Economic Impact of a North Slope Rail Extension on Northern Energy and Mineral Development

By

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Economic Constraints on Northern Development

Petroleum, natural gas, and mineral development in northern Alaska is constrained by higher capital and operating costs relative to other regions of Alaska and much higher costs relative to the contiguous states. The remote region has long supply chains, high transportation costs and is burdened with historic total tax burdens relative to jurisdictions with lower total costs. The evidence for the negative impact of cost differentials is the rapid increase in non-conventional oil and gas development through horizontal drilling and hydrofracturing of source bed shale deposits in mature sedimentary basins (Bakken, Eagle Ford, Permian) in the contiguous states and the absence of such development in Alaska.

The high cost of North Slope operations was well documented by the Department of Defense (DoD) from World War II on through the Cold War era before and even after oil was discovered in Prudhoe Bay in 1968 by the Atlantic Richfield Company (ARCO). Published historical DoD Construction Cost Factors for the North Slope range from five to six times the cost factors for shale oil producing areas in Texas (Eagle Ford) and North Dakota (Bakken). John M. Miller, the former Chief Financial Officer for ARCO and author of ***The Last Alaskan Barrel*** documented that ARCO essentially went out of business due to the high capital and operating costs and permitting delays during the development of the Giant oil field that it discovered at Prudhoe Bay.

Reducing oil taxes in Alaska is an essential and necessary first step. Developing a railroad system to the North Slope to handle the large volumes of bulk freight at competitive costs is an absolute necessary condition for non-conventional oil and gas development. These resources are characterized by large material factor inputs, low initial production (IP) rates and thus small profit margins. Rail transport to the North Slope can also provide backhaul capabilities for the low cost transport of mineral commodities to ice-free ports in south-central, Alaska.

Example of Proposed North Slope Shale Oil Development

In September 2012, Petroleum News reported on a proposal by Great Bear Petroleum to drill 200 wells per year in shale-oil targets on the North Slope including the Shublik Formation. As in shale oil developments in the contiguous states (Eagle Ford and Bakken) each well would include horizontal drilling technology and hydrofracturing of the shale units. Fracturing in the relatively shallow shales in Texas and North Dakota requires one to two million pounds of “frac sand” per well. The wells in the deeper portions of the Shublik Formation are expected to have longer horizontal laterals and require more sand, steel, cement, chemicals, and fuel to complete the wells and the reworking of the wells after initial production. It is estimated that the logistic requirements for each well in the Shublik Formation over the well’s expected life cycle is 12,000 tons. Thus to maintain a production rate of 200 wells per year, the annual freight load to the

North Slope is expected to be 2,400,000 tons. This is equivalent to 165 trucks (40 tons each) per day one way 365 days per year or nearly five 10,000 ton freight trains per week 52 weeks per year.

The comparative cost of trucking versus rail transport per well is as follows: (a) trucking distance from Fairbanks to Prudhoe is 470 miles; (b) trucking cost is estimated at $1.00 per ton-mile; (c) estimated cost of trucking per well is $5,640,000; (d) rail distance from Nenana to Prudhoe is 450 miles; (e) rail cost is estimated at $0.10 per ton-mile; (f) estimated rail transport cost per well is $450,000. The above analysis does not include the cost savings associated with loading materials on railcars at the freight source location and rail/barging the material to Alaska and on to the North Slope without off-loading the rail shipments and transferring it to trucks. Thus the cost saving per well for rail transport is at least a factor of 10 times.

Capital Cost Estimate for Nenana to Prudhoe Bay Rail Extension

From Dunbar siding just north of Nenana the total estimated distance for the Railroad Extension to Prudhoe Bay is 450 miles (see attached Map). From Dunbar, the proposed route extends along the east side of the Minto Flats Basin to approximately five miles south of Livengood. From there, the route follows the Hess Creek drainage to the Yukon River, crosses the Yukon River near the Dalton Highway Bridge, then proceeds up the Ray River along the western margin of the Trans-Alaska Pipeline Corridor to the Koyukuk River drainage, then up the Koyukuk to the Dietrich River and on to Atigun Pass, down the Atigun River to Pump Station 4, then into the Sagavanirktok River drainage, and finally down the Sag River to Prudhoe Bay.

Based on data from the Alaska/Canada Rail Link Phase I Pre-Feasibility Study and the Eielson, AFB to Delta Junction Rail Extension Study, the estimated cost of the track, ties, and rail for the North Slope Rail Extension is $2.7 billion (450 miles x $6,000 per mile). Two tunnels will be required for the project, one just south of the Yukon River and a second at Atigun Pass. Based on a very long (over 34 miles) and very deep (3000 feet) tunnel near completion in the Swiss Alps (at a unit cost of $285 million per mile) the cost of theses two relatively short and shallow tunnels are estimated at $456 million (1.6 miles x $285 million per mile) and $1,283 billion (4.5 miles x $285 million per mile) respectively. A bridge across the Yukon River is estimated at $500 million. This very preliminary estimate for the Yukon crossing is considered high as it is 2.5 times greater than an equally long bridge structure currently under construction across the Tanana River and 15 times greater than the original highway bridge across the Yukon ($31 million). Other bridges and a rail terminal at the North Slope are expected to add another $250 million for a total project capital cost of $5.2 billion.

Benefits/Cost Analysis

In order to simplify this analysis, it is assumed that the only benefits that would accrue to the State of Alaska are from a one eighth interest in the increased oil production (1/8 royalty oil). Benefits from other taxes will probably accrue but the amount is uncertain. It is also assumed that the increased oil production from the unconventional shale units will be at rates similar to the (IP) rates from other shale oil sources in the contiguous states. It is also assumed that the annual production will be limited to the IPs for the wells drilled during each year. In fact, production from each new well will continue on considerably longer and cumulative production

will be significantly greater than the number of wells drilled per year and the IP rates of those wells. Thus we shall underestimate annual benefits by the difference between the IP and the anuual decline rate for each well. The average IP rates for wells currently drilled in the Bakken ranges between 2000 and 3000 barrels per day. Thus 200 wells per year would add 400,000 barrels per day to the Trans-Alaska Pipeline. Assuming an oil price of $85 per barrel, the royalty oil would generate an expected $1.55 billion per year to the State of Alaska. For this analysis, the North Slope Rail Extension is assumed to have only a 30 year project life. This is a very conservative estimate as this time period is less than one half the current life of the Alaska Railroad and less than one quarter of the life of many railroads in the contiguous states

With a capital cost of $5.2 billion, an annual revenue of $1.55 billion, and a 30 year project life, the rate of return on the investment would be approximately 30%. Alternatively, stating that if the minimum attractive rate of return to Alaska is assumed to be 10%, the discounted benefits would exceed costs by 2.5 times.

Benefits to Northern Mineral Development

Of the more than seven thousand mineral occurrence in Alaska only two of the base-metal occurrences which have large tonnages and high grades and are near tidewater have been developed (Red Dog and Greens Creek Mines). Base metal mineral production from the Brooks Range Copper Belt and other base metal deposits north of the Yukon River are constrained by the high cost of transport of the relatively low unit value mineral concentrates to ice-free ports. For example, a 5,000 ton per day mine in the Ambler Mining District would produce approximately 1,500 tons per day of mineral concentrates composed dominantly of chalcopyrite. A pure 100 percent chalcopyrite ($CuFeS_2$) concentrate contains 34% copper. At a copper price of $3.20/lb., the concentrate would have a place value at the mine site of $2,160/ton (0.34 x 2000 x $3.20). The trucking distance from the Arctic Deposit to Port MacKenzie is 779 miles, thus the trucking cost at $1.00 per ton mile is $779.00. This is 36% of the value of the concentrate at the mine site. From the tidewater port, the concentrate must be shipped to a smelter and refining complex and the value of the concentrate will be further reduced by those costs On the average mines have mineral transportation costs that are 5-6% of total operating costs not total gross revenue.

With the availability of rail transport in the Pipeline Corridor, trucking from the Ambler Mining District can be limited to two hundred miles from the Arctic Deposit to the Corridor. The 579 mile rail transport at $0.10 per ton-mile to Port MacKenzie would reduce transport costs to $257.90. In addition to the Arctic Deposit and those along the proposed Ambler Mining District Road there are 685 known mineral occurrences within 50 miles of the centerline of the Pipeline Corridor from Nenana to Prudhoe Bay. At least one of these occurrences is expected to be developed as a consequence of a North Slope Rail Extension. Such developments will encourage more exploration and the discovery of additional mineral prospects and mines in northern Alaska..

Project Funding

The Alaska Railroad Corporation (ARRC) has the statutory authority to finance projects through the sale of non-recourse tax exempt revenue bonds. The sale of such bonds is predicated on the definition of a revenue source over the bonding period. Thus such bonds could be sold if

the ARRC entered into long-term agreements with North Slope operators for the delivery of oilfield freight and possibly petroleum products. The annual cost of debt on the entire $5.2 billion capital cost of the project at a 5% interest rate would be $260 million. One alternative would be to coer the cost of interest on the debt with a portion of the royalty revenues. A second alternative would by to cover the interest cost out of freight revenues. Table 1 is an estimate of such revenues:

Table 1. Estimated sources and amounts of rail freight revenues

Revenue Source	Tonnage/Year	Distance	Freight Rate	Revenue
	(Tons)	(Miles)	($0.10/ton-mile)	
Frac Wells (200 per year)	2,400,000	800	$0.10/ton-mile	$192,000,000
Conv. Oil Field Ops (1)	750,000	800	$0.10/ton-mile	$60,000,000
Incremental Oil Ops (2)	150,000	800	$0.10/ton-mile	$12,000,000
Incremental Oil Prod (3)	1,090,000	450	$0.10/ton-mile	$49,000,000
Fairbanks LNG	146,000	470	$0.10/ton-mile	$6,900,000
Ambler Copper	550,000	600	$0.10/ton-mile	$33,000,000
Second Base Metal (4)	550,000	600	$0.10/ton-mile	$33,000,000
Nat Gas Pipeline (5)	LS	800	$0.10/ton-mile	$65,000,000
Total Annual Revenue				$450,900,000

Notes:

(1) Based of ADOT&PF truck traffic for 2007.
(2) Incremental investment in conventional reservoirs expected from changes in oil taxes.
(3) Incremental total production of 20,000 bpd above pipeline capacity.
(4) One base metal mine in addition to Ambler Copper in northern Alaska.
(5) Annualized logistics (3% of total project cost) associated with the $65 billion LNG export project distributed over a 30 year period.

Thus the total estimated annual revenue is $450.9 million and the interest expense on the capital investment is $260 million, the estimated balance is $190.9 million or $0.04 per ton mile. This is an expected unit cost of operations for a railroad with this annual volume of freight.

Conclusion

A North Slope Rail Extension shall reduce transportation costs to the North Slope oil fields and provide for a more competitive economic climate for the development of the non-conventional oil and gas resources in the Arctic. In addition it will reduce the costs of additional production from the mature conventional oil reservoirs. The project is expected to have at least a 30% return on investment based on very preliminary cost and revenue estimates. Truly the easy and low cost oil from the North Slope has been produced however very large volumes of oil and natural gas remain. The production of this oil and gas will be dependent on the reduction of the historic high cost of operations in the region.

For the North Slope Rail Extension Project to move forward and definitive business case must be presented by the Alaska Railroad Corporation to the U.S. Surface Transportation Board. If approved by the STB and with funding made available the project would progress into the Environmental Impact Statement stage. Work in progress and work completed by the University of Alaska Fairbanks and its sub-contractors has and will continue to contribute to this endeavor.