska and Asia ever becomes a reality particularly. The development of large scale electronic commerce and internet shopping may greatly accelerate the need for this project.

The present total intermodal freight traffic on the combined Alaska Railroad and British Columbia Railway is estimated as 3 to 5 million short tons per year at the present time. This intermodal freight traffic could increase to between 5 and 10 million short tons per year with the completion of the Alaska-Canada connector railway from the Lower 48 States to Fairbanks without any significant impact of electronic commerce. This intermodal freight movement between Alaska and Canada and the Lower 48 States could increase to as much as 10 to 15 million short tons per year with extensive electronic commerce and internet shopping being utilized.

The final freight transport category for consideration with the proposed Alaska-Canada connector rail line are military cargoes as there are a number of Army, Air Force and Navy facilities located in Alaska. The starter cargo go justifying the entire construction of the 1,300 mile long (2,085 km) Alaska-Canada connector railroad line may be to develop a major missile base at Fort Greely near Delta Junction, Alaska.

The initial rail line construction would be for 70 miles from Eielson Air Force Base to Fort Greely at Delta Junction and then for 200 miles to the Yukon border. The expected mlitary cargoes to be hauled over the Alaska-Canada connector railway are expected to range between 3 and 10 million short tons per year depending on construction.

CONCLUSIONS

The completion of the construction of the Alaska-Canada connector railroad line over the 1,300 mile distance from Eielson, Alaska to Dease Lake and Fort Nelson, British Columbia will make it possible to link the Alaska Railroad with the rest of the North American railroad network.

It will then be possible to haul a wide variety of materials along this railroad line between Alaska, Canada and the Lower 48 States in both directions. In addition, it is also planned to have railroad passenger service along this rail line in order to serve the remote villages and communities.

There are a wide variety of commodities, which can be hauled along the Alaska-Canada connector railroad line, as listed in Table 14. The commodities identified, which can be hauled, include the categories of fuels, resources, metals, agriculture, chemicals, intermodal, military and other cargoes. It is estimated that between 45 and 120 million net short tons per year could hauled over the Alaska-Canada connector railroad line. The starter commodities to initiate the railway operation would most likely be the military related cargoes to the new missile base. The largest quantity of cargoes to be moved over the railway line would probably be fossil fuels, including coal, crude oil and petroleum products.

The expected increase in total cargo movements along the 1,300-mile long Alaska-Canada connector railroad line is illustrated in Figure 14. Approximately 65 percent of the total railway freight traffic increase in Northwestern Canada and Alaska will be in

Canada, primarily on the British Columbia Railway. Approximately 35 percent of this total railroad freight traffic will be on the Alaska Railroad. The total freight traffic movements to be expected along the planned 1,300 mile Alaska-Canada connector railroad line is expected to constitute about one-third of the total freight traffic movements to be expected in Northwestern Canada and Alaska.

The estimated freight traffic flow on the planned Alaska-Canada connector railroad is expected to increase from 5 million net short tons per year in 2006 as the startup to 20 million short tons per year in 2010. The freight traffic flows are expected to increase to 30 million net short tons per year in 2020 to 48 million tons per year in 2030, as shown in Table 15. The freight traffic flows are expected to increase from 1.4 billion net ton-miles in 2006 to 17.8 billion net ton-miles in 2030. The freight traffic revenues are expected to reach 222 million dollars per year by 2010 and increase to $665 million per year by 2030.

The startup of the Alaska Canada connector railway in 2006 will result in a rapid initial increase in freight traffic revenues based on military cargoes. The expected freight traffic revenues are expected to reach $222 million in 2010 and $357 million per year in 2020 as shown in Figure 15. These expected freight traffic revenues are expected to be sufficient to allow the railroad to be operated on a profitable basis after the year 2010 within 5 years of beginning its service. The above referenced railway freight traffic revenues are based on the cost, revenue and traffic data provided for the Alaska Railroad operation, as listed in Table 16.

The total amount of freight moved in 1991 was 5.1 million net short tons to generate 1.05 billion net ton-miles of freight traffic with an average haul distance of 205 miles, as compared to 305 miles for the British Columbia Railway. The total revenue generated from freight traffic on the Alaska Railroad was $48 million in 1991, which was 75 percent of the total. The passenger traffic on the Alaska Railroad constituted 25 percent of the total system revenue with a total of $16.4 million with 471,217 passengers in 1991 with an average trip length of 355 miles.

The proposed passenger service on the Alaska Canada connector railroad would have 1,800 to 2,900 passengers per day or 651,000 to 1,085,000 passengers per year with an average trip length of 435 miles. The rail passenger service would have revenues ranging from $15 to $100 million per year, as shown in Table 17. These passenger revenues would constitute 10 to 15 percent of the total for the proposed Alaska Canada connector railroad line.

The proposed Alaska Canada connector railroad line of 1,300 (1,805 km) from Eielson, Alaska to Fort Nelson and Dease Lake, British Columbia would have sufficient freight traffic to be economically viable with coal and oil, mineral and forest resources, intermodal cargoes and agricultural products the main constituents if proper development policies are implemented. There would be considerable freight traffic flows in both directions to serve to connect Alaska with the Lower 48 States. In addition, the future construction of this railway would serve as the vehicle to promote economic growth and development throughout the entire Greater Pacific Northwest productive triangle, as illustrated in Figure 16. This railway line could first be extended to western Alaska and ultimately to Asia and Europe by way of the Bering Strait tunnel, especially with the advent of electronic commerce.

TABLE 14

ESTIMATED INCREASES IN FREIGHT TRANSPORT BY COMMODITY FOR THE ALASKA CANADA CONNECTOR RAILROAD

Overall Category	Specific Commodity	Amount Tranported Million Tons/Year	Percent of Total	Freight Haul Direction
Fuels	Coal	5.1-15.0	11.1-11.3	Bidirectional
	Crude Oil	3.0-6.0	6.7-5.6	Southbound
	Petroleum Products	2.0-6.0	4.4—5.6	Southbound
	Subtotal	10.0-27.0	22.2-22.5	----
Resources	Forest Products	5.0-15.0	11.1-12.5	Southbound
	Gold Mining	1.0-3.0	2.3-2.5	Northbound
	Mineral Mining	2.0-6.0	4.4-5.0	Bidirectional
	Subtotal	8.0-24.0	17.8-20.0	----
Metals	Metallic Ores	1.0-3.0	2.2-2.6	Bidirectional
	Metal Products	2.0-5.0	4.3-4.2	Bidirectional
	Equipment and Machinery	2.0-5.0	4.3-4.3	Northbound
	Subtotal	5.0-13.0	10.8-11.1	----
Agriculture	Grain	3.0-8.0	6.6-6.8	Southbound
	Food Products	2.0-6.0	4.4-5.1	Northbound
	Hog and Pork	3.0-7.0	6.5-5.9	Bidirectional
	Subtotal	8.0-21.0	17.5-17.8	----
Chemical	Chemicals	2.0-5.0	----	Northbound
	Fertilizers	1.0-5.0	----	Bidirectional
	Subtotal	3.0-10.0	6.7-8.3	----
Intermodal	Intermodal Freight	5.0-10.0	----	Bidirectional
	Internet Shopping	3.0-5.0	----	Northbound
	Subtotal	8.0-15.0	12.5-17.5	----
Military	Military Cargoes	3.0-10.0	6.7-8.3	Bidirectional
Other	To be Determined	Unknown	Unknown	----
Total	Total Amount	45.0-120.0	100.0	----

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