Tacoma, June 5, 1963

Mr. Don Carlson,
Fullerton Avenue,
Chicago

Dear Don:

I am attaching copy of the cost study for which you provided some figures. After you have had a chance to study, unless you wish to retain it for reasons of your own, I would suggest that you turn it over to Mr. Kellow. This would indicate to him just what sort of costs and statistics should be maintained to permit setting up a study like this in a short time.

In this day and age, with the advantages of IBM equipment and other modern methods for tabulating, it should not be necessary to go thru the turmoil we did in drawing off this data from the train sheets and trying to balance our data.

Best of luck and thanks again for your help.

Sincerely,

Harry R. Morgan

hrm-k
Encl.

Tacoma, Washington
June 14, 1963

Mr. M.T. Sevedge,
Mr. N.H. McKagney,

Herewith correction sheets and a supplement to be inserted in Cost Study of May 31, 1963, forwarded to you on that date.

H.R. Morgan

cc:
Mr. G.J. Johnston
Mr. H.W. Reinold
Mr. Don Carlson

THE MILWAUKEE RAILROAD

A STUDY OF VARIOUS METHODS OF OPERATION ON ELECTRIFIED SECTIONS ROCKY MTN. & COAST DIVISIONS

May 31, 1963

Electrification Department,
Tacoma, Washington
May 31, 1963

ERATTA

Page 8 - Depreciation - last paragraph
Should read- A GP9 locomotive cost of $168,650 per advice, etc. The words "GP9 locomotive" were omitted.

Page 12 - top of page, second sentence reads February to October. This should read October '62 to February '63. End of sentence should read- by the train sheets in other cases.

Page 34 - last paragraph, fourth line up.
Draw a line thru "per mile horsepower hour." This is redundant.

Page 39 - Under Depreciation and Total Columns, fourth item down should be 3430 and 6945 respectively. Totals are correct.

H.R.M.

AG-668

ROCKY MOUNTAIN AND COAST DIVISIONS

A STUDY OF OPERATION WITH VARIOUS TYPES OF MOTIVE POWER

This study presents actual operating costs and statistics for certain key months on the Coast and Rocky Mountain Divisions.

These statistics were then used in developing operation and costs with various types and combinations of motive power.

Including the operation of the key months, May and September 1962 on the Coast Division, and August 1962 on the Rocky Mountain Division, ten schemes of motive power assignment are presented.

A comparative cost sheet for each division shows in total cost and cost per MGTM the relative merits of the various schemes.

A legend explains the source and methods of developing pertinent statistics and costs. Certain items such as fuel and power, and locomotive repairs, are covered in more detail.

One of the interesting comparisons is that between helper and non-helper operation on the Coast Division.

All supporting material for the study, except train sheets and time slips, is available in this department. Questions about any item can be answered by referring to this detail.

I would like to express my thanks to the Operating and Mechanical Departments of the electrified divisions, and to the Bureau of Statistics, Finance and Accounting at Chicago, who furnished certain statistics and costs.

H.R. Morgan

H.R. MORGAN
Electrical Engineer

Electrification Department,
Tacoma, Washington
May 31, 1963

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ROCKY MOUNTAIN DIVISION- COMPARATIVE MONTHLY OPERATING COSTS

Based on Business of August 1962

ITEM \ SCHEME	1 (Actual)	2	3	4 *
Locomotive Assignment				
Time Freight	EF-4 / GP-9	GP-9	GP-9	EF-4 / GP-9
Other Freight	EF-4 EF-5,3,2,			EF-4 EF-7 **
Helper	EF-5	EF-5	GP-9	EF-7 **
Gross Ton Miles-1000	241,450	241,450	241,450	241,450
EXPENSE - OPERATING				
Trainmen Road	$41,039	$41,039	$41,039	$41,039
Enginemen Road	32,488	33,490	33,490	32,471
Helper	6,677	6,677	6,726	6,530
Fuel & Power	51,907	56,818	60,013	50,782
Loco. Repairs	57,788	62,007	61,533	48,288
Lubricants	1,605	8,614	9,646	1,823
Other Supplies	978	1,864	1,992	602
Enginehouse Expense	4,844	4,181	4,181	4,326
Substation-Operation	15,854	8,200	--	15,854
Maint.	8,435	4,050	--	8,435
Line Maintenance	12,550	6,650	4,000	12,550
TOTAL COST	234,165	233,590	222,620	222,700
COST / MGTM	$ .9698	$ .9674	$ .9220	$ .9223
OTHER EXPENSE				
Depreciation	7,680	15,050	21,690	19,375
Interest	3,515	15,249	22,237	19,580
Increased Cost Mscl.Power ***			2,852	
TOTAL COST	$245,360	$264,069	269,399	$261,655
COST/MGTM	$ 1.016	$ 1.09367	$ 1.11575	$ 1.084

* In Scheme 4, two EF-7 units, 8100 HP replace an EF-5, 6680 HP and an EF-3 or 2 of 5010 HP. There is therefore a possibility of handling more tonnage per train and of reducing the number of trains with this locomotive. Speed would be same as EF-4's

** This is the new electric locomotive proposed by General Electric Co. Oct. 31, 1960.

*** If Traction Power Contract is cancelled miscellaneous power along R/W will be billed at commercial rates resulting in an increase in cost of $34,218 annually or $2852 per month.

Electrification Dept.,
Tacoma, Wash - Rev.6-14-63
May 31, 1963

COAST DIVISION - COMPARATIVE MONTHLY OPERATING COSTS

Based on Business of May and of Sept. 1962

ITEM \ SCHEME	5 May '62 (Actual)	6 Sept.'62 (Actual)	7 May '62	8 Sept. '62	9 Sept.'62	10 Sept. '62	11 Sept. '62
Locomotive Assignment							
Time Freight	EF5/GP9	EF5/GP9	3-EF7* / 1 GP9	2 EF-7*/ 1 GP9	2-EF7*/ 1 GP9	4-GP9	2-EF4 / GP9
Other Freight	EF5	EF5	2-EF7*	2 EF-7*	2 EF7* EF5	4 GP9	2-EF4
Helper	None	EF-5,3,2	None	2 EF-7*	EF5	4 GP9 3 GP9	2-EF4
Gross Ton Miles-1000	69,961	77,568	69,961	77,568	77,568	77,568	77,568
Expense - Operating							
Trainmen- Road	$22,137	$23,899	$22,137	$23,899	$23,899	$23,899	$23,899
Helper	--	1,431	--	1,431	1,431	1,431	1,431
Enginemen- Road	13,635	13,420	12,854	12,776	12,827	12,329	12,800
Helper	--	4,617	--	4,558	4,617	4,630	4,580
Fuel & Power	18,845	18,323	15,962	17,154	17,387	21,776	17,154
Locomotive Repairs	24,087	20,540	11,792	10,729	13,528	22,328	15,256
Lubricants	2,274	1,183	638	601	673	2,370	700
Other Supplies	286	387	140	131	149	476	210
Enginehouse Expense	3,196	2,207	1,523	1,180	1,319	1,730	1,180
Substation-Operation	10,069	9,744	10,069	9,744	9,744	--	9,744
Maint.	1,895	1,834	1,895	1,834	1,834	200	1,834
Line Maintenance	7,966	7,709	7,966	7,709	7,709	2,000	7,709
Total Cost	$104,390	$105,294	$84,976	$91,746	$ 95,117	$93,169	$96,497
Cost/MGTM	$ 1.492	$ 1.357	$ 1.2146	$ 1.183	$ 1.226	$ 1.201	$ 1.244
Other Expense							
Depreciation	$ 6,737	$ 3,307	$15,688	$18,027	$ 11,010	$ 19,310	$ 4,863
Interest	6,327	2,812	19,580	22,793	13,154	19,795	1,406
Miscellaneous Power						1,267	-
Total Cost	$117,454	$111,413	$120,244	$132,566	$119,281	$133,541	$102,766
Cost/MGTM	$ 1.679	$ 1.436	$ 1.7187	$ 1.709	$ 1.538	$ 1.722	$ 1.325

Electrification Department,
Tacoma, Washington
May 31, 1963 * Rev.6-14-63

* EF-7 is locomotive proposed by G.E.Co. 10/31/60

ROCKY MOUNTAIN DIVISION- OPERATING STATISTICS USING VARIOUS TYPES OF MOTIVE POWER

Based on Business of August 1962

ITEM \ SCHEME	1 (Actual)	2	3	4 *
Locomotive Assignment				
Time Freight	EF4 / GP9	GP 9	GP 9	EF4 / GP9
Other Freight	EF4's EF 5,3,2	GP 9	GP 9	EF 4 EF 7**
Helper	EF 5	EF 5	GP 9	EF 7**
MGTM				
Time Freight	133,503	133,503	133,503	133,503
Other Freight	107,947	107,947	107,947	107,947
Total	241,450	241,450	241,450	241,450
Loco MGTM	38,430	37,585	36,974	32,162
Trailing & Loco	279,880	279,035	278,424	273,612
Train Miles				
Time	26,947	26,947	26,947	26,947
Other	23,709	23,709	23,709	23,709
Total	50,656	50,656	50,656	50,656
Locomotive Miles				
Train	50,656	50,656	50,656	50,656
Road Switching	762	762	762	762
Lite	48	48	48	48
Helper	9,542	9,542	9,542	9,542
Total	61,008	61,008	61,008	61,008
Locomotive Unit Miles				
EF 4	78,711	--	--	78,711
EF 5	49,688	38,168	--	--
EF 3,2	24,615	--	--	--
EF 1	170	--	--	--
EF 7*	--	--	--	22,084
GP 9	39,708	260,010	298,178	39,708
Total	192,892	298,178	298,178	140,503

* In Scheme 4, two EF-7 Units, 8100 HP replace an EF-5, 6680 HP and an EF-3 or 2 of 5010 HP. There is therefore a possibility of handling more tonnage per train and of reducing the number of trains with this locomotive.
Speed would be same as EF-4's

** This is the new electric locomotive proposed by General Electric Co. October 31, 1960

Electrification Dept.,
Tacoma, Wash 5/31/63

COAST DIVISION - OPERATING STATISTICS USING VARIOUS TYPES OF MOTIVE POWER

Based on Business of May and of September 1962

ITEM \ SCHEME	5 May '62 (Actual)	6 Sept.'62 (Actual)	7 May '62	8 Sept.'62	9 Sept.'62	10 Sept.'62	
Locomotive Assignment							
Time Freight	EF5 ⁄ GP9	EF5⁄ GP9	3-EF7 ⁄ GP9	2 EF7⁄ GP9	2 EF7 ⁄ GP 9	4-GP9	Note: EF-7 is new electric locomotive proposed by Gen.Elec.Co. Oct. 31,1960
Other Freight	EF5	EF5	2-EF7	2 EF7	EF-7 EF-5	4-GP9	
Helper	None	EF-5,3,2	None	EF-7	EF5	4-GP9 3-GP9	
MGTM							
Time Freight	54,447	59,600	54,447	59,600	59,600	59,600	
Other Freight	15,514	17,968	15,514	17,968	17,968	17,968	
Total	69,961	77,568	69,961	77,568	77,568	77,568	
Loco. MGTM	18,480	15,831	11,965	10,777	12,252	11,676	
Trailing & Loco	88,441	93,399	81,926	88,345	89,820	89,244	
TRAIN MILES							
Time	13,384	12,963	13,384	12,963	12,963	12,963	
Other	4,024	4,483	4,024	4,483	4,483	4,483	
Total	17,408	17,446	17,408	17,446	17,446	17,446	
LOCOMOTIVE MILES							
Train	17,408	17,446	17,408	17,446	17,446	17,446	
Road Switching	1,992	2,334	1,992	2,334	2,334	2,334	
Lite	80	304	80	304	304	304	
Helper	--	3,765	--	3,765	3,765	3,765	
Total	19,480	23,849	19,480	23,849	23,849	23,849	
LOCOMOTIVE UNIT MILES							
EF-4	--	--					
EF-5	77,432	90,286	--	--	29,704	--	
EF-3,2	--	3,696	--	--	--	--	
EF-1	--	--	--	--	--	--	
EF-7	--	--	53,834	47,698	32,846	--	
GP-9	59,180	19,993	14,874	14,593	14,593	94,164	
Total	136,612	113,956	68,708	62,291	77,143	94,164	

Elec. Dept.,Tacoma
5/31/63

CONCLUSION

ROCKY MOUNTAIN DIVISION

Inspection of comparative cost operating expense only indicates that full diesel operation and electric operation with EF-4 and new electric (EF-7) locomotives are about the same, the first being $.9220/MGTM and the second being $.9223/MGTM. The figures could be thrown either way. However, when depreciation, interest and the increased cost of miscellaneous power are introduced, the electric operation comes up with a cost of $1.084/MGTM whereas the diesel operation costs $1.1158/MGTM. The latter costs are very real so that in the final analysis, the electric operation is the most economical.

COAST DIVISION

Inspection of comparative operating expense of the various schemes shows operation with new electric locomotives, Scheme 8, to be the most economical. When investment expense and miscellaneous power are introduced, operation with EF-4 locomotives, Scheme 11, is most economical, followed by operation with present power, Scheme 6, and then by operation with new electric road locomotives, EF-5 helper locomotives as developed in Scheme 9.

Scheme 9 appears to offer considerable returns in that it provides high speed operation for time freights with minimum investment at this time. The old EF-5 locomotives would continue in helper service and in emergency work, and dead freight service, until some time in the future when economics would justify their replacement.

The study also indicates that helper operation with the present locomotive assignment is more economical than non helper operation. In this connection there are other expenses, agents, away from home detention, etc., that have not been included in the study.

GENERAL

Generally, the study indicates that operating costs with modern power, electric or diesel, will run very close. When investment expense is introduced, the cost of electrical operation appears to be the lowest.

The increased efficiency of electric operation is offset to some extent by the costs of substations and lines, but these are almost constant, so that with increased traffic the odds swing more heavily in favor of electric operation.

H.R. Morgan

Tacoma, Washington
June 14, 1963

COMMENT

BOOSTER OPERATION

Booster operation was initially developed to enable us to handle a prescribed tonnage up Sixteen Mile Canyon without using a helper. It was so successful that its use was extended over the full division on the Rocky Mountain. Later on, on the Coast Division it was developed to permit transfer of diesel units from Othello to Tacoma, for maintenance. It is now an accepted operation and any new electric locomotives should come equipped for this type of operation.

NEW ELECTRIC LOCOMOTIVES

In 1960 the General Electric Company proposed a new locomotive having the same speed characteristics as the Joe Locomotive. This locomotive is similar to a diesel SD in that it has 6 traction motors and a diesel type cab. It looked like a diesel locomotive except for the pantograph mounted on the roof. Locomotives of this type, but with only 4 traction motors, have been in service on the BA&P Ry. for several years. These have been so successful and the maintenance cost so low, that this type is recommended to the Milwaukee.

In this study we called the new locomotive the EF-7 but in case of a future acquisition of electric power the whole subject should be reviewed. Any locomotives purchased should have control to handle diesel booster units.

DEPRECIATION

Our department of finance and accounting uses a life of 20 years for diesel and 25 years for electric locomotives and figures on these bases were used in the study. Life closer to actuality would be 15 years for diesel and 35 years for electric locomotives.

A cost of $168,650 per advice of our Accounting Department is used in the study. Today these locomotives would cost around $200,000 each.

POWER CONTRACT

Our Traction Power Contract permits the railroad to convert to another type of operation provided the new operation is patently superior to electric operation. On basis of operating experience and in view of the comparative costs as developed in this study it is doubtful that the railroad could legally support a change from electric to diesel on the basis of improvement.

COMMENT, CONTINUED

SIGNAL SYSTEM

In the case of dieselization, it would be necessary either to continue maintenance of the trolley poles account of the 4400-volt signal feeder system, or transfer this line to the present low voltage signal and communication pole line. This latter move would involve practically reconstruction of that line at a cost roughly estimated at a million and one-half dollars.

SUBSTATION AND LINE COSTS

It should be pointed out that all expenses are proportional to either gross ton miles or locomotive miles except substation and line expense. These are almost independent of business, operators' expense only rising a slight amount with excess overtime due to heavy business. The net result is that electrical operating cost per MGTM decreases with increased business. For instance in 1959, we handled 2,869,712 MGTM at a power cost of $.4322/MGTM. In 1962 we handled 1,822,997 MGTM and the power cost increased to $.5940/MGTM.

GENERAL

A comparison of the costs of different schemes of operation is essential to any investigation of motive power. But the most important factor is still - performance! The electric locomotive is ideal for mountain work. It does not back away from an overload. On the other hand, the diesel locomotive, for its own protection is designed to back away. That doesn't help operations when unexpected loads develop. And on river grades, the modern electric locomotive will compare favorably with any diesel locomotive. Line losses do exist, but taking all these, and also substation motor-generator set losses, into account we come up with an overall electrification system efficiency of about 70%. Against this, the diesel locomotive shows an efficiency of 27 to 30%.

AG-668

ROCKY MOUNTAIN AND COAST DIVISIONS

A STUDY OF OPERATION WITH VARIOUS TYPES OF MOTIVE POWER

LEGEND

GENERAL

In this study selected months on the Coast and Rocky Mountain Divisions were analyzed and basic data and costs developed for these particular months.

Using this data various combinations of locomotive power were assigned and cost developed for each scheme of operation. The various schemes are as follows:

On the Rocky Mountain Division four schemes are presented, as follows:

Scheme "1"- Present Day Operation for August 1962.

Scheme "2"- Operation Wherein Diesel Locomotives Are Used as Road Locomotives and Electric Locomotives Used as Helpers.

Scheme "3"- A Full Diesel Operation, in which case the electrification is retired.

Scheme "4"- An Operation Similar to the Present Operation, except that the old EF-5, 3 and 2 type locomotives are replaced with a new electric locomotive, designated as the EF-7.

On the Coast Division six schemes are presented as follows:

Scheme "5"- Actual Operation for the month of May 1962, when no helpers were used.

Scheme "6"- Actual Operation for the month of September 1962, when helpers were in use.

Scheme "7"- Operation with Business of May 1962, using modern electric locomotives and no helpers.

Scheme "8"- Operation with Business of September 1962, using modern electric locomotives with a helper.

Scheme "9"- Operation with Business of September 1962, using modern electric locomotives on the time freights, modern electric locomotive when available and an EF-5 at other times on other freight, and using an EF-5 in helper service.

Scheme "10"- Operation with Business of September 1962, using all GP-9 diesel locomotives.

Scheme "11"- Operation with Business of Sept.1962,using EF-4 locomotives with GP-9 unit on time freights only.

Revised June 14,1963

STATISTICS:

Statistics were developed from the train sheets, Form 110 and freight train delay reports for the basic months. It was assumed that the same number of trains would operate as in the operation of the basic month, tho it is realized that in some cases the train would be over-powered. This would provide for future growth and of course result in a faster operation over the division.

EXPENSES:

Train & Enginemen

Train and enginemen's wages were developed from the time slips for the basic months studied in Schemes 1, 5 and 6. Except for use of a pilot on the Coast Division, trainmen's wages remain constant for any one month involved in a new scheme of operation. Enginemen's wages will vary with the weight on drivers and therefore with the type of locomotive assigned to the service. In developing these wages, miles paid were accumulated in each case so that these permitted applying a different rate when developing expense for operation with a new combination of locomotive power.

Fuel & Power

Method of handling fuel and power is described on page 34 following.

Locomotive Repairs

Our method of developing locomotive repairs is covered on page 36.

Lubricants

The total cost of lubricants for electric operation and for diesel operation on each division was supplied by the Department of Finance and Accounting at Chicago. The Chief Statistician supplied total diesel locomotive unit miles for each division. Electric locomotive unit miles and diesel locomotive unit miles in booster service were developed in our basis statistics. From this data a cost per unit mile was developed for electric and for diesel locomotives separately, and this unit cost used in determining the lubricant cost for each scheme of operation.

Other Supplies

These were developed in the same way as lubricants.

Enginehouse Expense

In examining enginehouse expense, we found that there was a considerable increase in cost after IBM accounting started. There also

was considerable variation in the method used in counting engine units turned. To establish correct unit cost, data from the IBM reports for the months of February to October, inclusive, were used, and the engine units turned developed from "Statement of Engines Turned," Form 1754, where correctly reported, and by actual count as disclosed by the train sheets. In the case of terminals where switch engines were involved, switch engines turned were counted as one-third turn each. At Harlowton, passenger engines were counted as one-half turn each. This gave us a cost of units turned which appeared to be reasonable for present operation. When developing full diesel operation, as shown in Scheme 2, a cost of $3.50 per unit turned was used at Harlowton and at Deer Lodge. (Present operation shows $7.94 and $6.79 respectively). No changes were made in the cost at Avery, Othello and Tacoma.

Substation Operation
and Maintenance

These reflect actual operating costs for the months studied, and in schemes where full electric operation is used. In Scheme 2 where diesel engines handle road service and electric engines handle helper service only, the cost of five stations only are shown. There is some question about the expense of signal apparatus maintenance under full diesel operation; no expense is shown.

Line Maintenance

Actual operating expense is shown for all schemes, except Schemes 2 and 3.

In the case of Scheme 2, a cost estimated to cover maintenance of trolley only in the operating sections, and signal and 100,000-V lines over the full division is shown.

In the case of Scheme 3, an estimated cost covering maintenance of signal system and transmission line only is given.

Depreciation and Interest- Taxes

Under this item we show actual costs furnished by the Finance and Accounting Department at Chicago, as reflected by their records.

Charges for the EF-4 locomotives, substation automation, aluminum trolley feeder, and diesel locomotives added to the present fleet (this excludes units presently in service Avery to Othello- does not exclude units in booster service) are entered on the cost sheet. Likewise depreciation and interest for new electric locomotives are included.

Taxes amounted to $76.23 per year covering the substation buildings and machinery in Montana, and was not shown. It was found that taxes on similar equipment in Washington and Idaho, and on locomotives in all three states was based on the amount of business and had no relationship to the type of motive power used.

Miscellaneous Power

Under our traction contract electric power for our shops, stations, signals, and other railroad uses is charged to us at our traction power rate, $.00536 per KWH on the Rocky Mountain Division, and about $.0055 per KWH on the Coast Division. In case of cancellation of our traction contract this power would be billed at the prevailing commercial rate.

In 1959 this matter was investigated, and an estimate made of the increase in cost when billed at commercial rates. This estimated increase in cost is shown on the Comparative Cost Sheets-- supporting data is attached, pages 41-46.

LOCOMOTIVE ASSIGNMENT

Pages 30 and 31 show predicted requirements under the various schemes studied. Where some diesel units are already available (as on the section between Avery and Othello, and in booster service), the additional units required are indicated.

LOCOMOTIVE DATA

Page 32 shows weight, horsepower, tractive effort, speed, etc. for the locomotives considered in this study.

Page 33 shows data for various combinations of units, including repair costs and enginemen's pay scale.

TRAIN AND ENGINEMENS WAGES - AUGUST 1962

ROCKY MOUNTAIN - MAIN LINE

Eastbound

	Avery- Alberton				Alberton- Deer Lodge				Deer Lodge-Three Forks				Three Forks-Harlowton			
	No Trains	Total Pay $	Avg.Per Train Cost $	Paid Miles	No. Trains	Total Pay $	Avg.Per Train Cost $	Paid Miles	No. Trains	Total Pay $	Avg.Per Train Cost $	Paid Miles	No. Trains	Total Pay $	Avg.Per Train Cost $	Paid Miles
Time Frts																
Trainmen	31	2809	90	151	31	2502	81	134	30	2716	91	152	31	2767	89	149
Enginemen	31	2212	71	149	31	2020	65	136	30	2199	73	151	31	2211	71	147
Xtra Frts																
Trainmen	24	1987	83	141	24	1974	82	139	29	2938	101	168	30	2909	97	162
Enginemen	24	1513	63	140	24	1467	64	142	29	1988	69	148	30	2148	72	154

Westbound

	Alberton - Avery				Deer Lodge- Alberton				Three Forks- Deer Lodge				Harlowton-Three Forks			
Time Frts																
Trainmen	31	2352	76	130	30	2401	80	134	31	2651	85	146	31	2678	86	148
Enginemen	31	1968	63	133	30	2191	73	153	31	2175	70	146	31	2244	72	148
Extra Frts																
Trainmen	25	2031	81	135	26	2281	88	144	27	2669	99	164	29	2784	96	159
Enginemen	25	1551	62	138	26	1938	75	165	27	2107	78	170	29	2180	75	163

Avery Helper Wages = $3398
For 32 Time Slips = $ 106 per crew day

Butte Helper Wages = $3279
For 34 Time Slips = $ 96 per crew day

Summary					
	Time Frts.	Extras	Both	Helpers	Total
Enginemen	17220	14892	32112	6677	38789
Trainmen	20876	19573	40449	--	40449
Total	38096	34465	72561	6677	79238

Electrification Dept.,
Tacoma, Washington
May 31, 1963

TRAIN & ENGINEMEN WAGES MAY 1962

Coast Divn. Main Line

	Eastbound				Westbound			
	Tacoma Cle Elum	Cle Elum Othello	Total		Othello Cle Elum	Cle Elum Tacoma	Total	
Time Freights								
264 Trainmen	$4732.16	4002.41	8734.57	263	4042.96	4353.30	8396.26	$17,130.83
Enginemen	2624.20	2643.64	5267.84		2803.93	2379.59	5183.52	10,451.36
Total	7356.36	6646.05	14,002.41		6846.89	6732.89	13,579.78	
Other Freights								
Extra Trainmen	1559.18	1087.59	2646.77	Ex.W.	1062.66	1296.75	2359.41	$ 5,006.18
Enginemen	991.22	696.94	1688.16		718.49	776.71	1495.20	3,183.36
Total	2550.40	1784.53	4334.93		1781.15	2073.46	3854.61	
264 & Extras	9906.76	8430.58	18,337.34	263 & Xtras	8628.04	8806.35	17,434.99	
Divn. Total								$35,771.73
Wage Sheet Total								$37,029.05

SUMMARY

	Time Freights	Other Frts.	Both
Enginemen	$10,452	$3,183	$13,635
Trainmen	17,131	5,006	22,137
Total	$27,583	$8,189	$35,772

Electrification Department,
Tacoma, Washington
May 31, 1963

TRAIN & ENGINEMEN WAGES - SEPTEMBER 1962
(From Time Slips)

COAST MAIN LINE
(Helper Excluded)

		Eastbound						Westbound					
		Tacoma-Cle Elum			Cle Elum- Othello			Othello-Cle Elum			Cle Elum-Tacoma		
		No. Trains	Total Pay $	Per Train Cost $	No. Trains	Total Pay $	Per Train Cost $	No. Trains	Total Pay $	Per Train Cost $	No Trains	Total Pay $	Per Train Cost $
Time Frts.	Trainmen	30	4622	154	30	3775	126	30	4489	150	30	4824	161
	Avg. SM-OM-CM			129-31-29			112-0 -46			112-26-39			129-12-40
	Enginemen	30	2504	83	30	2310	77	30	2545	85	30	2386	80
	Avg. SM-OM-CM			128-30- 5			112-1- 37			112-25-42			129-16-16
Extras	Trainmen	9	1550	172	9	1078	120	13	1979	152	10	1582	158
	Avg.SM-OM-GM			126-33-72			112-13-25			112-78-18			129-37-32
	Enginemen	9	925	103	9	660	73	13	1239	95	10	851	85
	Avg.SM-OM-CM			127-36-55			112-19-17			112-39-21			129-38-13

Electrification Dept.,
Tacoma, Washington
May 20, 1963

Summary					
	Time Frts	Extras	Both	Helpers	Total
Enginemen	9,745	3,675	13,420	4,617	18,037
Trainmen	17,710	6,188	23,898	1,431	25,329
Total	27,455	9,863	37,318	6,048	43,366

COAST DIVISION

HELPER SERVICE - SEPTEMBER 1962

	Beverly	Cedar Falls	Total
ENGINEERS			
Straight Miles	5,108	3,586	8,694
Overtime Miles	911	253	1,164
Constr. Miles	16	186	202
Total Miles	6,035	4,025	10,060
Wages	$ 1,523.71	$ 928.93	$2,452.64
FIREMEN			
Straight Miles	5,108	3,586	8,694
Overtime Miles	911	253	1,164
Constr. Miles	16	186	202
Total Miles	6,035	4,025	10,060
Wages	$1,298.13	$ 865.78	$2,163.91
CONDUCTORS			
Straight Miles	3,536	3,000	6,536
Overtime Miles	300	144	444
Constr. Miles	84	0	84
Total Miles	3,920	3,144	7,064
Wages	$ 753.04	$ 678.03	$1,431.07
TOTALS:			
Miles	15,990	11,194	27,184
Wages	$ 3,574.88	$2,472.74	$6,047.62

Electrification Department,
Tacoma, Washington
May 20, 1963

AG-660

TRAFFIC PATTERN
ROCKY MOUNTAIN DIVISION
August, 1962
(Compiled from Train Sheets)

EASTWARD

	AVERY-ALBERTON		ALBERTON-DEER LODGE		DEER LODGE-THREE FORKS		THREE FORKS-HARLOWTON	
	Time Frts.	Extras	Time Frts.	Extras	Time Frts.	Extras	Time Frts.	Extras
No. Trains	31	24	31	24	30	29	31	30
Total Tons	189,736	114,384	190,546	114,440	185,510	140,295	193,650	136,520
Total Ton Miles	18,987,760	11,436,870	22,956,360	12,732,110	20,743,850	15,630,930	22,362,630	16,211,630
Per Train Average Tons	6,121	4,766	6,147	4,768	6,184	4,838	6,247	4,551
Per Train Max. Tons	6,785	6,229	7,225	6,229	6,590	6,500	6,765	5,885
Per Train Min. Tons	3,736	2,285	3,736	2,285	4,635	3,500	5,760	1,910
Per Train Av.Load-Mtys	92-14	77-19	89-13	77-19	95-10	73-22	96-10	68-24

Total MGTM EAST = 141,062

WESTWARD

No. Trains	31	25	30	26	31	27	31	29
Total Tons	111,635	107,811	109,380	123,004	111,850	117,118	108,700	126,145
Total Ton Miles	11,162,300	10,748,870	12,089,810	13,104,080	12,583,120	13,666,620	12,616,950	14,416,820
Per Train Average Tons	3,592	4,312	3,646	4,731	3,608	4,338	3,506	4,350
Per Train Max. Tons	4,035	6,445	4,570	6,760	3,800	5,758	3,800	4,500
Per Train Min. Tons	3,020	2,800	3,020	3,235	3,250	2,870	2,400	3,100
Per Train Av. Load-Mtys	54-27	21-99	54-29	24-106	52-32	30-85	53-29	24-92

Total MGTM WEST = 100,389

August Main Line MGTM = 241,451

Electrification Dept.,
Tacoma, Washington
April 5, 1963

COAST DIVISION TRAFFIC PATTERN - SEPTEMBER 1962

EASTBOUND

	Black River		Cedar Falls	
	Time Frts	Extras	Time Frts.	Extras
No. Trains	30	10	30	10
Tons Thru Station	145,050	31,793	167,281	38,846
Average Tons Per Train	4,835	3,179	5,576	3,885
Max.Tons Per Train	6,520	5,530	6,685	5,405
Min.Tons Per Train	268	150	241	110
Average Loads-Mtys	63 -33	27-62	75-22	36-64

WESTBOUND

	Beverly		Cle Elum	
	Time Frts.	Extras	Time Frts.	Extras
No.Trains	30	12	30	12
Tons Thru Station	139,501	54,898	141,353	55,284
Avg. Tons Per Train	4,650	4,575	4,712	4,607
Max. Tons Per Train	6,235	4,800	6,945	7,027
Min. Tons Per Train	3,205	4,031	3,205	2,955
Average Loads-Mtys	58- 41	42- 53	59- 43	41-61

Electrification Department,
Tacoma, Wash 5/31/63

AG-668

ROCKY MOUNTAIN DIVISION - AUGUST 1962

G.T.M. Trailing

Service	Avery-Alberton	Alberton Deer Lodge	Deer Lodge-Three Forks	Three Forks-Harlowton
Time Freights				
East	18,987,760	22,956,360	20,743,850	22,362,630
West	11,162,300	12,089,810	12,583,120	12,616,950
Total	30,150,060	35,046,170	33,326,970	34,979,580
Other Freights				
East	11,436,870	12,732,110	15,630,930	16,211,630
West	10,747,870	13,104,080	13,666,620	14,416,820
Total	22,184,740	25,836,190	29,297,550	30,628,450
Total Time and Other	52,334,800	60,882,360	62,624,520	65,608,030
East				
Time Frts.	18,987,760	22,956,360	20,743,850	22,362,630
Other Frts.	11,436,870	12,732,110	15,630,930	16,211,630
Total	30,424,630	35,688,470	36,374,780	38,574,260
West				
Time Frts.	11,162,300	12,089,810	12,583,120	12,616,950
Other Frts.	10,747,870	13,104,080	13,666,620	14,416,820
Total	21,910,170	25,193,890	26,249,740	27,033,770

TOTAL	East Bound	141,062,140	58.4%
	West Bound	100,387,570	41.6%
	Both	241,449,710	100.0%
TOTAL	Time Frts.	133,502,780	55.3%
	Other Frts.	107,946,930	44.7%
	Both	241,449,710	100.0%

From Rocky Mountain Divn. Train Sheet Analysis.

Electrification Dept.,
Tacoma, Wash
May 20, 1963

AG-668

COAST DIVISION- MAY 1962

GROSS TON MILE STATISTICS

Service	Tacoma-Cle Elum	Cle Elum-Othello	Tacoma-Othello
Time Freights			
East	15,055,684	15,459,496	30,515,180
West	12,056,815	11,874,818	23,931,633
Total	27,112,499	27,334,314	54,446,813
Other Freights			
East	4,501,892	4,717,380	9,219,272
West	3,285,045	3,009,855	6,294,900
Total	7,786,937	7,727,235	15,514,172
Total Time and Other	34,899,436	35,061,549	69,960,985
East			
Time Frts.	15,055,684	15,459,496	30,515,180
Other Frts.	4,501,892	4,717,380	9,219,272
Total	19,557,576	20,176,876	39,734,452
West			
Time Frts.	12,056,815	11,874,818	23,931,633
Other Frts.	3,285,045	3,009,855	6,294,900
Total	15,341,860	14,884,673	30,226,533
Total East and West	34,899,436	35,061,549	69,960,985
Percentages			
East	28.0%	28.8%	56.8%
West	21.9%	21.3%	43.2%
Both	49.9%	50.1%	100.0%
Time Frts.	38.8%	39.1%	77.9%
Other Frts.	11.1%	11.0%	22.1%
Both	49.9%	50.1%	100.0%

Electrification Dept.,
Tacoma, Washington.
May 20, 1963

COAST DIVISION- SEPTEMBER 1962

GROSS TON MILE STATISTICS

Service	Tacoma-Cle Elum	Cle Elum- Othello	Tacoma to Othello
Time Freights			
East	15,536,203	16,443,408	31,979,611
West	13,774,273	13,845,905	27,620,198
Total	29,310,496	30,289,313	59,599,809
Other Freights			
East	3,451,098	4,013,020	7,464,118
West	4,200,149	6,304,375	10,504,524
Total	7,651,247	10,317,395	17,968,643
Total Time & Other	36,961,743	40,606,708	77,568,451
East			
Time Freights	15,536,203	16,443,408	31,979,611
Other Freights	3,451,098	4,013,020	7,464,118
Total	18,987,301	20,456,428	39,443,729
West			
Time Freights	13,774,293	13,845,905	27,620,198
Other Freights	4,200,149	6,304,375	10,504,524
Total	17,974,442	20,150,280	38,124,722
Total East and West	36,961,743	40,606,708	77,568,451
Percentages			
East	24.5%	26.4%	50.9%
West	23.2%	25.9%	49.1%
Both	47.7%	52.3%	100 %
Time Freights	37.7%	39.1%	76.8%
Other Freights	9.9%	13.3%	23.2%
Both	47.6%	52.4%	100 %

Electrification Department,
Tacoma, Washington
May 20, 1963

ROCKY MTN. DIVISION - LOCOMOTIVE MILES- ROAD - AUGUST 1962

Service	Class of Loco	Road	Road Sw.	Lite	Helper	Lite Helper	Total
Time Freight	EF-4	26,947	126				27,073
Other Freight	EF-4	12,667	336	48			13,051
	EF-5	3,032	132				3,164
	EF-3,2	7,931	162				8,093
	EF-1	79	6				85
	Total	23,709	636	48			24,393
Helper	EF-5				6030	3228	9,258
	EF-2,3				74	38	112
	Diesel				86	86	172
	Total				6190	3352	9,542
TOTAL		50,656	762	48	6190	3352	61,008
% of Road			1.504%				

Note: Diesel Road Miles made as boosters are credited to the EF-4 Locomotives.

Electrification Dept.,
Tacoma, Washington
May 31, 1963

ROCKY MOUNTAIN DIVISION- LOCOMOTIVE UNIT MILES - AUGUST, 1962

Service	Class of Locomotive	Road	Road Sw.	Lite	Helper	Lite Helper	Total
Time Frts.	EF-4	53,894	252				54,146
	GP-9	36,633	138				36,771
Other Frts.	EF-4	23,833	636	96			24,565
	GP-9	2,373	48				2,421
	EF-5	12,128	528				12,656
	EF-3.2	23,793	486				24,279
	EF-1	158	12				170
Helpers	EF-5				24,120	12,912	37,032
	EF-3.2				222	114	336
	GP-9				258	258	516
Total		152,716	2100	96	24,600	13,284	192,892

Unit Miles by Classes	EF-4	EF-5	EF-3.2	EF-1	GP-9	Total
	54,146	12,656	24,279	170	36,771	
	24,565	37,032	336		2,421	
					516	
Total	78,711	49,688	24,615	170	39,708	192,892

Electrification Dept.,
Tacoma, Washington
May 20, 1963

AG-668

ROCKY MTN. DIVISION - AUGUST 1962

LOCOMOTIVE MILES & GROSS TON MILES

Locomotive	Miles	Weight in Tons	Loco. Ton Miles	Unit Miles
E-20	7333	2933		
21	6523	"		
70	7728	"		
71	3527	"		
72	6619	"		
73	7253	"		
74	7186	"		
75	6279	"		
76	6326	"		
77	6487	"		
78	5690	"		
79	7760	"		
Total EF-4's	78711	2933	23,085,936	78,711
36_2	85	388	24,480	170
29_3	4138	408	1,688,304	12,414
34	4258	528	2,248,224	17,032
42_3	4067	432	1,756,944	12,201
45	3762	576	2,166,912	15,048
49	4402	576	2,535,552	17,608
Total EF 2,3,5	20712	503.1	10,420,416	74,473
Total Electric	99423		33,506,352	153,184
Diesel	39708	124	4,923,792	39,708
Grand Total			38,430,144	192,892
Average Weight in Tons				
EF 2,3,5	20627	504	10,395,936	
EF 1,2,3,5	20712	503.1	10,420,416	
EF1,2,3,4,5	99423	337	33,506,352	
Diesel	Thru Frt.			36,771
	Way Frt.			2,421
	Helper			516
	Totals			39,708

Electrification Dept.,
Tacoma, Wash 5/31/63

COAST DIVISION- MAY 1962

LOCOMOTIVE MILES

Time Freights

East	Train	Road Sw. Term.	Way	Lite	Total	Number of Trains
Tacoma-Cle Elum	3618	0	576	31	4225	31
Cle Elum-Othello	3069	0	24	0	3093	31
Tacoma- Othello	6687	0	600	31	7318	62
West						
Othello-Cle Elum	3069	396	120	0	3585	31
Cle Elum- Tacoma	3628	0	312	31	3971	31
Othello- Tacoma	6697	396	432	31	7556	62
Total Time Freights	13384	396	1032	62	14874	124

Other Freights

East						
Tacoma- Cle Elum	1106	12	150	10	1278	10
Cle Elum-Othello	990	30	54	0	1074	10
Tacoma- Othello	2096	42	204	10	2352	20
West						
Othello- Cle Elum	891	150	54	0	1095	9
Cle Elum-Tacoma	1037	24	90	8	1159	9
Othello-Tacoma	1928	174	144	8	2254	18
Total Other Freights	4024	216	348	18	4606	38
Grand Total	17408	612	1380	80	19480	162

Electrification Department,
Tacoma, Washington.
May 20, 1963

COAST DIVISION LOCOMOTIVE MILES - MAY 1962

Locomotive	Total	Road Switch Term.	Road Switch Way	Lite	Train	Unit Miles	Weight	Loco G.T.M.
E-22	4742 *	144	354	21	4223	18,480	(4 Unit) 626 (3 Unit) 469	2,663,004 228,872
E-25	4769	186	306	17	4260	19,076	528	2,518,032
E-39	5176	156	360	22	4638	20,704	586	3,033,136
E-47	4793	126	360	20	4287	19,172	563	2,698,459
Total	19,480	612	1380	80	17,408	77,432	574.6	11,141,503
GP-9 **	19,480					59,180	124	7,338,320
						136,612		18,479,823

* E-22 operated 488 miles as a 3 unit at weight of 469 Tons

** GP-9's used 1, 2 or 3 units with EF-5's

Electrification Department,
Tacoma, Washington
May 20, 1963

AG-668

COAST DIVISION- SEPTEMBER 1962

TRAIN & LOCOMOTIVE MILES

Time Freights

East	Train	Road Sw. Term.	Road Sw. Way	Lite	Total	Number of Trains
Tacoma- Cle Elum	3510	30	486	29	4055	30
Cle Elum- Othello	2970	-	108	--	3078	30
Tacoma - Othello	6480	30	594	29	7133	60
West						
Othello- Cle Elum	2970	432	96	--	3498	30
Cle Elum- Tacoma	3513	12	408	29	3962	30
Othello - Tacoma	6483	444	504	29	7460	60
Total Time Freights	12963	474	1098	58	14593	120

Other Freights

East						
Tacoma- Cle Elum	1146	--	150	39	1335	10
Cle Elum- Othello	990	12	114	198	1314	10
Tacoma-Othello	2136	12	264	237	2649	20
West						
Othello- Cle Elum	1188	198	126	--	1512	12
Cle Elum-Tacoma	1159	12	150	9	1330	10
Othello- Tacoma	2347	210	276	9	2842	22
Total Other Freights	4483	222	540	246	5491	42
Grand Total	17446	696	1638	304	20084	162

Electrification Department,
Tacoma, Washington
May 20, 1963

COAST DIVISION LOCOMOTIVE MILES- SEPTEMBER 1962

Locomotive	Total	Lite	Road Switch	Helper	Lite Helper	Train	Loco Unit Miles	Loco Weight	Loco Ton Miles
E-22	3897	(99/15) 114	426			3357	15,588	626	2,439,522
E-25	4151	(99/29/15) 143	450			3558	16,604	528	2,191,728
E-33	3233	6	216	1028	395	1588	12,932	528	1,707,024
E-39	4416	16	510			3890	17,664	586	2,587,776
E-40_3	1232			748	484	0	3,696	432	532,224
E-47	4398	18	492			3888	17,592	563	2,476,074
E-50	2522	7	240	829	281	1165	10,088	576	1,452,672
Total Electric	23,849	304	2334	2605	1160	17,446	94,164	561.3	13,387,020
Diesel	19,993						19,993	124	2,474,668
Total	43,842						114,157		15,861,688

Electrification Department,
Tacoma, Washington
May 20, 1963

AG-668

LOCOMOTIVE ASSIGNMENT

ROCKY MOUNTAIN DIVISION

On Basis August '62 Traffic

		Required	On Hand	To be Procured
Scheme I				
Present Operation				
Road	EF-4	12	12	
Road &)	EF-5	3	3	
Helper)	EF-3,2	2	2	
Booster	GP-9	5	5	
Scheme 2-				
All Diesel Except Electric Helpers				
Helpers	EF-5	3	3	
Road	GP-9	32	22*	10
Standby	GP-9	4		4
				14
Scheme 3				
All Diesel				
Road	GP-9	32	22	10
Helpers	GP-9	8		8
Standby	GP-9	4		4
				22
Scheme 4-				
Present Operation but with new electric locomotives replacing the EF-5,3,2's				
Road	EF-4	12	12	
	EF-7	4	--	4
Helper	EF-7	6		6
				10

* GP-9's - 17 on run Avery-Othello
5 in Booster Service-RM Divn
22

Electrification Department,
Tacoma, Washington
May 31, 1963

AG-668

LOCOMOTIVE ASSIGNMENT

COAST DIVISION

On Basis May and Sept. '62 Traffic			Required	On Hand	To Be Procured
Scheme 5-	Present Operation				
	No Helper- Road	EF-5	4	4	
	Booster	GP-9	9	9	
Scheme 6-	Present Operation				
	Road	EF-5	6	6	
	Helper	EF-2	1	1	
	Booster	GP-9	5	5	
Scheme 7-	New Electric Locomotives				
	No Helper				
	Road	EF-7	10	0	10
	Booster	GP-9	3	3	
					10
Scheme 8-	New Electric Locomotives				
	Road	EF-7	8		8
	Helper	EF-7	4		4
	Booster	GP-9	3	3	
					12
Scheme 9-	New Electric Locomotives				
	With old EF-5's				
	to handle some extras				
	and helper service.				
	Road	EF-7	6		6
	Road	EF-5	2	2	
	Helper	EF-5	2	2	
					6
Scheme 10-	All Diesel Operation				
	Road	GP-9	16		
	Helper	GP-9	7		
	Standby	GP-9	2	10	15
Scheme 11-	EF-4 Electric Locomotives				
	Road	EF-4	8	8	
	Helper	EF-4	4	4	
	Booster	GP-9	2	2	

Electrification Department,
Tacoma, Washington
May 31, 1963
Revised June 14, 1963

WEIGHT - TRACTIVE EFFORT- HORSEPOWER AND SPEED

VARIOUS ELECTRIC & DIESEL LOCOMOTIVES

Class	Total Weight Pounds	Weight on Drivers Pounds	Tractive Effort # 18% Adh.	Traction Motor Amps Cont.	Traction Motor Amps Hourly	Tractive Effort # Cont.	Tractive Effort # Hourly	Horsepower at Rail Cont.	Horsepower at Rail Hourly	Speed - M.P.H. Cont.	Speed - M.P.H. Hourly	Speed - M.P.H. Max.
EF-1	576,000	451,000	81,200	230	285	80,800	106,000	3340	4100	15.5	14.5	45
EF-2	864,000	676,500	121,800	230	285	121,200	159,000	5010	6150	15.5	14.5	45
EF-3	816,000	691,000	124,400	230	285	121,200	159,000	5010	6150	15.5	14.5	45
EF-5	1,056,000* 1,152,000	931,000* 902,000	162,400	230	285	161,600	212,000	6680	8200	15.5	14.5	45
EF-4	586,600	443,100	79,750	345	375	77,000	85,500	5110	5530	25.2	24.5	70
GP-9	248,000	248,000	44,640	900	925	(a)	--	1550	--	(a)	--	65
New Electric Locomotive Proposed by G.E. Co. 10/31/60												
EF-7	376,000	376,000	67,680	345	375	60,000	70,800	4050	4590	25.2	24.2	70

(a) Varies inversely with speed always staying at or below generator output of 1232 KW. Minimum speed about 11 MPH.

(*) Loco. having bobbed C and D Units. Weight on drivers increased on those units, but slipping will still be controlled by weight on end units. Therefore 18% adhesion calculated on basis of 4 end units.

Electrification Department,
Tacoma, Washington
May 31, 1963

DATA ON LOCOMOTIVE COMBINATIONS - REPAIR COSTS & ENGINEMEN'S PAY SCALE

Loco	Rail Horsepower Cont.	Rail Horsepower 1-Hour	Weight Tons	Continuous Rail HP/Tons	Maintenance Cost Unit Basis ¢ Per Mile	Maintenance Cost Unit Basis ¢ Per 1000 Rail HP Mi.Cont.	Maintenance Cost Locomotive ¢ Per Mi.	Maintenance Cost Locomotive ¢ Per 1000 Rail HP Mi.Cont.	Enginemen's Pay/100 Thru Frt	Enginemen's Pay/100 Way Frt
EF-4	5110	5530	293	17.4	41.76	8.175	41.76	8.17	42.87	43.83
EF-5	6680	8200	576	11.6	17.62	10.55	70.48	10.55	46.33	47.29
GP-9	1550	1550	124	12.5	17.36	11.2	17.36	11.2	41.47	42.43
EF-7*	4050	4590	188	21.5	16.4	4.05	16.40	4.05	42.50	43.46
COMBINATIONS										
EF5/ 1 GP9	8230	9750	700	11.8			87.84	10.7	48.03	48.99
EF 5/ 2 GP9	9780	11300	824	11.9			105.20	10.8	49.73	50.69
EF 5/ 3 GP9	11330	12850	948	12.0			122.56	10.8	51.43	52.39
2 EF4	10220	11060	586	17.4			83.52	8.2	45.99	46.95
2 EF4/1-GP9	11770	12610	710	16.6			100.88	8.6	47.69	48.65
2 EF4/2-GP9	13320	14160	834	16.0			118.24	8.9	49.39	50.35
2 EF-7*	8100	9180	376	21.5			32.8	4.0	45.31	46.27
2 EF7 / 1 GP9	9650	10730	500	19.3			50.16	5.2	46.67	47.63
2 EF 7 / 2 GP9	11200	12280	624	18.0			67.52	6.0	48.37	49.33
3 EF 7	12150	13770	564	21.6			49.2	4.0	47.69	48.65
3 EF 7/ 1-GP9	13700	15320	688	19.9			66.56	4.9	49.39	50.35
3 EF 7/ 2-GP9	15250	16870	812	18.8			83.92	5.5	51.09	52.05

Above based on Miles from Mechanical Department and Repair Costs from Dept. of Finance & Accounting

* New locomotives proposed by General Electric Co. October 31, 1960. Repair costs are based on BA&P Ry. Co's experience with a somewhat similar locomotive and on G.E.Co. data.

Electrification Department,
Tacoma, Washington -May 31, 1963

FUEL AND POWER

In performing work a definite amount of energy is required regardless of the type of machine performing the service. In the case of locomotives this unit at the rail will be the same regardless of the type of locomotive used. In further calculations adjustments must be made for the efficiencies pertinent to the particular type of motive power used.

In establishing fuel and power consumption for operation over a prescribed district we have only one figure that means anything and that is electrical power consumption as metered in our substations. No attempt is made to establish accurate figures on diesel fuel consumption.

Thru the years electrical power consumption data has been accumulated so that the characteristics on each division are pretty well developed. Thus we know that we require 33.483 KWH at the substation 2300-volt bus on the Rocky Mountain Division and 34.0656 KWH at the 2300-volt bus on the Coast Division to handle 1000 gross ton miles.

Up to 1952 power was metered at the locomotive so that from the data developed up to that period we are able to establish percentage of power lost in MG set losses and line drop. We know the efficiency of the locomotive so that by properly applying these factors we are able to develop the relation between the 2300-volt KWH input at the substation and the KWH actually developed at the rail when motoring.

In applying this procedure for power development in these studies we developed the total gross ton miles of train and locomotives required to move the prescribed tonnage, deducted the KWH actually metered at the substation, and assigned the difference to the work done by the diesel locomotives. This value is then converted to KWH at the rail, to horsepower hours and thence to gallons of fuel oil on the basis of 1 horsepower hour consuming .075 gallon of fuel per rail horsepower hour. This latter value comes from data supplied by the American Association of Railroads for a locomotive operating in the northwest with usual periods of idling and light load movements.

This operation gives us the amount of diesel fuel oil required during the motoring cycle. In dynamic braking the diesel operates in the third notch and from data supplied by the E.M.D. we know that in this notch the diesel locomotive consumes 29.4 gallons of diesel fuel per hour. It is then only necessary to develop the amount of unit hours spent by the diesel locomotives in dynamic braking to establish the fuel consumption for the braking operation. This added to the motoring fuel gives us the total fuel consumption of the diesel locomotives.

This method has been used throughout the study in arriving at diesel locomotive fuel consumption.

A cost per gallon of $ .0971 as supplied by the Department of Finance and Accounting was used in developing the cost of diesel fuel.

LOCOMOTIVE REPAIRS

Electric Locomotives

To insure using a realistic figure that will not reflect temporary epidemics or other problems, repair costs for the three years— '60, '61 and '62 were weighted to the 1962 level and an average cost per unit mile developed. The mileage reported by the Mechanical Department, the repair cost reported by the Department of Finance and Accounting and the A.A.R. Indicies for the Western District were used to develop the following repair costs per unit mile:

Locomotive	Rail Horse Power	Cost/Unit Mile	Cost/MRHP Unit Miles
EF-5	6680	17.62¢	10.56¢
EF-4	5110	41.76¢	8.175¢

The cost per unit mile shown above was used in developing repair costs for electric locomotives.

Diesel Locomotives

When repair costs are kept on a division or district basis, they will correctly show the maintenance cost for locomotives working on that particular division. When, however, repair costs are buried in a system figure, and the system characteristics, grade and curvature, vary widely from the particular division in mind, the resultant repair cost per unit mile will not correctly reflect the costs of the division in mind.

Thus we have two mountain divisions, where diesel locomotives made 39,708 miles and 59,180 miles, or a total of 98,888 miles, buried in a system figure of 29,211,022 miles. This mountain mileage is about one-third of 1% of system miles, so that a system repair cost per unit miles would not come close to reflecting the repair cost of locomotives in mountain service. The system repair cost per unit mile ignores the increased maintenance required account of mountain service.

We might also say that repair costs will vary with the fuel consumption. This is certainly true on any uniform system. Fuel consumption would vary with the miles run and since repairs would vary with the miles run, we would have repairs varying with the fuel consumption.

Accepting this premise, we have at hand a means for developing a practical repair cost for locomotives used in mountain service. Fuel consumption will vary with the work done, and since more work is done on heavy grades, fuel consumption will increase and thereby provide a measure for increased repairs account of mountain service.

This is a very practical solution to the problem of developing accurage repair costs for locomotives in mountain service. The fuel consumption reflects the work done; in turn engine and locomotive wear vary with the work done. Even wheel wear is greater when the locomotive is doing heavy work than when it is doing light work.

Thus we have the following:

From 1962 Annual Report

Total Freight Diesel Locomotive Repairs - $5,672,642
(Account 311)

Total Gallons Diesel Fuel Oil- Freight Service - 56,979,067

Repair Cost per gallon Diesel Fuel Oil - $ .09955659

In this study repairs for diesel locomotives are developed by this method, using $ .09956 per gallon of diesel fuel consumed. As an example:

Rocky - Mtn- Aug. '62 Present Operation Scheme (1)
Gals. Diesel Oil - 118,486
Repair Cost 118,486 x $.09956 = $11,796.47

New Electric Locomotive

In October, 1960, the General Electric Co. proposed a 6 motor locomotive somewhat similar to the two locomotives they had sold to the B.A.& P. RY.CO. a few years earlier. These were 4 motor locomotives looking exactly like a diesel locomotive except for the pantograph.

Mr. Conroy of the B.A.& P. RY. CO. kindly furnished maintenance costs on his units. This on basis of 3000 miles per month amounted to $.1168 per unit mile or 4.7¢ per M Rail horsepower miles.

At the time of their 1960 proposal the General Electric Co. had provided a breakdown between labor and material for our EF-4 locomotives. Using these figures a cost per motored axle was developed and these figures applied to developing an annual cost for the proposed 6 motor locomotive. Assuming an annual mileage of 70,000 miles, a cost per unit mile of 16.4¢ results.

Taking Mr. Conroy's cost of $ .1168 per unit mile and adjusting for 6 instead of 4 traction motors, and keeping in mind the few miles made, we come up with a figure very close to the G. E. Co. figure. We therefore used the figure of 16.4¢ per mile when calculating repairs on the proposed locomotive.

We have designated the proposed locomotive as the EF-7

Electrification Dept.,
Tacoma, Wash 5/31/63

DEPRECIATION AND INTEREST

	Investment	Life Years	Salvage	Rates Depr.	Int.	Depreciation Year	Depreciation Month	Interest Year	Interest Month
ROCKY MOUNTAIN DIVISION									
Substation Automation	$303,679.			2.62%	0	$ 7947	$ 662	None	
Trolley Feeder	292,896			2.7%	0	7908	660	None	
COAST DIVISION									
Substation Automation	$ 23,947			2.6%	0	$ 623	$ 52	None	
Trolley Feeder	227,699			2.7%	0	6148	511	None	
SYSTEM									
EF-4 Loco each	$ 80,661	25	9.0%	3.63%	0	$2928	$ 244	--	
GP-9 Loco each	168,650	20	2.41%	4.88%	5.0%	8230	686	$ 8432	703
* EF-7 Loco each	385,555	25		3.64%	5.0%	14,034	1170	19,278	$1607
* GP-30 Loco each	204,200	20	2.41%	4.88%	5.0%	9,965	830	10,210	$ 851

Electrification Dept.,
Tacoma, Wash
May 31, 1963
Rev. June 14,1963

* New locomotives at current prices.

DEPRECIATION & INTEREST

SCHEME	DESCRIPTION	ITEM	UNITS	DEPRECIATION	INTEREST	TOTAL
1	Present Operation Electric with Diesel Boosters	Substation Automation		$ 662	$ None	$ 662
		Aluminum Trolley Feeder		660	-	660
		EF-4 Locomotives	12	2,928	-	2,928
		GP-9 Locomotives- Boosters	5	3,430	3,515	6,945
		Total		7,680	3,515	11,195
2	Diesel Road Locos. Electric Helpers	GP-9 Locomotives- Present Boosters	5	3,430	3,515	6,945
		GP-30 " - Additional Required	14	11,620	11,914	23,534
		Total		15,050	15,429	30,479
3	All Diesel Locos. Road and Helper	GP-9 Locomotives- Present Boosters	5	3,430	3,515	6,945
		GP-30 " - Additional Required	22	18,260	18,722	36,982
				21,690	22,237	43,927
4	Present Operation but new electric locomotives replacing EF-5,3,2 locomotives.	From Scheme I		7,680	3,515	11,195
		EF-7 Locomotives	10	11,695	16,065	27,760
		Total		19,375	19,580	38,955
5	Present Operation Electric with Diesel Boosters (No Helpers)	Substation Automation		52	None	52
		Aluminum Trolley Feeder		511	"	511
		GP-9 Locomotives	9	6,174	6,327	12,504
		Total		6,737	6,327	13,064
6	Present Operation Electric with Diesel Boosters (Helpers)	Substation Automation		52	None	52
		Aluminum Trolley Feeder		511	"	511
		GP-9 Locomotives	4	2,794	2,812	5,556
		Total		3,357	2,812	6,119

Revised June 14, 1963

DEPRECIATION & INTEREST

SCHEME	DESCRIPTION		UNITS	DEPRECIATION	INTEREST	TOTAL
7	New Electric Locomotives Diesel Booster (No Helper)	Substation Automation		$ 52	$ None	$ 52
		Aluminum Trolley Feeder		511	"	511
		EF-7 Locomotives	10	11,695	16,065	27,760
		GP-9 Locomotives-Booster	5	3,430	3,515	6,945
		Total		15,688	19,580	35,268
8	New Electric Locomotive Diesel Booster (Helpers)	Substation Automation		52	None	52
		Aluminum Trolley Feeder		511	"	511
		EF-7 Locomotives	12	14,034	19,278	33,312
		GP-9 Locomotives- Booster	5	3,430	3,515	6,945
		Total		18,027	22,793	40,820
9	New Electric Locomotives Old Elec.Loco for Dead Freight and Hlprs. Diesel Booster	Substation Automation		52	None	52
		Aluminum Trolley Feeder		511	"	511
		EF-7 Locomotives	6	7,017	9,639	16,656
		GP-9 Locomotive Boosters	5	3,430	3,515	6,945
		Total		11,010	13,154	24,164
10	All Diesel Operation	GP-9 Locomotives-	10	6,860	7,030	13,890
		GP-30 " Additional Required	15	12,450	12,765	25,215
			25	$ 19,310	$19,795	$39,105

* Accounting Department advises no interest charge to EF-4 locomotives, substation automation, aluminum trolley feeder.

Electrification Department,
Tacoma, Washington
May 31, 1963
Revised June 14, 1963

DEPRECIATION & INTEREST

SCHEME	DESCRIPTION	ITEM	UNITS	DEPRECIATION	INTEREST	TOTAL
11	EF-4 Locomotives	Substation Automation		$ 52	$ 0	$ 52
	Road & Helpers	Aluminum Trolley Feeder		511	0	511
	GP-9 Booster on	EF-4 Locomotives	12	2,928	0	2,928
	Time Frts.	GP-9 Locomotives	2	1,372	1,406	2,778
				$ 4,863	$1,406	$6,269

Tacoma, Washington
June 14, 1963

ESTIMATED COST INCREASE
FOR MISCELLANEOUS ELECTRIC ENERGY
IF PURCHASED OUTSIDE OF ELECTRIFICATION TRACTION CONTRACT

AG-608-B
1 of 2

ROCKY MOUNTAIN DIVISION

POWER	COST 1958	COST WITHOUT ELECTRIFICATION
Shops	$15,372	$35,462
Signals	5,873	14,653
Roadway buildings and Misc.	7,522	12,870
TOTAL	$28,767	$62,985
Increased Cost Without Electrification		$34,218

The above assumes that eleven signal feeder points will be retained and that most of roadway and building power will be fed from the signal feeder. This gives fewer metering points, with resulting higher load and lower rate. Pertinent commercial and industrial power company schedules were used in developing costs outside of traction contract. Peak loads at shops assumed on basis of past experience. Details of these calculations will be furnished on request.

Maintenance of the 4,400-volt signal line not included in either column.

Electrification Department
The Milwaukee Road
Seattle, Washington

H. R. Morgan

July 13, 1959
Revised Sept. 2, 1959

THE MILWAUKEE ROAD
ELECTRIFICATION DEPARTMENT

AG-609
1 of 2

MISCELLANEOUS POWER REQUIRED
FOR OTHER THAN ELECTRIFICATION FACILITIES
ON BASIS 1958 POWER CONSUMPTION
ROCKY MOUNTAIN DIVISION

	1958 KWH	1958 COST		COST PER KWH
		ENERGY	TRANSFORMATION	
SIGNALS:				
Avery	44,967			
East Portal	78,151			
Drexel	54,653			
Tarkio	98,030			
Primrose	85,710			
Ravenna	52,330			
Gold Creek	54,389			
Morel	71,640			
Janney	104,850			
Piedmont	88,450			
Eustis	97,863			
Francis	85,402			
Loweth	75,580			
Two Dot	103,758			
TOTAL SIGNALS	1,095,773	$5,873.35	—	.00536
SHOP POWER:				
Avery	260,665	$1,397.16	—	.00536
Deer Lodge	1,812,000	9,712.32	—	.00536
Harlowton	579,200	3,104.50	—	.00536
"	—	—	$1,158.40	.002
TOTAL SHOP POWER	2,651,865	$14,213.98	$1,158.40	.00579
ROADWAY BUILDINGS:				
Avery Hotel	60,000	$321.60	—	.00536
All Other Roadway	424,897	2,277.44	—	.00536
* Misc. Transf. Chgs.	(75,708)	—	$757.08	.01
Missoula Diesel	10,254	54.96	—	.00536
" "	—	—	102.54	.01
St. Regis Pump	3,280	17.59	—	.00536
" "	—	—	32.80	.01
Haugan Pump	12,580	67.43	—	.00536
" "	—	—	123.58	.01
TOTAL ROADWAY	511,011	$2,739.02	$1,016.00	.00734

* Misc. Transformation Charges (75,708 KWH - $757.08) relates to miscellaneous locations over entire Rocky Mountain Division for various roadway buildings. Parenthetical figures not included in total.

MISCELLANEOUS POWER REQUIRED
FOR OTHER THAN ELECTRIFICATION FACILITIES
ON BASIS 1958 POWER CONSUMPTION
ROCKY MOUNTAIN DIVISION

AG-609
2 of 2

	1958 KWH	1958 COST		COST PER KWH
		ENERGY	TRANSFORMATION	
DEPOTS:				
Harlowton Passenger	60,000	$321.60	—	.00536
" "	—	—	$120.00	.002
Ringling Relay	1,254	6.72	—	.00536
" "	—	—	12.54	.01
Butte Relay	40,760	218.47	—	.00536
" "	—	—	407.60	.01
Butte Passenger	7,308	39.17	—	.00536
" "	—	—	73.08	.01
Butte Freight	8,706	46.67	—	.00536
" "	—	—	87.06	.01
All Other Depots	221,031	1,184.73	—	.00536
* Misc. Transf. Chgs.	(61,058)	—	610.58	.01
TOTAL DEPOTS	339,059	$1,817.36	$1,310.86	.00923
MISCELLANEOUS:				
Division Track Heaters	82,650	$443.00	—	.00536
Avery Pump on Hill	13,263	71.09	—	.00536
Avery Pump Roundhouse	12,775	68.47	—	.00536
Deer Lodge Ice	3,522	18.88	—	.00536
" " "	—	—	$35.22	.01
Montana Street Crossing	116	.62	—	.00536
" " "	—	—	1.16	.01
TOTAL MISCELLANEOUS	112,326	$602.06	$36.38	.00568
GRAND TOTALS	4,710,034	$25,245.77	$3,521.64	.00611

NOTE: In order to balance to "Total Miscellaneous Power" column of EE-9 1958 Summary, add electrification facilities as follows:

Substation Auxiliary and Bungalows	609,732	$3,268.17	—	.00536
TOTAL MISC. POWER (EE-9 SUMMARY 1958)	5,319,766	$28,513.94	$3,521.64	.00602

* Miscellaneous Transformation Charges (61,058 KWH - $610.58) relates to miscellaneous locations over entire Rocky Mountain Division for various depots. Parenthetical figures not included in total.

Electrification Department
The Milwaukee Road
Seattle, Washington
May 6, 1959
Revised July 15, 1959
Aug. 7, 1959
Sept. 3, 1959

ESTIMATED COST INCREASE
FOR MISCELLANEOUS ELECTRIC ENERGY

AG-608-B
2 of 2

IF PURCHASED OUTSIDE OF ELECTRIFICATION TRACTION CONTRACT

COAST DIVISION

POWER	COST 1958	COST WITHOUT ELECTRIFICATION
For shops	$16,793	$18,150
For signals	$2,975	$10,250
For roadway buildings and miscellaneous	$2,916	$9,490
TOTAL	$22,684	$37,890
Increased cost without electrification		$15,206

Above assumes that the present eight signal feed points will remain and miscellaneous roadway power will be metered through these points. Tacoma Shops to be fed by Tacoma City Light. Othello Shops to be fed from The Washington Water Power Company. Pertinent commercial and industrial power company schedules were used in developing costs outside of traction contract. Peak loads at shops assumed on basis of past experience. Details of these calculations will be furnished on request.

Maintenance of the 4,400-volt signal line not included in either column.

Electrification Department
The Milwaukee Road
Seattle, Washington

H.R. Morgan

July 9, 1959
Revised Sept. 2, 1959

THE MILWAUKEE ROAD
ELECTRIFICATION DEPARTMENT

AG-608-A
1 of 2

MISCELLANEOUS POWER REQUIRED
FOR OTHER THAN ELECTRIFICATION FACILITIES
ON BASIS 1958 POWER CONSUMPTION
COAST DIVISION

	1958 KWH	COST	COST PER KWH
SIGNALS:			
Tacoma Junction	12,685		
Renton	135,739		
Cedar Falls	116,981		
Hyak	61,635		
Cle Elum	3,496		
Kittitas	107,232		
Doris	75,992		
Taunton	17,120		
TOTAL SIGNALS	530,879	$2,975.35	.00560
SHOP POWER:			
Tacoma	2,571,500		
Othello	417,240		
TOTAL SHOP POWER	2,988,740	$16,793.56	.00562
ROADWAY BUILDINGS:			
Track Department	63,508	$357.49	.00563
B&B Crews	6,388	35.96	.00563
Telegraph Crews	3,875	21.81	.00563
Extra Gangs	6,024	33.91	.00563
Signal Maintainer	1,160	6.53	.00563
Section Foreman	940	5.29	.00563
Rented Tac. Jct. #3	3,306	18.61	.00563
All Other Roadway	31,384	176.69	.00563
TOTAL ROADWAY	116,585	$656.29	.00563
ADVERTISING:	18,260	$101.63	.00557
SPRING SWITCH:			
Hyak	19,800	$121.51	.00614
Rockdale	13,450	83.84	.00623
TOTAL SPRING SWITCH	33,250	$205.35	.00618

MISCELLANEOUS POWER REQUIRED
FOR OTHER THAN ELECTRIFICATION FACILITIES
ON BASIS 1958 POWER CONSUMPTION
COAST DIVISION

AG-608-A
2 of 2

	1958 KWH	COST	COST PER KWH
MICROWAVE, ROCKDALE	2,970	$16.53	.00557
WATER PUMP, HYAK	23,785	$125.91	.00529
DEPOTS:			
*Tacoma Junction	13,198		
Cedar Falls Depot	27,657		
Cedar Falls #3	6,850		
Cedar Falls Hotel-Cafe	81,695		
Cle Elum Depot	19,039		
Cle Elum Hotel	36,764		
Cle Elum Restaurant	96,898		
Kittitas Depot	3,570		
Beverly Depot	6,610		
Beverly Trainmen	22,535		
Othello Yard Lights	6,250		
TOTAL DEPOTS	321,066	$1,809.79	.00564
GRAND TOTALS	4,035,535	$22,684.41	.00562

NOTE: In order to balance to "Total Miscellaneous Power" column of EE-9 1958 Summary, add electrification facilities as follows:

Substation Auxiliary and Bungalows	357,431	$2,046.10	.00572
TOTAL MISC. POWER (EE-9 SUMMARY 1958)	4,392,966	$24,730.51	.00563

* Telegraph Dept. uses power shown under "depots", Tacoma Junction for lighting, operation of repeaters, and other telephone and telegraph equipment.

Electrification Department
The Milwaukee Road
Seattle, Washington

May 6, 1959
Revised July 15, 1959
Aug. 7, 1959
Sept. 3, 1959

Tacoma, Washington
June 14, 1963

Mr. F.G. McGinn:

My Cost Study was released May 31st and as might be expected contained several errors. I felt responsible for these and issued several correction sheets on June 5th.

Since then I reviewed the study at length and noted several items that I thought should be changed. Also Mr. Kirk worked up Scheme 11 showing the cost of EF-4 operation on the Coast Division.

I also felt that the cost of operation with minimum and maximum traffic should be explored.

Accordingly, I worked out a series of corrected sheets which should replace sheets of the same number in the book you now have. The original sheets should be discarded. These new sheets cover changes due to Scheme 11 and also changes in depreciation and interest brought about by handling diesels to be procured at new prices instead of at the price of the present GP-9 diesels as advised by the Accounting Department. This places new diesels on the same level as new electrics. I understand GP-9 locomotives are no longer being manufactured and therefore GP-30 locomotives are listed where additional diesel units are to be procured.

A supplement is also attached. This explores the cost of operation under the various schemes when minimum and maximum traffic is being handled. A family of curves is attached. This supplement should be inserted in the back of the original study.

H.R. Morgan

cc:
Mr. W.J. Quinn
Mr. C.E. Crippen
Mr. V.E. Glosup
Mr. L.V. Anderson
Mr. F.A. Upton
Mr. R.G. Scott
Mr. A.W. Hallenberg
Mr. T.B. Kirk

SUPPLEMENT

TO STUDY OF MAY 31, 1963

ON VARIOUS METHODS OF OPERATION

IN ELECTRIFIED TERRITORY

Tacoma, Washington
June 13, 1963

SUPPLEMENT

TO STUDY OF MAY 31, 1963

In any comparative cost study, the first requirement is accurate basic statistics. Once these have been developed, the application and extension of unit costs is a matter of intrepretation, based on knowledge of the operation and of the equipment involved.

In this study every effort was made to be accurate and to support every figure by statistics or references to the source. It should therefore be possible to check any figure that might subsequently be challenged. Any difference in intrepretation or handling will not cause a change in end results of more than three or four thousand dollars, not enough to contradict the end finding of the study.

In certain instances the tendency was to lean over backwards--for instance, in the case of depreciation and interest, a life of 20 years was used for diesel locomotives, whereas experience to date shows a life of about 12 to 15 years. And in the case of new electric locomotives, a life of 25 years is used though in our own service we have electric locomotives that have been running about 49 years. Similarly, on the B. A.& P. Railroad, electric locomotives have been in service over 50 years.

With so much data developed it is always a challenge to explore further. For instance, what would be the cost of each scheme when handling minimum and maximum amounts of traffic? Inspection of past records showed the minimum month to be January, 1950, on both divisions, (ignoring the 1930 depression), and the maximum month to be January, 1945, on both divisions.

	Rocky Mountain	Coast
Minimum MGTM Jan. 1950	140,811	48,714
Study MGTM	241,450	77,568 *
Maximum MGTM Jan. 1945	327,617	122,264

* Ignoring the operation with no helpers.

Assuming that the cost per MGTM for the first eight items in the study (trainmen to enginehouse expense incl.) would remain approximately constant, the costs of these items for minimum and maximum MGTM were

developed for each scheme. Interest, depreciation, miscellaneous power, substation and line maintenance were presumed to remain constant. Substation operation was presumed to vary from minimum operator assignment with about $135 per month overtime to almost full operator assignment with about $135 per month overtime. (With traffic of September on Coast and August on the Rocky Mountain, overtime amounted to about $945 and $1260 per month respectively on the two divisions. This is due to trains running off schedule and to switching for line clearances, etc.)

In developing costs for handling maximum MGTM, it was necessary to determine whether or not the locomotive assignment was sufficient to handle the business. It was assumed that the traffic pattern would be the same as in the study months and that east and westbound tonnage would increase proportionately. Gross ton miles for the limiting sections (mountain) were developed and then tonnage assigned to trains on basis of recognized tonnage ratings. Eastbound presented no problem. Westbound, it would be necessary, on Piedmont Hill for instance, to use helpers on the time freights, and in full diesel operation, it would be necessary to increase tonnage per train to the point that speed would drop to about 13-14 miles per hour. However this would be an extreme condition and should be acceptable for the short time involved. The end result is that no additional locomotive power would be required for any of the schemes studied.

Costs for Schemes 5 and 7 (no helpers), were developed, but since it was easily seen from inspection that helper operation was more economical, curves for these two schemes were not shown on the charts as finally set up.

H.R. Morgan

Tacoma, Washington
June 14, 1963

COSTS OF VARIOUS SCHEMES WITH MIN. & MAX. MGTM

ROCKY MOUNTAIN DIVISION

	1	2	3	4	
MIN. MGTM					
Depr. & Int.	$11,195	$30,479	$43,927	$38,955	
Line Maint.	12,550	6,650	4,000	12,550	
Sub Maint.	8,435	4,050	-	8,435	
Miscl. Power			2,852		
Total Fixed Expense	$32,180	41,179	50,779	59,940	
Sub. Opr. (Min. Overtime)	14,300	7,300	--	14,300	
	46,480	48,479	50,779	74,240	
Other Expense Varies with MGTM	115,078	125,205	127,497	108,392	
TOTAL	161,558	173,684	178,276	182,632	
Cost Per MGTM	$ 1.14734	$1.23347	$1.2661	$1.29700	
MAX. MGTM					
Fixed Expense	32,180	41,179	50,779	59,940	
Sub. Opr.	17,470	10,068	--	17,470	
	49,650	51,247	50,779	77,410	
Other Expense Varies with MGTM	267,745	291,307	296,641	252,190	
TOTAL	317,395	342,554	347,420	329,600	
Cost per MGTM	$ .968798	$1.04560	$1.0604	$1.00605	

Tacoma, Washington
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COSTS OF VARIOUS SCHEMES WITH MIN. & MAX. MGTM

COAST DIVISION

	5	6	7	8	9	10	11
MIN. MGTM							
Depr. & Int.	$ 13,064	$ 6,119	$35,268	$40,820	$24,164	$39,105	$6,269
Line Maint.	7,966	7,709	7,966	7,709	7,709	2,000	7,709
Sub Maint.	1,895	1,834	1,895	1,834	1,834	200	1,834
Miscl. Power							
Total Fixed Expense	22,925	15,662	45,129	50,363	33,707	42,572	15,812
Sub Opr. (Min. Overtime)	9,200	8,900	9,200	8,900	8,900	--	8,900
	32,125	24,562	54,329	59,263	42,607	42,572	24,712
Other Expense Varies with MGTM	58,809	54,014	45,292	45,506	47,622	57,130	48,489
Total	90,934	78,576	99,621	104,769	90,229	99,702	73,201
Cost Per MGTM	$1.86669	$1.161300	$2.04501	$2.15069	$1.85222	$2.0467	$1.5027
MAX. MGTM							
Fixed Expense	22,925	15,662	45,129	50,363	33,707	42,572	15,812
Sub. Opr.	13,259	12,831	13,259	12,831	12,831	-	12,831
	36,184	28,493	58,388	63,194	46,538	42,572	28,643
Other Expense Varies with MGTM	147,602	135,565	113,675	114,212	119,524	143,386	121,700
Total	183,786	164,058	172,063	177,406	166,062	185,958	150,343
Cost Per MGTM	$1.5032	$1.34183	$1.40731	$1.45101	$1.35822	$1.5210	$1.2297

Tacoma, Washington
June 14, 1963

EXPENSES VARYING WITH GROSS TON MILES

SCHEME	Expense Varying with MGTM	Study MGTM	Cost Per MGTM	MGTM Min. Month (Jan. 1950)	Cost Min. MGTM	MGTM Max. Month (Jan. 1945)	Cost Max. MGTM	Ratio Study MGTM Max. MGTM	
1	$197,326	241,450	$ .81725	140,811	$115,078	327,617	$267,745	1.3568	
2	214,690	241,450	.88917	140,811	125,205	327,617	291,307	1.3568	
3	218,620	241,450	.90545	140,811	127,497	327,617	296,641	1.3568	
4	185,861	241,450	.76977	140,811	108,392	327,617	252,190	1.3568	
5	84,460	69,961	1.20724	48,714	58,809	122,264	147,602	1.7476	
6	86,007	77,568	1.10879	48,714	54,014	122,264	135,565	1.5762	
7	65,046	69,961	.92975	48,714	45,292	122,264	113,675	1.7476	
8	72,459	77,568	.93414	48,714	45,506	122,264	114,212	1.5762	
9	75,830	77,568	.97759	48,714	47,622	122,264	119,524	1.5762	
10	90,969	77,568	1.17276	48,714	57,130	122,264	143,386	1.5762	
11	77,210	77,568	.99538	48,714	48,489	122,264	121,700	1.5762	

Tacoma, Washington
June 14, 1963

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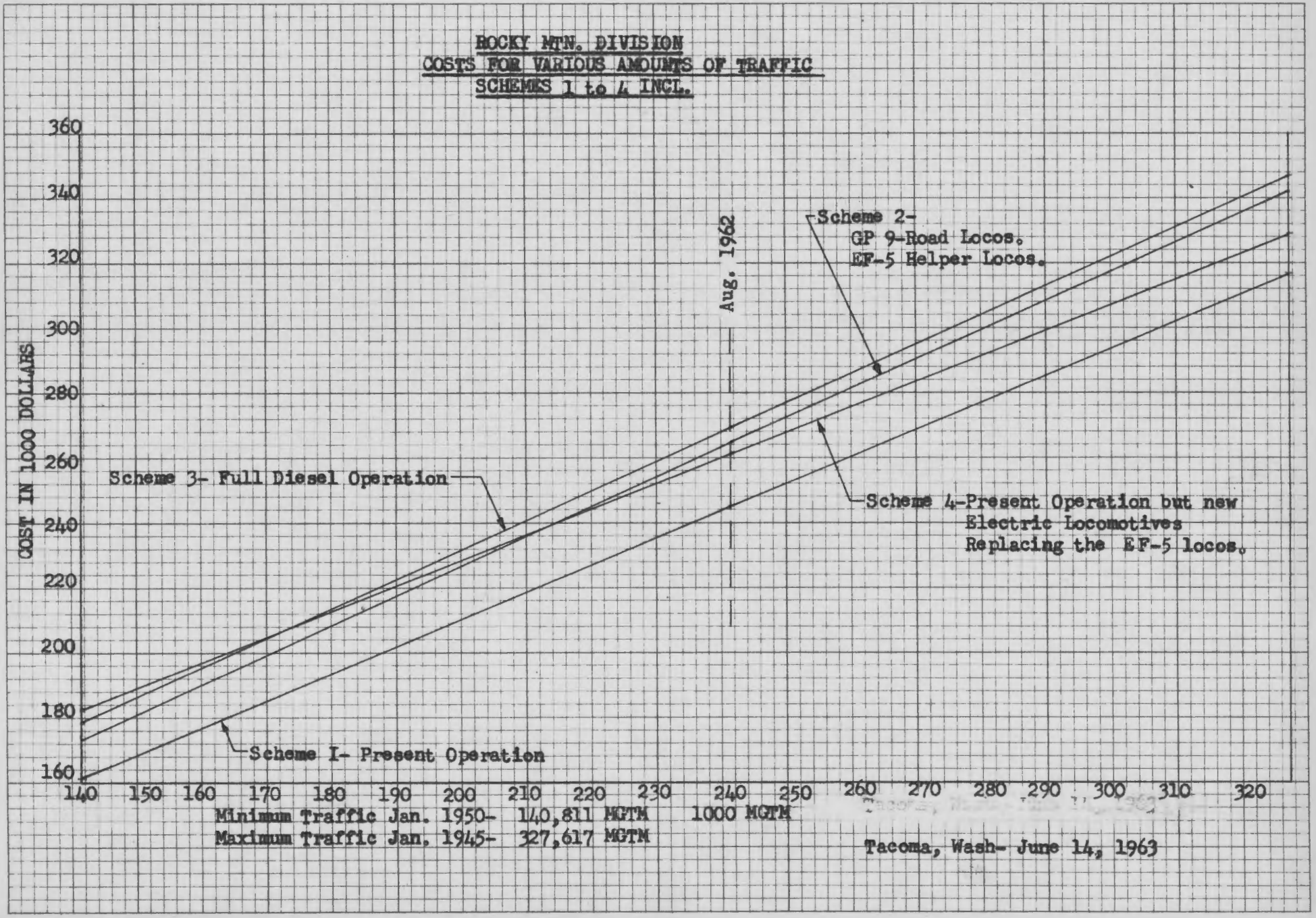

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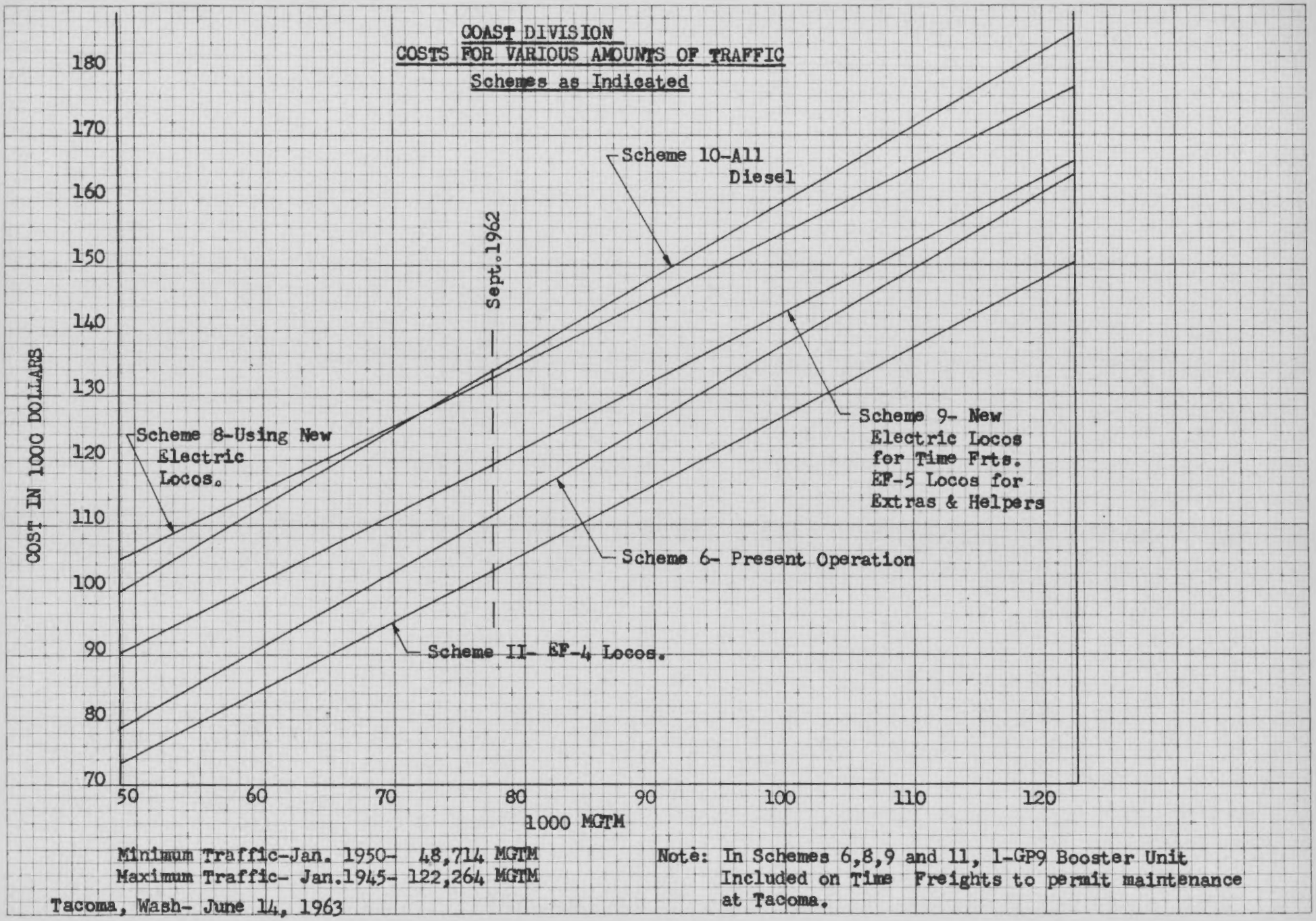

Minimum Traffic-Jan. 1950- 48,714 MGTM
Maximum Traffic- Jan.1945- 122,264 MGTM

Note: In Schemes 6,8,9 and 11, 1-GP9 Booster Unit Included on Time Freights to permit maintenance at Tacoma.

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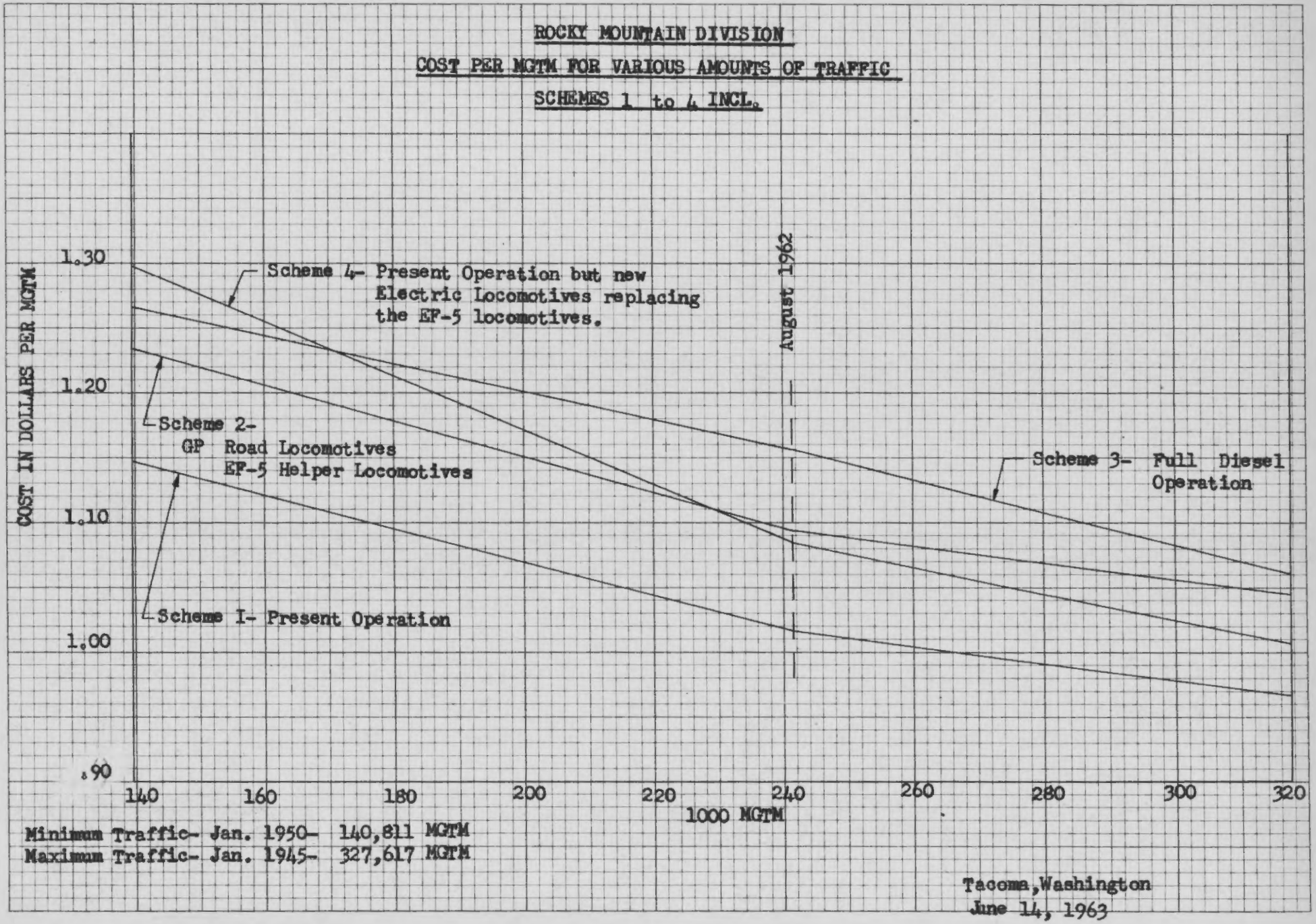
ROCKY MOUNTAIN DIVISION
COST PER MGTM FOR VARIOUS AMOUNTS OF TRAFFIC
SCHEMES 1 to 4 INCL.



Minimum Traffic- Jan. 1950- 140,811 MGTM
Maximum Traffic- Jan. 1945- 327,617 MGTM

Tacoma, Washington
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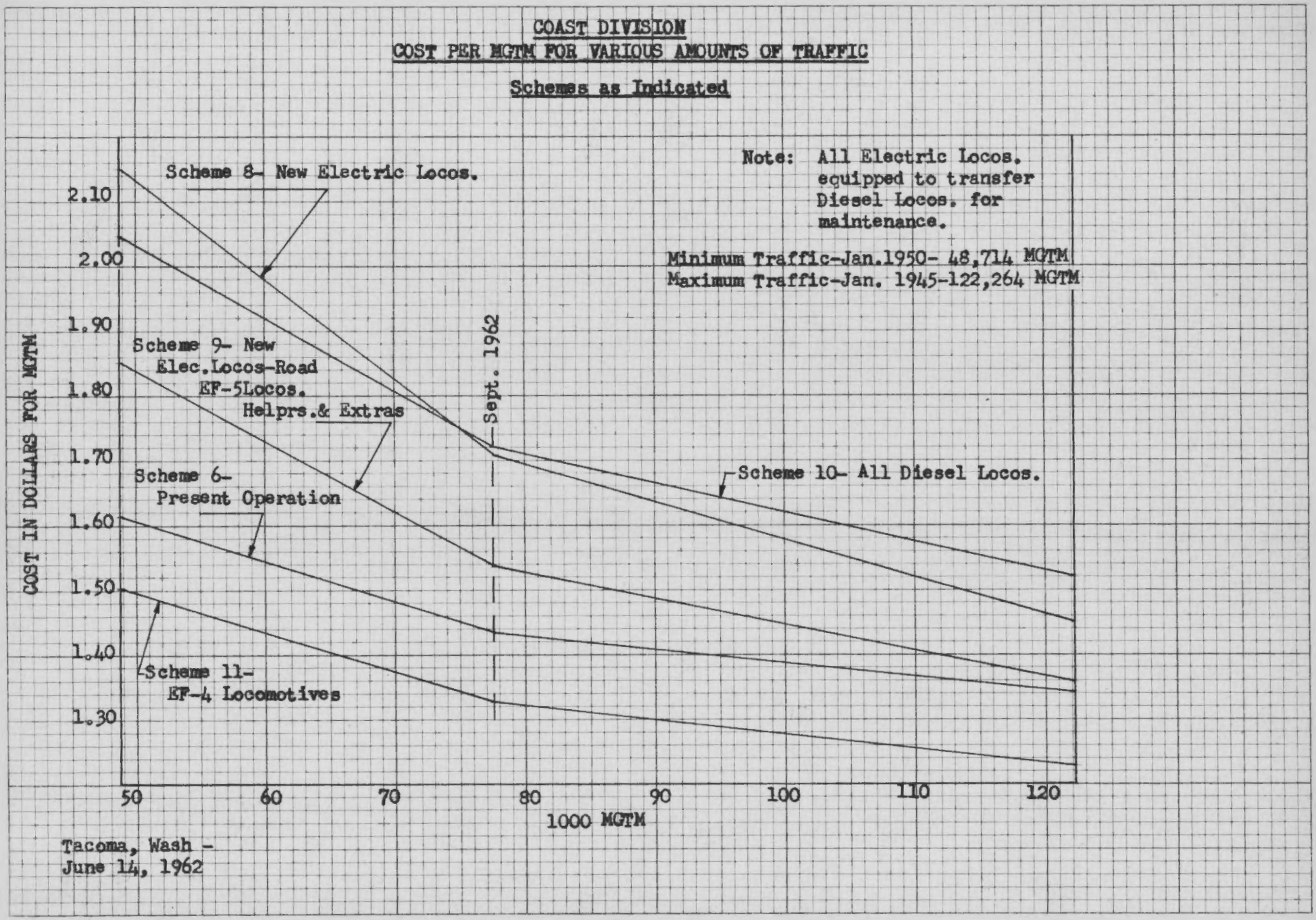
COAST DIVISION
COST PER MGTM FOR VARIOUS AMOUNTS OF TRAFFIC
Schemes as Indicated



Tacoma, Wash -
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