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 $1.091/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 cost operating expense shows operation with new electric locomotives (EF-7) to be the most economical. When depreciation, interest and miscellaneous power are introduced, the present operation with helpers is the most economical. However this has the threat of increased locomotive repairs as the years go by, and does nothing to improve speed over the division. To improve this factor, it is necessary to turn to operation with new locomotives on the time freights and old locomotives in helper service. This again imposes the threat of increased locomotive repair costs in the future. The best operation would appear to be obtainable with new locomotives, either with or without helpers. Further study might be made of helper operation. The diesel operation on the other hand increases to $1.845 per MGTM (compared to $1.619 per MGTM for new electric locomotives).

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.

H. R. Morgan

H.R. Morgan,
Electrical Engineer

Electrification Department,
Tacoma, Washington
May 31, 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%.

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 accummulated 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.