

Tucson, March 29, 1959

File: General
E-5-44

Mr. P.G. McGinnis

Starting in 1949 there have been nine studies made of the comparative cost of electric and diesel operation.

Herewith a tabulation and summary of these studies which may be helpful to bring them into focus.

/s/ T B Kirk

Electrical Engineer

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STUDIES

AG-722

COMPARATIVE ELECTRIC & DIESEL COSTS

Year Made	Study Made By	Territory	Period for Data	Operating Electric	Costs Diesel	Total - Including New Investment Costs	Electric	Diesel
1949	L. Wylie	Coast Divn.	Average '45 47 & 43	\$ 601,259	\$ 903,815	\$ 601,259		\$ 903,815
1959	Accounting Dept.	Coast & R.M. Divn.	1958	3,482,911	2,300,194	3,482,911		3,525,639
1959	L. Wylie	Idaho Divn.	1,000,000 MGTM Trailing	395,463	346,240	741,703		603,493
1959	L. Wylie	Idaho Divn.	2,000,000 MGTM	654,301	931,489	1,213,808		1,367,304
1963	H.R. Morgan	Coast Divn.	Sept. 1962	49,032	50,880	89,902		86,872
1963	Mech. Dept	Coast Divn.	Sept. 1962	52,717	47,710	Not	Shown	
1963	H. L. Morgan	R.M. Divn	Aug. 1962	142,660	181,305	181,615		182,052
1963	Mech. Dept	R.M. Divn	Aug. 1962	139,633	135,336	Not	Shown	
1968	L. Wylie	Harlowton To Tacoma	1966	2,974,741	3,691,000	4,963,741		5,482,038
1968	L. Wylie	"	1986	2,422,741	4,410,000	6,072,741		6,403,075
1968	B. Kirk	Harlowton To Tacoma	1971 - 5,647,000 MGTM Trailing	3,000-V DC \$3,192,000	3,346,500	3,000-V DC \$5,202,693		4,684,500
1968	B. Kirk	"	"	25 K.V. AC \$2,372,000		25 K.V. AC \$5,322,500		
1968	B. Kirk	"	1975- 7,000,000 MGTM	3,000-V DC \$3,738,426	4,713,090	3,000-V DC \$6,115,426		6,221,000
						25 K.V. AC \$5,727,650		
1968	E.M.D. Using Data from L. Wylie's 1968 Report	Harlowton To Tacoma	1966	2,276,375	1,504,698	3,226,108		2,037,769
			1986	2,590,981	1,804,690	3,076,429		2,431,833

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SUMMARY OF STUDIESELECTRIC VS. DIESEL OPERATION

- Note on AG-722- Operating costs include fuel and power, engine maintenance and supplies, and electrification costs. Train and engine crew costs not included. Total costs- Include operating costs plus charges on new investment.
- 1949 Study- L. Wylie - Coast Division only
 Conclusion - Would require \$4,058,800 new investment for diesels if electrification discontinued.
- 1959 Study- Accounting Department- Coast and Rocky Mountain Divisions
 Conclusions- Would require \$12,650,000 new investment for diesels if electrification discontinued.
 Comment- This study included \$416,687 annual charges for depreciation and taxes on the existing electrification. These charges not included in other studies.
- 1959 Study- L. Wylie - Electrification Avery to Othello
 Conclusion- Would require \$6,582,432 new investment. Would require double existing 1958 traffic of 1,000,000 MGTM to justify.
 Comment - Additional electric engines not included. Better utilization of existing engines would handle.
 1968 Trailing MGTM this section 1,350,332
- 1960 Study- General Electric Company- Study of cost to rebuild old freight units.
 Conclusion- Recommended purchase of 18 new units at cost of \$6,940,000
 Comment - Essentially the same engine now being offered by General Electric. H.P. has been raised from 4,050 to 4,550 continuous.

- 1963 Study - H.R. Morgan- Coast and Rocky Mountain Divisions
- Conclusion- New electric locomotives would require an investment of \$7,711,100
Complete dieselization would require \$7,420,000 for new engines
- Comment - Diesel boosters would still be used with the new electric engines
- 1963 Study- Mechanical Department- Coast and Rocky Mtn. Divisions
- Comment- Same data as H.R. Morgan's Study, except for engine maintenance costs. Final operating estimate essentially the same. No estimate of investment costs.
- 1968 Study- L. Wylie- Complete Electrification Harlowton to Tacoma.
- Conclusions- New Investment - 1966 conditions:
All Electric \$21,677,712
All Diesel 16,320,000
New Investment - 1986
All Electric \$32,377,712
All Diesel 13,080,000
- Comment- Mr. Wylie assumed engine maintenance costs per unit mile of 40¢ for diesels and 34¢ for electric. These costs are high for 1966, but may be valid for 1986. Most economists expect wages in 1986 to be at least double those of 1966. Maintenance charges involving a large labor component will certainly tend to rise. These charges would include engine maintenance and electrification operating costs. Diesel fuel costs are expected to rise faster than electric power rates.
- 1968 Study- J. Kirk- Harlowton to Tacoma
- New Investment - 1971 for 5,647,000 MGTM
3,000-V D.C. Electric \$22,024,000
25 KV A.C. Electric 29,491,000
All Diesel 1,426,000
- New Investment - 1975 for 7,000,000 MGTM
3,000-V D.C. Electric \$26,650,000
25 KV A.C. Electric 33,990,000
All Diesel 5,186,000

1968 Study- B. Kirk- Harlowton to Tacoma (Continued)

Comment- Low investment shown for diesels is based on Accounting Department statement that net salvage from electrification could be applied to cost of new diesels.
1968 MGTM (Trail) was 5,749,497

1968 Study- C.M.D.

Conclusions: New Investment - 1966 conditions

All Electric	\$19,777,712
All Diesel	7,463,000

Investment Remaining - 1986 conditions

All Electric	\$8,111,092
All Diesel	3,730,000

Comment- Used train data, and electrification data, from L. Wylie's 1963 Study.
Estimate of engines required and of maintenance costs not realistic.

General Comments on Studies-

The most notable trend in these studies is the swing in required new investment from diesels to electric. In the early studies the electrification was assumed to be adequate as it then existed, while for dieselization a complete new set of engines would be required. Due to increased diesel operation over electrified territory, and the desire for a continuous operation between Harlowton and Tacoma, the later studies show a higher new investment required for an adequate electrification than for complete dieselization.

The present, and probable future power rates, are very attractive; less than half the proposed rates on which other Western Railroads are basing their electrification studies. The Oil Companies have told us that diesel fuel may rise 3¢ or 4¢ in the next few years.

Electric locomotive maintenance costs on other railroads have been less than half those of comparative diesels. This ratio has not developed on the Milwaukee due to low mileage and poor utilization of the electric engines. Complete electrification Harlowton to Tacoma would result in higher mileage, which added to consolidated shop facilities, would considerably reduce unit mile costs.

Prices may be expected to rise, with the resulting effect on operations having a large labor component. Substation operation is presently the largest electrification cost. A gradual change to solid state rectifier stations would eliminate most of the operating cost and would greatly reduce maintenance.

Tacoma, January 24, 1968

VICE PRESIDENT

File: General

P-5-114

Mr. F.O. McGinn:

As you know, electric operation on the Coast Division since March has consisted of helper operation and an occasional extra train. At present there are three engines totalling eleven units in operation. These units are going out of service at the rate of one every two to three months.

Presumably, when the five sets of remote control diesel units are placed in service the helper will not be needed for regular trains. Extra diesel units are now used to handle extra trains between Avery and Othello, and it would appear that a minimum of additional units would be needed to extend this operation to Tacoma.

Operating Statistics

Compared to 1967, electric operation in 1968, as indicated by energy consumption, is down 49% but we have been able to reduce operating costs but 9%. Four substation positions have been cancelled, but uncertain train operation has built up overtime to wipe out part of the saving.

Line maintenance cannot be reduced under present operation. The high incidence of right of way fires, which spread to the pole lines, has increased the repair work required, and delayed normal maintenance.

Retirement of Electrification

If a decision is made to retire the Coast Division electrification, the least immediate cost would be to retain the trolley poles and the high voltage signal feeder circuit. It would then only be necessary to make connection with Power Company lines at 20 to 40 mile intervals. Phone conversations with Mr. D.L. Wylie indicate that this is his thinking also.

1/24/69

The estimated salvage from the remainder of the overhead system is \$1,418,000. Labor charges to retire are estimated at \$325,000, for a net of \$1,093,000.

The eight substations are estimated to have a salvage value of \$100,000. However, part of the equipment should be retained for repairs to identical machines on the Rocky Mountain Division. As replacements each armature will take the place of a \$10,000 to \$14,000 rewind.

Transmission Line

The transmission line should be sold if possible. An estimated sale price is \$200,000, subject to considerable negotiation.

The Coast Division power contract with the Washington Water Power Co., and with the Puget Sound Power & Light Co. as sub-contractor, is in force until May 1, 1976. A Use of Facilities Clause in this contract allows the Power Companies to wheel power over the line for interchange, and also to various taps to serve their loads. In connection with former studies, our Law Department has stated their opinion that we could be required to maintain the line in service during the life of the contract.

With electric train operation discontinued it would probably cost \$30,000- \$40,000 a year for minimum maintenance.

Some of the Power Company taps have built up to heavy loads requiring a high degree of reliability, and in an attempt to obtain this reliability Puget Power has installed automatic and remotely controlled switches at their expense.

The Puget Sound Power engineering people feel that they should own and operate the line, but there has never been a discussion with their management on the subject.

Power Costs

Our present power rates are based on energy received at 100,000 volts. With the substations eliminated we would probably have to pay a higher rate for our miscellaneous loads. These charges would be about as follows:

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Traction power- 1968, \$61,605.

This cost would be eliminated. Equivalent energy at the rail from diesel fuel would be \$66,500.

<u>Shop power-</u>	Tacoma Shops	\$13,621
	Othello Shops	2,480

Preliminary discussion with Tacoma City Light indicates that power can be delivered to the Tacoma Shops at a rate comparable to present costs. Othello shop power is delivered to us at 13,000-volts. The present rate should not change.

Signal power - \$2,992

Rate will increase but amount needed will decrease. Cost about as at present.

Substation auxiliaries- \$3,294

Will be eliminated.

Misc. Roadway Buildings, Depots, etc. - \$2,109

Some will be eliminated. Cost will increase to possibly \$3,000.

Retirement Procedures

The present line crews and equipment would be the nucleus of forces to remove the overhead, with additional lower rated ground forces.

This project primarily would be a material handling problem and special equipment would save costs. The enclosed sketch shows a hy-rail truck equipped to wind two strands of cable simultaneously. Chet Miller has some preliminary figures on this equipment which would be in the \$25,000 range. For the short time needed, it could probably be on a lease basis.

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