THE COST OF TRANSPORTING COAL FROM GASCOYNE, NORTH DAKOTA TO BIG STONE, SOUTH DAKOTA: A PRELIMINARY ANALYSIS

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I. INTRODUCTION

This report constitutes a preliminary analysis of the cost of transporting coal from Gascoyne, North Dakota to Big Stone City, South Dakota. The movement has been analyzed using Rail Form A costs for the Burlington Northern Railroad in conjunction with annualized rehabilitation cost estimates, which have been approximated using a market interest rate.

The report is preliminary in nature because in-depth analyses are necessary concerning the investment cost in roadway to the Burlington Northern. A determination of the annualized equivalency cost of this investment is complicated by the nature of the bond issue, which involved different issues of bonds at different interest rates and with different maturation dates, as well as by the fact that ownership of the line passes to the railroad at the end of the bonding period. Such a determination cannot be conclusively made without detailed studies concerning the present value of railroad properties by type of asset, the future value of salvageable track materials, as well as distinctions between embedded values in rail assets and value added by rehabilitation—all of which are currently being undertaken.

In lieu of line-specific roadway investment cost, therefore, adjusted Rail Form A (RFA) values have been used. More will be said concerning the development of these issues and their interpretation. First, however, the report begins with a description of the movement which is being analyzed and the methodologies which are used.

Movement Description

The Gascoyne-to-Big Stone movement has certain clearly definable characteristics which can be well-documented. The movement is cyclial in nature, involving railroad-owned power and shipper-owned cars. The train normally consists of between 100 and 112 cars. Four locomotive units are normally used to pull the consist, three power units, however, may be sufficient for certain times of the year, or for lighter tonnages.

Both loading and unloading are automated, "run-through" processes. At origin, the train of cars is pulled-through by the power units, at very slow speeds, while the loading of cars via overhead chute occurs. At destination, the cars are unloaded by means of a rotary-dumping facility without the necessity for uncoupling individual cars. In neither instance, however, at origin or destination, is the locomotive set uncoupled from the consist.

The entire process takes roughly 48 hours from the time the loading cycle beings. Four hours, approximately, are required to load the train at origin. Approximately the same amount is required at destination. The line-haul running time is roughly 20 hours in either direction, comprising a total of 48 hours.

The movement calls for an annual volume of at least 2 million tons of coal. In addition to the coal traffic, other traffic over the segment results in a weighted-average of 6.77 million gross ton miles per mile of rail on the Gascoyne to Big Stone section of the line.

II. METHODOLOGY

As noted earlier, estimates for movement costs, not including the annualized rehabilitation cost, have been developed using Rail Form A (RFA) costs. The costs used are from a 1977 application of the Burlington Northern and St. Louis San Francisco Railroads together, and have been updated to current levels using railroad-specific cost indices.

The costs used are the same as those maintained internally in File 5-50-1977 by the Burlington Northern (1977 BN-SLSF Rail Form A) with the exception that the costs have been updated to reflect a more current cost of capital (16.5%). The operating characteristics and size of the train have been developed specifically for this movement.

Overview of Rail Form A

Rail Form A provides estimates of the system-average cost of providing service. The formula produces unit costs for a variety of output or production measures (i.e., locomotive unit miles). This unit cost is then multiplied by the number of service units or production measures consumed in the provision of any particular service.

To illustrate, the locomotive unit mile costs, which reflect locomotive depreciation, fuel, repairs, and operating expenses, are developed for a particular movement as follows. First, the number of locomotive units used is determined. Secondly, the number of units is multiplied by the round trip mileage to determine the number of service units—locomotive unit miles—consumed by the journey. The number of locomotive unit miles (LUM) are then multiplied by the RFA unit cost to determine the total trip cost. This process is essentially repeated for the range of production measures used in the provision of the particular service.

Not every movement utilizes all of the RFA output units which the formula provides costs for, however. The specific measures incurred in the provision of cost for this movement are depicted in Table 1. The consumption of these, it should be noted, will differ significantly from the system-average consumption ratios which are built-in the aggregate carload cost published in ICC cost scales. The number of switch engine minutes consumed, particularly, will vary considerably from the system-average. Also, it will be noted that only non-ownership car-mile expenses are included. Ownership, repair, and maintenance of the freight cars, as noted earlier, are the responsibility of the shipper.

TABLE 1. RAIL FORM A PRODUCTION UNITS CONSUMED IN THE GASCOYNE TO BIG STONE MOVEMENT.

OUTPUT MEASURE	EXPENSE RELATIONSHIP	RAIL FORM A CORE NUMBER
Gross Ton Mile	Weight and Distance Related	B(3261)
Locomotive Unit Mile	Locomotive Distance Related	B(3262)
Train Mile	Non-Wage Expenses	B(3263)
Train Mile	Crew Wages	B(3317)
Carload	Station Clerical	B(3265)
Carload	Terminal Supplies/Expenses	B(3187)
Ton	Loss and Damage	B(3188)
Ton	Claims Clerical	B(3276)
Switch Engine Minutes	Locomotive, Wage, Time Related	B(3281)*
Car Mile	Private Line Inspection	B(3195)
Car Mile	Train Supplies & Expenses	B(3186)

*This expense item, which is the raw gross ton mile expense, is adjusted to account for non-revenue switching expenses.

Calculation of Movement Service Units

The amount of each type of service unit consumed on the Gascoyne-to-Big Stone movement are depicted in Table 2. The number of locomotive switching minutes at origin and destination were determined on the basis of the number of units per train and the maximum amount of tariff free time (4 hours). As noted earlier, both loading and unloading are automated pull-through processes where the power units do not cut-and-pull blocks of cars as in classification yards, or on the normal single-car shipments. The total time spent at origin-destination, for the most part, consists of the run through operations where the units may be idling at slow speed for hours.

	TABLE 2. CALCULATION OF MOVEMENT SERVICE UNITS.		
	ITEM	**AMOUNT**	**SOURCE***
1.	Cars Per Train	105	Direct Estimate
2.	Tons Per Car	95	Direct Estimate
3.	Tons Per Shipment	9,975	Line 1 x Line 2
4.	Miles	348.8	Distance Tariff
5.	Net Ton Miles	3,476,287.5	Line 3 x Line 4
6.	Tare Weight of Car	35	Direct Estimate
7.	Tare Weight of Train	3,675	Line 1 x Line 6
8.	Tare Ton Miles	2,563,680	Line 4 x Line 7 x 2
9.	Gross Ton Miles	6,039,967.5	Line 5 + Line 8
10.	Locomotive Units Per Train	4	Direct Estimate
11.	Locomotive Unit Miles	2,790.4	Line 4 x Line 10 x 2
12.	Train Miles	697.6	Line 4 x 2
13.	Car Miles	73,248	Line 12 x Line 1
14.	Hours at Origin-Destination	8	Direct Estimate
15.	Locomotive Switching Hours	32	Line 14 x Line 10
16.	Locomotive Switching Minutes	1,920	Line 15 x 60

* All direct estimates were obtained from power company personnel or the Department of Transportation of South Dakota.

The system-average RFA cost for switch engine minute, admittedly, reflects system-average switching conditions—yard and way switching both and for this reason probably tends to overstate the true cost per minute for the Gascoyne movement. Here, the engines are simply at idle with very minimal power requirements. The RFA switch engine minute does include allocations other than for fuel and mileage-related repairs. Locomotive depreciation on a time-basis, as well as train wages, are reflected in the estimate. For this reason it may be a fairly-close proxy of true locomotive-hour costs at origin and destination.

Line-haul locomotive depreciation, repairs, and maintenance are reflected in the locomotive unit mile expense.

Treatment of Road Capital Expense

RFA variable unit costs reflect a return on the average investment in road and equipment. Investment for road, including stations and office buildings, terminals, and way switching track in addition to main tracks, is allocated primarily to the gross ton miles, train mile, locomotive switching minute, and carload (station clerical expenses) service units shown above. The logic is that a portion of these investment costs will vary with the level of traffic. They, therefore, can be expensed directly as a function of the traffic as opposed to the miles of road.

This approach assumes, of course, the system-average level of investment for Burlington Northern network as a whole. For this particular situation, therefore, their use must be interpreted with some caution. Because the State of South Dakota obtained the line-segment at what may have been less-than market price, and because of the passage of ownership to the Burlington Northern at the end of bonding period, the use of a variable rate of return may serve to somewhat overstate the actual cost. Even if that is the case, however, there are strong arguments to suggest that true market price is irrelevant in this instance—it is actual acquisition cost (which reflects embedded road capital cost) which is important. In that case, which is felt to be the most realistic assumption, use of variable Rail Form A costs with the system-wide average for roadway investment, should provide a very close proxy of the costs which vary with traffic.

Cost of Capital

Assuming that the Rail Form A average level of roadway investment which varies with traffic is reflective of the Gascoyne-to-Big Stone line-segment, a rate of return on that investment, which is part of the cost of doing business, may be allowed in the variable cost estimation. The rate of return, as noted by the ICC, should be set at the current cost of capital. Any sinking funds set-up by BN, that is, to retire the outstanding issue of bonds, would have to obtain at least some external capital. Embedded debt interest rates, therefore, would not be reflective of the true cost of capital.

The rate of return on roadway investment, as well as the rate of return on equipment, consequently, have been set at the current cost of capital (16.5 percent) as estimated by the ICC. The ICC's estimation reflects a weighted average of both debt and equity capital, weighted by the capital structure of the railroad industry.

A description of the derivation of this figure would be beyond the scope of this report. Suffice it to say, therefore, that this figure represents the best collective estimate of government and industry analyses, and should be fairly close to the carrier's real cost of capital for sinking fund accounts.

Fixed Roadway Costs

Up until now, only the variable rate of return on roadway assets has been discussed. A certain proportion of the costs for roadway investment do not vary with the traffic, however. These costs, rather, are a function of the miles of track.

Under Rail Form A procedures, the variable return on investment is factored on 50 percent of the investment base. The remaining 50 percent is felt to be fixed regardless of the level of traffic.

The average level of fixed investment per mile of road has been determined from the Rail Form A input data. For purposes of this analysis, Burlington Northern RFA, exclusive of the St. Louis-San Francisco, has been used, the reason being that the average level of investment per mile of road for the Burlington Northern system *prior-to* merger was felt to be most indicative of regional land and investment values for the line-segment under analysis. Investment for the old St. Louis-San Francisco Railway (SLSF) would primarily have been a function of the land values and traffic characteristics of the southern plains and the deep south rather than the Upper Great Plains. Use of this data, therefore, would have tended to further remove the system average from the actual line-segment values.

Using BN's net investment base for depreciated property plus an allowance for working capital, an average figure of $6,700 per mile of road (in 1977 dollars) has been derived. This figure, it should be pointed out, reflects the average investment per mile of road rather than mile of track. The ratio of investment in yard switching tracks, way switching tracks, and stations and office buildings, therefore, is reflected in the figure. For every mile of road, that is, a certain level of investment is incurred not only in the actual running track and roadbed, but in support facilities as well. The use of this figure (per mile of road) reflects, in essence, the additional investment in yard and way switching tracks as well as buildings and stations associated with the Gascoyne-to-Big Stone line.

Allocation of Fixed Roadway Costs

Once the necessary return on roadway investment for the entire line-segment has been calculated, as depicted below,

(1) FCAP = FIXPM x MR

where:

FCAP = total fixed capital cost for the Gascoyne-to Big Stone segment

FIXPM = average fixed cost per mile of road

MR = miles of road

the return has been allocated to all traffic moving on the line-segment. The fixed roadway costs are, in effect, a common expense which must be borne by all traffic. The most equitable method of allocation, therefore, would be on a gross ton mile basis. That way, all users of the line would bear a pro-rata allocation in direct proportion to their usage.

Determination of Traffic Density

The traffic density, that is the total number of gross ton miles per mile moving over the line-segment, has been determined from railroad density charts. Using 1981 data, a weighted-average for segment (east and west of Aberdeen) was determined on the basis of the mileage and density of each section. The weighted average of 6,770,000 gross ton miles per mile of rail (GTMM) has been used as the basis for the allocation of fixed investment costs.

Something should be said regarding this statistic. GTMM indicates the gross tonnage, on the average, which is moving-over every mile of rail in the segment. That is, in the expression: gross ton miles per mile, the miles cancel each other out, leaving the estimated gross tonnage on the line-segment.

Maintenance of Way Costs

Rail Form A also incorporates maintenance of way expenditures into the variable unit costs. A certain portion of maintenance of way expenditures, however, are fixed per mile of track. These expenses are not caused by traffic but by weathering/aging and include fixed costs such as vegetation control and a portion of superintendence costs which are incurred regardless of whether one or one thousand carloads are originated.

RFA partitions maintenance of way (MOW) accounts into variable and constant portions. For the Burlington Northern network, exclusive of the SLSF, fixed MOW costs constitute 41.37 percent of RFA MOW expenses[1], or $4,072 per mile of road (in 1977 dollars). For every mile of road, therefore, the fixed maintenance of way associated with way switching and associated yard switching tracks, as well as attendant stations and buildings, in conjunction with the maintenance of first and second main lines of track, is constituted by this figure. To determine the total cost for the total line-segment, consequently, the per mile cost, as before, has been multiplied by the miles of road.

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[1]The rationale for using BN 1977 as approved to BN-SLSF Rail Form A are the same as set forth earlier in the analysis of roadway investment.

Allocation of Fixed Maintenance of Way

Fixed MOW expenses incurred on behalf of the line-segment as a whole have been allocated to the traffic in the same manner as was done previously in the case of roadway investment. The allocation results in an apportionment of 28.90¢ for each ton of coal traffic.

This figure, as the name implies, is a gross tonnage estimate, including the weight of the locomotive units. To obtain coals' share of the allocation, therefore, the annual gross tons of cars and locomotives have been developed for the coal train, as depicted in Table 3.

	TABLE 3. DEVELOPMENT OF COAL GROSS TONS ON SEGMENT ANNUALLY.	
	ITEM	**AMOUNT**
1.	ANNUAL FREIGHT TONS	2,000,000
2.	ANNUAL CARLOADS	21,053
3.	NUMBER OF TRAINS	200
4.	AVERAGE POWER UNITS	4
5.	AVERAGE WEIGHT OF UNIT (TONS)	180
6.	GROSS TONS OF LOCOMOTIVES	144,000
7.	TARE WEIGHT OF CAR	35
8.	TARE TONS ANNUALLY	736,855
9.	TOTAL COAL: GROSS TONS ON LINE	2,751,255

Once these figures have been derived, the fixed line-segment cost denoted above may be allocated to the traffic. The allocation, based on the line-segment traffic density, results in a fixed cost of 34.5¢ per gross ton. The summation of the fixed burden to the coal traffic thus is $949,705. The remainder must be allocated across other classes of traffic on the segment.

The annual gross tonnage cost, as determined above, has been placed on a revenue tonnage basis by dividing the total cost by the number of revenue tons (2 million). This has the effect of placing the gross tonnage cost on a basis which is more amenable to rate comparison.

Rehabilitation

Anticipated rehabilitation costs will be incurred over the line-segment in the near future. Again, as was the case with roadway investment, detailed cost studies are needed before an annualized equivalency cost can be accounted for.

The analysis is complicated by the fact that the loan, obtained from FRA, is interest-free until the tenth anniversary of the note. Furthermore, it is not known at present just when the money will be invested or the exact proportion of costs going to various types of assets. Efforts are currently being made to ascertain this schedule from the railroad or other sources. Until that time, however, no precise determination can be made.

Some general guidelines for reasonableness have been calculated, however. The anticipated investment has been amortized over the life of each class of asset (rails versus other) as if all outlays had been made in the present year. The interest rate which was used over the life of the asset is the same of the railroad's cost of capital.[2] While this may be thought to properly assess the annualization rate during the years of asset life exceeding the loan life (after the 20th year), it is doubtful that this interest rate is reflective of anything valid during the early life of the loan, where government subsidization of the cost of capital. More appropriately, this might be thought to constitute

[2]The working papers and assumptions underlying this calculation may be examined at the UGPTI during normal working hours.

the annualized equivalent cost (AEC) of the rehabilitation project if the railroad had secured the funding in private capital market. This represents the annualized equivalent cost, that is, which would have resulted in the absence of government subsidy.

The market estimation of an AEC may be a useful gauge of reasonableness from this perspective: it is the *highest* AEC which would prevail even without subsidization. Any AEC allocated-out to the traffic by the railroad, therefore, should be less-than the market-derived AEC of $1.77.

III. SUMMARY AND INTERPRETATION

This report is designed to provide preliminary information regarding the Gascoyne-to-Big Stone coal movement. There are two items which must be considered in any interpretation: (1) exact investment data are still being developed, and while RFA estimates provide good proxies, the absolute accuracy cannot be pinpointed, and (2) the use of a market interest rate for annualization provides an estimation of AEC for rehabilitation which constitutes the upper boundary of reasonableness for such estimates, but does not, itself, provide the exact AEC for the traffic in question. With these qualifications, however, the following cost estimates should provide useable estimates of the cost of service involved.

Cost Estimates

Three layers of cost estimation are presented below. The first level constitutes the RFA variable cost-of-service without the inclusion of any fixed line-segment costs. This is analogous to movement costs calculated for regulatory purposes. The second layer of cost consists of variable cost plus fixed line-segment costs—road capital and MOW—allocated to the traffic. This is a more realistic representation of true cost-of-service given the density of the line and historic operating patterns. The third and final layer of cost constitutes both variable and fixed line-segment costs plus an allocation of fixed systems costs other than MOW and road capital. This would more closely reflect the true long-run cost-of-service than either of that previous estimates. These costs are depicted in Table 4.

	TABLE 4. SUMMARY OF COST ESTIMATES: GASCOYNE-TO-BIG STONE	
	ITEM	AMOUNT PER TON
1.	VARIABLE COST	$3.93
2.	VARIABLE PLUS FIXED LINE-SEGMENT COST	5.24
3.	FULL COST	5.94

In addition, in interpreting these figures it must be recalled that an allocation of rehabilitation cost of less than $1.77 per ton would perhaps be justified on behalf of the railway.