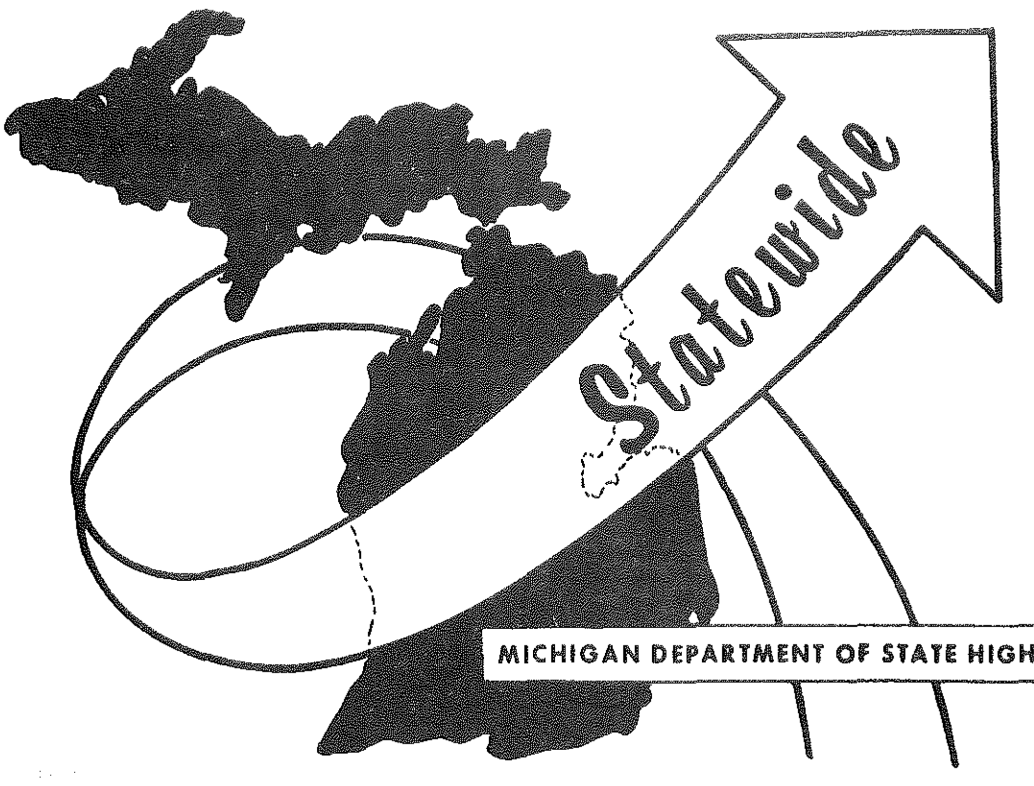
Statewide Transportation Analysis & Research

MICHIGAN'S STATEWIDE TRANSPORTATION
MODELING SYSTEM
VOLUME XV-A

RAILROAD FINANCIAL IMPACT ANALYSIS

STATEWIDE RESEARCH & DEVELOPMENT
JANUARY, 1976



MICHIGAN DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

MICHIGAN DEPARTMENT

OF

STATE HIGHWAYS AND TRANSPORTATION

BUREAU OF TRANSPORTATION PLANNING

MICHIGAN'S STATEWIDE TRANSPORTATION
MODELING SYSTEM
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RAILROAD FINANCIAL
IMPACT ANALYSIS

STATEWIDE RESEARCH & DEVELOPMENT
JANUARY, 1976

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, GOVERNOR

DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

STATE HIGHWAYS BUILDING, 425 WEST OTTAWA PHONE 517-373-2090
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JOHN P. WOODFORD, DIRECTOR

January 21, 1976

Mr. Sam F. Cryderman, Deputy Director
Bureau of Transportation Planning
Michigan Department of State Highways
and Transportation
P.O. Drawer K
Lansing, Michigan 48904

Dear Mr. Cryderman:

This is the first in a series of reports the Highway Planning Division will be presenting on procedures developed to monitor the simulated social, economic, and environmental impacts caused by or related to the implementation of proposed railroad plans. While a subsequent report describes those procedures utilized to predict the impact of a plan's implementation on the economic well-being of the surrounding community, this report documents techniques used to describe the economic consequences of such implementation on the finances of a particular railroad company.

The techniques described herein are to a large degree those developed by the United States Railroad Association (USRA). Special attention is given to those portions of the technique that have been modified by this Division to reflect a more realistic Michigan approach. The Michigan version of the USRA procedures have been adopted solely for short term evaluation. Future railroad analysis will be performed using techniques which have the "systems" concept at their analytical core. These procedures, to be used in long range planning, are currently in development.

This report was prepared by Mr. Mark D. DuBay of the Statewide Transportation Planning Procedures Section under the supervision of Mr. Richard E. Esch, Manager.

Sincerely,

R. J. Lilly

R. J. Lilly, Administrator
Highway Planning Division

RAILROAD FINANCIAL IMPACT ANALYSIS

BY

MARK D. DUBAY

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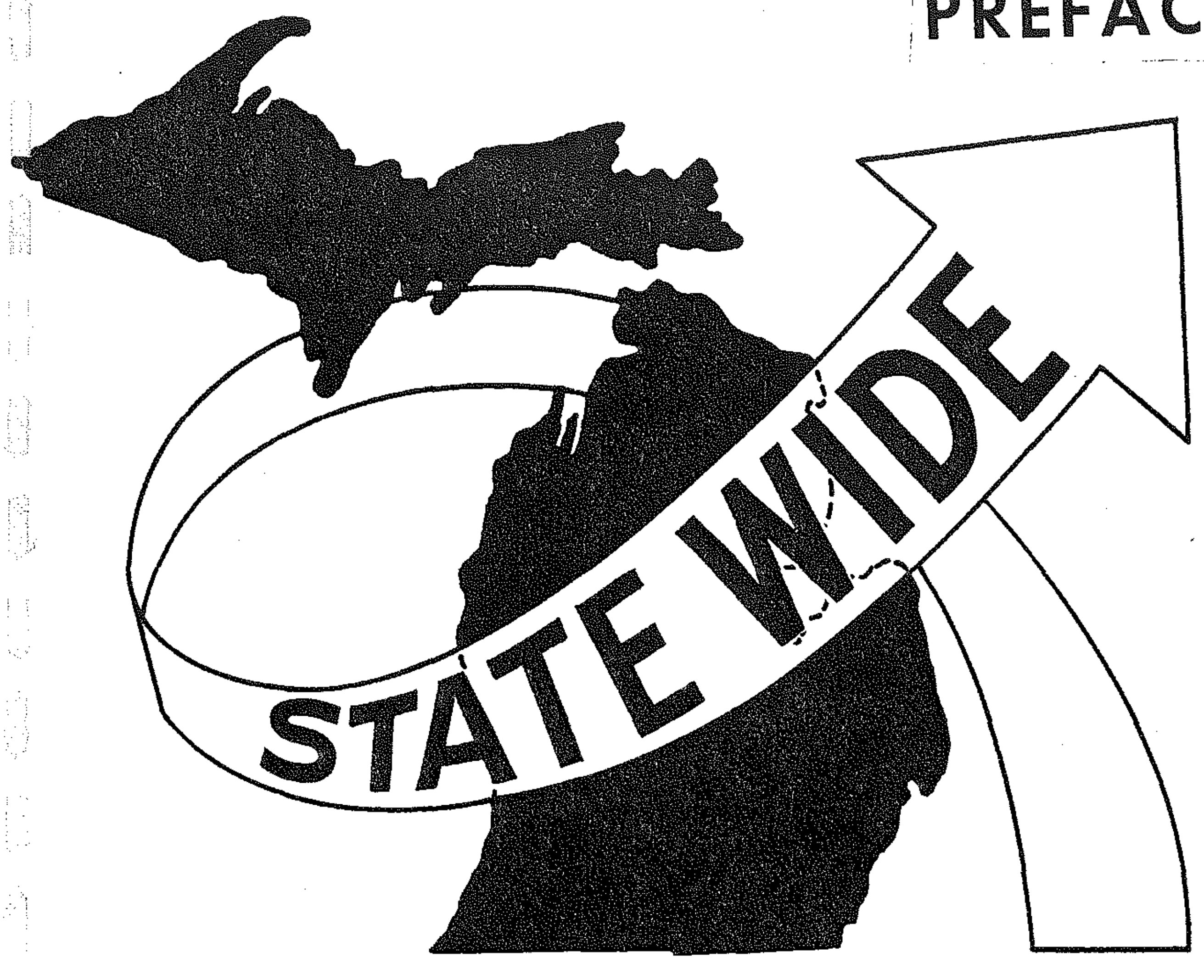
PREFACE



PREFACE

Since early in 1974, the Statewide Transportation Planning Procedures Section of the Michigan Department of State Highways and Transportation has been developing automated techniques for the planning and evaluation of statewide multi-modal transportation systems. Volume XIII of the Section's report series entitled "Michigan Goes Multi-Modal" documents those procedures utilized in the definition of a state rail network and several computer programs which make the network invaluable to the future modeling of statewide rail traffic and commodity flows. A critical step in realizing a rail modeling capability within the Department was accomplished in July 1975 when a three part report (Volume XIV) was written detailing the technical development of commodity flow matrices based on both a 1% and a 100% sample. This development will eventually enable the Department to accurately model rail traffic patterns by railroad company and to estimate many of its associated costs and revenues. While these "tools" will give the Department a systematic means of monitoring traffic patterns and, therefore, a basis for making preliminary planning decision, they do not provide answers to the economic issues that may arise around suggested alternative plans. A means of evaluating proposed rail configurations was thought to be the necessary next step in developing a comprehensive rail planning system. This technique, in the final form, should give state officials the ability to select (from the State's perspective) an economically "optimal" plan.

The United States Rail Association (USRA) has computerized a procedure which fulfills, to some extent, Michigan's short run need for a rail evaluation process. Although USRA has been criticized for its analytical approach to several aspects of financial accounting, Viability Analysis, as it has come to be called, has generally been recognized as being conceptually sound. Because the Department had access to its use, thus negating those costs it would have incurred in developing its own approach, and because it was thought that its analytical flaws were not insurmountable, the technique was adopted as the third critical piece in the State's rail system planning process until a better system could be devised.

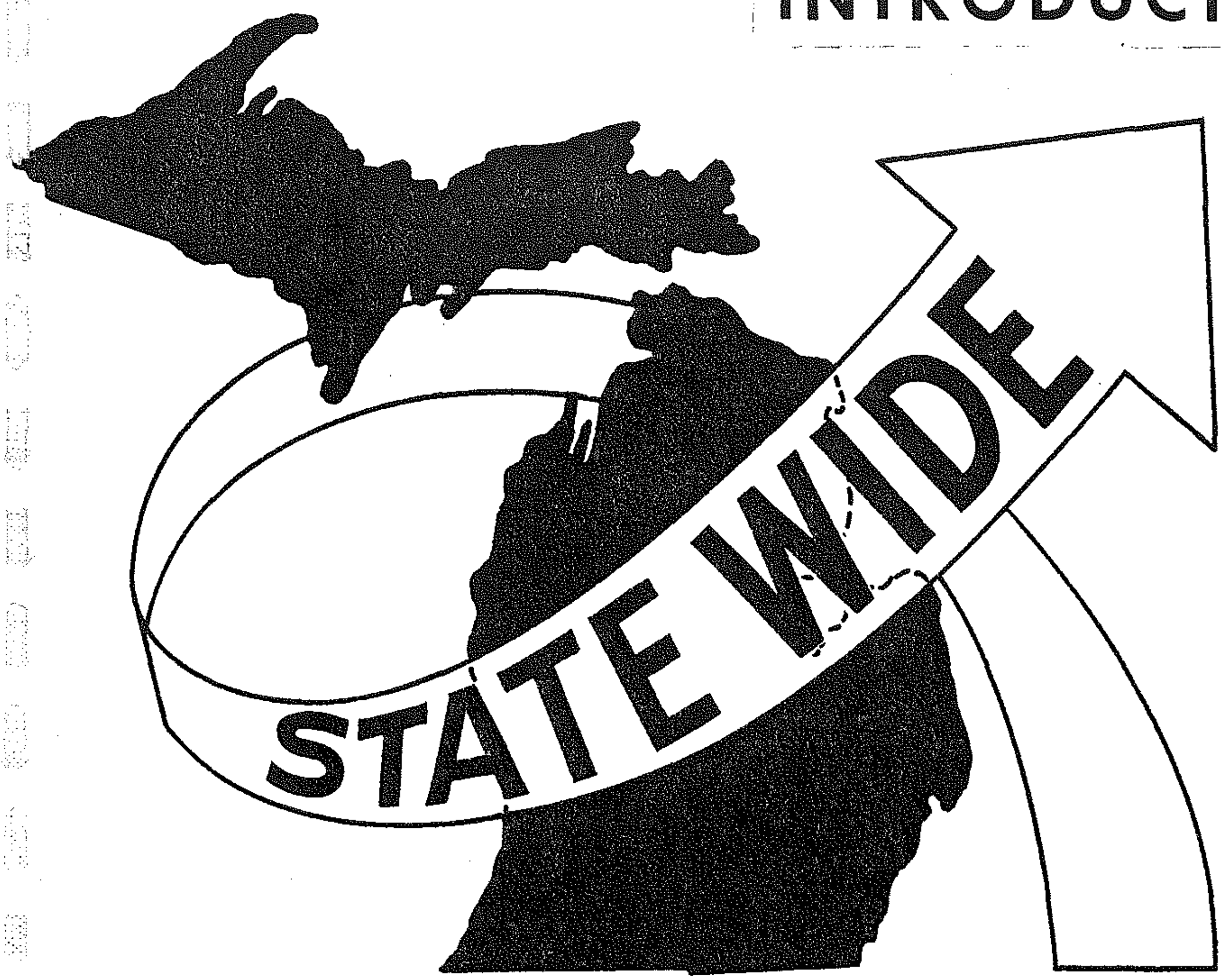
Subsequent to introductory remarks concerning background information on the nation's rail crisis, congressional formation of USRA and actions taken by USRA in its move to formulate a solvent rail company (ConRail), the report enters a detailed discussion of viability analysis in both its original form and its form as modified to meet the needs of state transportation officials. Examples of the printed output from both the USRA and Michigan (modified) models shall be included in the final section of this document.

A current list of other reports dealing with the Statewide Model's development and application is presented here for your convenience.

STATEWIDE TRAVEL MODELING SERIES

Volume	I	Objectives and Work Program
Volume	I-A--	Region 4 Workshop Topic Summaries
Volume	I-B--	Single and Multiple Corridor Analysis
Volume	I-C--	Model Applications: Turnbacks
Volume	I-D--	Proximity Analysis: Social Impacts of Alternate Highway Plans on Public Facilities
Volume	I-E--	Model Applications: Cost-Benefit Analysis
Volume	I-F--	Air and Noise Pollution System Analysis Model
Volume	I-G--	Transportation Planning Psychological Impact Model
Volume	I-H--	Level of Service Systems Analysis Model: A Public Interaction Application
Volume	I-J--	Service-Area Model
Volume	I-K--	Effective Speed Model: A Public Interaction Tool
Volume	I-L--	System Impact Analysis Graphic Display
Volume	I-M--	Modeling Gasoline Consumption
Volume	II --	Development of Network Models
Volume	III --	Multi-Level Highway Network Generator ("Segmental Model")
Volume	III-A--	Semi-Automatic Network Generator Using a "Digitizer"
Volume	V	Part A --Travel Model Development: Reformation-Trip Data Bank Preparation
Volume	V	Part B --Development of the Statewide Socio-Economic Data Bank for Trip Generation-Distribution
Volume	VI --	Corridor Location Dynamics
Volume	VI-A--	Environmental Sensitivity Computer Mapping
Volume	VII --	Design Hour Volume Model Development
Volume	VII-A--	Capacity Adequacy Forecasting Model
Volume	VII-B--	Modeling Major Facility Opening Impact on DHV
Volume	VIII --	Statewide Public and Private Facility File
Volume	IX --	Statewide Socio-Economic Data File
Volume	X-A--	Statewide Travel Impact Analysis Procedures
Volume	X-B--	Statewide Social Impact Analysis Procedures
Volume	X-C--	Statewide Economic Impact Analysis Procedures
Volume	XI --	Computer Run Times - An Aid in Selecting Statewide Travel Model System Size
Volume	XIII --	Michigan Goes Multi-Modal
Volume	XIII-A--	Multi-Modal Mobility and Accessibility Analysis
Volume	XIV-A--	Commodity Flow Matrix - Ann Arbor Railroad
Volume	XIV-B--	Commodity Flow Matrix - Penn Central Railroad
Volume	XIV-C--	Commodity Flow Matrix Michigan Railroads 1% Sample
Volume	XV-A--	Railroad Financial Impact Analysis
Volume	XV-B--	Railroad Community Impact Analysis
Volume	XV-C--	Railroad Environmental Impact Analysis
Volume	XVI --	Multi-Modal Analysis: Dial-a-Ride
Volume	XVII --	Statewide Intermodal Impact Analysis - Truck and Railroad

INTRODUCTION



INTRODUCTION

The problems which underlie the bankruptcy of the Penn Central Transportation Company, after only two years of existence, and six other lesser railroad companies in the Northwest and Midwest Regions of the Nation are as complex as they are numerous. Basically, the rail industry's financial difficulties stem from three factors: 1) changes in technology, 2) shifts in government policy, and 3) a reorientation of the economy's transportation needs. It was the Penn Central's collapse in 1970 that startled the federal congress to action. Since this company alone employed over 90,000 people, operated 20,000 miles of railroad covering 16 states and served 55 percent of the Nation's manufacturing plants, the Penn Central formed a truly integral part of the Nation's total transportation system. On January 2, 1974, Congress enacted the Regional Rail Reorganization Act of 1973 and mandated the formation of the United States Rail Association (USRA) which was to devise a "plan" to revitalize the rail industry in the region through the establishment of the Consolidated Rail Corporation (ConRail). Decisions as to which of the bankrupt rail lines would be included in the new federal corporation were to be based on an economic analysis of each rail segment within the region.

This analysis, popularly known as "Viability Analysis", utilized traffic and revenue information from the carrier's waybill file to determine the revenue associated with all traffic which had, in 1973, either its origin or destination or both its origin and destination at stations along a study segment. Known system level fixed costs were employed within the analysis as a basis for quantifying seven different types of costs which were then subtracted from revenue estimates to determine the economic viability of a line. Viability was defined as a line showing a net profit after all related costs are subtracted from total revenue. If a profit was indicated through the analysis; if the segment was viable, it would be a likely candidate for inclusion within the ConRail system. If not, it would be eligible for federal subsidy not to exceed a two-year period subsequent to ConRail's taking legal control.

The USRA's version of Viability Analysis suffers from two basic flaws which have often been cited as causing an understatement of profitability for many infrequently traveled (i.e., light-density) branch lines. While these lines may admittedly be of marginal value when analyzed in isolation, it may be shown, when considered from a system perspective, that they are of significant importance in generating a profit for the national transportation industry. The first criticism, then, is leveled at the method in which USRA determined a line's total revenue potential. Their analysis took on a traditional economic perspective in that it determined the revenue associated with a particular segment based solely upon the traffic which had its origin and/or destinations at stations along that line. This approach is valid when one wishes to know the amount of revenue made by the line's owner. Since USRA wanted to evaluate questionable branch lines, it logically did so in terms of the branch's impact on its probable revenue and expenses. But ConRail is to be a solution to a national transportation problem, and, therefore, it should have evaluated the line's impact on the welfare of the entire nation - not merely upon its own existence. Sound public policy requires that each branch line be evaluated from the national system point of view. To illustrate this problem, a carload of industrial goods which travels to New York City via a solvent carrier but has its origin on a bankrupt Penn Central line in the Detroit area would have its revenue credited only to the bankrupt line for the length of its journey on this line (or a percentage thereof) despite its generating revenue for the other solvent carrier. The earnings of the solvent carrier are not attributed to the branch. If the bankrupt line was abandoned, its profit and the nation's profit would be reduced by that amount less expenses.

The second major criticism of the methodology often cited is that USRA equates variable costs with avoidable costs. The assumption is that while certain costs may be unavoidable with abandonment of only a single line, they become avoidable in a massive abandonment of light density lines. This concept is employed to justify the substitution of variable cost for avoidable cost of both off-branch and on-branch train operations. One can accept that if a branch line which generates a few carloads a year is abandoned, the carrier will realize savings of freight car costs and some fuel costs as a result of one or two fewer cars being connected to a (main line) train. It is also not difficult to accept that these cars and their lading have some effect upon maintenance of way, loss and damage and switching costs. But it is not reasonable to assume or accept a theory which states that a few carloads, spread over an entire year, moving either outbound or inbound and carrying several different commodity types would cluster with other such carloads in a manner which would relieve the railroad of the need to operate an entire or several entire trains. The proposition, upon which a portion of the USRA analysis rests, that the variable cost of a whole train on the main line can be avoided by abandoning any single branch, is unacceptable.

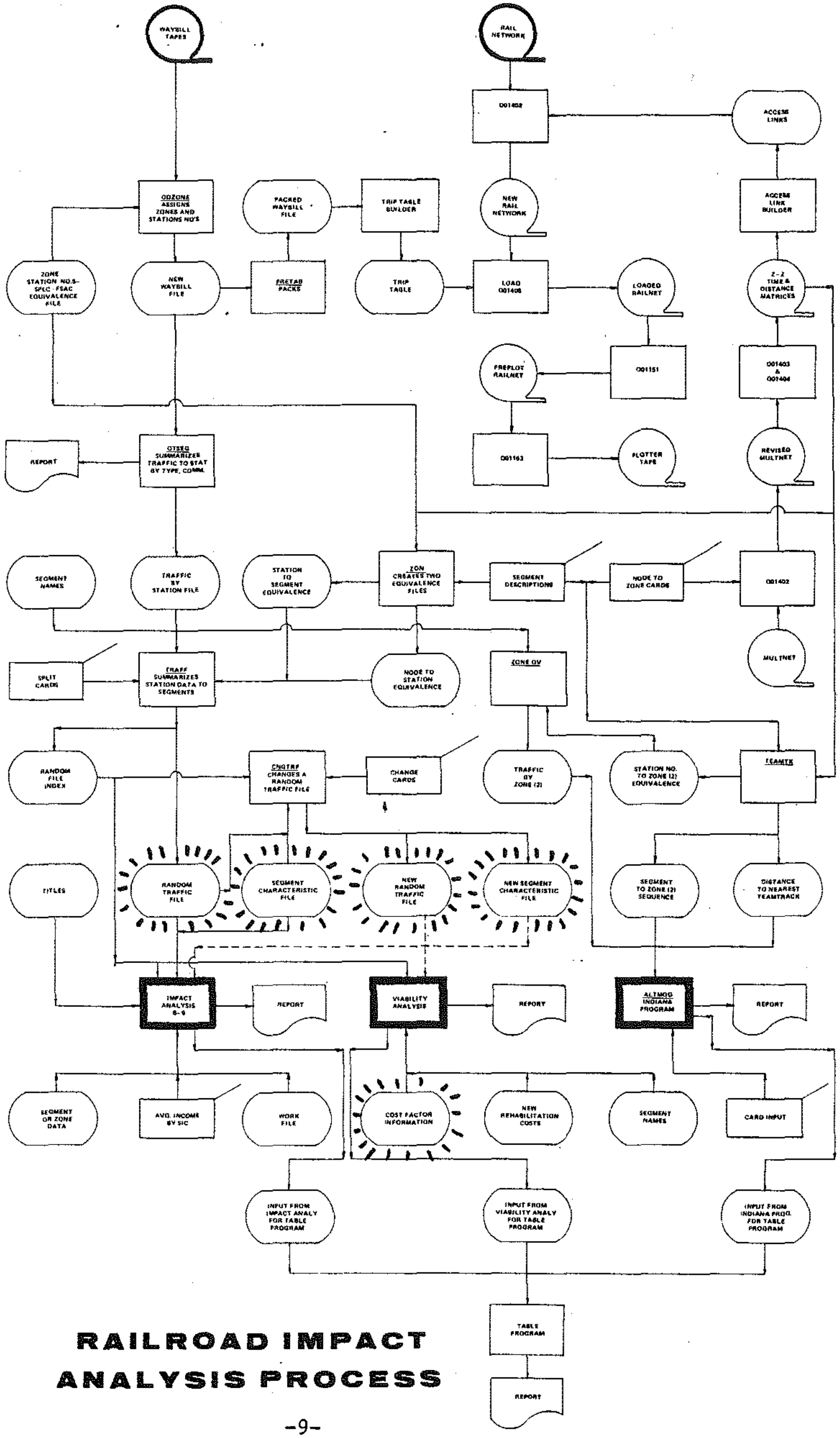
The Railroad Planning Procedures Report published by the U.S. Department of Transportation cites four methods of revenue and cost allocation popularly used in the assessment of branch line profitability. The USRA method which is discussed therein suffers from the basic conceptual problems reviewed above. The "car ownership" method is useful because of its ease of application - i.e., the procedure is short and easy to complete. Because of this attribute, however, the approach is overly simplistic. It does not fully or realistically capture both direct and indirect costs associated with the operation of a branch line. Perhaps the "best" method of financially assessing both branch and main line rail operations is by means of the "Full Allocation" method. This procedure takes into consideration all revenues associated with each freight trip by allocating them on a per mile basis to all segments used in the trip. Once cost categories associated with those actions necessary to make individual freight movements have been identified, cost allocations may, likewise, be made on a per mile basis. Since a rail network has been developed for the State and because trip tables based upon a 1% sample of all freight movement within the State are now available, work may now begin on the development of a "Full Allocation" cost and revenue methodology. Such a system will, upon completion, give state rail planners the ability to realistically monitor the financial impact of alternate rail plans. The "Full Allocation" method will permit the adoption of "system" plans which will have been derived from a true "systems" approach.

Because this allocation method remained in the research and development stage at a time when the State was required to submit a "State Rail Plan", the Department was forced to adopt the already operational USRA methodology. With this adoption came some of the USRA approach's inherent weaknesses. The problem of misallocation of branch line revenue could not, for example, be resolved without a fundamental shift in analytical emphasis. Therefore, the revenue estimates in all figures included throughout this report should be taken to mean carrier revenue as opposed to statewide system revenue. The USRA model's second flaw - that of confusing which costs are avoidable and unavoidable with branch line abandonment - is, however, correctable and it, to a large degree, has been removed from the Michigan version of the analysis.

The remainder of this report shall focus on the operation of the USRA model and those program modifications which have been implemented in converting the analysis to a more realistic Michigan approach. A general discussion of the two models shall be followed by a more technical discussion for those who may be interested in adopting or employing the various models for their own purposes.

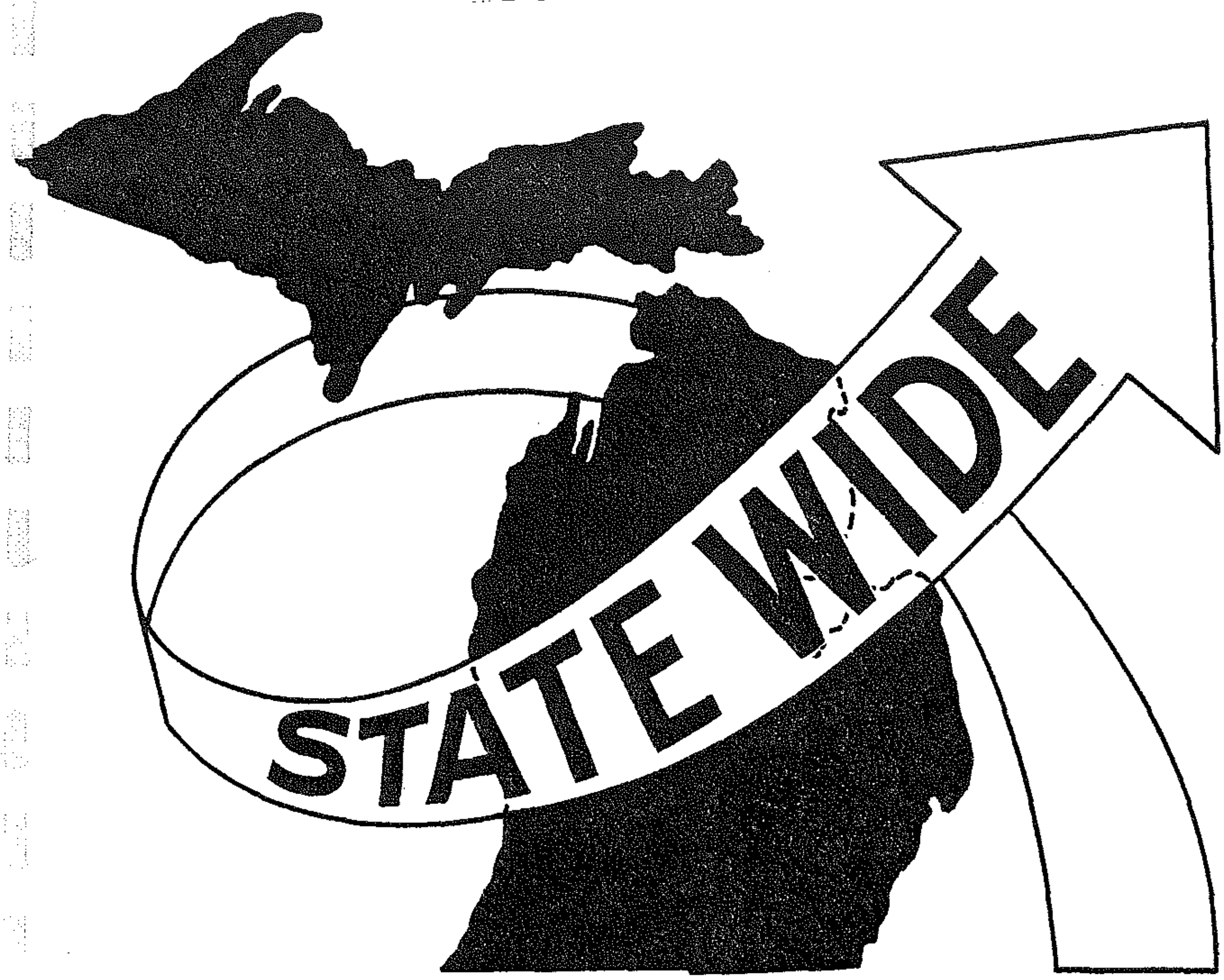
Before moving to this presentation, it should be pointed out that the viability analysis is only one technique which has been made operational on Control Data Corporation's 6600 computing system in anticipation of meeting federal requirements concerning the rail reorganization and a future state need of determining branch line subsidies. Figure 1 shows a flow diagram of the "Railroad Impact Analysis Process" as it presently exists within the Statewide Transportation Planning Procedures Section. While Viability Analysis emphasizes the financial impact of rail abandonment on the revenue and expenses of a rail carrier, the Community Impact Analysis (B-9) developed by R. L. Banks and Associates determines the economic consequences of rail abandonment upon the populace of the surrounding region. A program adopted from the State of Indiana estimates the environmental impacts resulting from a rail abandonment. (See Volume XV-B "Railroad Community Impact Analysis" and Volume XV-C "Railroad Environmental Impact Analysis".) From Figure 1, it should become obvious that these three programs share common input files. They are all basically "driven" by a traffic file which has recorded within it, carloads, tons, and revenue generated and attracted to particular stations along a rail segment. As this traffic file is manipulated in simulation of proposed rail abandonments, the rail impact analysis process is able to quickly monitor the suspected consequences. This report shall deal exclusively with the traffic, line characteristic, cost factor and "other" files which provide the inputs to the Viability Analysis. These files have been highlighted in Figure 1.

FIGURE 1



RAILROAD IMPACT ANALYSIS PROCESS

A GENERAL DISCUSSION - THE USRA APPROACH TO VIABILITY ANALYSIS

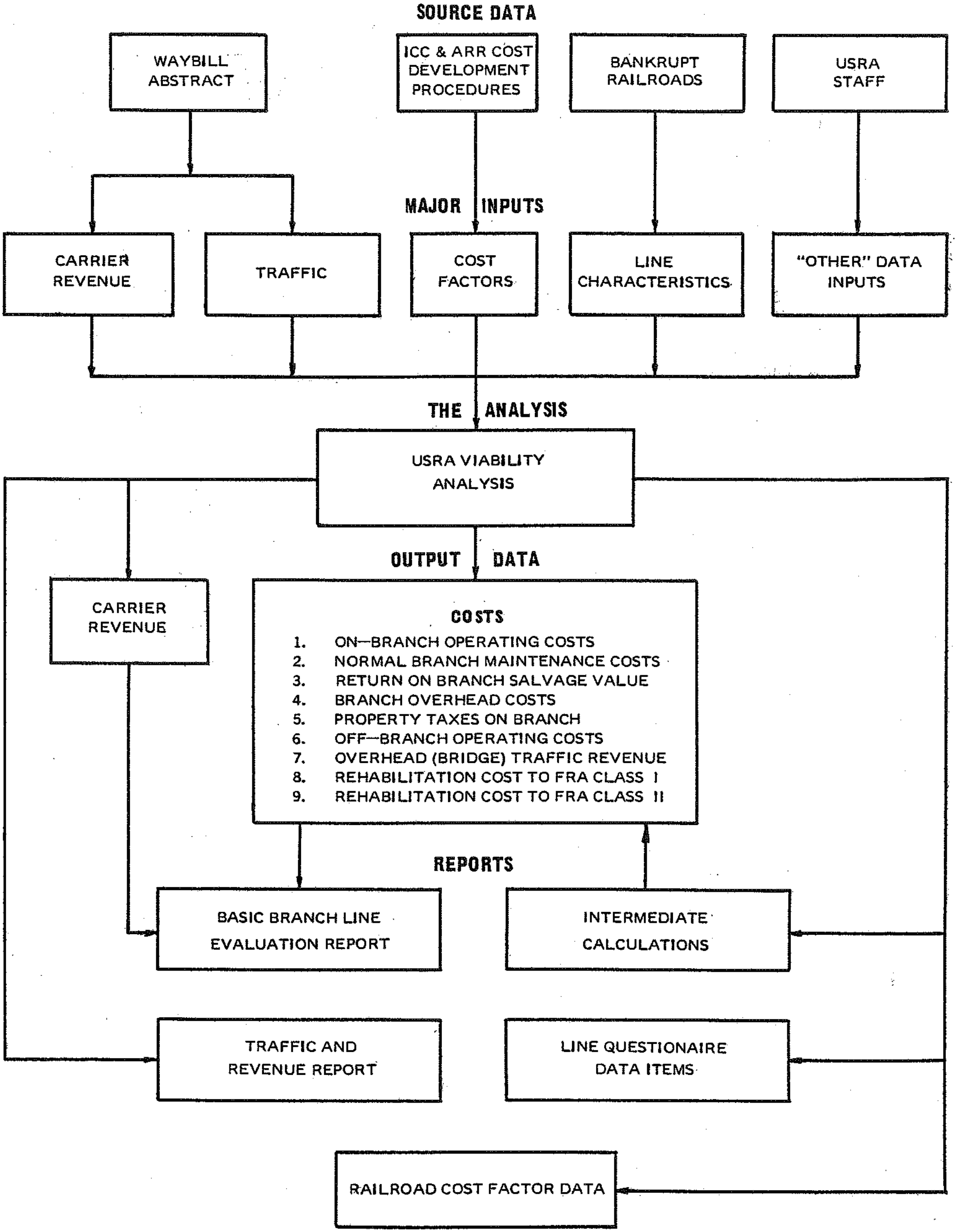


A GENERAL DISCUSSION - THE USRA APPROACH TO VIABILITY ANALYSIS

Figure 2 shows a generalized flow diagram of the analysis process designed by USRA. The final output generated by the computerized routine is a "Basic Branch Line Evaluation Report". It was upon the basis of this report that USRA made many preliminary planning decisions concerning the inclusion of rail segments within the ConRail system. As mentioned above, a line segment had a good possibility of being included in the Federal rail corporation, if, after a series of operating costs were subtracted from the estimated revenues, it was able to show a net profit. Figure 3 is a reproduction of the "Evaluation Report" for a single segment of the bankrupt Ann Arbor Railroad. One can readily identify the ten individual cost figures labeled simply "costs" on the flow diagram. The sequential deduction of each of these costs from, in the first case, the estimated revenue and in all other cases from the residual of revenue above costs, has resulted in a series of tests by which the USRA analyst has been able to judge the viability of each line. The following discussion shall be devoted to an explanation of this process and the data and procedures used therein.

It can be seen from Figure 2 that a carrier's revenue for a particular rail segment is determined from information contained within the waybill abstract. This abstract is the official record of all traffic which has either its origin or destination or both its origin and destination at stations along a rail segment. Data contained in this file describes the number of carloads, short haul miles and the amount of tonnage and revenues for all traffic by a seven-digit commodity code. USRA aggregated this information to a two-digit system. (See Figure 4.) Figures 5-A and 5-B show the "Traffic and Revenue Report" for the same Ann Arbor segment presented above. This report is printed on a line specific basis with each execution of the viability computer routine. The data contained therein is a simple summary of that which is contained within the waybill file.

FIGURE 2


SOURCE DATA
WAYBILL ABSTRACT
ICC & ARR COST DEVELOPMENT PROCEDURES
BANKRUPT RAILROADS
USRA STAFF
MAJOR INPUTS
CARRIER REVENUE
TRAFFIC
COST FACTORS
LINE CHARACTERISTICS
"OTHER" DATA INPUTS
THE ANALYSIS
USRA VIABILITY ANALYSIS
OUTPUT DATA
CARRIER REVENUE
COSTS
1. ON—BRANCH OPERATING COSTS
2. NORMAL BRANCH MAINTENANCE COSTS
3. RETURN ON BRANCH SALVAGE VALUE
4. BRANCH OVERHEAD COSTS
5. PROPERTY TAXES ON BRANCH
6. OFF—BRANCH OPERATING COSTS
7. OVERHEAD (BRIDGE) TRAFFIC REVENUE
8. REHABILITATION COST TO FRA CLASS I
9. REHABILITATION COST TO FRA CLASS II
REPORTS
BASIC BRANCH LINE EVALUATION REPORT
INTERMEDIATE CALCULATIONS
TRAFFIC AND REVENUE REPORT
LINE QUESTIONAIRE DATA ITEMS
RAILROAD COST FACTOR DATA

010 ANN ARBOR RAILROAD 1300 DUNDEE – OWOSSO

======= BASIC BRANCH LINE EVALUATION REPORT =======

LINE 1)	CARRIER BRANCH REVENUE	921400.
LINE 2)	ON–BRANCH OPERATING COSTS	357357.
LINE 3)	TEST I NET REVENUE AFTER ON–BRANCH OPERATING COSTS	564043.
LINE 4)	NORMAL BRANCH MAINTENANCE COSTS	501843.
LINE 5)	TEST II NET REVENUE AFTER NORMAL BRANCH MAINTENANCE COSTS	62200.
LINE 6)	RETURN ON BRANCH SALVAGE VALUE	237330.
LINE 7)	TEST III NET REVENUE AFTER RETURN ON BRANCH SALVAGE VALUE	–175130.
LINE 8)	BRANCH OVERHEAD COSTS	33878.
LINE 9)	TEST IV NET REVENUE AFTER BRANCH OVERHEAD COSTS	–209008.
LINE 10)	PROPERTY TAXES ON BRANCH	0.
LINE 11)	TEST V NET REVENUE AFTER PROPERTY TAXES ON–BRANCH	–209008.
LINE 12)	OFF BRANCH OPERATING COSTS	429501.
LINE 13)	TEST VI NET REVENUE AFTER OFF BRANCH OPERATING COSTS	–638510.
LINE 14)	OVERHEAD BRIDGE TRAFFIC REVENUE	0.
LINE 15)	TEST VII NET REVENUE AFTER ADDING BRIDGE TRAFFIC REVENUE	–638510.
LINE 16)	REHABILITATION COST TO FRA TRACK CLASS I	0.
LINE 17)	TEST VIIIA NET REVENUE AFTER IMPROVING TO TRACK CLASS I	–638510.
LINE 18)	REHABILITATION COST TO FRA TRACK CLASS II	170184.
LINE 19)	TEST VIIIB NET REVENUE AFTER IMPROVING TO TRACK CLASS II	–808693.

FIGURE 3

STANDARD TRANSPORTATION COMMODITY CODE

Major Group Headings:

01 Farm Products
08 Forest Products
09 Fresh Fish or Other Marine Products
10 Metallic Ores
11 Coal
13 Crude Petroleum, Natural Gas, or Gasoline
14 Nonmetallic Minerals; except fuels
19 Ordnance or Accessories
20 Food or Kindred Products
21 Tobacco Products
22 Basic Textiles
23 Apparel; aao. other finished textile products or knit apparel
24 Lumber or Wood Products; except furniture - see 25
25 Furniture or Fixtures
26 Pulp, paper, or Allied Products
27 Printed Matter
28 Chemicals or Allied Products
29 Petroleum or Coal Products
30 Rubber or Miscellaneous Plastics Products
31 Leather or Leather Products
32 Stone, Clay, or Glass Products
33 Primary Metal Products
34 Fabricated Metal Products; except Ordnance - see 19, Machinery - see 35 or 36, or Transportation Equipment - see 37
35 Machinery; except Electrical - see 36
36 Electrical Machinery or Equipment; aao. supplies
37 Transportation Equipment
38 Instruments or Photographic Goods; aao. optical goods, watches or clocks
39 Miscellaneous Products of Manufacturing
40 Waste or Scrap Materials; viz. scrap or waste materials - not identified by industry producing
41 Miscellaneous Freight Shipments
42 Containers, Shipping, Returned Empty; aao. carriers or devices
44 Freight Fowarder Traffic
45 Shipper Association or Similar Traffic
46 Miscellaneous Mixed Shipments; except forwarder - see 44, Shipper Association - see 45
47 Small Packaged Freight Shipments

FIGURE 4

TRAFFIC AND REVENUE REPORT

LOCAL TRAFFIC						CONRAIL TRAFFIC					
STCC	CARS	TONS	$CONRAIL	$TOTAL	SHORT HAUL MILES	STCC	CARS	TONS	$CONRAIL	$TOTAL	SHORT HAUL MILES
1	0.	0.	0.	0.	0.	1	7.	611.	1749.	1749.	552.
11	0.	0.	0.	0.	0.	11	0.	0.	0.	0.	0.
14	0.	0.	0.	0.	0.	14	0.	0.	0.	0.	0.
20	0.	0.	0.	0.	0.	20	0.	0.	0.	0.	0.
22	0.	0.	0.	0.	0.	22	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.	24	0.	0.	0.	0.	0.
25	0.	0.	0.	0.	0.	25	0.	0.	0.	0.	0.
26	1.	41.	188.	188.	0.	26	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.	28	0.	0.	0.	0.	0.
29	0.	0.	0.	0.	0.	29	0.	0.	0.	0.	0.
30	0.	0.	0.	0.	0.	30	1.	6.	323.	323.	326.
32	0.	0.	0.	0.	0.	32	0.	0.	0.	0.	0.
33	0.	0.	0.	0.	0.	33	0.	0.	0.	0.	0.
34	0.	0.	0.	0.	0.	34	0.	0.	0.	0.	0.
35	0.	0.	0.	0.	0.	35	0.	0.	0.	0.	0.
36	0.	0.	0.	0.	0.	36	0.	0.	0.	0.	0.
37	0.	0.	0.	0.	0.	37	0.	0.	0.	0.	0.
40	0.	0.	0.	0.	0.	40	0.	0.	0.	0.	0.
41	0.	0.	0.	0.	0.	41	0.	0.	0.	0.	0.
42	0.	0.	0.	0.	0.	42	0.	0.	0.	0.	0.
47	0.	0.	0.	0.	0.	47	0.	0.	0.	0.	0.
50	1.	41.	188.	188.	0.	50	8.	617.	2072.	2072.	878.

FIGURE 5-A

TRAFFIC AND REVENUE REPORT

LOCAL TRAFFIC

STCC	CARS	TONS	$CONRAIL	$TOTAL	SHORT HAUL MILES
1	151.	11594.	24899.	120917.	9716.
11	15.	982.	2376.	6749.	700.
14	146.	11108.	27777.	97616.	10764.
20	66.	2730.	6866.	90525.	3769.
22	6.	83.	401.	2184.	220.
24	1141.	48138.	212804.	1554594.	211596.
25	1100.	10970.	86089.	388221.	53497.
26	103.	3406.	14073.	60949.	10866.
28	395.	32452.	69048.	389760.	12964.
30	71.	990.	4750.	18648.	1322.
32	186.	10414.	22253.	125926.	11264.
33	32.	2177.	10229.	51548.	6395.
34	12.	102.	657.	3130.	576.
35	20.	519.	4496.	16525.	1721.
36	1.	9.	288.	641.	280.
37	3561.	88398.	400919.	2139011.	118214.
40	19.	337.	1549.	11808.	567.
41	48.	599.	2624.	18752.	1117.
42	54.	711.	5242.	17808.	1660.
47	0.	99.	1955.	12535.	0.
50	7330.	234230.	919140.	5212270.	464317.

CONRAIL TRAFFIC

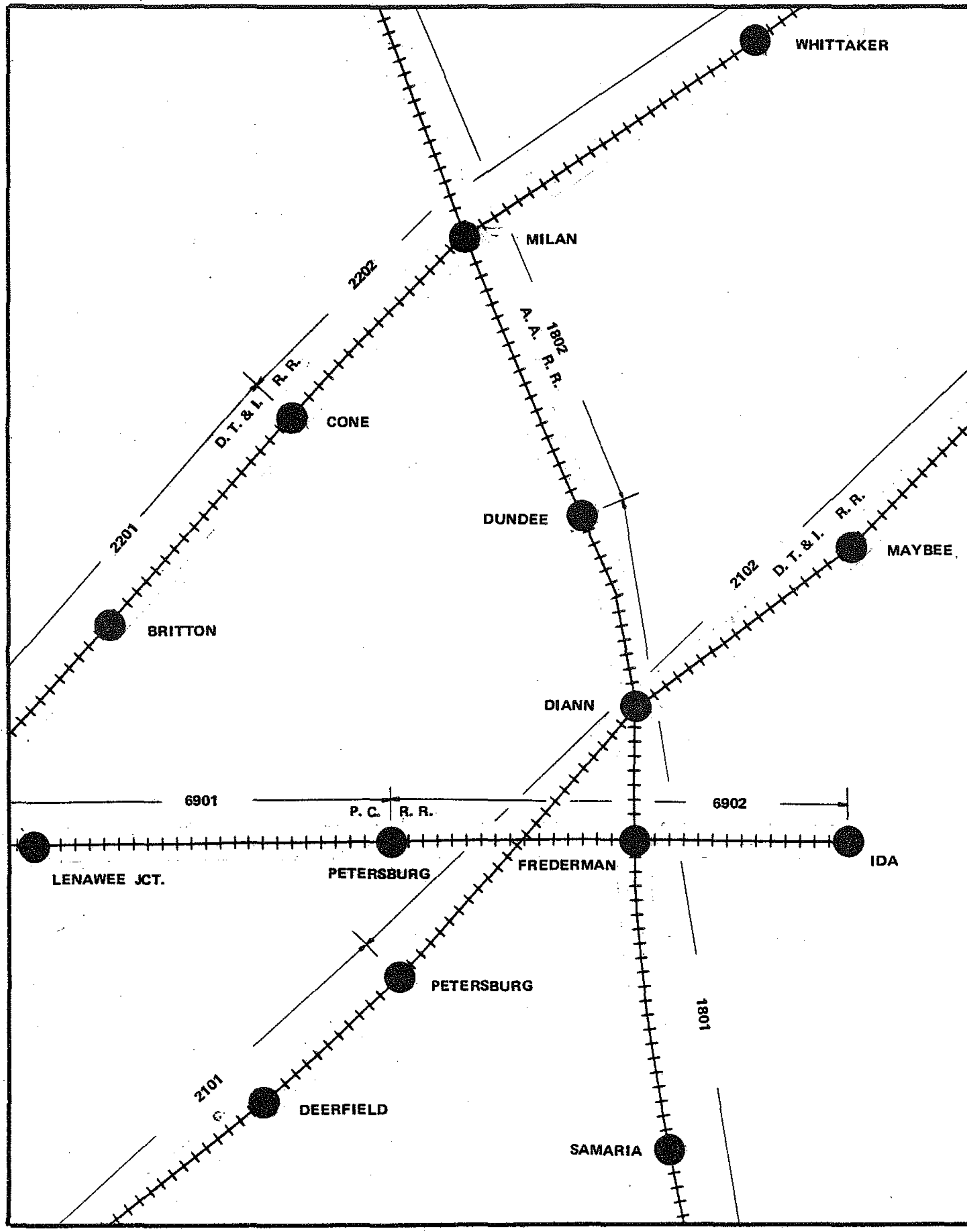
STCC	CARS	TONS	$CONRAIL	$TOTAL	SHORT HAUL MILES
1	158.	12205.	26648.	122666.	10268.
11	15.	982.	2376.	6749.	700.
14	146.	11108.	27777.	97616.	10764.
20	66.	2730.	6866.	90525.	3769.
22	6.	83.	401.	2184.	220.
24	1141.	48138.	212804.	1554594.	211596.
25	1100.	10970.	86089.	388221.	10866.
26	104.	3447.	14261.	61137.	12964.
28	395.	32452.	69048.	389760.	12964.
30	72.	996.	5073.	18971.	1648.
32	186.	10414.	22253.	125926	11264.
33	32.	2177.	10229.	51548.	6395.
34	12.	102.	657.	3130.	576.
35	20.	519.	4496.	16525.	1721.
36	1.	9.	288.	641.	280.
37	3561.	88398.	400919.	2139011.	118214.
40	19.	377.	1549.	11808.	567.
41	48.	599.	2624.	18752.	1117.
42	54.	711.	5242.	17808.	1660.
47	0.	99.	1955.	12535.	0.
50	7339.	234888.	921400.	5214530.	465195.

FIGURE 5-B

The various labels within this report indicate that there are three types of traffic associated with each segment - i.e., Local, ConRail, and Interline. The matrix labeled "Total" is, as the title suggests, a summation of the three other traffic arrays. All data associated with traffic generated or attracted to a segment is placed within one of the three matrices on the basis of their origin and termination. Local traffic is defined as that traffic which has both its origin and destination at stations along a study segment. To be considered "ConRail", traffic must have either its origin or destination at stations along those segments of a carrier scheduled to become part of the ConRail system. Interline traffic is that traffic which has either its origin or destination on segments of a solvent rail carrier and its origin or destination on (at stations along) a segment of the proposed ConRail system. Mentioning this traffic differentiation is important because it is around these definitions that certain costing procedures utilized within the analysis have been developed. To illustrate the three types of traffic, please refer to Figure 6 which depicts a portion of the state's rail network. Each line is labeled as belonging to a particular rail company and are broken into fictitious numbered segments by brackets. An example of a local trip, then, is one which has its origin on the Penn Central Segment 6902 at the Ida station and its destination on the same segment at Fredeman. A ConRail trip may have its origin on the Ann Arbor Segment 1801 at Samaria and its destination on Segment 1802 at Milan while a trip that is classified as interline might have its origin on the Penn Central Segment 6902 at Ida and its termination on the Ann Arbor Segment 1802 at Milan. It should be mentioned that a trip which has its origin on the D.T. & I. Segment 2101 at Deerfield and travels to the Whittaker station on D.T. & I.'s Segment 2202 via the Ann Arbor Railroad is not counted in any of the

FIGURE 6

A PORTION OF THE MICHIGAN RAILROAD SYSTEM



traffic files related to the Ann Arbor Railroad. Although certain costs and revenues result from the Deerfield-to-Whittaker trip, none are accounted for in the USRA analysis of the Ann Arbor Railroad. This, as suggested above, is a major flaw of the USRA technique.

Notice that row fifty (STCC 50) within the "Traffic and Revenue Report" (Figures 5-A and 5-B) is a total of the previous forty-seven commodity types. The fourth column (labeled $ ConRail), fiftieth row in each of the three traffic matrices is a total revenue estimate for traffic of that type. The fourth column, fiftieth row of the "Total" traffic array is, then, the total carrier revenue figure appearing in the "Evaluation Report". In this case, the rail line is estimated to make the Ann Arbor Railroad $921,400 a year. This total revenue information, as mentioned, is taken directly from the summarized waybill file and is printed in the "Evaluation Report" without further manipulation. All other traffic data specific to each of the Standard Transportation Commodity Codes (STCC) are used as input to the cost estimating procedures developed by USRA.

Several additional files are also used as input to the USRA model. These include the "Railroad Cost Factors Data" and the "Line Questionnaire Data Items". Figure 7 shows an example of this information for the Ann Arbor line discussed above. The "Questionnaire Data" was, as Figure 2 indicates, largely provided by the carrier involved. The railroad completed a systematic questionnaire dealing with each line segment individually. Since some information was incomplete, USRA staff was required to develop techniques to estimate the missing data. For example, a relationship involving the number of shippers and carloads handled was devised to calculate siding and yard miles in those cases where this information was not provided by the carrier. Overhead items such as: traffic expense, transportation superintendence; signals and interlockers; stationery and printing;

010 ANN ARBOR RAILROAD 1300 DUNDEE — OWOSSO

LINE QUESTIONNAIRE DATE ITEMS

ITEM	1)	CARD NUMBER ONE	1.000
ITEM	2)	RAILROAD CODE	10.000
ITEM	3)	FIRST STATE	MI
ITEM	4)	SECOND STATE	
ITEM	5)	THIRD STATE	
ITEM	6)	SEGMENT CODE	1300
ITEM	7)	LINE LENGTH IN MILES	86.800
ITEM	8)	SINGLE TRACK MILES	86.800
ITEM	9)	MULTI-TRACK MILES	0.000
ITEM	10)	SIDING AND YARD MILES	29.000
ITEM	11)	ANNUAL TRIPS	260.000
ITEM	12)	LOCOMOTIVES	1.000
ITEM	13)	RATED HORSEPOWER	2500.000
ITEM	14)	CREW SIZE	3.000
ITEM	15)	HOURS SERVING BRANCH	12.000
ITEM	16)	SERVING YARD TO BRANCH MILES	.500
ITEM	17)	STATION EMPLOYEES	0.000
ITEM	18)	IM TUNNELS AND SUBWAYS	0.000
ITEM	19)	IM BRIDGE-TRESTLE-CULVERT	1.000
ITEM	20)	IM STATION + OFFICE BUILDINGS	1.000
ITEM	21)	IM ROADWAY BUILDINGS	1.000
ITEM	22)	IM WHARVES AND DOCKS	0.000
ITEM	23)	IM COAL/ORE WHARVES + DOCKS	0.000
ITEM	24)	IM TOFC/COFC TERMINALS	0.000
ITEM	25)	IM COMMUNICATIONS SYSTEMS	1.000
ITEM	26)	IM SIGNALS AND INTERLOCKERS	1.000
ITEM	27)	JOINT MAINTENANCE DR	0.000
ITEM	28)	JOINT MAINTENANCE CR	0.000
ITEM	29)	PERCENT TIES GOOD	.100
ITEM	30)	OVRHD TRAFFIC EXPENSE	1.000
ITEM	31)	OVRHD TRANSP SUPERINTENDENCE	1.000
ITEM	32)	OVRHD SIGNALS + INTERLOCKERS	1.000
ITEM	33)	OVRHD STATIONERY + PRINTING	1.000
ITEM	34)	OVRHD INSURANCE	1.000
ITEM	35)	PROPERTY TAXES ON BRANCH	0.000
ITEM	36)	CARD NUMBER TWO	2.000
ITEM	37)	RAILROAD CODE	10.000
ITEM	38)	FIRST STATE	MI
ITEM	39)	SECOND STATE	
ITEM	40)	THIRD STATE	
ITEM	41)	SEGMENT CODE	1300
ITEM	42)	NUMBER OF TIES TO FRA CLASS I	0.000
ITEM	43)	MILES OF TRACK TO FRA CLASS I	0.000
ITEM	44)	NUMBER OF TIES TO FRA CLASS II	29400.000
ITEM	45)	MILES OF TRACK TO FRA CLASS II	0.000
ITEM	46)	NUMBER OF GRADE CROSSINGS	123.000
ITEM	47)	AUTHORIZED TIMETABLE SPEED	40.000
ITEM	48)	OVERHEAD BRIDGE CARLOADS	-.000

RAILROAD COST FACTOR DATA

CF	1)	LOCOMOTIVE COST PER HOUR	12.1000
CF	2)	TWO-MAN CREW COST PER HOUR	18.2400
CF	3)	THREE-MAN CREW COST PER HOUR	25.3300
CF	4)	FOUR-MAN CREW COST PER HOUR	32.4200
CF	5)	FIVE-MAN CREW COST PER HOUR	39.3600
CF	6)	STATION EMPLOYEE ANNUAL COST	15469.0000
CF	7)	CABOOSE COST PER MILE	.0420
CF	8)	CABOOSE COST PER DAY	8.7000
CF	9)	REGULAR INDIRECT MAINTENANCE COST FACTOR	.3761
CF	10)	VARIABLE MAINT. TUNNELS AND SUBWAYS	0.0000
CF	11)	VARIABLE MAINT. BRIDGE-TRESTLE-CULVERT	.0451
CF	12)	VARIABLE MAINT. STATION + OFFICE BLDGS.	0.0000
CF	13)	VARIABLE MAINT. ROADWAY BUILDINGS	0.0000
CF	14)	VARIABLE MAINT. WHARVES AND DOCKS	.0088
CF	15)	VARIABLE MAINT. COAL/ORE WHARVES + DOCKS	0.0000
CF	16)	VARIABLE MAINT. TOFC/COFC TERMINALS	0.0000
CF	17)	VARIABLE MAINT. COMMUNICATIONS SYSTEMS	.0177
CF	18)	VARIABLE MAINT. SIGNALS AND INTERLOCKS	0.0000
CF	19)	VARIABLE MAINT. JOINT MAINTENANCE DR	.0314
CF	20)	VARIABLE MAINT. JOINT MAINTENANCE CR	-.2069
CF	21)	STEEL, GROSS SCRAP VALUE PER MILE	29912.5000
CF	22)	GOOD TIES, GROSS SCRAP VALUE EACH	5.0000
CF	23)	FAIR/POOR TIES, GROSS SCRAP VALUE EACH	0.0000
CF	24)	DISMANTLING AND REMOVAL COST PER MILE	9000.0000
CF	25)	RATE OF RETURN ON NET SCRAP VALUE	.0830
CF	26)	MAINTENANCE OF WAY SUPERVISION	150.0000
CF	27)	TRANSPORTATION SUPERVISION	.3879
CF	28)	MOW-CLERICAL SUPPT, ACCDNT	.0529
CF	29)	STATION CLERICAL	5.0892
CF	30)	UPGRADING, TURNOUTS	1033.6001
CF	31)	UPGRADING, GRADE CROSSINGS	5367.0508
CF	32)	UPGRADING, COST PER TIE INSERTED	32.3800
CF	33)	UPGRADING, COST PER MILE OF TRACK	33856.1016
CF	34)	GROSS TON-MILE UNIT COSTS	.0015
CF	35)	TERMINAL SWITCHING COST PER CARLOAD	20.9469
CF	36)	INTERCHANGE SWITCHING COST PER CAR	5.8824
CF	37)	IN-ROUTE SWITCHING COST PER CAR	3.3748
CF	38)	SYSTEM AVERAGE TRAIN SPEED	18.0147
CF	39)	TIES PER MILE	2816.0000
CF	40)	MAINTENANCE, SIDING AND YARD TRACKS	2939.0000
CF	41)	ACRES OF LAND PER TRACK MILE	7.2700
CF	42)	LAND VALUE PER ACRE	500.0000
CF	43)	TRANSP-CLERICAL SUPPT, ACCDNT	.5887
CF	44)	DUMMY	0.0000
CF	45)	DUMMY	0.0000
CF	46)	DUMMY	0.0000
CF	47)	DUMMY	0.0000
CF	48)	DUMMY	0.0000

FIGURE 7

and insurance are all designated as either zero or one. This scheme indicates whether the computerized analysis is to apply these costs or not -- a one indicates yes while a zero implies no. Property taxes on branch lines are always zero since neither the carrier nor any governmental agency provided the information at the time the system was being designed and developed. All remaining items on the line questionnaire data item list were taken directly from the carrier questionnaire. The "Railroad Cost Factor Data" consists of cost components developed on a railroad specific basis. A manual compiled by the Rail Services Planning Office (RSPO) entitled Cost Development Procedures Manual gives a detailed explanation of how each of the forty-three cost factors appearing in Figure 7 were devised. Basically, many of the procedures have been adopted, with varying degrees of modification, from costing techniques already in use by the Interstate Commerce Commission (ICC) and by the American Association of Railroads (AAR). Several of these procedures will be quickly evaluated when this report enters a discussion of the approach devised by the Department in an attempt to better estimate the various costs utilized within the USRA technique. For those who wish to review a complete presentation of these procedures, it is suggested that the reader obtain a copy of the above mentioned manual. The simplified flow chart of the analysis process employed by USRA (Figure 2) indicates that "other" inputs are used in the computation of the costs incurred by operating a certain rail segment. These inputs are cost factors developed by USRA staff to describe: loss and damage cost for net ton; car mile costs; car day cost; car tire weight; empty return ratio; circuity of local and interline traffic. Still, other inputs describe normalized maintenance expenses as a function of traffic density and the car-day/trip-frequency table reports the number of days a car will remain on branch as a function of service frequency and type of movement (see Figures 8-A and 8-B).

DIRECT MAINTENANCE CLASS/COST TABLE

0 MILLIONS OF GROSS TON MILES CLASS	.200	5.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	9999.000
0 DIRECT MAINTENANCE COSTS PER MILE	2601.	3079.	3471.	6035.	7463.	8906.	10279.	12399.	13393.	13606.

CAR–DAY/TRIP–FREQUENCY TABLE

0FREQ	LCL.SEGMENT	LCL.SYSTEM	INTERLINE
1	19.00	11.00	11.00
2	15.29	8.29	8.29
3	12.05	6.38	6.38
4	11.07	5.82	5.82
5	10.43	5.63	5.63
6	9.14	4.64	4.64
7	8.00	4.00	4.00

FIGURE 8-A

TABLE OF COMMODITY CLASS FACTORS FOR ALL LINES

0 STCC	LOSS DAMAGE $ / NET TON	CAR MILE COST $ / CAR MILE	CAR DAY COST $ / CAR DAY	CAR TARE WEIGHT	EMPTY RETURN RATIO	CIRCUITY, LOCAL RR TRAFFIC	CIRCUITY, INTER LINE TRAFFIC
1	.226900	.029000	2.890000	28.059000	1.760300	1.100390	1.163940
8	.185100	.071000	1.800000	28.400000	1.753500	1.105960	1.179480
9	.185100	.026000	3.160000	30.880000	1.677500	1.097070	1.150300
10	.011250	.025000	2.730000	27.100000	1.827900	1.100530	1.152976
11	.007080	.024000	2.720000	26.920000	1.838100	1.100220	1.150760
13	.185100	.160000	.067000	31.400000	2.143800	1.100100	1.199700
14	.006200	.028000	2.720000	27.500000	1.850200	1.100700	1.158890
19	.185100	.026000	3.250000	29.800000	1.652500	1.105660	1.166630
20	.454900	.040000	3.110000	31.500000	1.964500	1.100200	1.167040
21	3.177600	.028000	2.340000	32.000000	1.762800	1.107500	1.167760
22	.185100	.026000	3.320000	30.100000	1.642400	1.103140	1.160560
23	.185100	.028000	3.400000	33.850000	1569600	1.096560	1.166300
24	.082200	.028000	2.980000	30.480000	1.753000	1.100220	1.172050
25	2.353600	.025000	2.910000	27.890000	1.567500	1.108240	1.168210
26	.269800	.027000	3.360000	30.070000	1.662000	1.108080	1.168690
27	.185100	.024000	4.050000	32.870000	1.721000	1.085730	1.140620
28	.104800	.080000	2.020000	31.030000	1.932900	1.101220	1.185280
29	.039200	.128000	.850000	31.140000	2.051400	1.100116	1.191930
30	.987500	.026000	3.210000	28.650000	1.588500	1.092730	1.145030
31	.185100	.026000	3.310000	30.480000	1.618500	1.094610	1.154880
32	.086800	.031000	3.130000	32.370000	1.837000	1.101640	1.175890
33	.128900	.025000	3.070000	28.900000	1.837600	1.099450	1.154930
34	.462900	.025000	3.050000	29.520000	1.746800	1.100130	1.156710
35	1.424800	.024000	3.420000	30.780000	1.800800	1.090110	1.150310
36	1.905400	.028000	3.600000	32.500000	1.708000	1.103010	1.163330
37	1.174600	.021000	7.900000	35.600000	1.927100	1.096234	1.163070
38	.185100	.034000	3.890000	35.710000	1.720300	1.097390	1.161210
39	.185100	.026000	3.100000	30.300000	1.573500	1.103260	1.162490
40	.185100	.028000	2.730000	27.400000	1.787300	1.102780	1.157630
41	.185100	.026000	3.400000	31.700000	1.626000	1.096960	1.155060
42	.185100	.027000	3.800000	34.700000	1.645900	1.096180	1.153150
44	.984800	.027000	3.720000	34.700000	1.574700	1.087480	1.142120
45	.873700	.026000	3.900000	35.500000	1.598100	1.083920	1.137810
46	.185100	.028000	4.300000	40.290000	1.567000	1.073340	1.124760

FIGURE 8-B

With this brief discussion of the various computerized input files employed by USRA complete, we now enter a presentation of the "Intermediate Calculations" suggested in the generalized flow diagram. Figure 9 is a reproduction of the report obtained through the analysis of the above described Ann Arbor segment. Each of the ten major cost estimates shown in both the flow diagram and the "Evaluation Report" are, with a few exceptions, aggregates of several component costs which appear in this listing. The following discussion shall focus on which of these intermediate calculations are used in the final estimate of the major costs categories employed within the Evaluation Report. No attempt is made here to describe how each of the component costs are actually calculated but are presented merely to suggest which type of costs were considered important by USRA staff. The extended labels of each cost should prove sufficient to give the reader a general idea of the nature of each cost being accounted for.

-- On-Branch Operating Costs (ONBOC) --

ONBOC can be determined through a simple summation of the following intermediate calculations: LUHC, CHC, SEC, OBFCC, OBCAB and LOTSC. (See Figure 9 for specific values) This can be verified by actually adding the various component costs.

ONBOC = LUHC + CHC + SEC + OBFCC + OBCAB + LOTSC

357357 = 37752 + 79029 + 0 + 236411 + 4157 + 7

LUHC = Locomotive Unit Hour Cost
CHC = Crew Hour Cost
SEC = Station Employee Cost
OBFCC = On-Branch Freight Car Cost
OBCAB = On-Branch Caboose Cost
LOTSC = Local Traffic Switching Cost

-- Normal Branch Maintenance Costs (NBMC) --

NBMC = NBMM + NBMO

501843 = 384556 + 117286

NBMM = Branch Maintenance
NBMO = Siding/Yard Track Maintenance

LISTING OF INTERMEDIATE CALCULATIONS

1)	LUH	LOCOMOTIVE UNIT HOURS	3120.00000
2)	LUHC	LOCOMOTIVE UNIT HOURS COST	37752.00000
3)	CH	CREW HOURS	3120.00000
4)	CHC	CREW HOURS COST	79029.60000
5)	SEC	STATION EMPLOYEE COST	0.00000
6)	FREAK	FREQUENCY DECIMAL NUMBER	5.00000
7)	FQ	FREQUENCY WHOLE NUMBER	5.00000
8)	OBCMC	ON-BRANCH CAR MILE COSTS	19003.21080
9)	OBCDC	ON-BRANCH CAR DAY COSTS	217407.88100
10)	OBFCC	ON-BRANCH FREIGHT CAR COSTS	236411.0918
11)	CM	CABOOSE MILES	45136.00000
12)	CMC	CABOOSE MILE COSTS	1895.71200
13)	CBDAYS	CABOOSE DAYS	260.00000
14)	CBDC	CABOOSE DAYS COST	2262.00000
15)	OBCAB	ON-BRANCH CABOOSE COST	4157.71200
16)	LOTSC	LOCAL TRAFFIC SWITCHING	6.74960
17)	GT	GROSS TONS	788269.82400
18)	GTC	GROSS TONS CLASS MILLIONS	.78827
19)	DMC	DIRECT MAINTENANCE COSTS	267257.20000
20)	IMC	INDIRECT MAINTENANCE FACTOR	.43890
21)	NBMM	BRANCH MAINTENANCE	384556.38508
22)	NBMO	SIDING/YARD TRACK MAINT.	117286.37910
23)	TTM	TOTAL TRACK MILES	115.80000
24)	TSSV	GROSS SCRAP VALUE, STEEL	3463867.50000
25)	TSVGT	GROSS SCRAP VALUE, GOOD TIES	122214.40000
26)	TSVFPT	GROSS SCRAP VALUE F/P TIES	0.00000
27)	LSV	GROSS SALVAGE VALUE, LAND	315518.00000
28)	GSV	GROSS SCRAP VALUE	3901599.90000
29)	TDRC	DISMANTLE AND REMOVAL COSTS	1042200.00000
30)	NSV	NET SCRAP VALUE	2859399.90000
31)	RETNSV	RETURN ON NET SCRAP VALUE	237330.19170
32)	MOWS	M O W SUPERINTENDENCE	13020.00000
33)	TRANS	TRANS. SUPERINTENDENCE	1210.24800
34)	MCLAC	MOW CLERICAL SUPPORT, ACCIDE	14137.90588
35)	TCLAC	TRANSP CLERICAL SUPPORT, ACC	5510.23200
36)	OBCM	OFF-BRANCH CAR MILES	310233.25675
37)	OBTTM	OFF-BRANCH TARE TON MILES	8960410.29518
38)	OBNTM	OFF-BRANCH NET TONE MILES	8108308.22635
39)	OBGTM	OFF-BRANCH GROSS TON MILES	17068718.52153
40)	GTMC	GROSS TON MILE COSTS	25603.07778
41)	CIS	CARS RECEIVING IND. SWITCH	8.00000
42)	IS	INDUSTRY SWITCHING COSTS	167.57520
43)	CI	CARS INTERCHANGED	13361.00000
44)	ICSC	INTERCHANGE SWITCHING COSTS	78594.74640
45)	NIS	NUMBER INTERTRAIN SWITCHES	15853.00000
46)	ITSC	INTERTRAIN SWITCHING COSTS	53500.70440
47)	TSC	TOTAL SWITCHING COSTS	132263.02600
48)	LDC	LOSS AND DAMAGE COST	145648.11976
49)	ICSD	INTERCHANGE SWITCHING DAYS	6680.35058
50)	RTD	RUNNING TIME DAYS	717.54654
51)	ITSD	INTERTRAIN SWITCHING DAYS	8113.58314
52)	OBSD	OTR OFF-BRANCH SWITCHING DAYS	32.00000
53)	OBCD	OFF-BRANCH CAR DAYS	15543.48026
54)	OFBCDC	OFF-BRANCH CAR DAY COSTS	77125.06616
55)	OFBCMC	OFF-BRANCH CAR MILE COSTS	11466.32543
56)	OFBFCC	OFF-BRANCH FRT CAR COSTS	88591.39159
57)	SCO	STATION CLERICAL	37395.44160
58)	FRA1	UPGRADE TO TRACK CLASS I	0.00000
59)	FRA2	UPGRADE TO TRACK CLASS II	1701[illegible] [illegible].57371
60)	DELTA	FRA2 LESS FRA1	170183.57371

FIGURE 9

-- Return On-Branch Salvage Value (ROBSV) --

ROBSV = RETNSV

237330 = 237330

RETNSV = Return on Net Scrap Value

-- Branch Overhead Costs (BOC) --

BOC + MOWS + TRANS + MCLAC + TCLAC

33878 = 13020 + 1210 + 14137 + 5510

MOWS = M.O.W. Superintendence
TRANS = Transportation Superintendence
TCLAC = Transportation Clerical Support, Accident
MCLAC = M.O.W. Clerical Support, Accident

-- Property Taxes on Branch --

This estimate differs from others since it uses line questionnaire data as a basis for its calculation exclusively. Although a calculation is attempted, line ten within the Evaluation Report will always be set to zero since no line -- specific property tax information -- exists.

-- Off-Branch Operating Costs (OFBOC) --

OFBOC = GTMC + TSC + LDC + OFBFCC + SCO

429501 = 25603 + 132263 + 145648 + 88591 + 37395

GTMC = Gross Ton Mile Costs
TSC = Total Switching Costs
LDC = Loss and Damage Costs
OFBFCC = Off-Branch Freight Car Costs
SCO = Station Clerical

The analysis technique designed by USRA ignores the costs and revenues associated with bridge traffic. Bridge traffic is defined as that traffic which uses a rail segment as a means of completing its trip but has neither its origin nor its termination along that segment. The computerized routine will always set line fourteen within the Evaluation Report to zero.

REHAB1 = FRA1

0 = 0

FRA1 = Upgrade to Track Class I

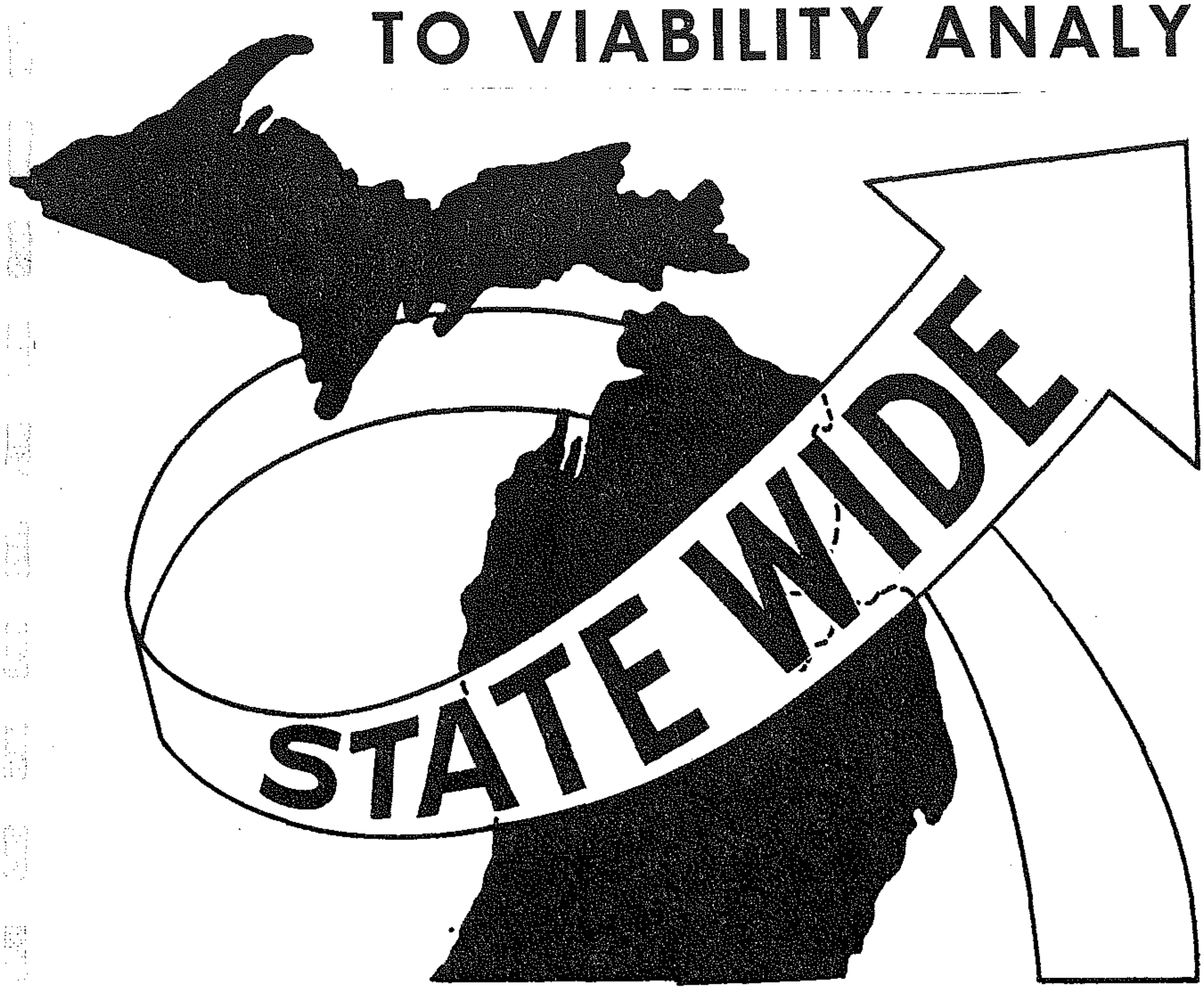
REHAB2 = FRA2

170184 = 170184

FRA2 = Upgrade to Track Class II

Once the nine totals have been estimated for the cost categories described above using the procedures just reviewed, they are employed in the Evaluation Report to conduct a series of tests. The squential subtraction of each cost total from the revenue estimate yields "a test" in which the USRA analyst was able to determine the economic viability of a rail segment. The analyst was, through this testing procedure, able to isolate which cost categories were contributing most heavily to the profit or loss of the line.

A GENERAL DISCUSSION - THE MICHIGAN APPROACH TO VIABILITY ANALYSIS



A GENERAL DISCUSSION - THE MICHIGAN APPROACH TO VIABILITY ANALYSIS

The USRA estimates (using their version of Viability Analysis) that the Ann Arbor Railroad lost in 1973 approximately $638,310 by operating its rail line from Dundee to Owosso. Many people familiar with railroad economics believe this estimate has been inflated through the inclusion of certain costs not actually applicable to the branch line situation. The designers of the USRA model have equated variable costs with avoidable costs. From their point of view, when the traffic which was generated and/or attracted to an abandoned segment is shifted to main line segments, as they assume it will be, it will cause the railroad industry to become more efficient since fewer trains and trackage will be needed to move the same amount of traffic. If only a single branch line were abandoned, its traffic would have an insignificant impact on the operation of trains in the area. But as more and more lines are abandoned, the variable costs associated with the operation of those lines can be avoided to a large extent because a single train can now be used to pull, for example, one hundred cars where prior to branch line abandonment, perhaps ten trains were used. This assumes, of course, that these one hundred cars can be collected at the same time of year and are headed in the same direction. This, as pointed out above, seems very unlikely to occur. Therefore, all those costs included by the USRA as being avoidable with abandonment should be modified to more accurately reflect the situation as this Department perceives it. The following is a discussion of those costs which have been lowered to reflect the fact that many costs, as included by the USRA, are actually unavoidable, i.e., they will be incurred by the railroad company regardless of the operation of a branch line or not. Since these costs are unavoidable, they should not be allocated to any specific type of rail segment -- light-density branch lines included.

-- On-Branch Operating Costs -- *

As has been shown in the above presented formula, this cost category has five components: 1) Locomotive, 2) Freight-train car, 3) Caboose, 4) Crew-Related and 5) Station-Related Costs. Each category will be presented in turn.

1) LOCOMOTIVE

The USRA charges locomotive-related cost at a rate of $16.39 per locomotive unit-hour which were advanced as variable on a systemwide basis. They were applied to branch line locomotive operation by apportionment. Because of this, their avoidability as to specific light density lines is questioned. While the elimination of one light density line may save locomotive miles or hours, it is highly unlikely that it would save an amount equivalent to that generated by a complete unit. A locomotive can only be disposed of in toto - i.e., since it is an indivisible piece of equipment, there is no potential savings of a locomotive; the disposition is complete or not at all. Abandoning a line will save hours or miles of locomotive operation and therefore their associated costs, but this will certainly not include those costs associated with the complete unit. Locomotive-related costs avoided by reduction in miles or hours operated are, then, rightly charged to branch lines. USRA has overstated such costs, however, as a result of using system average unit costs. Light-density branch lines are generally severed by low-horsepower locomotives which pull fewer loads and empties, providing infrequent service over short distances as compared with system operations. The nature of the work performed on light-density lines is similar to that done in yards. Therefore, the expenses per unit-hour should be associated with yard locomotive expenses per unit-hour. When this fact is realized and adjustments are made to the total cost of locomotive operation on branch lines, the $16.39 unit-cost utilized by USRA is significantly reduced.

*The unit cost magnitudes used for illustration are, in all cases, those from the Penn Central Railroad.

For a discussion of how the various sub-costs were reduced in response to this shift in economic perspective, one should consult the Task 3 Report prepared by R. L. Banks and Associates in a new estimate of locomotive unit-costs - $9.93. It is this figure that will be used in the future execution of the Michigan version of the USRA model.

2) FREIGHT-TRAIN CAR COSTS

While the freight train car costs developed on a mileage basis for "typical" cars by commodity type seem reasonable, it is hoped that in future applications of the Michigan Model these costs can be refined by using a seven-digit STC code rather than the two-digit system used in the original USRA model.

3) CABOOSE COSTS

This Department has removed the $8.70 per caboose-day that was used by USRA in their calculation of on-branch operating costs on the basis that discontinuance of service on a specific branch line is not likely to aid a rail company in the avoidance of such costs. As in the case of locomotives, a caboose is indivisible and associated costs can be avoided only when it can be shown that traffic on a branch line is of such a magnitude that it requires the services of a caboose in and of itself. This will not normally occur in a branch line situation.

4) CREW COSTS

It is unreasonable to assume, as the USRA methodology does, that the cost of a train crew can be saved with the abandonment of a line when the crew works the line for only a few hours per day or week as part of its regular assignment. Where such a savings is demonstrated, these costs are properly associated with the line's operation and accounted for in the "Evaluation Report". USRA also used an overtime wage scale in situations not deemed appropriate. Straight-time wages are generally charged to branch line operations, but when it is found that a crew serving a branch regularly works overtime which could be eliminated or reduced by discontinuance of service on the branch, even though the crew continues to work elsewhere, the branch crew time is charged, in the Michigan methodology, at overtime rates.

5) STATION EMPLOYEE COSTS

The costs charged by USRA to branch lines as a result of manning rail stations are system averages. The Michigan methodology will, in the future, incorporate a more realistic "direct" cost of the employees involved.

-- Normal Branch Maintenance Cost --

This cost category is comprised of two component types - direct and indirect maintenance costs. While USRA's calculation of direct normal maintenance seems appropriate, their charges to indirect branch maintenance are incorrect. The following is a list of those costs which cannot be avoided with branch line abandonment as USRA contends, unless they can solely be related to a specific line.

1. MISECELLANEOUS STRUCTURES
2. ROADWAY MACHINES
3. DISMANTLING RETRIEVAL EQUIPMENT
4. SMALL TOOLS AND SUPPLIES
5. RIGHT-OF-WAY EXPENSE
6. PUBLIC IMPROVEMENT MAINTENANCE
7. REMOVING SNOW, ICE AND SAND

Since these costs are unavoidable, they are excluded from the Michigan methodology. Several studies have shown that when the non-avoidable nature of these charges are taken into account, most branch line maintenance costs have been overstated by approximately 20 percent.

-- Return on Net Salvage Value --

The USRA has assumed that each bankrupt rail company forgoes 8.3% of the salvage value of a rail line in the form of an opportunity cost by keeping the line in service. There is no debate with either the logic of the opportunity cost or its assigned interest rate. The Michigan accounting approach differs with that used by USRA in that it does not value the steel, ties, and land associated with each line as highly as did USRA. Since most track in Michigan is less than the 100-pound weight assumed by the association and because it considerably over and understated the value of land per acre along various Michigan lines, the net salvage value per mile of $24,562 is not satisfactory. The long term rail planning process will gather line-specific data concerning both the value of land per acre and rail weight per mile.

-- Branch Overhead Costs --

Present statistics have required the USRA to analyze each branch line individually. While it is true that in the aggregate, the discontinuance of branch line services or several lines may impact system-level overhead costs, it is not correct to assign such savings to specific branch lines because they are not generated as a result of operating any particular line. They are incurred simply as a result of conducting business. It is recognized that overhead costs may be saved through discontinuance of services in some cases - e.g., when the level of traffic on a line reach certain magnitudes, the Michigan methodology is based on this reasoning.

-- Property Taxes --

Currently, line specific property tax data does not exist for Michigan branch lines. This information, as well as other applicable tax data, will be collected and utilized in future runs of the analysis.

-- Off-Branch Operating Costs --

The USRA has assumed that branch line discontinuance will, in the aggregate, permit the savings of many road-train crews and similar train-related (variable) cost categories. This assumption may be true; but, in the present context, where the statute has required the assessment of avoidable cost on a line-specific basis, it is irrelevant. The Michigan method is based on the view that abandonment of no single marginal light density line would, by itself, reduce the number of trains on the main-line system and therefore would not significantly impact the carrier's overhead costs. In addition, USRA charged loss and damage costs to branch lines on all interline traffic when, in fact, these costs are shared between the involved roads. The Michigan methodology makes an appropriate adjustment to overhead costs by reducing loss and damage costs on interline traffic by one half.

-- Branch Overhead Traffic --

The USRA has cited the extreme difficulty of dealing with overhead (bridge) traffic in an efficient manner as reason for excluding it from its light density line evaluation. Such exclusion understates the importance of certain branch lines to the profitable operation of the system. USRA, in devising its "system" plan, failed to take into account, system implications of proposed network alterations. It assumed that branch line traffic would continue to move albeit via a different routing. No attempt was made to monitor the impact that this traffic rerouting would have upon the costs and revenues of those branch and main lines which would be required to carry the additional traffic burden. Perhaps one of the best means of approaching this bridge traffic problem would be through the use of the "Full Allocation" method mentioned in the introduction in conjunction with the standard transportation procedures of trip table construction, network building and traffic assignment. Given that the use of such procedures is beyond the short-range capabilities of this Department, the USRA methodology might be made more realistic by estimating that portion of on branch expenses which are not avoided with abandonment. From this perspective, then, the expense of moving overhead traffic on the branch should be deducted from the avoidable expense charged to the branch.

Where a reasonable determination of the new routing of overhead traffic can be made, any greater (or lesser) mileage, as compared with movement over the branch, should be taken into account. If the new routing is longer, the added expense would serve further to reduce the expenses to be avoided by branch discontinuance.

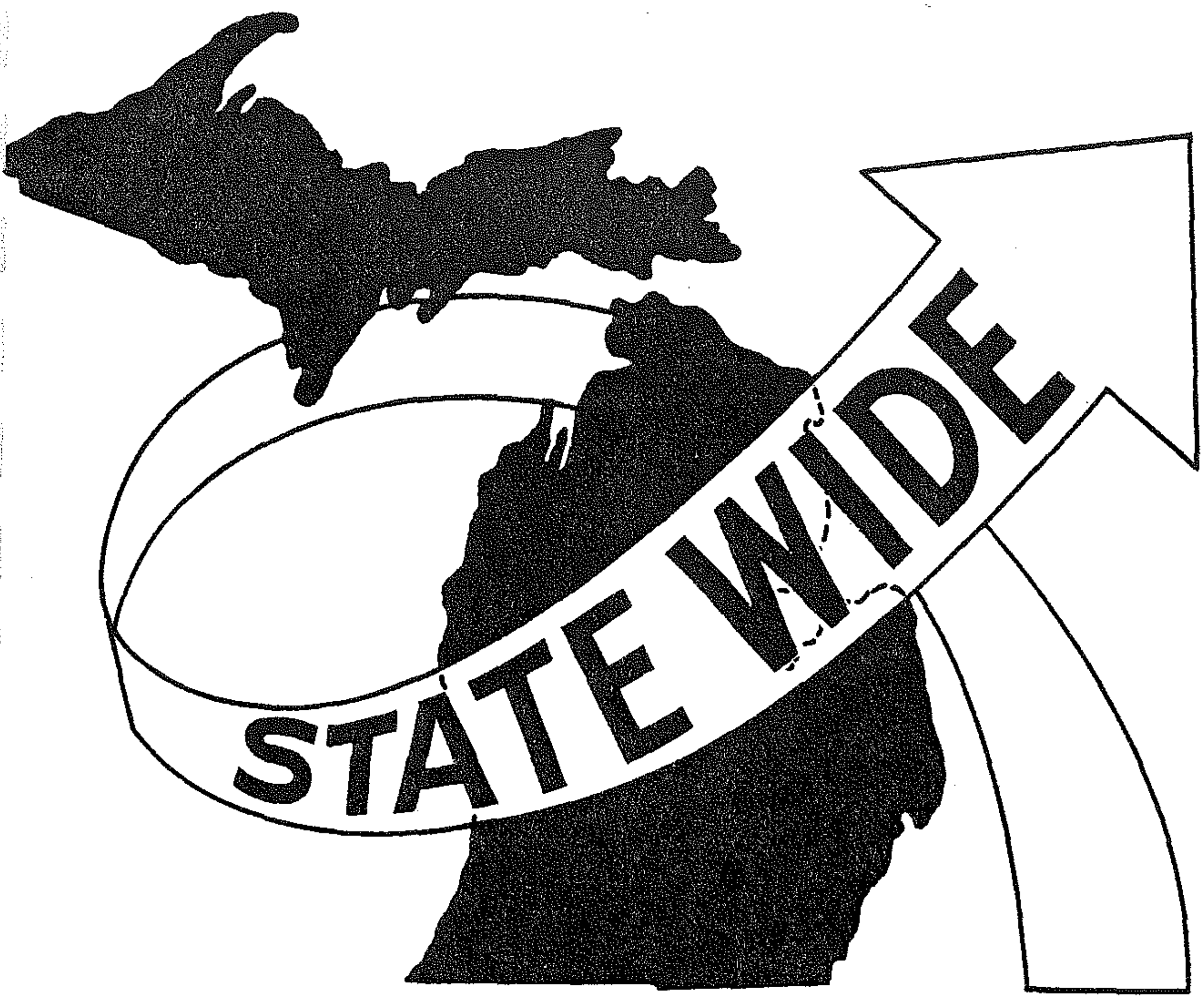
-- Rehabilitation Cost --

The USRA has determined the expense of rehabilitating branch lines by applying cost factors on a segment-by-segment basis to the number of ties needing replacement and the number of grade crossings and turnouts needing repair. The cost factors utilized were:

COST PER TIE INSERTED	$32.38
COST PER MILE OF RAIL INSTALLED	$33,856.10
COST PER TURNOUT	$1,033.60
COST PER GRADE CROSSING	$5,367.05

There has been an extended debate over whether these cost factors and the replacement estimates are valid. For example, USRA found need to repair an extremely large number of grade crossings. There is a real question as to whether repair of all of these crossings is needed to bring the line up to FRA Class I. In addition, turnouts have been, without any reference to reality, estimated upon the basis of a set number per mile. A special study was conducted by this Department to calculate actual replacement needs at costs which reflect the line specific situation. It is the results of this study that will be used in any future use of the Michigan analysis.

THE USRA COMPUTER PROGRAM



THE USRA COMPUTER PROGRAM

It was mentioned in the introduction to this report that subsequent to a generalized discussion of both the USRA and Michigan versions of Viability Analysis, a more technical presentation of the analysis would be undertaken. This section begins that presentation. Those not interested in the internal logic of the program should skip to the next section where an extensive comparison of the differences in the two techniques is made on a single Penn Central study segment.

The following pages include a full listing of the "Viability Analysis" computer program as received from USRA. The program (see Figure 10) originally written in Fortran IV for an IBM 370 and compiled via the FORTGCLG compiler, has been modified to run on the CDC 6600 SCOPE batch operating system. While several modifications have been made to allow more efficient program execution, the majority of changes to the IBM version have been made simply to permit the program's compilation on the CDC system by means of the 6600 "Fortran Extended" compiler. Those conversant with the Fortran programming language should be able to detect which portions of the program are used in computing the output data which have been printed in both the "Table of Intermediate Calculations" and the "Basic Branch Line Evaluation Report". This process should be facilitated by the numerous "comment" statements which have been inserted for purposes of identification and description. Additional diciphering of the program has been provided with the inclusion of a list of "Variable Definitions" (Figure 11) and a "Flow Diagram" (Figure 12). The variable definitions list indicates a variable's name as used within the program, the number of elements specific to each variable (e.g., IPTSW(9)), a short description of the variable, its type (i.e., I = Integer, L = Logical, etc.) and its function (i.e., Con = Control, In = Input, Out = Output and Int = Intermediate).

Once the reader is familiar with this list, he may begin to follow the flow of the program's logic as presented in the diagram. Although certain questions concerning the program's operation may remain after reviewing the material in these three figures, one should have a fairly good "feel" for the overall manipulation of data within the program. The more important input files have already been identified and examples of each presented above. Several other input files are not actually used in the calculation of the intermediate costs but rather are simply "header" data which are used in the labeling of the printed output (see the variable definition list). Familiarity with the control variables should prove useful in a more complete comprehension of the flow diagram. The meaning and use of the Intermediate calculations as shown in the definition list should, by now, be clear. Note: It should be pointed out that those variables which relate to the program statements which begin at line 740 (follow the numbering scheme at the far left of the program listing) are not of importance to us here. They provide the analyst with a series of statistical summaries descriptive of a line's operating characteristics. No mention of these tables has been made before and none shall be again. For this reason, one need not concern himself with the last four pages of both the list of variable definitions and the program flow chart, unless, of course, he wishes to know the nature of these summary tables. A study of the initial portions of all three figures (i.e., up until the variable TESTLS is first employed) should prove sufficient to give one considerable knowledge of the way in which the program determines those costs printed in each "Branch Line Evaluation Report".

Perhaps a better means of helping one to comprehend the viability program would have been to trace how each of the various input files are utilized within the analysis on a statement by statement basis. The mere size of the input files and the complexity of the program in terms of the number of calculations made has, however, prevented the adoption of this approach. Several manuals are already in existence and could be consulted if one desires to gain a deeper understanding of the more technical aspects of the program's operation.*

*Viability Analysis Programmer's Manual, United States Railway Association, Washington, D.C. 20595

*Cost Development Procedures Manual
Rail Services Planning Office
Washington, D.C. 20423

FIGURE 10

```
      PROGRAM MCHRL(INPUT,OUTPUT,TAPE1,TAPE2,TAPE4,TAPE9,TAPE10,          PLUS3     1
     1TAPE14,TAPE16,TAPE17,TAPE20,TAPE13=OUTPUT)                           PLUS3     2
C     DECLARE VARIABLES AS INTEGER OR REAL AND SET ARRAY SIZE              USRA      4
      REAL LOCAL(50,5),CONRL(50,5),INTER(50,5),STCC(50,7),TCD(50),         USRA      5
     1SEG(48),TASK(19),CF(48),CD(7,3),DRM(2,10),STATE(3),SEGMNT,           USRA      6
     * MCLAC,ICSDI,ITSDI,                                                  USRA      7
     2LUHC,LUH,IMC,NBMM,NBMO,NSV,IS,NIS,ICSC,ITSC,LDC,CONINT(50,5),        USRA      8
     3ICSD,ITSD,LUMC,TOTAL(50,5)                                           USRA      9
      INTEGER AAR,FQ,RR,R,TAPN1,TAPN2,OUT,ERR,ERRORS,RNAME(10),            USRA     10
     1CFH(48,10),TH(19,15),SEGROW(48,10),NAME(15),PAGE,STUBS(72,9),        USRA     11
     2C1AAR,C2AAR,CCFI,ERR1,ERR2,ERR3,ERR4                                 USRA     12
        INTEGER   T1,ACTUAL,POSITN,MIN,WHERE,WHLIST(9),T6,TAPN4            USRA     13
       LOGICAL ENDF                                                        PLUS3     3
           INTEGER   T2(500),T5(500)                                       USRA     14
            DIMENSION IFTRT(9,10)                                          USRA     15
          INTEGER OUTB,OUTC                                                USRA     16
           REAL ZIP(60)                                                    USRA     17
         REAL T3(500),T4(500)                                              USRA     18
         LOGICAL WHAT, KREWT,ITRYPS,IFGOOD                                 USRA     19
       LOGICAL IFI,IFII,IFIII,IFIV,IFV,IFVI,IFVII,IFVIII,IFVIIB,IFBAD      USRA     20
        REAL OUTLST(72),MOWS                                               USRA     21
       COMMON/OUTLST/ LUH, LUHC, CH, CHC, SEC, FREAK, RFQ, OBCMC, OBCDCV   USRA     22
     1 OBFCC, CM, CMC, CBDAYS, CBDC, OBCAB,LOTSC,GT, GTC, DMC, IMC,        USRA     23
     2 NBMM, NBMO, TTM, TSSV, TSVGT, TSVFPT, LSV, GSV, TDRC, NSV,          USRA     24
     3 RETNSV, MOWS, TRANS, MCLAC, TCLAC,OBCM, OBTTM, OBNTM, OBGTM,        USRA     25
     4 GTMC, CIS, IS, CI, ICSC, NIS, ITSC, TSC, LDC, ICSD,                 USRA     26
     5 RTD, ITSD, OBSD, OBCD, OFBCDC,OFBCMC, OFBFCC, SCO,                  USRA     27
     6 FRA1, FRA2, DELTA                                                   USRA     28
        REAL TESTLS(18),TESTK(14),LSV,LOTSC                                USRA     29
        DIMENSION SNAM(500,15), RQRI(500,3), DOUT(30)                      USRA     30
        INTEGER SNAM                                                       USRA     31
          DIMENSION ITALY(9,2)                                             USRA     32
C                                                                          USRA     33
           REAL OUTLT(500,16)                                              USRA     34
          LOGICAL IPTSW(9)                                                 USRA     35
          INTEGER FOUND                                                    USRA     36
          DIMENSION IPX(9)                                                 USRA     37
          DIMENSION IN(2)                                                  PLUS4     1
         EQUIVALENCE (ZIP(1),LUH)                                          USRA     38
      DATA ENDF/.FALSE./                                                   PLUS3     4
          DATA MINE/-1/                                                    USRA     39
      DATA IFTRT/4HI--O,4HII--,4HIII-,4HIV--,4HV--P,4HVI--,4HVII-,         PLUS2     1
     1  2*4HVIII,4HN-BR,4HNORM,4H RET,4HBRAN,4HROPE,4HOFF-,4H OVE,         USRA     41
     2  2*4H-A   ,4HANCH,4HAL B,4HURN ,4HCH O,4HRTY ,4HBRAN,4HRHEA,        USRA     42
     3  2*4HIMPR,4H OPE,4HRANC,4HON B,4HVERH,4HTAXE,4HCH O,4HD (B,         USRA     43
     4  2*4HOVIN,4HRATI,4HH MA,4HRANC,4HEAD ,4HS ON,4HPERA,4HRIDG,         USRA     44
     5  2*4HG TR,4HNG C,4HINTE,4HH SA,4HCOST,4H BRA,4HTING,4HE) T,         USRA     45
     6  2*4HACK ,4HOSTS,4HNANC,4HLVAG,4HS    ,4HNCH ,4H COS,4HRAFF,        USRA     46
     7  2*4HTO F,4H    ,4HE CO,4HE    ,2*4H    ,4HTS  ,4HIC  ,2*4HRA C,    USRA     47
     8  4H    ,4HSTS ,5*4H    ,2*4HLASS,7*4H    ,2*4H I  /                 PLUS2     2
           DATA TAPN4/4/                                                   USRA     49
          DATA OUTB/9/,OUTC/10/                                            USRA     50
      DATA ITALY/4HI    ,4HII  ,4HIII ,4HIV  ,4HV    ,                     PLUS      3
     1  4HVI  ,4HVII ,2*4HVIII,7*4H    ,4H-A  ,4H-B  /                     PLUS2     3
        DATA WHLIST/3,5,7,9,11,13,15,17,19/                                USRA     53
```

```
            DATA IPX/3,5,7,9,11,13,15,17,19/                              USRA    54
             DO 3333 I=1,9                                                USRA    55
 3333       IPTSW(I)=.TRUE.                                               USRA    56
 C                                                                        USRA    57
             LN=100                                                       USRA    58
            FOUND=0                                                       USRA    59
 C                                                                        USRA    60
          LM=100                                                          USRA    61
          WHAT=.TRUE.                                                     PLUS5    1
         IFI=.TRUE.                                                       USRA    64
         IFII=.TRUE.                                                      USRA    65
         IFIII=.TRUE.                                                     USRA    66
         IFIV=.TRUE.                                                      USRA    67
         IFV=.TRUE.                                                       USRA    68
         IFVI=.TRUE.                                                      USRA    69
         IFVII=.TRUE.                                                     USRA    70
         IFVIII=.TRUE.                                                    USRA    71
         IFVIIb=.TRUE.                                                    USRA    72
            IFBAD=.FALSE.                                                 USRA    73
 C      ASSIGN NUMBERS TO LOGICAL TAPE UNITS - TAPE1 = TRAFFIC TAPE, TAPE2 USRA    74
 C      = CARD DATA, OUT = OUTPUT DATA, ERR = ERROR MESSAGES              USRA    75
        TAPN1=1                                                           PLUS3    5
        TAPN2=2                                                           PLUS3    6
        OUT=13                                                            USRA    78
        ERR=14                                                            USRA    79
        ERRORS=0                                                          USRA    80
 C                                                                        USRA    81
 C           ZERO OUT OUTPUT LIST                                         USRA    82
             DO 616 I=1,60                                                USRA    83
 616         ZIP(I)=0.0                                                   USRA    84
 C  INITIALIZE OUTPUT SEQUENCE                                            USRA    85
 C                                                                        USRA    86
          WRITE(14,2111)                                                  USRA    87
          WRITE(10,2111)                                                  USRA    88
          WRITE(20,2111)                                                  USRA    89
            WRITE(9,2111)                                                 USRA    90
          WRITE(13,2111)                                                  USRA    91
 2111     FORMAT(1H ,5X,5H     )                                          USRA    92
 C                                                                        USRA    93
            LINES=0                                                       USRA    94
 C                                                                        USRA    95
 C - - READ LOCAL TO SEGMENT, LOCAL TO SYSTEM, AND INTERLINE CAR DAYS      USRA    96
 C             FOR 1 TO 7 DAY FREQUENCY OF SERVICE                        USRA    97
        READ(TAPN2,80)                                                    PLUS3    7
        READ(TAPN2,80) ((CD(I,J),J=1,3),I=1,7)                            USRA    98
 C - - READ DIRECT MAINTENANCE COST/MILE FOR 10 FREIGHT CLASSES           USRA    99
        READ(TAPN2,81) ((DRM(I,J),J=1,10),I=1,2)                          USRA   100
 C      READ RAILROAD NUMBER AND NAME                                     USRA   101
        READ(TAPN2,105) RR,(RNAME(I),I=1,10)                              USRA   102
 C      READ COST FACTOR HEADINGS                                         USRA   103
        READ(TAPN2,106) ((CFH(I,J),J=1,10),I=1,48)                        USRA   104
 C      READ 48 COST FACTORS                                              USRA   105
          IF(WHAT) WRITE(14,5003)                                         USRA   106
        READ(TAPN2,1021) (CF(I),I=1,8)                                    USRA   107
          IF(WHAT)WRITE(14,5004)(CF(I),I=1,8)                             USRA   108
```

```
      READ(TAPN2,1022) (CF(I),I=9,16)                                USRA  109
        IF (WHAT) WRITE(14,5004)(CF(I),I=9,16)                       USRA  110
      READ(TAPN2,1023) (CF(I),I=17,24)                               USRA  111
        IF (WHAT)WRITE(14,5004)(CF(I),I=17,24)                       USRA  112
      READ(TAPN2,1022) (CF(I),I=25,32)                               USRA  113
        IF(WHAT)WRITE(14,5004)(CF(I),I=25,32)                        USRA  114
      READ(TAPN2,1022) (CF(I),I=33,40)                               USRA  115
        IF(WHAT)WRITE(14,5004)(CF(I),I=33,40)                        USRA  116
      READ(TAPN2,1022) (CF(I),I=41,48)                               USRA  117
        IF(WHAT)WRITE(14,5004)(CF(I),I=41,48)                        USRA  118
 5003 FORMAT(1H1,*    COST FACTORS *)                                PLUS    4
5004     FORMAT(/8(1X,F13.6)/)                                       USRA  120
C     READ COST AND WEIGHT DATA FOR 50 STCC CLASSIFICATIONS          USRA  121
      DO 808 I=1,50                                                  USRA  122
      READ(TAPN2,101)  (STCC(I,J),J=1,7)                             USRA  123
  808 CONTINUE                                                       USRA  124
C     READ TASK HEADINGS                                             USRA  125
      DO 809 I=1,19                                                  USRA  126
      READ(TAPN2,107)  (TH(I,J),J=1,15)                              USRA  127
  809 CONTINUE                                                       USRA  128
C     READ SEGMENT DATA HEADINGS                                     USRA  129
      DO 810 I=1,48                                                  USRA  130
      READ(TAPN2,108)  (SEGROW(I,J),J=1,10)                          USRA  131
  810 CONTINUE                                                       USRA  132
C--READ HEADINGS FOR INTERMEDIATE CALCULATIONS                        USRA  133
      DO 851 I=1,72                                                  USRA  134
      READ(TAPN2,109) (STUBS(I,J),J=1,9)                             USRA  135
  851 CONTINUE                                                       USRA  136
C--BEFORE LINE-BY-LINE ANALYSIS DO-LOOP, PRINT OUT:                  USRA  137
C                                                                    USRA  138
C--      STCC ARRAY OF COMMODITY CLASS FACTORS                       USRA  139
C--      DRM ARRAY OF DIRECT MAINTENANCE COST CLASSES/FACTORS        USRA  140
C--      CD ARRAY OF CAR DAY COSTS BY FREQUENCY/TYE SERVICE          USRA  141
      PAGE=1                                                         USRA  142
      WRITE(14,90) PAGE                                              USRA  143
      WRITE(14,91)                                                   USRA  144
      DO 321 K=1,50                                                  USRA  145
      IF(STCC(K,1).NE.0.00) WRITE(14,92) K,(STCC(K,J),J=1,7)         USRA  146
  321 CONTINUE                                                       USRA  147
C--NOW LIST ON THE SAME PAGE OF CONSTANTS THE DRM ARRAY OF GROSS     USRA  148
C--TONNAGE CLASSES AND THEIR CORRESPONDING DIRECT MAINTENANCE COSTS  USRA  149
C--PER MILE                                                          USRA  150
      PAGE=PAGE+1                                                    PLUS3   8
      WRITE(14,93) PAGE                                              USRA  152
      WRITE(14,94)(DRM(1,J),J=1,10)                                  USRA  153
      WRITE(14,95) (DRM(2,J),J=1,10)                                 USRA  154
C--NOW LIST CAR-DAY/TRIP-FREQUENCY TABLE                             USRA  155
      WRITE(14,96)                                                   USRA  156
      WRITE(14,97)                                                   USRA  157
      DO 801 I=1,7                                                   USRA  158
      WRITE(14,98) I,(CD(I,J),J=1,3)                                 USRA  159
  801 CONTINUE                                                       USRA  160
      WRITE (14,2112)                                                USRA  161
      READ(16,1044)                                                  PLUS3   9
        DO 305 NN=1,500                                              USRA  162
```

```
      READ(16,1044)ARR,SEGMNT,(NAME(J),J=1,15),                        PLUS      5
     #    (STATE(J),J=1,3)                                             USRA    164
      IF(EOF(16))306,802                                               PLUS      6
  802 CONTINUE                                                         PLUS      7
          T5(NN)=NN                                                    USRA    165
305       T4(NN)=SEGMNT                                                USRA    166
306         T6=NN-1                                                    USRA    167
             REWIND 16                                                 USRA    168
             POSINN=1                                                  USRA    169
             IACT=1                                                    USRA    170
        IF(WHAT)WRITE(14,5001)T6                                       USRA    171
        IF(WHAT)WRITE(14,5002)(T4(NN),NN=1,T6)                         USRA    172
C                                                                      USRA    173
         DO 9000 NN=1,1000                                             USRA    174
      READ(TAPN1,300)SEGMNT                                            PLUS5     2
  300 FORMAT(10X,A4)                                                   PLUS3    11
      IF(EOF(1))10001,308                                              USRA    179
  308 CONTINUE                                                         USRA    180
            T2(NN)=NN                                                  USRA    181
9000      T3(NN)=SEGMNT                                                USRA    182
10001       T1 = NN-1                                                  USRA    183
          IF(WHAT)WRITE(14,5001) T1                                    USRA    184
5001      FORMAT(1H1,5X,I6)                                            USRA    185
5002      FORMAT(/25(1X,A4))                                           USRA    186
            IF(WHAT)WRITE(14,5002)(T3(NN),NN=1,T1)                     USRA    187
C     T1 IS THE NUMBER OF SEGMENT RECORDS ON TAPE1...                  USRA    188
C     T2(I) WHERE I IS 1-500 AND WILL BE A POSITIONAL POINTER          USRA    189
C           TO WHICH RECORD ON TAPE1 THAT A SEGMENT CODE OF            USRA    190
C           T3(I) MAY BE FOUND....                                     USRA    191
            IF(WHAT)GO TO 777                                          USRA    192
       REWIND TAPN1                                                    USRA    193
       ACTUAL = 1                                                      USRA    194
       POSITN =1                                                       USRA    195
      NBTR=0                                                           USRA    196
      NBSR=0                                                           USRA    197
      IFLAG=0                                                          USRA    198
C--BEGIN LINE-BY-LINE FEASIBILITY ANALYSIS CALCULATIONS                USRA    199
C    INITIALIZE ERROR FLAGS - MTD= MISSING TAPE DATA+                  USRA    200
C    MSD= MISSING SEGMENT DATA+ ERR1= SEGMENT NUMBER MISMATCH+         USRA    201
C     ERR2= CARD SEQUENCE ERROR+ ERR3= RAILROAD CODE MISMATCH+         USRA    202
C     ERR4= STATE CODE MISMATCH                                        USRA    203
      READ(TAPN4,103)                                                  PLUS5     3
  590 MTD=0                                                            USRA    204
      MSD=0                                                            USRA    205
      ERR1=0                                                           USRA    206
      ERR2=0                                                           USRA    207
      ERR3=0                                                           USRA    208
      ERR4=0                                                           USRA    209
            IFLAG = 0                                                  USRA    210
C     READ LINE SEGMENT CHARACTERISTICS DATA                           USRA    211
  600 READ(TAPN4,103)(SEG(J),J=1,48)                                   PLUS      9
      IF(EOF(4))700,601                                                USRA    213
  601 CONTINUE                                                         USRA    214
      DOUT(2) = SEG(7)                                                 USRA    215
      DOUT(3) = SEG(12)                                                USRA    216
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          DOUT(4) = SEG(14)                                               USRA    217
           IF (SEG(1) .NE. 9.0 .OR. SEG(36) .NE. 9.0) GO TO 611          USRA    218
           WRITE(ERR,167) SEG(6)                                          USRA    219
           NBSR=NBSR+1                                                    PLUS3    13
           GO TO 612                                                      USRA    221
    611    CONTINUE                                                       USRA    222
           IF (SEG(1) .EQ. 1.0 .AND. SEG(36) .EQ. 2.0) GO TO 612         USRA    223
           WRITE(ERR,160) SEG(6)                                          USRA    224
           ERRORS=ERRORS+1                                                PLUS3    14
               BACKSPACE TAPN4                                            USRA    226
           GO TO 590                                                      USRA    227
    612    CONTINUE                                                       USRA    228
             LINES=LINES+1                                                PLUS3    15
           DO 10100 I=1,T1                                                USRA    230
           IF(T3(I).EQ.SEG(6))  GO TO 10200                               USRA    231
    10100   CONTINUE                                                      USRA    232
             WRITE(ERR,10101) SEG(6)                                      USRA    233
    10101 FORMAT(1H1,/5X,*----- NO TAPE RECORD FOUND TO MATCH REQ*,       PLUS     10
         1  *EST FOR SEGMENT *,A4,* -----*)                               PLUS     11
              DO 10111 I=1,T6                                             USRA    236
            IF(T4(I).EQ.SEG(6))GO TO 10112                                USRA    237
    10111    CONTINUE                                                     USRA    238
              WRITE(ERR,10102)SEG(6)                                      USRA    239
    10102 FORMAT(1H1,/* ----- NO DATA FOUND TO MATCH REQUEST FOR *,       PLUS     12
         1  *SEGMENT *,A4,* NO CALCULATIONS WILL BE MADE -----*)          PLUS     13
               ERRORS=ERRORS+1                                            PLUS3    16
                GO TO 590                                                 USRA    243
    10112     CONTINUE                                                    USRA    244
          READ(16,1044)                                                   PLUS3    17
             DO 10113 II=1,I                                              USRA    245
             READ(16,1044)ARR,SEGMNT,(NAME(J),J=1,15),                    USRA    246
         *  (STATE(J),J=1,3)                                              USRA    247
    10113    CONTINUE                                                     USRA    248
              REWIND 16                                                   USRA    249
    C                                                                     USRA    250
               TOTAL(50,1) = 0.0                                          USRA    251
               GO TO 181                                                  USRA    252
    10200   POSITN = I                                                    USRA    253
            IF (POSITN .EQ. ACTUAL) GO TO 10500                           USRA    254
            IF (POSITN .GT. ACTUAL) GO TO 10300                           USRA    255
            N = ACTUAL - POSITN                                           USRA    256
            DO 10210 I = 1,N                                              USRA    257
            BACKSPACE TAPN1                                               USRA    258
    10210   ACTUAL = ACTUAL - 1                                           USRA    259
             GO TO 10500                                                  USRA    260
    10300     N = POSITN - ACTUAL                                         USRA    261
            DO 10310 I=1,N                                                USRA    262
          READ(TAPN1,103)                                                 PLUS2     5
    10310      ACTUAL=ACTUAL+1                                            PLUS3    18
    10500      CONTINUE                                                   USRA    265
    C     READ LINE SEGMENT TRAFFIC AND REVENUE DATA                      USRA    266
          CALL REED(TAPN1,AAR,STATE,SEGMNT,NAME,LOCAL,CONRL,INTER,ENDF)   PLUS3    19
          IF(ENDF)GO TO 700                                               PLUS3    20
     6111 CONTINUE                                                        PLUS     17
          DOUT(1) = SEGMNT                                                USRA    272
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            ACTUAL=ACTUAL+1                                                PLUS3     21
      IF(STATE(1).NE.SEG(3).OR.STATE(1).NE.SEG(38)) ERR4=1                 USRA     274
      IF(STATE(2).NE.SEG(4).OR.STATE(2).NE.SEG(39)) ERR4=1                 USRA     275
      IF(STATE(3).NE.SEG(5).OR.STATE(3).NE.SEG(40)) ERR4=1                 USRA     276
C     PRINT ERROR MESSAGES AND COUNT ERRORS                                USRA     277
      IF(ERR3.EQ.1) WRITE(ERR,161) SEGMNT,C1AAR,C2AAR,AAR                  USRA     278
      IF(ERR4.EQ.1) WRITE(ERR,162) SEGMNT,(SEG(I),I=3,5),                  USRA     279
     1 (SEG(I),I=38,40),(STATE(I),I=1,3)                                   USRA     280
      IF(ERR2.EQ.1) WRITE(ERR,160) SEGMNT                                  USRA     281
      IF(ERR1.NE.0) WRITE(ERR,163) SEG(6),SEG(41),SEGMNT                   USRA     282
      IF(ERR1.EQ.0.AND.ERR2.EQ.0) GO TO 180                                USRA     283
      ERRORS=ERRORS+1                                                      PLUS3     22
      WRITE(ERR,164) SEGMNT                                                USRA     285
      IF(ERR1.EQ.1) IFLAG = 2                                              USRA     286
      IF(ERR1.EQ.1) GO TO 590                                              USRA     287
      IFLAG=1                                                              USRA     288
      IF(ERR1.EQ.2) GO TO 590                                              USRA     289
      IF(ERR2.EQ.1) GO TO 590                                              USRA     290
      IF(ERR3.EQ.1) GO TO 590                                              USRA     291
      IF(ERR4.EQ.1) GO TO 590                                              USRA     292
C     CREATE CONINT AND TOTAL ARRAYS                                       USRA     293
  180 DO 201 I=1,50                                                        USRA     294
      DO 202 J=1,5                                                         USRA     295
      TOTAL(I,J)=LOCAL(I,J)+CONRL(I,J)+INTER(I,J)                          PLUS2      7
      CONINT(I,J)=CONRL(I,J)+INTER(I,J)                                    PLUS2      8
  202 CONTINUE                                                             USRA     298
  201 CONTINUE                                                             USRA     299
C      FILL DOUT FOR DISK OUTPUT                                           USRA     300
      DOUT(5) = TOTAL(50,1)                                                USRA     301
      DOUT(6) = TOTAL(50,2)                                                USRA     302
      DOUT(7) = TOTAL(50,5)                                                USRA     303
      DOUT(8) = LOCAL(50,1)                                                USRA     304
      DOUT(9) = LOCAL(50,2)                                                USRA     305
      DOUT(10) = LOCAL(50,5)                                               USRA     306
      DOUT(11) = CONRL(50,1)                                               USRA     307
      DOUT(12) = CONRL(50,2)                                               USRA     308
      DOUT(13) = CONRL(50,5)                                               USRA     309
      DOUT(14) = INTER(50,1)                                               USRA     310
      DOUT(15) = INTER(50,2)                                               USRA     311
      DOUT(16) = INTER(50,5)                                               USRA     312
C --- BYPASS SEGMENTS WITH BLANK CARD RECORDS AND CALCULATE ONLY           USRA     313
C       SALVAGE AND REHAB FOR THOSE WITH BLANK TRAFFIC RECORDS             USRA     314
      IF(MSD.NE.1) GO TO 181                                               USRA     315
      WRITE(ERR,166) SEGMNT                                                USRA     316
      GO TO 590                                                            USRA     317
  181 IF(TOTAL(50,1).NE.0.0) GO TO 18                                      USRA     318
      MTD=1                                                                USRA     319
      NBTR=NBTR+1                                                          PLUS3     23
      DO 183 I=1,19                                                        USRA     321
      TASK(I)=0.0                                                          USRA     322
  183 CONTINUE                                                             USRA     323
      WRITE(ERR,167) SEGMNT                                                USRA     324
   18 AAR=RR                                                               USRA     325
C     TASK ONE - TOTAL CARRIER BRANCH REVENUE                              USRA     326
   25 IF(MTD.EQ.1) GO TO 225                                               USRA     327
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      TASK(1)=TOTAL(50,3)                                                USRA    328
C     TASK TWO - ON BRANCH OPERATING COSTS                               USRA    329
C     CALCULATE LOCOMOTIVE UNIT HOUR COST (LUHC)                         USRA    330
      LUH=SEG(11)*SEG(12)*SEG(15)                                        USRA    331
      LUHC=CF(1)*LUH                                                     USRA    332
C     CALCULATE CREW HOUR COSTS (CHC)                                    USRA    333
      KREW=IFIX(SEG(14))                                                 USRA    334
        KREWT=.FALSE.                                                    USRA    335
        INCREW=KREW                                                      USRA    336
      IF(KREW.LE.5) GO TO 206                                            USRA    337
        KREWT=.TRUE.                                                     USRA    338
      WRITE(ERR,207) SEGMNT,KREW                                         USRA    339
      KREW=5                                                             USRA    340
      GO TO 209                                                          USRA    341
  206 IF(KREW.GE.2) GO TO 209                                            USRA    342
        KREWT=.TRUE.                                                     USRA    343
      WRITE(ERR,208) SEGMNT,KREW                                         USRA    344
      KREW=2                                                             USRA    345
  209 CH=SEG(11)*SEG(15)                                                 USRA    346
      CHC=CH*CF(KREW)                                                    USRA    347
C     CALCULATE STATION EMPLOYEE COSTS (SEC)                             USRA    348
      SEC=SEG(17)*CF(6)                                                  USRA    349
C     CALCULATE ON BRANCH FREIGHT CAR COSTS (OBFCC)                      USRA    350
C     CALCULATE FREQUENCY OF TRAINS AND ROUND OFF                        USRA    351
      FREAK=SEG(11)/52.                                                  USRA    352
      FQ=IFIX(FREAK)                                                     USRA    353
        ITRYPS=.FALSE.                                                   USRA    354
      COMPAR=FREAK-FQ                                                    USRA    355
      IF(COMPAR.GE.0.5) FQ=FQ+1                                          PLUS3    24
C     CORRECT FREQUENCY GREATER THAN 7 OR LESS THAN 1                    USRA    357
      IF(FQ.LE.7) GO TO 192                                              USRA    358
      WRITE(ERR,190) SEGMNT,FREAK                                        USRA    359
        ITRYPS=.TRUE.                                                    USRA    360
      FQ=7                                                               USRA    361
      GO TO 193                                                          USRA    362
  192 IF(FQ.GE.1) GO TO 193                                              USRA    363
      WRITE(ERR,191) SEGMNT,FREAK                                        USRA    364
        ITRYPS=.TRUE.                                                    USRA    365
      FQ=1                                                               USRA    366
C     CALCULATE ON BRANCH CAR MILE COSTS (OBCMC)                         USRA    367
  193 OBCMC=0.0                                                          USRA    368
              RFQ=FLOAT(FQ)                                              USRA    369
      DOUT(17) = RFQ                                                     USRA    370
      DO 210 K=1,49                                                      USRA    371
      OBCMC=OBCMC+(TOTAL(K,1)*STCC(K,2))                                 PLUS2     9
  210 CONTINUE                                                           USRA    373
      OBCMC=SEG(7)*OBCMC                                                 USRA    374
      DOUT(18) = OBCMC                                                   USRA    375
C     CALCULATE ON BRANCH CAR DAY COSTS (OBCDC)                          USRA    376
      OBCDC=0.0                                                          USRA    377
      DO 211 K=1,49                                                      USRA    378
      TCD(K)=(LOCAL(K,1)*CD(FQ,1))+(CONRL(K,1)*CD(FQ,2))+                PLUS     18
     1 (INTER(K,1)*CD(FQ,3))                                             USRA    380
      OBCDC=OBCDC+(TCD(K)*STCC(K,3))                                     PLUS     19
  211 CONTINUE                                                           USRA    382
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      OBFCC=OBCMC+OBCDC                                                 PLUS    20
      DOUT(19) = OBCDC                                                  USRA   384
C     CALCULATE ON BRANCH CABOOSE COSTS (OBCAB)                         USRA   385
C     CABOOSE MILES                                                     USRA   386
      CM=SEG(7)*SEG(11)*2.0                                             USRA   387
C     CABOOSE MILE COST (CMC)                                           USRA   388
      CMC=CM*CF(7)                                                      USRA   389
C     CABOOSE DAYS                                                      USRA   390
      CBDAYS=(SEG(15)*SEG(11))/12.                                      USRA   391
C     CABOOSE DAY COST (CBDC)                                           USRA   392
      CBDC=CBDAYS*CF(8)                                                 USRA   393
      OBCAB=CMC+CBDC                                                    PLUS    21
C     RECORD ON BRANCH OPERATING COSTS                                  USRA   395
       LOTSC=LOCAL(50,1)*CF(37)*2.                                      USRA   396
      TASK(2)=LUHC+CHC+SEC+OBFCC+OBCAB+LOTSC                            PLUS    22
C     TASK THREE - TEST ONE - NET REVENUE AFTER ON BRANCH OPERATING COST USRA  398
      TASK(3)=TASK(1)-TASK(2)                                           USRA   399
C     TASK FOUR-BRANCH MAINTENANCE                                      USRA   400
C     GROSS TONS (GT)                                                   USRA   401
      GT=TOTAL(50,2)+(((SEG(12)*120.)+25.)*SEG(11)*2.)                  PLUS    23
      DO 215 K=1,49                                                     USRA   403
      GT=GT+(TOTAL(K,1)*STCC(K,4)*2.)                                   PLUS    24
  215 CONTINUE                                                          USRA   405
C     GROSS TON CLASS (GTC)                                             USRA   406
      GTC=GT/1000000.                                                   USRA   407
C     FIND DIRECT MAINTENANCE FOR GROSS TON CLASS                       USRA   408
      DO 216 J=1,10                                                     USRA   409
      IF(GTC.GT.DRM(1,J)) GO TO 216                                     USRA   410
      DMC=SEG(7)*DRM(2,J)                                               USRA   411
      GO TO 217                                                         USRA   412
  216 CONTINUE                                                          USRA   413
C     CALCULATE INDIRECT MAINTENANCE COST (IMC)                         USRA   414
  217 IMC=CF(9)                                                         USRA   415
      DO 224 J=18,28                                                    USRA   416
      IMC=IMC+(SEG(J)*CF(J-8))                                          PLUS    25
  224 CONTINUE                                                          USRA   418
C     MAINTENANCE SIDING AND YARD TRACKS (NBMO)                         USRA   419
      NBMM=DMC*(1.+IMC)                                                 PLUS    26
C     NORMALIZED BRANCH MAINTENANCE MAIN AND OTHER (NBMM - NBMO)        USRA   421
      NMBO=(SEG(10)*CF(40)*(1.+CF(9)))                                  PLUS    27
C     RECORD BRANCH MAINTENANCE                                         USRA   423
      TASK(4)=NBMM+NBMO                                                 PLUS    28
      DOUT(28) = TASK(4)                                                USRA   425
C     TASK FIVE - TEST TWO - NET REVENUE AFTER BRANCH MAINTENANCE       USRA   426
      TASK(5)=TASK(3)-TASK(4)                                           USRA   427
C     TASK SIX - RETURN ON BRANCH SALVAGE VALUE                         USRA   428
C     TOTAL TRACK MILES (TTM)                                           USRA   429
  225 TTM=SEG(10)+SEG(7)                                                PLUS    29
C      GROSS SCRAP VALUE, STEEL (TSSV)                                  USRA   431
C                                                                       USRA   432
      TSSV=TTM*CF(21)                                                   USRA   433
C      GROSS SCRAP VALUE, GOOD TIES (TSVGT)                             USRA   434
      TSVGT=SEG(7)*CF(39)*SEG(29)*CF(22)                                USRA   435
C      GROSS SCRAP VALUE, FAIR/POOR TIED (TSVFPT)                       USRA   436
       TSVFPT=SEG(7)*CF(39)*(1.-SEG(29))*CF(23)                         USRA   437
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C      GROSS SALVAGE VALUE, LAND                                       USRA   438
         LSV=SEG(7)*CF(41)*CF(42)                                      USRA   439
C     GROSS SCRAP VALUE (GSV)                                          USRA   440
      GSV=TSSV+TSVGT+TSVFPT+LSV                                        PLUS    30
C     TOTAL DISMANTLE AND REMOVAL COST (TDRC)                          USRA   442
      TDRC=TTM*CF(24)                                                  USRA   443
C     NET SCRAP VALUE (NSV)                                            USRA   444
      NSV=GSV-TDRC                                                     USRA   445
C     RETURN ON NET SALVAGE VALUE (RETNSV)                             USRA   446
      RETNSV=NSV*CF(25)                                                USRA   447
C     RECORD RETURN ON NET BRANCH SALVAGE VALUE                        USRA   448
      TASK(6)=RETNSV                                                   USRA   449
      DOUT(29) = TASK(6)                                               USRA   450
C     TASK SEVEN - TEST THREE - NET REVENUE AFTER RETURN ON NET BRANCH USRA   451
C     SALVAGE VALUE                                                    USRA   452
      TASK(7)=TASK(5)-TASK(6)                                          USRA   453
      IF(MTD.EQ.1) GO TO 264                                           USRA   454
C     TASK EIGHT - BRANCH OVERHEAD COSTS                               USRA   455
C     MAINTENANCE OF WAY SUPERINTENDENCE                               USRA   456
         MOWS = CF(26)*SEG(7)                                          USRA   457
C      TRANSPORTATION SUPERINTENDENCE                                  USRA   458
         TRANS = CF(27) * CH                                           USRA   459
C     CLERICAL SUPPORT / ACCIDENTS                                     USRA   460
        MCLAC = CF(28) * DMC                                           USRA   461
      DOUT(20) = MCLAC                                                 USRA   462
         TCLAC=CF(43)*CH*SEG(14)                                       USRA   463
C     RECORD BRANCH OVERHEAD COSTS                                     USRA   464
      TASK(8)=MOWS+TRANS+MCLAC+TCLAC                                   PLUS    31
C     TASK NINE - TEST FOUR - NET REVENUE AFTER BRANCH OVERHEAD COSTS  USRA   466
      TASK(9)=TASK(7)-TASK(8)                                          USRA   467
C     TASK TEN - PROPERTY TAXES ON BRANCH                              USRA   468
C     TAXES PER MILE FOUND IN SEG(35) AND MILES IN SEG(7)              USRA   469
      TASK(10)=SEG(35)*SEG(7)                                          USRA   470
C     TASK ELEVEN - TEST FIVE - NET REVENUE AFTER PROPERTY TAXES       USRA   471
      TASK(11)=TASK(9)-TASK(10)                                        USRA   472
C     TASK TWELVE - OFF BRANCH OPERATING COSTS                         USRA   473
       OBCM=0                                                          USRA   474
       OBTTM=0                                                         USRA   475
       OBNTM=0                                                         USRA   476
       NISC=0                                                          USRA   477
       NIS1=0                                                          USRA   478
        NIS=0                                                          USRA   479
        DO 240 K=1,49                                                  USRA   480
C      OFF-BRANCH CAR, NET AND TARE TON MILES, INTER TRAFFIC           USRA   481
       OFBCMI=(INTER(K,5)-INTER(K,1)*SEG(7)/2.)*STCC(K,7)              USRA   482
       FBCMIE=OFBCMI*STCC(K,5)                                         USRA   483
        FBTTMI=FBCMIE*STCC(K,4)                                        USRA   484
        FBNTMI=(OFBCMI/INTER(K,1))*INTER(K,2)                          USRA   485
C      OFF-BRANCH CAR, NET AND TARE TON MILES, CONRL TRAFFIC           USRA   486
       OFBCMS=(CONRL(K,5)-CONRL(K,1)*SEG(7)/2.)*STCC(K,6)              USRA   487
       FBCMCE=OFBCMS*STCC(K,5)                                         USRA   488
        FBTTMC=FBCMCE*STCC(K,4)                                        USRA   489
        FBNTMC=(OFBCMS/CONRL(K,1)) * CONRL(K,2)                        USRA   490
C       TOTAL OFF-BRANCH CAR, TARE, NET   GROSS TON MILES              USRA   491
      OBCM=OBCM+FBCMIE+FBCMCE                                          PLUS2   10
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          OBTTM=OBTTM+FBTTMI+FBTTMC                                    PLUS2     11
          OBNTM=OBNTM+FBNTMI+FBNTMC                                    PLUS2     12
            NISC=(FBCMCE/CONRL(K,1))/200.                              USRA     495
            NISI=(FBCMIE/INTER(K,1))/200.                              USRA     496
          NIS=NIS+(NISC*CONRL(K,1))+(NISI*INTER(K,1))                  PLUS2     13
  240       CONTINUE                                                   USRA     498
          DOUT(21) = OBCM                                              USRA     499
          DOUT(22) = OBTTM                                             USRA     500
          DOUT(23) = OBNTM                                             USRA     501
          OBGTM=OBTTM+OBNTM                                            PLUS2     14
C           GROSS TON MILE COSTS (GTMC)                                USRA     503
            GTMC=OBGTM*CF(34)                                          USRA     504
C           CALCULATE THE NUMBER OF INTERTRAIN SWITCHES (NIS)          USRA     505
          NIS=NIS+2.*(CONRL(50,1)+INTER(50,1))                         PLUS2     15
C         CALCULATE TOTAL SWITCHING COSTS (TSC)                        USRA     507
C         CALCULATE INDUSTRY SWITCHING (IS)                            USRA     508
           CIS=CONRL(50,1)                                             USRA     509
          IS=CONRL(50,1)*CF(35)                                        USRA     510
C         CARS INTERCHANGED (CI)                                       USRA     511
          CI=0.0                                                       USRA     512
          DO 251 K=1,49                                                USRA     513
          IF(INTER(K,1).EQ.0.0) GO TO 251                              USRA     514
          CI=CI+(INTER(K,1)*STCC(K,5))                                 PLUS2     16
    251 CONTINUE                                                       USRA     516
C         ROUND CARS INTERCHANGED TO WHOLE NUMBER                      USRA     517
          COMPAR=CI                                                    USRA     518
          CI=FLOAT(IFIX(CI))                                           USRA     519
          FRAC=COMPAR-CI                                               USRA     520
          IF(FRAC.GE.0.5)CI=CI+1                                       PLUS2     17
C         INTERCHANGE SWITCHING COST (ICSC)                            USRA     522
          ICSC=CI*CF(36)                                               USRA     523
C         INTERTRAIN SWITCHING COSTS (ITSC)                            USRA     524
          ITSC=NIS*CF(37)                                              USRA     525
C         TOTAL SWITCHING COSTS (TSC)                                  USRA     526
          TSC=IS+ICSC+ITSC                                             PLUS2     18
C         CALCULATE LOSS AND DAMAGE COST (LDC)                         USRA     528
          LDC=0.0                                                      USRA     529
          DO 253 K=1,49                                                USRA     530
          IF(TOTAL(K,2).EQ.0.0) GO TO 253                              USRA     531
          LDC=LDC+(TOTAL(K,2)*STCC(K,1))                               PLUS2     19
    253 CONTINUE                                                       USRA     533
          DOUT(24) = LDC                                               USRA     534
C         CALCULATE OFF BRANCH FREIGHT CAR COSTS (OFBFCC)              USRA     535
C         SWITCHING AND RUNNING TIME DAYS                              USRA     536
          OFBCDC=0.0                                                   USRA     537
          OFBCMC=0.0                                                   USRA     538
             OBCD=0.0                                                  USRA     539
          ICSD=0.0                                                     USRA     540
          RTD=0.0                                                      USRA     541
             OBCD=0.0                                                  USRA     542
          ITSD=0.0                                                     USRA     543
          OBSD=0.0                                                     USRA     544
             DO 260 K=1,49                                             USRA     545
             ICSDI=0.0                                                 USRA     546
             RTDI = 0                                                  USRA     547
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                ITSDI =0.0                                              USRA     548
                OBSDI = 0.0                                             USRA     549
      C     INTERCHANGE SWITCHING DAYS (ICSD)                           USRA     550
            IF (INTER(K,1).EQ.0.0) GO TO 261                            USRA     551
            ICSDI=INTER(K,1)*STCC(K,5)*0.5                              USRA     552
            ICSD=ICSD+ICSDI                                             PLUS      32
      C     RUNNING TIME DAYS (RTD)                                     USRA     554
      261        CONTINUE                                               USRA     555
              OFBCMI=(INTER(K,5)-(INTER(K,1)*SEG(7)/2.))                USRA     556
           1    * STCC(K,5)  * STCC(K,7)                                USRA     557
              OFBCML=(CONRL(K,5)-(CONRL(K,1)*SEG(7)/2.))                USRA     558
           1    * STCC(K,5)  * STCC(K,6)                                USRA     559
            RTDI=(OFBCMI+OFBCML)/(CF(38)*24.)                           PLUS2     20
            RTD=RTD+RTDI                                                PLUS      33
      C     INTERTRAIN SWITCHING DAYS (ITSD)                            USRA     562
            ITSDI=(((OFBCMI+OFBCML)/200.)*0.5)+INTER(K,1)+CONRL(K,1)    PLUS2     21
            ITSD=ITSD+ITSDI                                             PLUS      34
      C     OTHER OFF BRANCH TERMINAL SWITCHING DAYS                    USRA     565
        262        CONTINUE                                             USRA     566
              OBSDI=CONRL(K,1)*4.                                       USRA     567
            OBSD=OBSD+OBSDI                                             PLUS      35
      C     OFF BRANCH CAR DAYS (OBCD)                                  USRA     569
        263 OBCDI=ICSDI+RTDI+ITSDI+OBSDI                                PLUS      36
            OBCD=OBCD+OBCDI                                             PLUS      37
            OFBCDC=OFBCDC+(OBCDI*STCC(K,3))                             PLUS      38
            DOUT(25) = OBCD                                             USRA     573
            DOUT(26) = OFBCDC                                           USRA     574
      C     OFF BRANCH CAR MILE COSTS (OFBCMC)                          USRA     575
              IF(OFBCMI.LT.0.0)OFBCMI=0.0                               USRA     576
              IF(OFBCML.LT.0.0)OFBCML=0.0                               USRA     577
            OFBCM=OFBCM+OFBCML                                          PLUS      39
            OFBCMC=OFBCMC+(OFBCM*STCC(K,2))                             PLUS      40
            DOUT(27) = OFBCMC                                           USRA     580
        260 CONTINUE                                                    USRA     581
      C       OFF-BRANCH FREIGHT CAR COSTS                              USRA     582
            OFBFCC=OFBCDC+OFBCMC                                        PLUS2     22
      C        SCO = CF(29) * TOTAL(50,1)                               USRA     584
            SCO=(CF(29)*TOTAL(50,1))+(CF(29)*LOCAL(50,1))+              PLUS      41
           *    (CF(29)*CONRL(50,1))                                    USRA     586
      C     RECORD TOTAL OFF BRANCH  OPERATING COSTS                    USRA     587
            TASK(12)=GTMC+TSC+LDC+OFBFCC+SCO                            PLUS2     23
      C     TASK THIRTEEN - TEST SIX - NET REVENUE AFTER OFF BRANCH     USRA     589
      C     OPERATING COSTS                                             USRA     590
            TASK(13)=TASK(11)-TASK(12)                                  USRA     591
      C     TASK FOURTEEN - OVERHEAD (BRIDGE) TRAFFIC REVENUE SHOULD BE USRA     592
      C     CALCULATED HERE                                             USRA     593
            TASK(14)=0.0                                                USRA     594
      C     TASK FIFTEEN - TEST SEVEN - NET REVENUE AFTER ADDING OVERHEAD   USRA     595
      C     BRIDGE TRAFFIC REVENUE                                      USRA     596
            TASK(15)=TASK(13)+TASK(14)                                  PLUS      42
      C      TASK SIXTEEN-UPGRADING COST TO FRA TRACK CLASS I           USRA     598
      C                                                                 USRA     599
             IF(SEG(42) .LE. 0.0) GO TO 1264                            USRA     600
        264 TASK(16)=(CF(30)*SEG(7)+CF(31)*SEG(46)+CF(32)               PLUS2     24
           1  *SEG(42)+CF(33)*SEG(43))/10.                              PLUS2     25
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                GO TO 1265                                                    USRA   603
        1264    TASK(16)=0.0                                                  USRA   604
        1265   FRA1=TASK(16)                                                  USRA   605
              DOUT(30) = TASK(16)                                             USRA   606
        C       TASK SEVENTEEN-TEST EIGHT A NET REVENUE AFTER UPGRADING TO FRA  USRA   607
        C       TRACK CLASS I                                                 USRA   608
              IF(MTD.NE.1) GO TO 265                                          USRA   609
              TASK(17)=TASK(7)-TASK(16)                                       USRA   610
              GO TO 266                                                       USRA   611
          265 TASK(17)=TASK(15)-TASK(16)                                      USRA   612
        C                                                                     USRA   613
        C      TASK EIGHTEEN-UPGRADING COST TO FRA TRACK CLASS II             USRA   614
                IF (SEG(44) .LE.0.0) GO TO 1266                               USRA   615
          266 TASK(18)=(CF(30)*SEG(7)+CF(31)*SEG(46)                          PLUS    43
             1  +CF(32)*SEG(44)+CF(33)*SEG(45))/10.                           PLUS    44
               GO TO 1267                                                     USRA   618
        1266    TASK(18)=0.0                                                  USRA   619
        1267     CONTINUE                                                     USRA   620
              FRA2=TASK(18)                                                   USRA   621
              DELTA=FRA2-FRA1                                                 USRA   622
        C     TASK NINETEEN - TEST EIGHT--B - NET REVENUE AFTER UPGRADING     USRA   623
        C     TO FRA TRACK CLASS II                                           USRA   624
              IF(MTD.NE.1) GO TO 267                                          USRA   625
              TASK(19)=TASK(7)-TASK(18)                                       USRA   626
              GO TO 268                                                       USRA   627
          267 TASK(19)=TASK(15)-TASK(18)                                      USRA   628
        C--OVERALL SECTION FOR LINE SEGMENT EVALUATION OUTPUT                 USRA   629
        C-- AS WELL AS                                                        USRA   630
        C--LISTING OF: TRAFFIC AND REVENUE TABLES                             USRA   631
        C--            LINE SEGMENT QUESTIONNAIRE DATA ITEMS                  USRA   632
        C--            RAILROAD COST FACTOR DATA ITEMS                        USRA   633
        C--AND                                                                USRA   634
        C--            INTERMEDIATE CALCULATIONS                              USRA   635
        C-                                                                    USRA   636
        C                                                                     USRA   637
        C                                                                     USRA   638
        C                                                                     USRA   639
        C                                                                     USRA   640
        C                                                                     USRA   641
        C  OUTPUT TO DISK FOR FUTURE ANALYSIS - ADDED 22 JAN 75               USRA   642
        C      WRITE IN BINARY                                                USRA   643
          268  WRITE (17) DOUT                                                USRA   644
        C--OUTPUT SECTION FOR PRIMARY NET REVENUE EVALUATION TESTS            USRA   645
              PAGE=PAGE+1                                                     PLUS3   25
              WRITE(OUT,171)AAR,(RNAME(J),J=1,10),SEGMNT,(NAME(J),J=1,15),    USRA   647
             1                  (STATE(J),J=1,3),PAGE                         USRA   648
              IF(MTD.EQ.1) WRITE(OUT,42)                                      USRA   649
              WRITE(OUT,1711)                                                 USRA   650
              DO 271 I=1,19                                                   USRA   651
              WRITE(OUT,1712) I,(TH(I,J),J=1,15),TASK(I)                      USRA   652
          271 CONTINUE                                                        USRA   653
        C--OUTPUT SECTION FOR THREE-PAGE TRAFFIC AND REVENUE REPORT            USRA   654
              IF(MTD.EQ.1) GO TO 274                                          USRA   655
              PAGE=PAGE+1                                                     PLUS3   26
              WRITE(OUT,171)AAR,(RNAME(J),J=1,10),SEGMNT,(NAME(J),J=1,15),    USRA   657
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     1                    (STATE(J),J=1,3),PAGE                          USRA  658
      WRITE(OUT,172)                                                     USRA  659
      WRITE(OUT,1731)                                                    USRA  660
      WRITE(OUT,175)                                                     USRA  661
      DO 281 K=1,50                                                      USRA  662
      KAZAM=000                                                          USRA  663
      DO 282 J=1,5                                                       USRA  664
      IF(TOTAL(K,J).NE.0.000) KAZAM=KAZAM+1                              PLUS3  27
  282 CONTINUE                                                           USRA  666
      IF(KAZAM.EQ.000) GO TO 281                                         USRA  667
      WRITE(OUT,176) K,(LOCAL(K,J),J=1,5),K,(CONRL(K,J),J=1,5)           USRA  668
  281 CONTINUE                                                           USRA  669
      PAGE=PAGE+1                                                        PLUS3  28
      WRITE(OUT,171)AAR,(RNAME(J),J=1,10),SEGMNT,(NAME(J),J=1,15),       USRA  671
     1                    (STATE(J),J=1,3),PAGE                          USRA  672
      WRITE(OUT,172)                                                     USRA  673
      WRITE(OUT,1732)                                                    USRA  674
      WRITE(OUT,175)                                                     USRA  675
      DO 283 K=1,50                                                      USRA  676
      KAZAM=000                                                          USRA  677
      DO 284 J=1,5                                                       USRA  678
      IF(TOTAL(K,J).NE.0.000) KAZAM=KAZAM+1                              PLUS3  29
  284 CONTINUE                                                           USRA  680
      IF(KAZAM.EQ.000) GO TO 283                                         USRA  681
      WRITE(OUT,176) K,(INTER(K,J),J=1,5),K,(TOTAL(K,J),J=1,5)           USRA  682
  283 CONTINUE                                                           USRA  683
          IKTEST=1                                                       USRA  684
           IF(IKTEST.EQ.1) GO TO 274                                     USRA  685
      PAGE=PAGE+1                                                        PLUS3  30
      WRITE(OUT,171)AAR,(RNAME(J),J=1,10),SEGMNT,(NAME(J),J=1,15),       USRA  687
     1                    (STATE(J),J=1,3),PAGE                          USRA  688
      WRITE(OUT,172)                                                     USRA  689
      WRITE(OUT,1733)                                                    USRA  690
      WRITE(OUT,1176)                                                    USRA  691
      DO 285 K=1,50                                                      USRA  692
      KAZAM=000                                                          USRA  693
      DO 286 J=1,5                                                       USRA  694
      IF(TOTAL(K,J).NE.0.000) KAZAM=KAZAM+1                              PLUS3  31
  286 CONTINUE                                                           USRA  696
      IF(KAZAM.EQ.000) GO TO 285                                         USRA  697
      WRITE(OUT,176) K,(CONINT(K,J),J=1,5)                               USRA  698
  285 CONTINUE                                                           USRA  699
C--OUTPUT SECTION FOR SEGMENT ITEMS AND RAILROAD COST FACTOR DATA         USRA  700
C                                                                        USRA  701
C--SUBSEQUENTLY THERE MAY BE MERIT IN USING VARIED DECIMAL POINT         USRA  702
C--LOCATIONS FOR THE LINE SEGMENT DATA ITEMS ... BUT NOT NOW++++++++     USRA  703
C                                                                        USRA  704
  274 PAGE=PAGE+1                                                        PLUS3  32
      WRITE(OUT,171)AAR,(RNAME(J),J=1,10),SEGMNT,(NAME(J),J=1,15),       USRA  706
     1                    (STATE(J),J=1,3),PAGE                          USRA  707
      WRITE(OUT,185)                                                     USRA  708
      DO 273 I=1,48                                                      USRA  709
      IF(I.GT.2.AND.I.LT.7) GO TO 901                                    USRA  710
      IF(I.GT.37.AND.I.LT.42) GO TO 901                                  USRA  711
      WRITE(OUT,186) I,(SEGROW(I,J),J=1,10),SEG(I),                      USRA  712
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     1             I,(CFH(I,J),J=1,10),CF(I)                                 USRA   713
      GO TO 273                                                              USRA   714
  901 WRITE(OUT,187) I,(SEGROW(I,J),J=1,10),SEG(I),                          USRA   715
     1             I,(CFH(I,J),J=1,10),CF(I)                                 USRA   716
  273 CONTINUE                                                               USRA   717
      IF(NTD.NE.1) GO TO 277                                                 USRA   718
  275 CONTINUE                                                               USRA   719
  277 PAGE=PAGE+1                                                            PLUS3   33
      WRITE(OUT,171)AAR,(RNAME(J),J=1,10),SEGMNT,(NAME(J),J=1,15),           USRA   721
     1                 (STATE(J),J=1,3),PAGE                                 USRA   722
      WRITE(OUT,1714)                                                        USRA   723
      DO 855 I=1,30                                                          USRA   724
      IX=I+30                                                                PLUS3   34
      WRITE(OUT,1717) I,(STUBS(I,J),J=1,9),ZIP(I),                           USRA   726
     1             IX,(STUBS(IX,J),J=1,9),ZIP(IX)                            USRA   727
  855 CONTINUE                                                               USRA   728
C        I=30                                                                USRA   729
C        WRITE(OUT,11717) I,(STUBS(I,J),J=1,9),ZIP(I)                        USRA   730
        IF(KREWT)WRITE(OUT,5006)INCREW,KREW                                  USRA   731
 5006 FORMAT(/* -- NOTE- INPUT CREW SIZE =*,I4,                              PLUS    45
     1  *, CREW SIZE USED IN CALCULATIONS =*,I4)                             PLUS    46
        IF(ITRYPS)WRITE(OUT,5007)FREAK,FQ                                    USRA   734
 5007 FORMAT(/* -- NOTE- INPUT TRIPS PER WEEK =*,F8.4,                       PLUS    47
     1  *, TRIPS PER WEEK USED IN CALCULATIONS ON-BRANCH CAR *,              PLUS    48
     2*DAY COSTS =*,I4)                                                      PLUS    49
C                                                                            USRA   738
         DO 7141 III=1,14                                                    USRA   739
         TESTLS(III)=0.0                                                     USRA   740
7141     TESTK(III)=0.0                                                      USRA   741
         TESTLS(15)=0.0                                                      USRA   742
C                                                                            USRA   743
C                                                                            USRA   744
       DO 931 III=1,9                                                        USRA   745
       IF(TASK(WHLIST(III)) .LT. 0.0 ) GO TO 932                             USRA   746
931     CONTINUE                                                             USRA   747
       III=10                                                                USRA   748
932      CONTINUE                                                            USRA   749
C                                                                            USRA   750
C STATEMENT NUMBER                                                           USRA   751
          IFGOOD=.FALSE.                                                     USRA   752
        TESTLS (1) = SEG(6)                                                  USRA   753
C STATE NUMBERS 1,2,3                                                        USRA   754
         TESTLS (2) = SEG(3)                                                 USRA   755
         TESTLS (3) = SEG(4)                                                 USRA   756
         TESTLS (4) = SEG(5)                                                 USRA   757
C LENGTH IN MILES                                                            USRA   758
         TESTLS (5) = SEG(7)                                                 USRA   759
C REVENUE                                                                    USRA   760
         TESTLS (6) = TOTAL(50,3)                                            USRA   761
C LOSS THRU TEST VIII-A (IF ANY)                                             USRA   762
         TESTLS (7) = 0.0                                                    USRA   763
         IF (TASK(17) .LT. 0.0 ) TESTLS (7) = TASK(17)                       USRA   764
C TOTAL CARS                                                                 USRA   765
         TESTLS (8) = TOTAL(50,1)                                            USRA   766
C TOTAL TONS                                                                 USRA   767
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            TESTLS (9) = TOTAL(50,2)                                  USRA     768
      C REVENUE/MILES                                                 USRA     769
            TESTLS (10) = TESTLS (6) / TESTLS (5)                     USRA     770
      C CARS/MILES                                                    USRA     771
            TESTLS (11) = TESTLS (8) / TESTLS (5)                     USRA     772
      C REVENUE/CAR                                                   USRA     773
            TESTLS (12) = TESTLS (6) / TESTLS (8)                     USRA     774
      C LOSS/CAR (IF ANY)                                             USRA     775
            TESTLS (13) = 0.0                                         USRA     776
            IF (TESTLS(7) .LT. 0.0) TESTLS (13) = TESTLS(7)/TESTLS(8) USRA     777
      C                                                               USRA     778
      C                                                               USRA     779
      C REVENUE/TON                                                   USRA     780
            TESTLS (14) = TESTLS(6)/TESTLS(9)                         USRA     781
      C LOSS/TON (IF ANY)                                             USRA     782
            TESTLS (15) = 0.0                                         USRA     783
            IF(TESTLS(7).LT.0.0)TESTLS(15)=TESTLS(7)/TESTLS(9)        USRA     784
      C TOTAL COST                                                    USRA     785
         TESTLS(16) = TESTLS(6) - TASK(17)                            USRA     786
      C NET REVENUE PER CAR                                           USRA     787
         TESTLS(17) = (TESTLS(6) - TESTLS(16)) / TESTLS(8)            USRA     788
      C REQUIRED RATE INCREASE                                        USRA     789
         TESTLS(18) = 0.                                              USRA     790
         IF (TESTLS(7).LT.0)  TESTLS(18) = ABS(TESTLS(7)/TESTLS(8))   USRA     791
     *     / TESTLS(12)                                               USRA     792
      C                                                               USRA     793
           IF (III.EQ.10)GOTO 14910                                   USRA     794
      7551     CONTINUE                                               USRA     795
            IF (LN .GE.48) GO TO 5555                                 USRA     796
      5556    CONTINUE                                                USRA     797
      C SEGMENT NUMBER                                                USRA     798
            TESTK(1)=SEG(6)                                           USRA     799
      C LENGTH IN MILES                                               USRA     800
            TESTK(2)=SEG(7)                                           USRA     801
      C TOTAL CARLOADS                                                USRA     802
            TESTK(3) = TOTAL(50,1)                                    USRA     803
      C TOTAL CARS                                                    USRA     804
            TESTK(4)=TESTK(3)*2.                                      USRA     805
      C ANNUAL TRIPS                                                  USRA     806
            TESTK(5)=SEG(11)                                          USRA     807
      C AVERAGE CAR/TRIP                                              USRA     808
            TESTK(6)=TESTK(4)/TESTK(5)                                USRA     809
      C SWITCHING TIME PER TRIP                                       USRA     810
         TBX        = TESTK(6) * 7.                                   USRA     811
         IX         = TBX / 60.                                       USRA     812
         TESTK(7) = IX                                                USRA     813
         TESTK(8) = TBX - TESTK(7) * 60.                              USRA     814
      C TIME ASSIGNED TO BRANCH                                       USRA     815
         IX         = SEG(15)                                         USRA     816
         TESTK(9)   = IX                                              USRA     817
         TESTK(10) = (SEG(15) - TESTK(9)) * 60.                       USRA     818
      C                                                               USRA     819
      C RESIDUAL RUNNING TIME                                         USRA     820
         XTIME      = SEG(15) - TBX / 60.                             USRA     821
         IX         = XTIME                                           USRA     822
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          TESTK(11) = IX                                              USRA    823
          TESTK(12) = (XTIME - TESTK(11)) * 60.                       USRA    824
      C MILES TO SERVING YARD                                         USRA    825
             TESTK(93)=SEG(16)                                        USRA    826
      C MILES PER HOUR                                                USRA    827
             TESTK(14)=(TESTK(2)*2.)/XTIME                            USRA    828
             IF(IFGOOD)GO TO 8001                                     USRA    829
             IF(III.NE.9)                                             USRA    830
           * WRITE(OUTC,5117)(ITALY(III,LK),LK=1,2),(STATE(LK),LK=1,3) USRA    831
             IF (III.EQ.9)                                            USRA    832
           * WRITE(OUTC,5118)(ITALY(III,LK),LK=1,2),(STATE(LK),LK=1,3) USRA    833
             WRITE(OUTC,5114)TESTK                                    USRA    834
             GO TO 8002                                               USRA    835
      8001    CONTINUE                                                USRA    836
             WRITE(OUTC,15117)(STATE(J),J=1,3)                        USRA    837
             WRITE(OUTC,5114)TESTK                                    USRA    838
       8002 FOUND=FOUND+1                                             PLUS3    35
            LN=LN+1                                                   PLUS3    36
            OUTLT(FOUND,1) = FLOAT(III)                               USRA    841
            DO 9820 LK=1,15                                           USRA    842
            SNAM(FOUND,LK) = NAME(LK)                                 USRA    843
       9820 OUTLT(FOUND,LK+1)=TESTLS(LK)                              PLUS3    37
            DO 9821 LK=1,3                                            USRA    845
       9821 RURI(FOUND,LK)=TESTLS(LK+15)                              PLUS3    38
             GO TO 590                                                USRA    847
      C                                                               USRA    848
      14910   CONTINUE                                                USRA    849
      C       WE PASSED ALL TASK TESTS...                             USRA    850
            TESTLS(7)=TASK(17)                                        USRA    851
            TESTLS(13)=TESTLS(7)/TESTLS(8)                            USRA    852
            TESTLS(15)=TESTLS(7)/TESTLS(9)                            USRA    853
      C                                                               USRA    854
            IF(LM.GE.52)GO TO 14918                                   USRA    855
      14919    CONTINUE                                               USRA    856
              IMLX=IFIX(TESTLS(6))                                    USRA    857
              IMLY=IFIX(TESTLS(8))                                    USRA    858
              IMLZ=IFIX(TESTLS(9))                                    USRA    859
               WRITE(OUTB,5111)(TESTLS(NN),NN=1,5),IMLX,TESTLS(7),    USRA    860
           *  IMLY,IMLZ,(TESTLS(NN),NN=10,15)                         USRA    861
            LM=LM+1                                                   PLUS3    39
             IFGOOD=.TRUE.                                            USRA    863
             GO TO 7551                                               USRA    864
      C                                                               USRA    865
      5555      CONTINUE                                              USRA    866
                WRITE(OUTC,5113)                                      USRA    867
      C                                                               USRA    868
             LN=3                                                     USRA    869
             GO TO 5556                                               USRA    870
      14918   CONTINUE                                                USRA    871
              WRITE(OUTB,9800)                                        USRA    872
              LM=5                                                    USRA    873
              GO TO 14919                                             USRA    874
       5117 FORMAT(/*         NEGATIVE VALUE AT TEST *,2A4,/2X,3A2)   PLUS     50
       5118 FORMAT(/*         PASSED ONLY TEST VIII-A *,2A4,/2X,3A2)  PLUS     51
        700 CONTINUE                                                  USRA    877
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      C  SUMMARY PRINT OF REQUIRED RATE INCREASES - ADDED 22 JAN 75          USRA   878
            IPAG = 1                                                           USRA   879
            ICNT = 60                                                          USRA   880
            DO 850 I = 1,FOUND                                                 USRA   881
            IF (ICNT .LT. 60) GO TO 825                                        USRA   882
            WRITE (20,8500) IPAG                                               USRA   883
            IPAG=IPAG+2                                                        PLUS    52
            ICNT = 5                                                           USRA   885
      825   WRITE (20,8510) (OUTLT(I,J),J=3,5), OUTLT(I,2),                    USRA   886
           *    (SNAM(I,J),J=1,12), OUTLT(I,6), OUTLT(I,7), RQRI(I,1),        USRA   887
           *    OUTLT(I,9), OUTLT(I,13), RQRI(I,2), RQRI(I,3)                 USRA   888
            ICNT=ICNT+1                                                        PLUS    53
      850   CONTINUE                                                           USRA   890
                 DO 9830 I=1,9                                                 USRA   891
                  WRITE(20,2112)                                               USRA   892
                 DO 9824 IY=1,FOUND                                            USRA   893
                 IF(OUTLT(IY,1).NE.FLOAT(I))GO TO 9824                         USRA   894
                  IF(.NOT.IPTSW(I))GO TO 9823                                  USRA   895
                 IF(I.NE.9) WRITE(20,9802)(IFTRT(I,LLL),LLL=1,10)              USRA   896
                 IF(I.EQ.9) WRITE(20,9803)(IFTRT(I,LLL),LLL=1,10)              USRA   897
                  WRITE(20,5110)                                               USRA   898
                  IPTSW(I)=.FALSE.                                             USRA   899
                    IPLNCT=6                                                   USRA   900
      9823        CONTINUE                                                     USRA   901
                 IMLX=IFIX(OUTLT(IY,7))                                        USRA   902
                 IMLY=IFIX(OUTLT(IY,9))                                        USRA   903
                 IMLZ=IFIX(OUTLT(IY,10))                                       USRA   904
                  WRITE(20,5111)(OUTLT(IY,LK),LK=2,6),IMLX,OUTLT(IY,8),        USRA   905
           *  IMLY,IMLZ,(OUTLT(IY,LK),LK=11,16)                                USRA   906
      C                                                                        USRA   907
            IPLCNT=IPLCNT+3                                                    PLUS    54
                 IF(IPLNCT.GE.59)IPTSW(I)=.TRUE.                               USRA   909
      9824        CONTINUE                                                     USRA   910
      9830        CONTINUE                                                     USRA   911
            NCALC=LINES-ERRORS-NBSR-NBTR                                       USRA   912
            WRITE(ERR,165) LINES,NCALC,NBTR,NBSR,ERRORS                        USRA   913
        777 STOP                                                               USRA   914
      C     FORMATS FOR PROGRAM CONSTANTS OUTPUT                               USRA   915
      90    FORMAT(1H1,7X,*TABLE OF COMMODITY CLASS FACTORS FOR ALL LINES*,    PLUS    55
           -        40X,*PAGE*,I6/)                                           PLUS    56
      91    FORMAT(1H0,* STCC    LOSS   DAMAGE      CAR MILE COST*,            PLUS    57
           - 7X,*CAR DAY COST       CAR TARE         EMPTY RETURN      *,      PLUS    58
           - *CIRCUITY, LOCAL    CIRCUITY, INTERLINE*/,                        PLUS    59
           - 9X,*$ / NET TON       $ / CAR MILE          $ / CAR DAY       *,  PLUS    60
           - *WEIGHT                RATIO               RR TRAFFIC        *,   PLUS    61
           - *TRAFFIC*)                                                        PLUS    62
      92    FORMAT(1X,I4,F14.6,6F18.6)                                         PLUS    63
      93    FORMAT(///1H1,*DIRECT MAINTENANCE CLASS/COST TABLE*,40X,*PAGE*,    PLUS    64
           - I5/)                                                              PLUS    65
      94    FORMAT(1H0,*MILLIONS OF GROSS TON MILES CLASS*,10F9.3)             PLUS    66
      95    FORMAT(1H0,*DIRECT MAINTENANCE COSTS PER MILE *,10F9.0,//////)     PLUS    67
      96    FORMAT(///1X,*CAR-DAY/TRIP-FREQUENCY TABLE*)                       PLUS    68
      97    FORMAT(1H0,*FREQ     LCL.SEGMENT      LCL.SYSTEM       INTERLINE*///) PLUS 69
      98    FORMAT(1X,I4,3F15.2)                                               PLUS    70
      C     FORMATS FOR TAPE AND CARD READS                                    PLUS    71
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      80    FORMAT(3F5.2)                                                   PLUS        72
      81    FORMAT(10F8.2)                                                  PLUS        73
      82    FORMAT(2(F6.0,F6.3,F6.0))                                       PLUS        74
      100   FORMAT(4X,I2)                                                   PLUS        75
      101   FORMAT(7F10.6)                                                  PLUS        76
      1021  FORMAT(5F10.2,F10.0,F10.4,F10.2)                                PLUS        77
      1022  FORMAT(F10.4,7F10.4)                                            PLUS        78
      1023  FORMAT(4F10.4,4F10.2)                                           PLUS        79
      1024  FORMAT(F10.3,7F10.0)                                            PLUS        80
      1025  FORMAT(F10.0,F10.8,5F10.2,F10.0)                                PLUS        81
      1026  FORMAT(8F10.0)                                                  PLUS        82
      103   FORMAT(F1.0,F3.0,1X,3A2,A4,4F4.1,F3.0,F1.0,F4.0,F1.0,F3.1,F4.1, PLUS        83
           -F2.0,11F1.0,F3.3,5F1.0,F5.0,/,F1.0,F3.0,1X,3A2,A4,2(F6.0,F4.1), PLUS        84
           -F3.0,F2.0,F6.0)                                                 PLUS        85
        105 FORMAT(A3,10A3)                                                 PLUS2       26
      C     DATA HEADING FORMATS                                            PLUS        87
      106   FORMAT(10A4)                                                    PLUS        89
      107   FORMAT(15A4)                                                    PLUS        90
      108   FORMAT(10A3)                                                    PLUS        91
      109   FORMAT(9A4)                                                     PLUS        92
      C     FORMATS FOR ERROR MESSAGES                                      PLUS        93
      160   FORMAT(1H0,*DATA CARDS FOR SEGMENT *,A4,*ARE NOT IN PROPER 1-2 SEQ PLUS     94
           -UENCE*)                                                         PLUS        95
      161   FORMAT(1H0,*AAR CODE ON DATA CARDS DOES NOT MATCH TAPE FOR SEGMENT PLUS     96
           - *,A4,* AAR-CARD1= *,A4,* AAR-CARD2= *,I4,* AAR-TAPE= *,I4)     PLUS        97
      162   FORMAT(1H0,*STATE CODE ON DATA CARDS DOES NOT MATCH TAPE FOR SEGME PLUS     98
           -NT *,A4,* STATE-CARD1= *,3A2,* STATE-CARD2= *,3A2,* STATE-TAPE= *, PLUS     99
           - 3A2)                                                           PLUS       100
      163   FORMAT(1H0,*SEGMENT CODE ON DATA CARDS DOES NOT MATCH TAPE - - SEG PLUS    101
           -MENT-CARD1= *,A4,* SEGMENT-CARD2= *,A4,* SEGMENT-TAPE= *,A4)    PLUS       102
      164   FORMAT(1H0,*CALCULATIONS FOR SEGMENT *,A4,* NOT PERFORMED DUE TO PLUS      103
           -A CARD SEQUENCE OR SEGMENT CODE MISMATCH ERROR*)                PLUS       104
      165   FORMAT(1H0,//,24X,* === SUMMARY OF CALCULATIONS === *,/,1H0,20X,*T PLUS    105
           -OTAL NUMBER OF LINES CONSIDERED= *,I4,/,1H0,20X,*COMPLETELY CALCUL PLUS    106
           -ATED LINES= *,I4,/,1H0,20X,*PARTIALLY CALCULATED LINES (NO TRAFFIC PLUS    107
           -)= *,I4,/,1H0,20X,*NO CALCULATIONS - INCOMPLETE SEGMENT DATA= *,I4 PLUS    108
           -,/,1H0,20X,*NO CALCULATIONS - UNMATCHED DATA= *,I4)             PLUS       109
      166   FORMAT(1H0,* SEGMENT DATA IS INCOMPLETE OR MISSING FOR SEGMENT *, PLUS     110
           -A4,* NO CALCULATIONS WILL BE MADE*)                             PLUS       111
      167   FORMAT(1H0,* NO TRAFFIC DATA INPUT FOR SEGMENT *,A4,* - ONLY SALVA PLUS    112
           -GE AND REHAB WILL BE CALCULATED*)                               PLUS       113
      207   FORMAT(1H0,*SEGMENT *,A4,* HAS A *,I2,* MAN CREW - THE MAXIMUM VAL PLUS    114
           -UE OF 5 WILL BE USED*)                                          PLUS       115
      208   FORMAT(1H0,*SEGMENT *,A4,* HAS A *,I2,* MAN CREW - THE MINIMUM VAL PLUS    116
           -UE OF 2 WILL BE USED*)                                          PLUS       117
      190   FORMAT(1H0,*FREQUENCY ON SEGMENT *,A4,* IS *,I3,* - THE MAXIMUM VA PLUS    118
           -LUE OF 7 WILL BE USED*)                                         PLUS       119
        191 FORMAT(1H1,/*FREQUENCY ON SEGMENT *,A4,* IS *,I3,*- THE MINIMUM VA PLUS2    27
           -LUE OF 1 WILL BE USED*)                                         PLUS       120
      40    FORMAT(1H0,*AAR-TAPE HAD NO MATCH IN CF INDEX FOR SEGMNT *,A4,* - PLUS     121
           - AAR-CARD1= *,A3,* WILL BE USED*)                               PLUS       122
      41    FORMAT(1H0,*AAR-TAPE AND AAR-CARD1 HAD NO MATCH IN CF INDEX FOR SE PLUS    123
           -GMNT *,A4,* - NO CALCULATIONS WILL BE MADE*)                    PLUS       124
      223   FORMAT(1H0,*ON SEGMENT *,A4,* TOTAL LENGTH DOES NOT EQUAL THE SUM PLUS     125
           -OF 1 AND 2 TRACK LENGTHS - CAUTION*)                            PLUS       126
```

```
      C     FORMATS FOR OUTPUT PAGE HEADINGS                                PLUS
      171   FORMAT(1H1,A3,3X,10A3,8X,A4,3X,15A3,2X,3(1X,A2),10X,*PAGE*,I5//)  PLUS
      42    FORMAT(45X,*==== OUT OF SERVICE LINE =====*)                    PLUS
      1711  FORMAT(1H0,*=======  BASIC BRANCH LINE EVALUATION REPORT*,      PLUS
           -              *  ======*/)                                      PLUS
      1712  FORMAT(1H0,*LINE *,I2,*)  *,15A4,F12.0)                         PLUS
      1714  FORMAT(1H0,35X,*LISTING OF INTERMEDIATE CALCULATIONS*,/)        PLUS
      1717  FORMAT(1X,I2,*)  *,9A4,F13.5,I12,*)  *,9A4,F15.5)              PLUS
      11717 FORMAT(1X,I2,*)  *,9A4,F13.5)                                   PLUS
      172   FORMAT(1H0,46X,*TRAFFIC AND REVENUE REPORT*)                    PLUS
      1731  FORMAT(1H0,*====================  LOCAL TRAFFIC  ==========*,   PLUS
           -*============        ====================  CONRAIL TRAFFIC  *,  PLUS
           -*======================*)                                       PLUS
      1732  FORMAT(1H0,*===================  INTERLINE TRAFFIC  ========*,  PLUS
           -*============        ====================  TOTAL TRAFFIC  *,    PLUS
           -*======================*)                                       PLUS
      1733  FORMAT(1H0,*==================  NONLOCAL TRAFFIC  =========*,    PLUS
           -*==============*)                                               PLUS
      175   FORMAT(1H0,55X,*SHORT HAUL*,57X,*SHORT HAUL*,/1X,               PLUS
           -*STCC         CARS         TONS     $CONRAIL      $TOTAL     MILES*,  PLUS
           - 6X,                                                            PLUS
           -*STCC         CARS         TONS     $CONRAIL      $TOTAL     MILES*/)  PLUS
      1176  FORMAT(1H0,55X,*SHORT HAUL*,/1X,                                PLUS
           -*STCC         CARS         TONS     $CONRAIL      $TOTAL     MILES*)  PLUS
      176   FORMAT(1H0,I4,F12.0,F11.0,2F12.0,F11.0,I10,F12.0,F11.0,2F12.0,  PLUS
           - F11.0)                                                         PLUS
      185   FORMAT(1H0,23X,*LINE QUESTIONNAIRE DATA ITEMS*,                 PLUS
           -           36X,*RAILROAD COST FACTOR DATA*/)                    PLUS
      186   FORMAT(1X,* ITEM *,I2,*)  *,10A3,F12.3,10X,                     PLUS
           -       *CF *,I2,*)  *,10A4,F16.4)                               PLUS
      187   FORMAT(1X,* ITEM *,I2,*)  *,10A3,8X,A4,10X,                     PLUS
           -       *CF *,I2,*)  *,10A4,F16.4)                               PLUS
      2112  FORMAT (1H1)                                                    PLUS
      5110  FORMAT(1H0,*SEGMENT  STATE(S)   LENGTH*,15X,                    PLUS
           -  *NET REVENUE   TOTAL     TOTAL  REVENUE/  CARS/     REVENUE/  *,  PLUS
           -  *NET REV/     REVENUE/  NET REV/*,/                           PLUS
           -  * NUMBER    1--2--3   (MILES)      REVENUE   TEST VIII-A*,    PLUS
           -  *   CARS       TONS       MILE     MILE          CAR        CAR*,  PLUS
           -  *          TON        TON*,/)                                 PLUS
      C                                                                     PLUS
      5111  FORMAT(//,2X,A4,2X,3(1X,A2),F9.2,I13,F13.2,2I9,F10.2,           PLUS
           -   F8.2,F11.2,F10.2,F12.2,F10.2)                                PLUS
      C                                                                     PLUS
      5113  FORMAT(1H1,40X,*OPERATING CHARACTERISTICS SUMMARY*,/            PLUS
           -  1X,*SEGMENT  LENGTH    TOTAL    TOTAL   ANNUAL       *,       PLUS
           -  *AVERAGE SWITCHING TIME    TIME ASSIGNED   RESIDUAL *,        PLUS
           -  *RUNNING    MILES TO*/,* NUMBER    *,                         PLUS
           -  * MILES  CARLOADS    CARS    TRIPS   CAR/TRIP          *,     PLUS
           -  *PER TRIP         TO BRANCH       TIME - HRS + MIN  *,        PLUS
           -  *SERVING YARD   M. P. H.*/)                                   PLUS
      5114  FORMAT(2X,A4,F10.2,F11.2,2F9.2, F11.2,                          PLUS
           -   F9.0, * -*,F4.0,F10.0, * -*,F4.0,F10.0, * -*,                PLUS
           -  F4.0, F15.2, F12.2,///////)                                   PLUS
      C                                                                     PLUS
      C                                                                     PLUS
```

```
      9800 FORMAT(1H1,20X,*STATISTICAL SUMMARY OF LINES WHICH *,
          - *PASSED ALL TESTS*/, 47X, *NET*, 6X,
          -  *TOTAL*,11X,*REVENUE*,25X,*NET*,19X,*NET*,/
          - * SEGMENT  STATE(S)    LENGTH*,18X,*REVENUE*,4X,*LOADED   TOTAL*,
          - *    PER        CARS/     REVENUE/  REVENUE/  REVENUE/  *,
          - *REVENUE/*,/* NUMBER     1--2--3   (MILES)       REVENUE     *,
          - *TEST VIII-A   CARS      TONS    MILE          MILE        CAR*,
          - *          CAR          TON          TON*,/)
      C
      C
      C
      9801 FORMAT(//2X,A4,3X,3(1X,A2),F8.2,F13.2,F12.2,F10.2,2F8.2,
          -    F11.2,F13.2,F9.2,F11.2,///////)
      C
      C
      C
      9802 FORMAT(1H1,* STATISTICAL SUMMARY OF LINES WHICH FAILED *,
          -     *VIABILITY TEST *, 10A4,/)
      C
      C
      C
      9803 FORMAT (1H1,* STATISTICAL SUMMARY OF LINES WHICH PASSED ONLY *,
          -     *VIABILITY TEST *, 10A4,/)
      C
      C
      C
      1044 FORMAT(A3,A4,15A3,1X,3A2)
      C
      C
      15117 FORMAT(/,9X,*SEGMENT PASSED ALL TESTS*,/2X,3A2)
      C
      C
      8500 FORMAT(1H1,* STATISTICAL SUMMARY OF REQUIRED RATE INCREASES*
          -     ,60X,*PAGE  *,I5,//,11X,*SEG*,39X,*LENGTH*,18X,*TOTAL*,
          -     7X, *CAR*, 7X,*REVENUE/    NET REV/     REQUIRED*, /,
          -     *  STATE   NUMB*, 12X, *SEGMENT NAME*, 15X, *(MILES)*,
          -    4X,*REVENUE        COST*,7X,*LOADS        CAR          CAR*,
          -     8X, *INCREASE*)
      8510 FORMAT (/3(1X,A2),1X,A4,1X,12A3,1X,F8.2,1X,F11.0,1X,F11.0,
          -    1X, F9.0, 1X, F11.2, 1X, F11.2, 1X, F13.3)
           END
```

FIGURE 11

VARIABLE	DESCRIPTION	TYPE	FUNCTION
IPTSW (9)	Print Switch For	L	CON
LN	No. of Lines Printed	I	CON
FOUND	Flag Denoting Number Failing Test	I	CON
LM	Line Count for Second Print Group	I	CON
WHAT	Print Flag for Diagnostic Prints	L	CON
IFI	Denote if Test I Failed	L	CON
IFII	Denote if Test II Failed	L	CON
IFIII	Denote if Test III Failed	L	CON
IFIV	Denote if Test IV Failed	L	CON
IFV	Denote if Test V Failed	L	CON
IFVI	Denote if Test VI Failed	L	CON
IFVII	Denote if Test VII Failed	L	CON
IF VIII	Denote if Test VIII Failed	L	CON
IFVIIIB	Denote if Test VIIIB Failed	L	CON
IFBAD		L	CON
TAPE1	Tape unit number of the traffic tape	I	CON
TAPE2	Tape unit number for line segment data	I	CON
OUT	Unit Number for Output File	I	CON
ERR	Unit Number for Error File	I	CON
ERRORS	Number of errors in execution	I	CON
ZIP (60)	Array of output variables - Equivalenced to individual variables	R	Output
LINES	No. of lines considered for analysis	I	CON
CD(7,3)	Local to Segment, Local to System, and Interline Car Days for 1-7 Day Frequency of Service	R	Input

VARIABLE	DISCRIPTION	TYPE	FUNCTION
CD(7,3)	Car Days per Day for Local to Segment, Local System, and Interline	R	In
DRM (2,10)	Direct Maintenance Cost/Mile for 10 Freight Classes	R	In
RR	Railroad Number	I	In
RNAME(10)	Railroad Name	R	In
CFH(48,10)	Cost Factor Headings	I	In
CF(48)	Cost Factors for Up to 10 Railroads	R	In
TCC (50,7)	Cost & Weight Data for Standard Transportation Commodity Code	R	In
TH (19,15)	Task Headings	I	In
SEGROW (48,10)	Segment Data Headings	I	In
STUBS (72,9)	Headings for Intermediate Calculations	I	In
PAGE	Page Number	I	CON
ARR	Railroad Code - i.e. 622 for Penn Central	I	In
SEGMENT	Segment Number	R	In
NAME (15)	Segment Name	R	In
STATE (3)	State Codes	R	In
T5 (500)	Index of Segments	I	CON
T4 (500)	Array of Segment Numbers	I	CON
T6	No of Segments Read	I	CON
POSINN	Desired Tape Position	I	CON
IACT	Actual Tape Postion	I	CON

VARIABLE	DESCRIPTION		TYPE	FUNTION
LOCAL (50, 5)	Local	Cars, Tons, ConRail Dollars, Total Dollars	R	In
CONRL (50,5)	ConRail	and Short Haul Car Miles by	R	In
INTER (50,5)	Interline	Standard Transportation Commodity Code	R	In
T2 (1000)	Indexes of Segment Traffic Information		I	CON
T3 (1000)	Segment No. Corresponding to Traffic Information		I	CON
T1	No. of Segment entries on traffic tape		I	CON
ACTUAL	Current Tape Position		I	CON
POSITN	Positn of Segment Tape having requested information		I	CON
NBTR	Number of Tape Records		I	CON
NBSR	Number of Segment Records		I	CON
IFLAG	ERROR FLAG			
MTD	Missing Tape Data Flag		I	CON
MSD	Missing Segment Data Flag		I	CON
ERR1	Segment Number Mismatch		I	CON
ERR2	Card Sequence Error		I	CON
ERR3	Railroad Code Mismatch		I	CON
ERR4	State Code Mismatch		I	CON
SEG(48)	Line Segment Characteristics		R	In
DOUT (30)	Disk output array for Sub-segment Analysis		R	OUT
TOTAL (50,5)	Local, Conrl, and Inter Arrays Totaled		R	OUT
CONINT(50,5)	Conrl and Inter Arrays Totaled		R	INT
TASK (19)	Array of results from Viability Analysis		R	OUT
LUH	Locomotive Unit Hours		R	INT
LUHC	Locomotive Unit Hour Costs		R	INT
KREW	Crew Size		I	CON
CH	Crew Hours		R	INT

	TASK (1)	-	Total Carrier Branch Revenue
	TASK (2)	-	On Branch Operating Costs
Test I	TASK (3)	-	Net Revenue after on branch operating costs
	TASK (4)	-	Branch Maintenance Costs
Test II	TASK (5)	-	Net Revenue After Branch Maintenance
	TASK (6)	-	Return on Branch Salvage Value
Test III	TASK (7)	-	Net Revenue After Return on Branch Salvage
	TASK (8)	-	Branch Overhead Costs
Test IV	TASK (9)	-	Net Revenue After Branch Overhead Costs
	TASK (10)	-	Property Taxes on Branch
Test V	TASK (11)	-	Net Revenue After Property Taxes
	TASK (12)	-	Off-Branch Operating Costs
Test VI	TASK (13)	-	Net Revenue After Off-Branch Operating Costs
	TASK (14)	-	Overhead (Bridge) Traffic Revenue
Test VII	TASK (15)	-	Net Revenue After Overhead Traffic Revenue
	TASK (16)	-	Upgrading Cost to FRA Track Class I
Test VIII	TASK (17)	-	Net Revenue After Upgrading to FRA Track Class I
	TASK (18)	-	Upgrading Cost to FRA Track Class II
Test VIII-B	TASK (19)	-	Net Revenue After Upgrading to FRA Track Class II

Viability Analysis Task Array

VARIABLE	DESCRIPTION	TYPE	FUNCTION
CHC	Crew Hour Costs	R	INT
SEC	Station Employee Costs	R	INT
FREAK	Frequency of Trains (Decimal)	R	INT
FQ	Frequency of Trains (Integer)	R	INT
RFQ	Frequency of Trains (Whole)	I	INT
OBCMC	On Branch Car Mile Costs	R	INT
OBCDC	On Branch Car Day Costs	R	INT
TCD (49)	Total Car Days By Commodity	R	INT
OBFCC	On Branch Freight Car Costs	R	INT
CM	Caboose Miles	R	INT
CMC	Caboose Mile Costs	R	INT
CB DAYS	Caboose Days	R	INT
CBDC	Caboose Day Costs	R	INT
OBCAB	On Brn-ch Caboose Costs	R	INT
LOTSC	Local Total Switching Costs	R	INT
GT	Gross Tons	R	INT
GTC	Gross Ton Class	R	INT
DMC	Direct Maintenance Cost	R	INT
IMC	Indirect Maintenance Cost	R	INT
NBMM	Maintenance Siding and Yard Tracks	R	INT
NBMO	Normalized Branch Maintenance Main & Other	R	INT
TTM	Total Track Miles	R	INT
TSSV	Gross Scrap Value, Steel	R	INT
TSVGT	Gross Scrap Value, Good Ties	R	INT
TSVFPT	Gross Scrap Value, Fair/Poor Ties	R	INT
LSV	Gross Scrap Value, Land		

VARIABLE	DESCRIPTION	TYPE	FUNCTION
GSV	Gross Scrap Value	R	INT
TDRC	Total Dismantal anf Removal Cost	R	INT
NSV	Net Scrap Value	R	INT
RET NSV	Return on Net Salvage Value	R	INT
MOW	Maintenance of Way Superintendence	R	INT
TRANS	Transportation Superintendence	R	INT
MCLAC	Clerical Support/Accidents	R	INT
TCLAC	Transportation - Clerical Support/Accidents	R	INT
OBCM	Off-Branch Car Ton Miles	R	INT
OBTTM	Off-Branch Tare Ton Miles	R	INT
OBNTM	Off-Branch Net Ton Miles	R	INT
NISC	Number of Intertrain Swithces, ConRail	I	INT
NISI	Number of Intertrain Switches, Interline	I	INT
NIS	Number of Intertrain Switches, Total	R	INT
OFBCMI	Off-Branch Car Miles, Interchange	R	INT
FBCMIE	Off-Branch Car Miles, Interchange with Circuity & Empty Return	R	INT
FBTTMI	Interline Off-Branch Tare Ton Miles	R	INT
FBNTMI	Interline off-Branch Net Ton Miles	R	INT
OFBCMS	Off-Branch Car Miles, ConRail	R	INT
FBCMCE	Off-Branch Car Miles, ConRail With Circuity & Empty Return	R	INT
FBTTMC	ConRail Off-Branch Tare Ton Miles	R	INT
FBNTMC	ConRail Off-Branch Net Ton Miles	R	INT
OBGTM	Off-Branch Gross Ton Miles	R	INT
GTMC	Gross Ton Miles Costs	R	INT
CIS	Total Number of ConRail Cars	R	INT
IS	Cost of Industry Switching	R	INT

VARIABLE	DESCRIPTION	TYPE	FUNCTION
CI	Cars Interchanges (whole)	R	INT
ICI	Cars Interchanged (integer)	I	INT
ICSC	Interchange Switching Costs	R	INT
ITSC	Intertrain Switching Costs	R	INT
TSC	Total Switching Costs	R	INT
LDC	Loss and Damage Cost	R	INT
OFBCDC	Off-Branch Car Day Costs	R	INT
OFBCMC	Off-Branch Car Mile Costs	R	INT
OBCD	Off-Branch Car Days	R	INT
ICSD	Interchange Switching Days	R	INT
RTD	RUNNING Time Days	R	INT
ITSD	Intertrain Switchung Days	R	INT
OBSD	Off-Branch Switching Days	R	INT
ICSDI	Interline Interchange Switching Days	R	INT
RTDI	RUNNING Time Days, Interline	R	INT
ITSDI	Intertrain Switching Days, Interline	R	INT
OBSDI	Off-Branch Switching Days, ConRail	R	INT
OFBCML	Off-Branch Car Miles, ConRail	R	INT
OBCDI	Off-Branch Car Days, Interline	R	INT
OFBCM	Off-Branch Car Miles	R	INT
OFBFCC	Off-Branch Freight Car Costs	R	INT
SCO	Station Clerical Operating Costs	R	INT
FRA1	Upgrading Cost to FRA Track Class I	R	INT
FRA2	Upgrading Cost to FRA Track Class II	R	INT
DELTA	Difference in Upgrading Costs	R	INT
KAZAM	Number of Non-Zero Traffic & Revenue Records	I	CON
IKTEST	Flag for Printing Out Non-Local Traffic	I	CON
IX	Print Counter for Intermediate Variable Print	I	CON

VARIABLE	DESCRIPTION	TYPE	FUNCTION
TESTLS (18)	Output Array	R	OUT
TESTK (14)	Output Array	R	OUT
WHLIST (9)	Index of Tasks Which Are Tests	I	CON
IFGOOD	Flag Noting the Failure of A Test	L	CON
TBX	Switching Time Per Trip (Minutes)	R	IMT
IX	Switching Time Per Trip (Hours)	I	IMT
XTIME	Residual Running Time (Decimal Hours)	R	INT
OUTLT (500,16)	Segment Summary Output Arra	R	OUT
SNAM (500,15)	Segment Name Indexed Summary Array	R	OUT
RQUI (500,3)	Segment Summary of Cost Data	R	OUT
IMLX	Total Revenue	I	OUT
IMLY	Total Cars	I	OUT
IMLZ	Total Tons	I	OUT
IPAG	Page Count for Summary Print	I	OUT
ICNT	Line Count for Summary Print	I	OUT
IPTSW (9)	Print Switch for Page Headers	L	OUT
IFTRT(9,10)	Page Headers for the 9 tests' summaries	I	OUT
IPLNCT	Line Count for Print OUt	I	OUT
NCALC	Number of Line Segments Calculated	I	OUT
KREWT	Flag denoting error in crew size	L	CON
INCREW	Crew size in error	I	OUT
ITRIPS	Flag denoting error in trips	L	CON

TESTLS (1)	=	Segment Code
TESTLS (2)	=	First State Code
TESTLS (3)	=	Second State Code
TESTLS (4)	=	Third State Code
TESTLS (5)	=	Length In Miles
TESTLS (6)	=	Total Revenue
TESTLS (7)	=	Loss Thru Test VIII - A
TESTLS (8)	=	Total Cars
TESTLS (9)	=	Total Tons
TESTLS (10)	=	Revenue Per Mile
TESTLS (11)	=	Cars Per Mile
TESTLS (12)	=	Revenue Per Mile
TESTLS (13)	=	Loss Per Car
TESTLS (14)	=	Revenue Per Ton
TESTLS (15)	=	Loss Per Ton
TESTLS (16)	=	Total Cost
TESTLS (17)	=	Net Revenue Per Car
TESTLS (18)	=	Required Rate Increase

TESTLS ARRAY DEFINITIONS

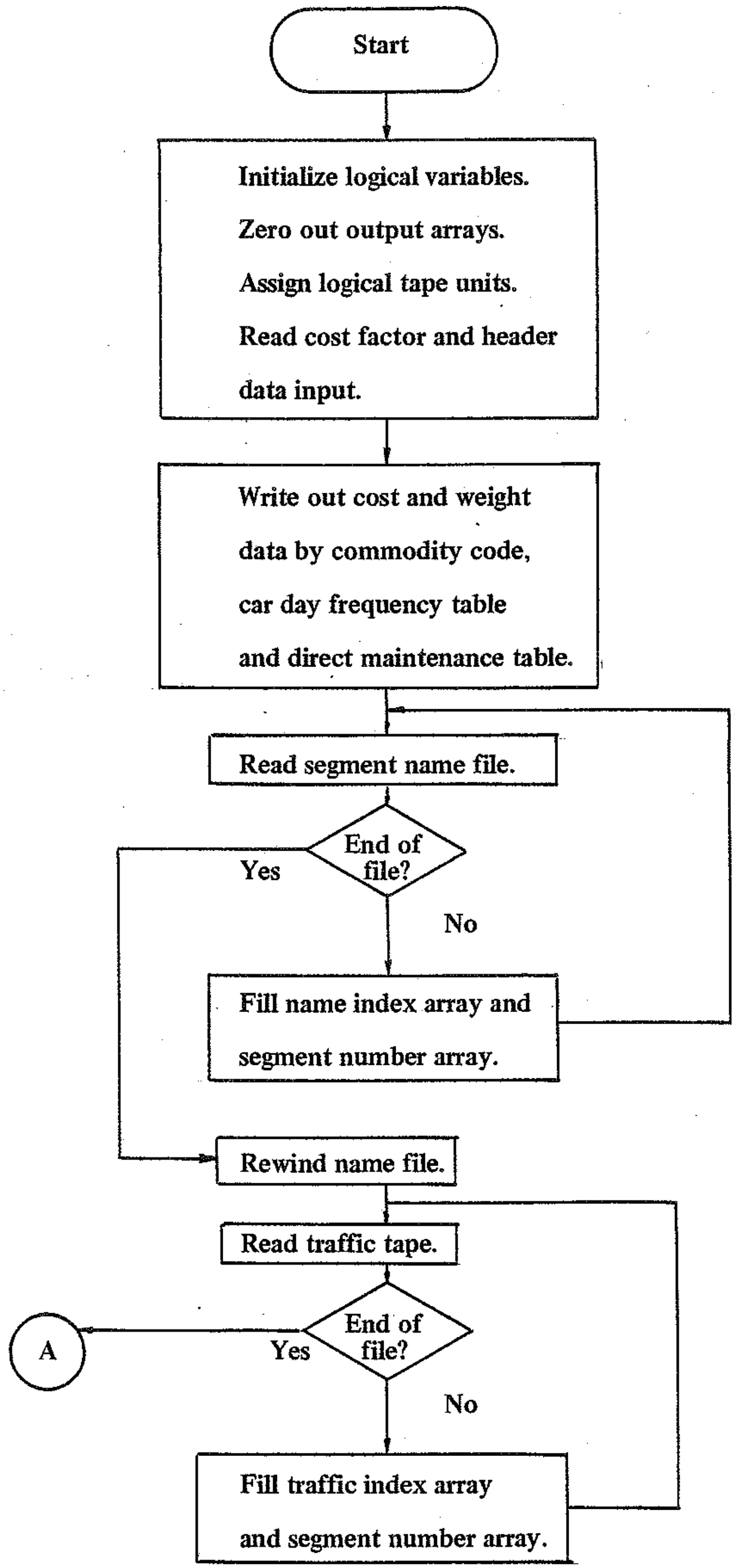
TESTK	(1)	Segment Number
TESTK	(2)	Length in Miles
TESTK	(3)	Total Carloads
TESTK	(4)	Total Cars
TESTK	(5)	Annual Trips
TESTK	(6)	Average Cars Per Trip
TESTK	(7)	Switching Time Per Trip (Hours)
TESTK	(8)	Switching Time Per Trip (Minutes)
TESTK	(9)	Time Assigned to Branch (Hours)
TESTK	(10)	Time Assigned to Branch (Minutes)
TESTK	(11)	Residual Running Time (Hours)
TESTK	(12)	Residual Running Time (Minutes)
TESTK	(13)	Miles to Serving Yard
TESTK	(14)	Miles Per Hour

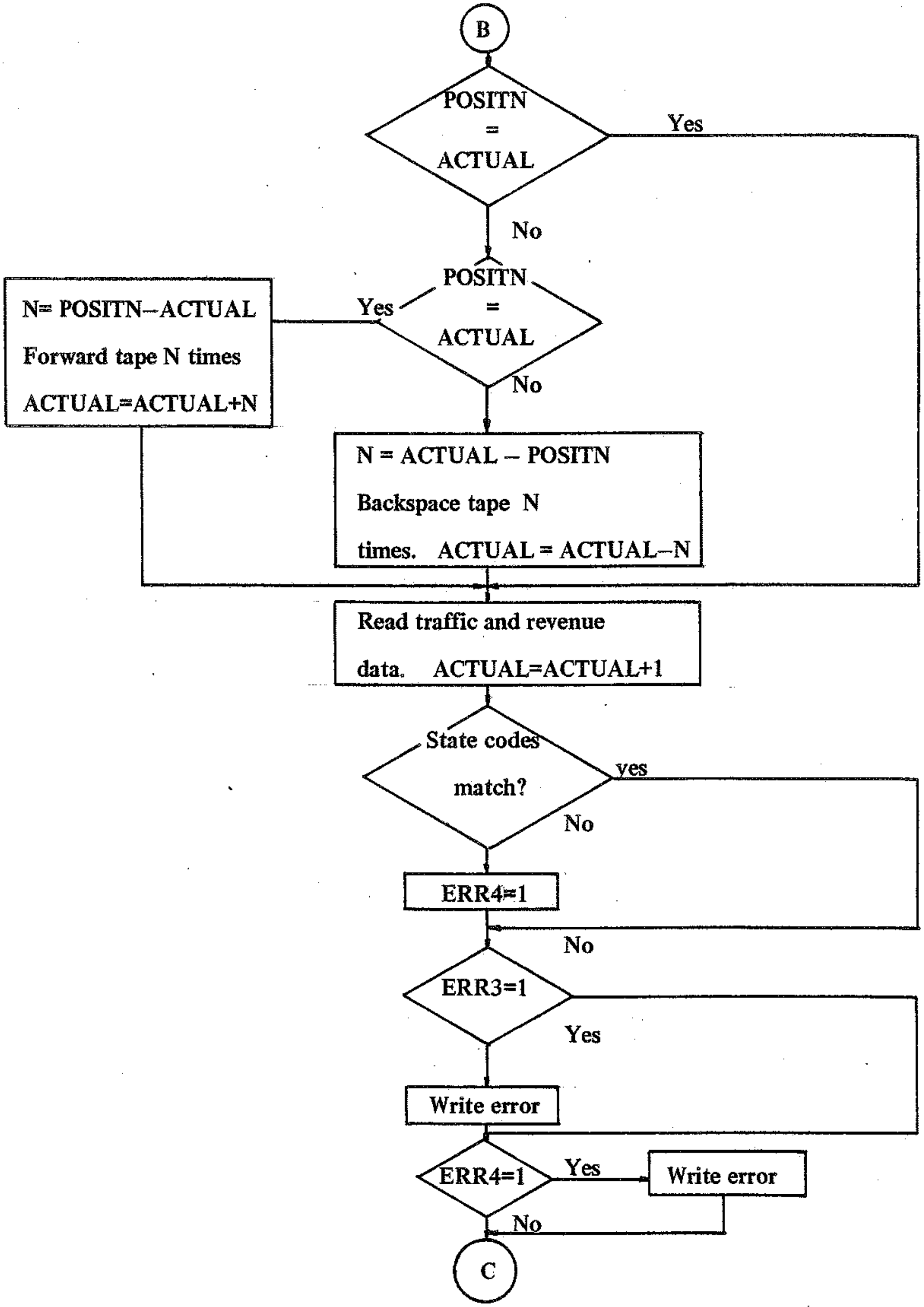
TESTK ARRAY DEFINITION

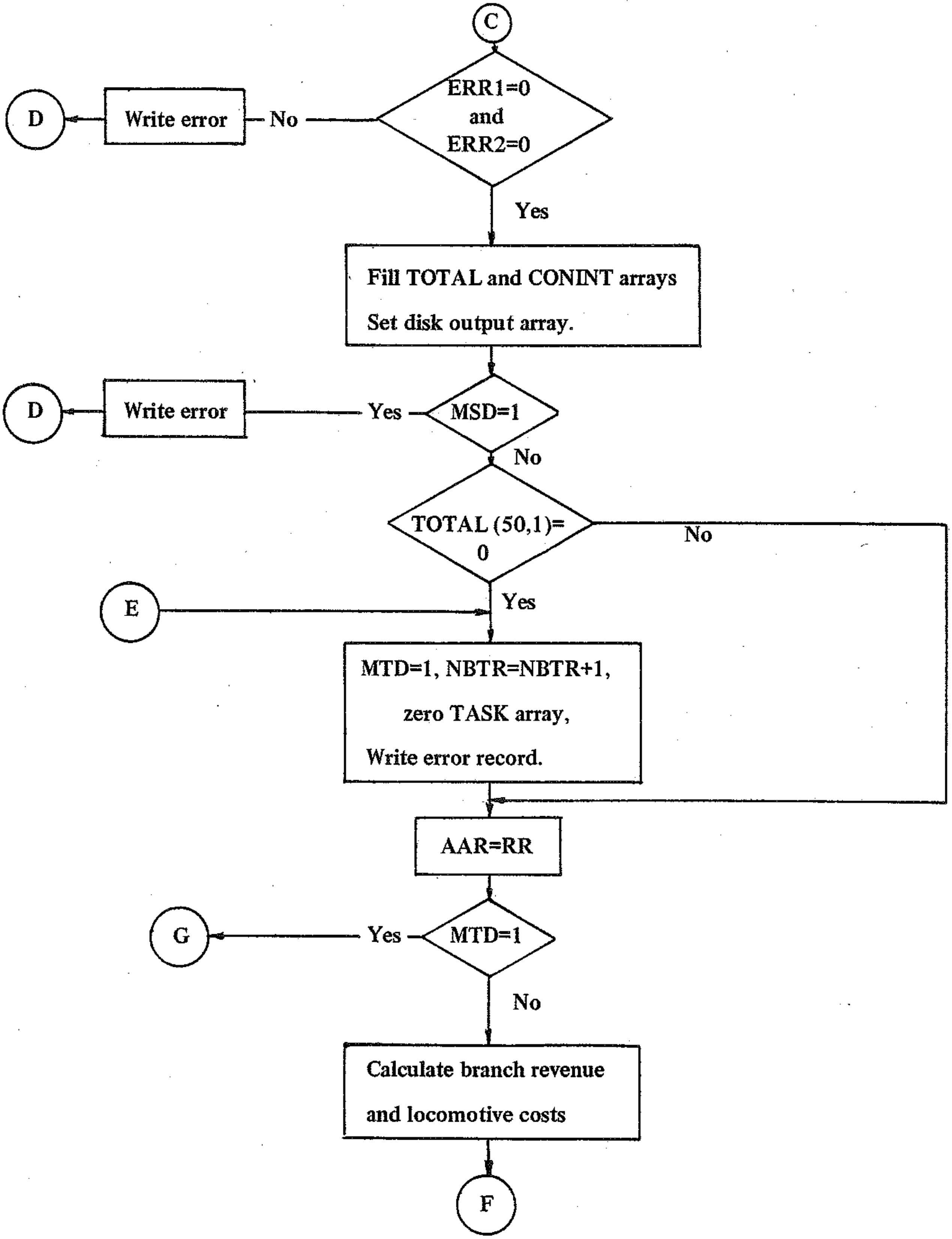
OUTLT	(N,1)	Task That Segment Failed
OUTLT	2	First State Code
OUTLT	3	Second State Code
OUTLT	4	Third State Code
OUTLT	5	Length in Miles
OUTLT	6	Total Revenue
OUTLT	7	Loss Thur Test VIII- A
OUTLT	8	Total Cars
OUTLT	9	Total Tons
OUTLT	10	Revenue Per mile
OUTLT	11	Cost Per Mile
OUTLT	12	Revenue Per Car
OUTLT	13	Loss Per Car
OUTLT	14	Revenue Per Ton
OUTLT	15	Loss Per Ton

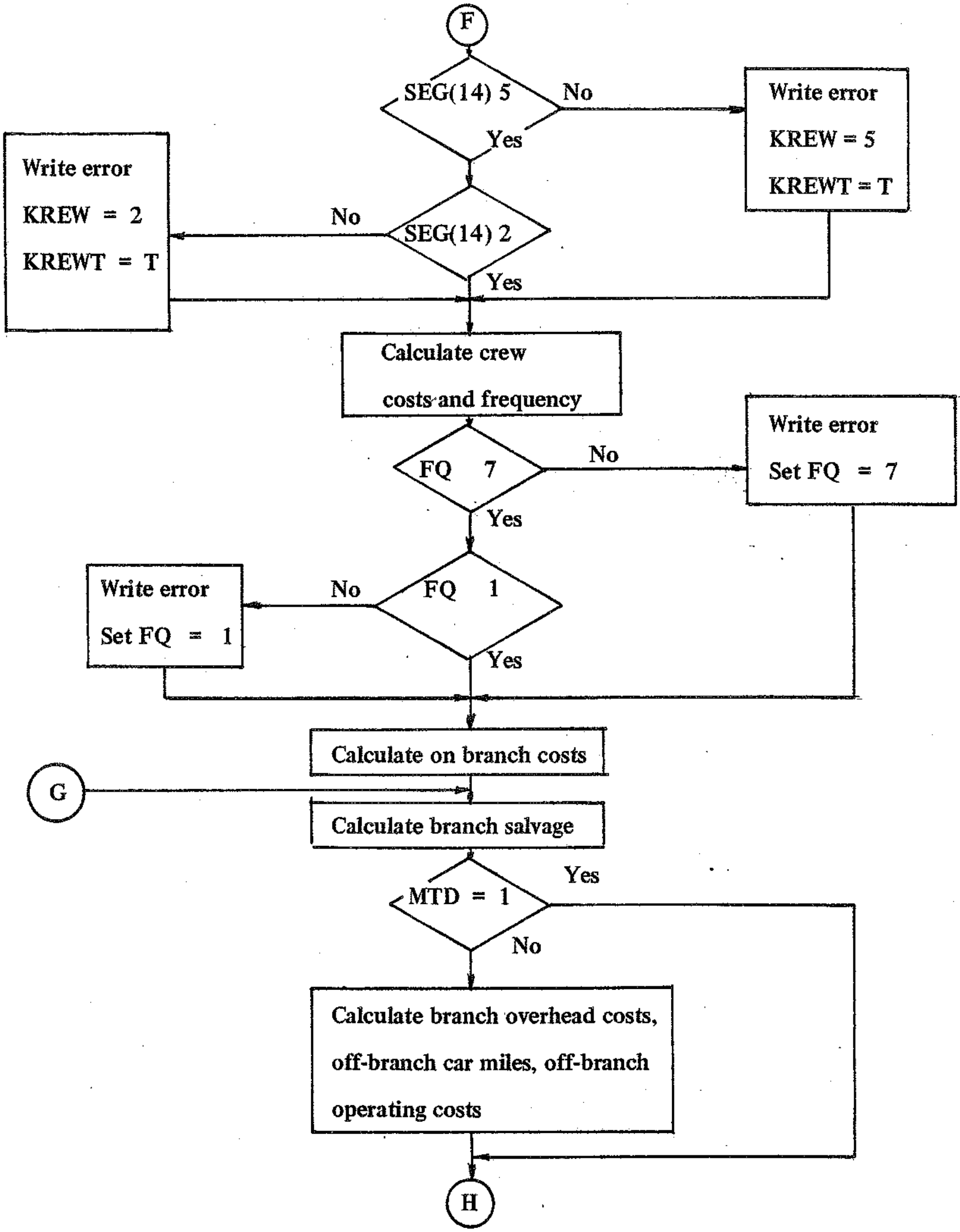
OUTLT ARRAY DEFINITIONS

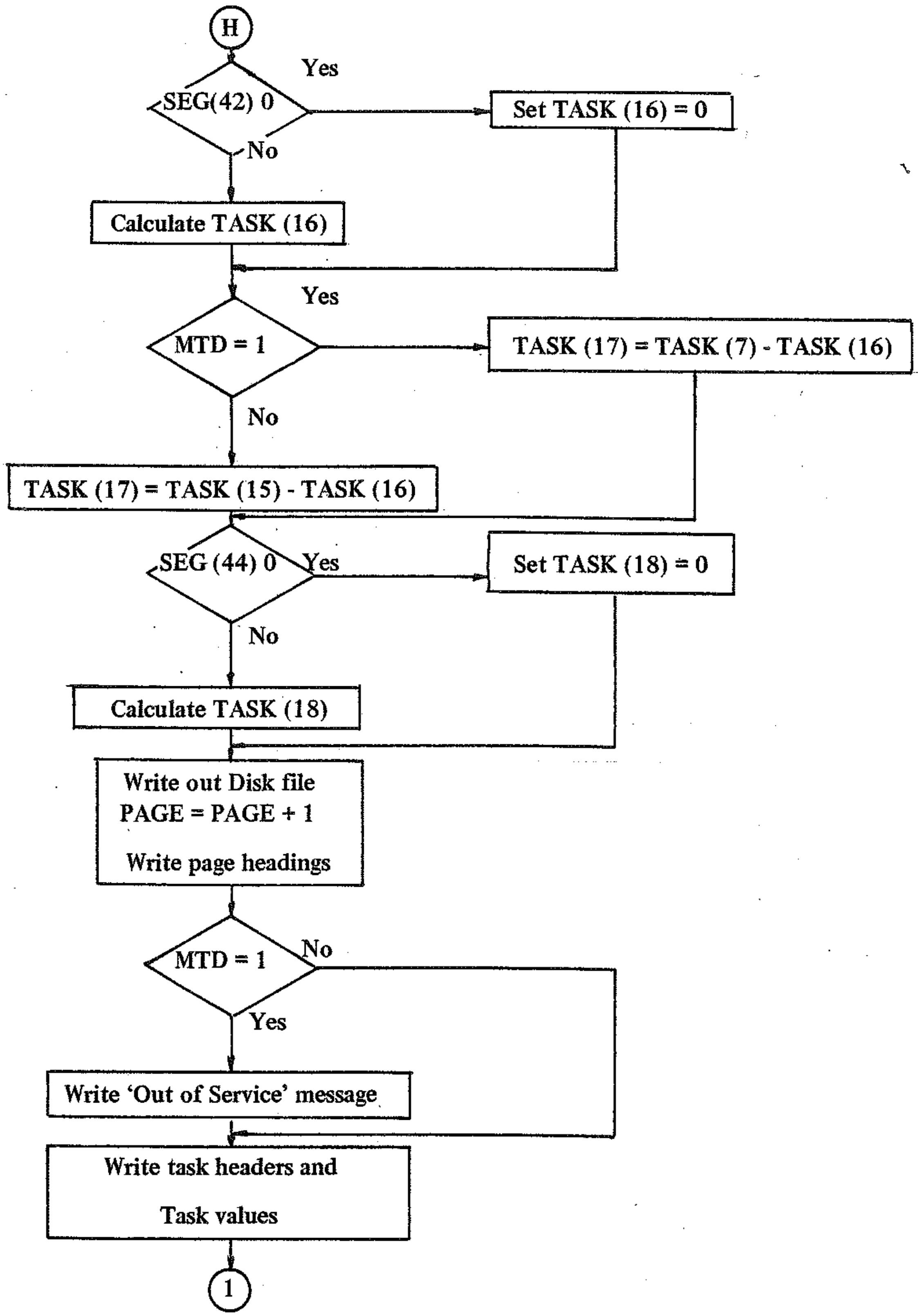
FIGURE 12

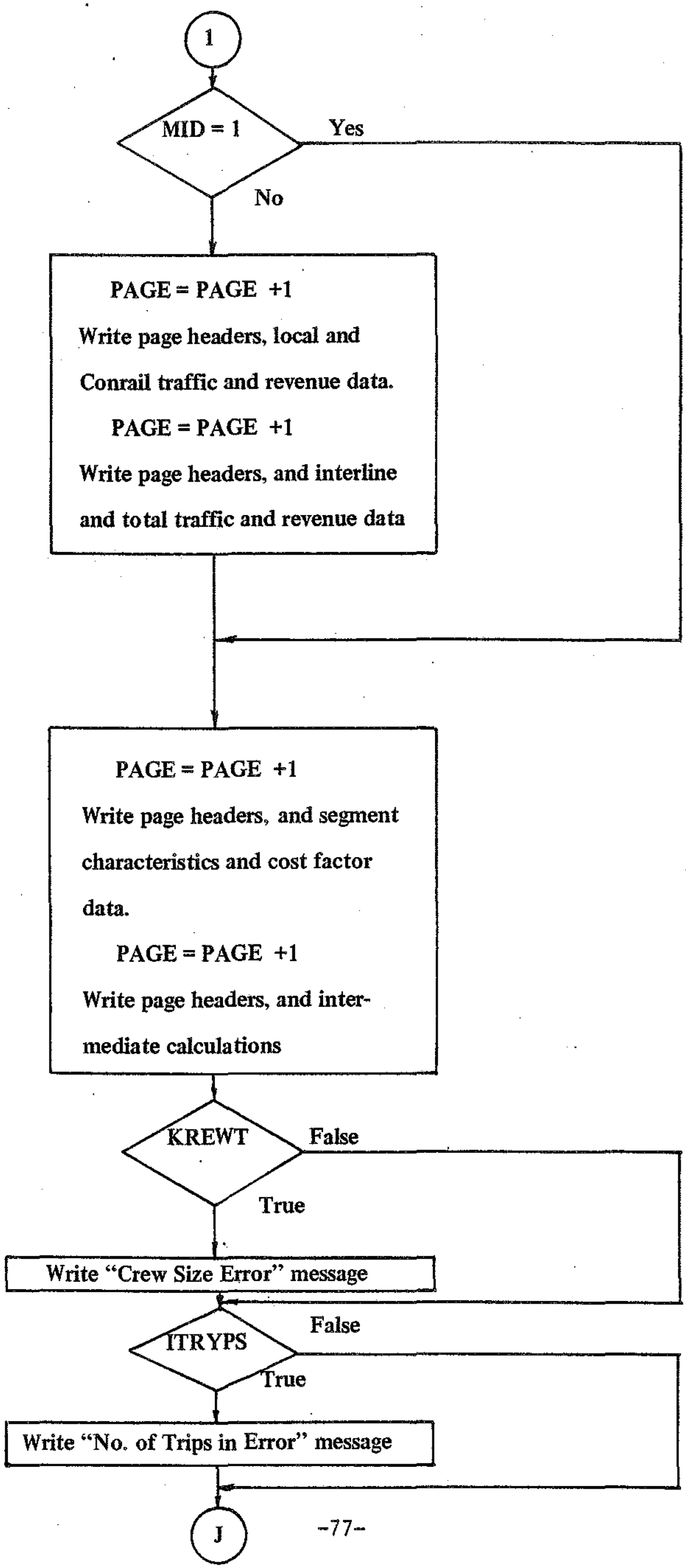

Start
Initialize logical variables.
Zero out output arrays.
Assign logical tape units.
Read cost factor and header data input.
Write out cost and weight data by commodity code, car day frequency table and direct maintenance table.
Read segment name file.
End of file?
Yes
No
Fill name index array and segment number array.
Rewind name file.
Read traffic tape.
End of file?
Yes
A
No
Fill traffic index array and segment number array.

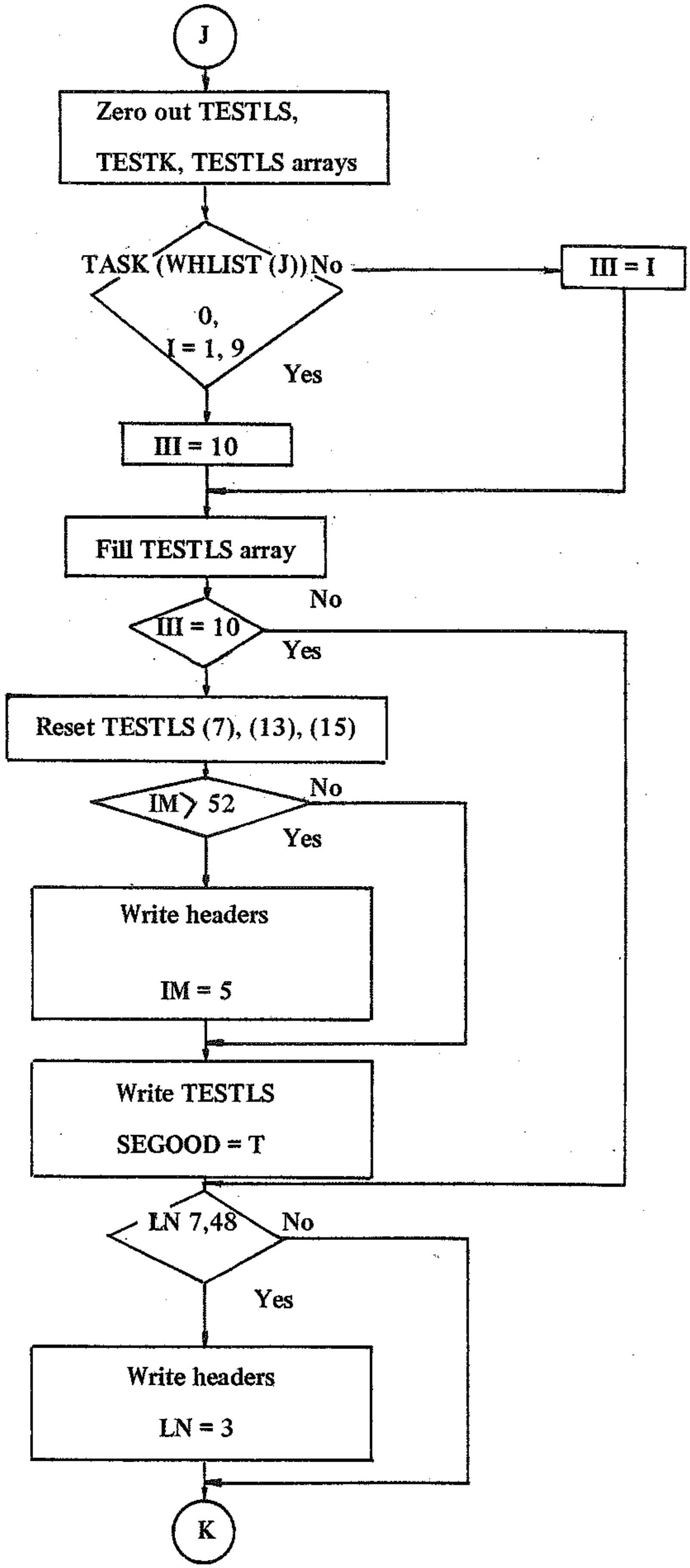

B
POSITN
=
ACTUAL
Yes
No
POSITN
=
ACTUAL
Yes
N= POSITN–ACTUAL
Forward tape N times
ACTUAL=ACTUAL+N
No
N = ACTUAL – POSITN
Backspace tape N
times. ACTUAL = ACTUAL–N
Read traffic and revenue
data. ACTUAL=ACTUAL+1
State codes
match?
yes
No
ERR4=1
No
ERR3=1
Yes
Write error
ERR4=1
Yes
Write error
No
C

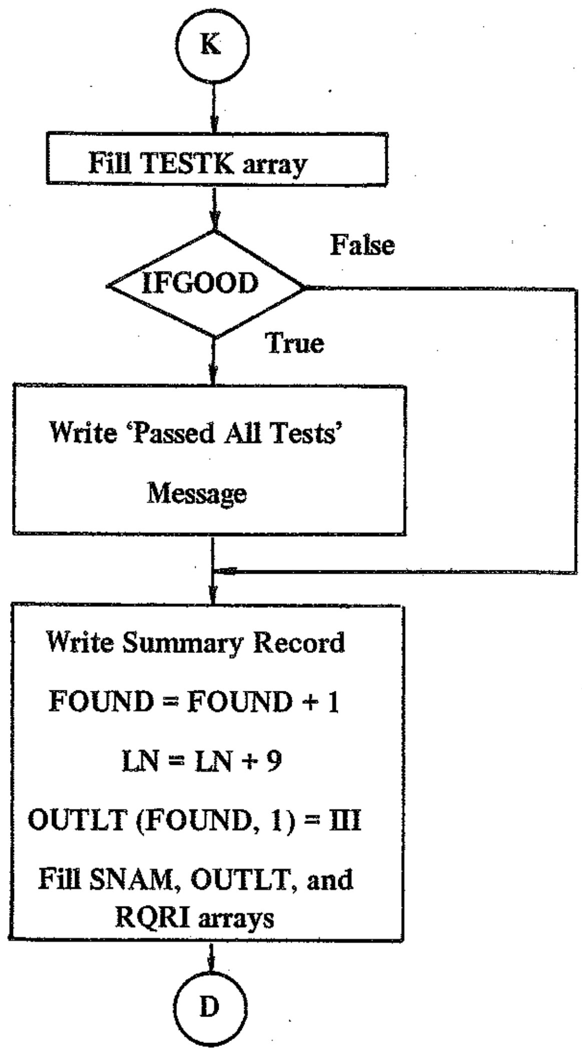

C
ERR1=0
and
ERR2=0
No
Write error
D
Yes
Fill TOTAL and CONINT arrays
Set disk output array.
MSD=1
Yes
Write error
D
No
TOTAL (50,1)=
0
No
Yes
E
MTD=1, NBTR=NBTR+1,
zero TASK array,
Write error record.
AAR=RR
MTD=1
Yes
G
No
Calculate branch revenue
and locomotive costs
F

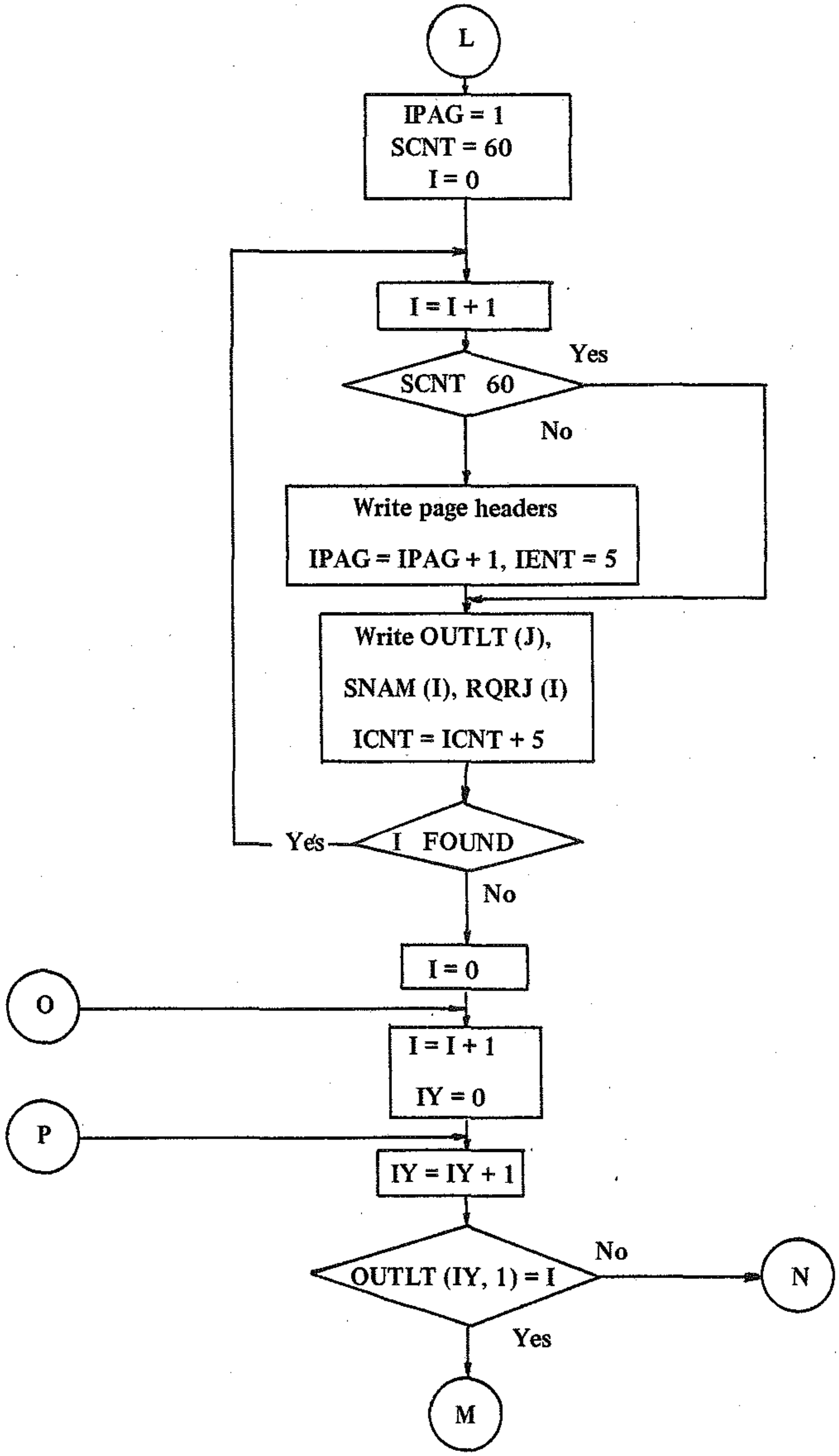

F
SEG(14) 5
No
Yes
Write error
KREW = 5
KREWT = T
Write error
KREW = 2
KREWT = T
No
SEG(14) 2
Yes
Calculate crew
costs and frequency
FQ 7
No
Yes
Write error
Set FQ = 7
Write error
Set FQ = 1
No
FQ 1
Yes
Calculate on branch costs
G
Calculate branch salvage
MTD = 1
Yes
No
Calculate branch overhead costs,
off-branch car miles, off-branch
operating costs
H

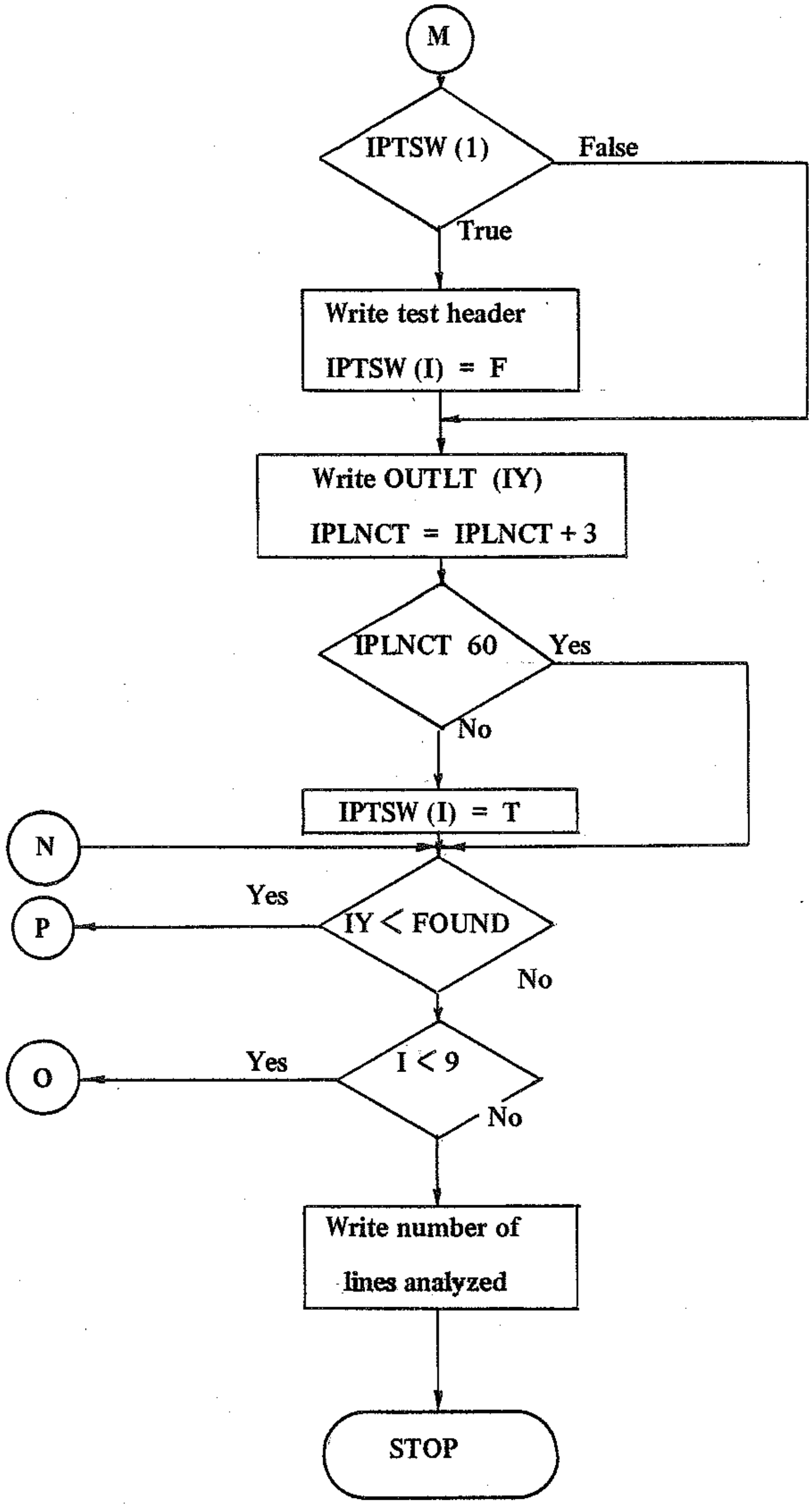

H
SEG(42) 0
Yes
Set TASK (16) = 0
No
Calculate TASK (16)
Yes
MTD = 1
TASK (17) = TASK (7) - TASK (16)
No
TASK (17) = TASK (15) - TASK (16)
SEG (44) 0
Yes
Set TASK (18) = 0
No
Calculate TASK (18)
Write out Disk file
PAGE = PAGE + 1
Write page headings
MTD = 1
No
Yes
Write 'Out of Service' message
Write task headers and
Task values
1


1
MID = 1
Yes
No
PAGE = PAGE +1
Write page headers, local and
Conrail traffic and revenue data.
PAGE = PAGE +1
Write page headers, and interline
and total traffic and revenue data
PAGE = PAGE +1
Write page headers, and segment
characteristics and cost factor
data.
PAGE = PAGE +1
Write page headers, and inter-
mediate calculations
KREWT
False
True
Write "Crew Size Error" message
ITRYPS
False
True
Write "No. of Trips in Error" message
J


J
Zero out TESTLS,
TESTK, TESTLS arrays
TASK (WHLIST (J)) 0,
I = 1, 9
No
III = I
Yes
III = 10
Fill TESTLS array
III = 10
No
Yes
Reset TESTLS (7), (13), (15)
IM > 52
No
Yes
Write headers
IM = 5
Write TESTLS
SEGOOD = T
LN 7,48
No
Yes
Write headers
LN = 3
K


K
Fill TESTK array
False
IFGOOD
True
Write 'Passed All Tests' Message
Write Summary Record
FOUND = FOUND + 1
LN = LN + 9
OUTLT (FOUND, 1) = III
Fill SNAM, OUTLT, and RQRI arrays
D


L
IPAG = 1
SCNT = 60
I = 0
I = I + 1
SCNT 60
Yes
No
Write page headers
IPAG = IPAG + 1, IENT = 5
Write OUTLT (J),
SNAM (I), RQRJ (I)
ICNT = ICNT + 5
I FOUND
Yes
No
I = 0
O
I = I + 1
IY = 0
P
IY = IY + 1
OUTLT (IY, 1) = I
No
N
Yes
M


M
IPTSW (1)
False
True
Write test header
IPTSW (I) = F
Write OUTLT (IY)
IPLNCT = IPLNCT + 3
IPLNCT 60
Yes
No
IPTSW (I) = T
N
Yes
P
IY < FOUND
No
Yes
O
I < 9
No
Write number of
lines analyzed
STOP

MODIFICATIONS TO THE USRA PROGRAM - THE MICHIGAN VERSION

MODIFICATIONS TO THE USRA PROGRAM - THE MICHIGAN VERSION

This section of the report concerns itself with a description of the changes made in the USRA version of the Viability Analysis to reflect those modifications suggested by R. L. Banks and Associates. A single Penn Central segment (394) as analyzed by USRA has been chosen as a means of indicating how each of the programmatic and input file changes effects the cost component estimates as displayed in the "Basic Branch Line Evaluation Report". Figures 13 and 14 present this report as produced through the execution of the USRA (Figure 13) and Michigan (Figure 14) versions of the program. Note that the estimated revenue in both reports is the same, but most of the associated costs vary. This is a result of the fact that this Department objects to the way in which the USRA allocated costs to a line not to its methodology in determining revenue. Table 1 indicates which of the various component costs within each of the nine major cost categories vary by analytical approach. The Michigan approach generally associates lower costs with the operation of a line due to the adoption of the reasoning argued by Banks et al. The exclusion of unavoidable costs from the calculation of each major cost category invariably reduces the apparent cost of a line's operation. Table 1, in giving a cost by cost breakdown, suggests which of the component costs are subject to reduction, if not elimination, and which are immune to the logic of the Michigan approach. One should note that all data used in the original analysis is 1973 specific. The USRA has recommended the application of certain factors to make the various component costs more descriptive of a projected 1976 situation. Where these factors have been used is shown in Table 1. Other figures within this section may include data obtained through the application of these factors without expressly stating such.

Before proceeding with a discussion of specific program modifications, it should be noted that the component costs used therein have been taken directly from the "Table of Intermediate Calculations" which have been supplied for both the USRA and the Michigan Analyses (see Figures 15 and 16). Other information concerning the physical and operating characteristics of the exemplary segment (394) and the railroad specific "cost factors", as used in the USRA model and as modified for use in the Michigan Model, are presented in Figures 17 and 18.

In the following discussion, when data is taken from the table of intermediate calculations, it shall be noted by an IC in parentheses--e.g., Locomotive Unit Hours (IC). Likewise, data from the "Line Questionnaire" shall be indicated with an (LQ) while railroad cost factors shall be noted by (RC). In the formulas below, data from the LQ will be represented as, for example, SEG(1) rather than by "item" 1 as is used in Figures 17 and 18.

Table 1 indicates that this category of costs is composed of six components: LUHC, CHC, SEG, OBFCC, OBCAB and LOTSC. Inspection of the data specific to each methodology reveals that the LUHC, CHC, and OBCAB are the only component costs within this category that differ by accounting system. Each of these shall be discussed in turn.

1) LOCOMOTIVE UNIT HOUR COST (LUHC)

The USRA calculated this cost by means of the following Fortran IV statement: LUHC = CF(1) *LUH

Where:

CF(1) = $16.39	(RC) - Figure 5
LUH = 300 hours	(IC) - Figure 3

By substitution, we find that:

LUHC = $16.39 x 300 = $3917 which can be verified by consulting Figure 15.

The following Fortran IV statements have been placed within the viability analysis to remove those locomotive related costs which cannot be avoided with line abandonment.

```
ALCRLB  =  CF(44)/CF(1)
RLBX  = 1
If (LUH/SEG(12).GE.2000) RLBX = ALCRLB
LUHC  = CF(1) * LUH * RLBX
```

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=========== Basic Branch Line Evaluation Report ===========

Line 1)	Carrier Branch Revenue	219986.
Line 2)	On-Branch Operating Costs	39884.
Line 3)	Test I Net Revenue After On-Branch Operating Costs	180102.
Line 4)	Normal Branch Maintenance Costs	98950.
Line 5)	Test II Net Revenue After Normal Branch Maintenance Costs	81152
Line 6)	Return On-Branch Salvage Value	39459.
Line 7)	Test III Net Revenue After Return On-Branch Salvage Value	41693.
Line 8)	Branch Overhead Costs	4278.
Line 9)	Test IV Net Revenue After Branch Overhead Costs	37415.
Line 10)	Property Taxes On-Branch	0.
Line 11)	Test V Net Revenue After Property Taxes On-Branch	37415.
Line 12)	Off-Branch Operating Costs	112419.
Line 13)	Test VI Net Revenue After Off-Branch Operating Costs	-75004.
Line 14)	Overhead Bridge Traffic Revenue	0.
Line 15)	Test VII Net Revenue After Adding Bridge Traffic Revenue	-75004.
Line 16)	Rehabilitation Cost to FRA Track Class I	60589.
Line 17)	Test IIIA Net Revenue After Improving To Track Class I	-135592.
Line 18)	Rehabilitation Cost To FRA Track Class II	201102.
Line 19)	Test VIIIB Net Revenue Atfer Improving To Track Class II	-276106.

FIGURE 13

============= Basic Branch Line Evaluation Report ============

Line 1)	Carrier Branch Revenue	219986.
Line 2)	On-Branch Operating Costs	20963.
Line 3)	Test I Net Revenue After On-Branch Operating Costs	199023.
Line 4)	Normal Branch Maintenance Costs	87386.
Line 5)	Test II Net Revenue After Normal Branch Maintenance Costs	111636.
Line 6)	Return On-Branch Salvage Value	39459.
Line 7)	Test III Net Revenue After Return On-Branch Salvage Value	72178.
Line 8)	Branch Overhead Costs	0.
Line 9)	Test IV Net Revenue Branch Overhead Costs	72178.
Line 10)	Property Taxes On-Branch	0.
Line 11)	Test V Net Revenue After Property Taxes On-Branch	72178.
Line 12)	Off-Branch Operating Costs	73427.
Line 13)	Test VI Net Revenue After Off-Branch Operating Costs	-1249.
Line 14)	Overhead Bridge Traffic Revenue	0.
Line 15)	Test VII Net Revenue After Adding Bridge Traffic Revenue	-1249.
Line 16)	Rehabilitation Cost To FRA Track Class I	60589.
Line 17)	Test VIIIA Net Revenue After Improving To Track Class I	-61838.
Line 18)	Rehabilitation Cost To FRA Track Class II	201102.
Line 19)	Test VIIIB Net Revenue After Improving To Track Class II	-202351.

FIGURE 14

TABLE 1

1976 Increases
USRA SEGMENT 394
GROSVENOR-MORENCI

---

1) On Branch Operating Costs
Line 2 = LUHC + CHC + SEC + OBFCC + OBCAB + LOTSC

	USRA	MICHIGAN
LUHC	4917.00	1722.00
CHC	9912.00	0.00
SEC	0.00	0.00
OBFCC	12962.66	12962.00
OBCAB	295.62	78.12
LOTSC	0.00	0.00
Line 2	28086.66	14762.12
1976 Increases	28087 x 1.42 = 39884	14762 x 1.42 = 20963

LUHC = Locomotive Unit Hour Cost
CHC = Crew Hour Cost
SEC = Station Employee Costs
OBFCC = On-Branch Freight Car Costs
OBCAB = On-Branch Caboose Cost
LOTSC = Local Traffic Switching

---

2) Normal Branch Maintenance Costs
Line 4 = NBMM + NBMO

	USRA	MICHIGAN
NBMM	70739.18	62495.47
NBMO	3659.23	3208.50
Line 4	74398.41	65703.97
1976 Increases	74398 x 1.33 = 98950	65704 x 1.33 = 87386

NBMM = Branch Maintenance
NBMO = Siding/Yard Track Maintenance

---

3) Return on Branch Salvage Value
Line 6 = RETNSV

	USRA	MICHIGAN
RETNSV	39458.59	39458.59
Line 6	39458.59	39458.59
1976 Increases	39459 x 1 = 39459	39459 x 1 = 39459

RETNSV = Return on Net Scrap Value

TABLE 1

4) Branch Overhead Costs

Line 8 = MOWS + TRANS + MCLAC + TCLAS

	USRA	MICHIGAN
MOWS	2790.00	0.00
TRANS	116.37	0.00
MCLAC	991.76	0.00
TCLAC	379.92	0.00
Line 8	4278.00	0.00
1976 Increases	4278 x 1 = 4278	0 x 1 = 0

MOWS = M.O.W. Superintendence
TRANS = Trans. Superintendence
TCLAC = Transp. Clerical Support, Accident
MCLAC = M.O.W. Clerical Support, Accident

5) Property Taxes on Branch

Line 10 = 0.00

6) Off Branch Operating Costs

Line 12 = GTMC + TSC + LDC + OFBFCCC + SCO

	USRA 1973		USRA 1976 Increases	MICHIGAN 1973		MICHIGAN 1976 Increases
GTMC	38765.18	x 1.170 =	45355.27	11990.48	x 1.170 =	14028.86
TSC	22806.27	x 1.278 =	29146.41	21022.61	x 1.278 =	26866.90
LDC	2693.66	x 1.278 =	3442.50	1672.25	x 1.278 =	2137.14
OFBFCC	23782.24	x 1.278 =	30393.70	23782.24	x 1.278 =	30393.70
SCO	3193.22	x 1.278 =	4080.94	0.00	x 1.278 =	0.00
	91240.		112419.	58468.		73427.

GTMC = Gross Ton Mile Costs
TSC = Total Switching Costs
LDC = Loss and Damage Cost
OFBFCC = Off-Branch Freight Car Costs
SCO = Station Clerical

7) Overhead Bridge Traffic Revenue

Line 14 = 0.00

8) Rehabilitation Cost to FRA Track Class I

Line 16 = FRA 1

	USRA	MICHIGAN
FRA 1	60589.	60589.
Line 16	60589.	60589.
1976 Increases	60589. x 1. = 60589.	60589. x 1. = 60589.

FRA 1 = Upgrade to Track Class I

TABLE 1

9) Rehabilitation Cost to FRA Track Class II
Line 18 = FRA 2

	USRA	MICHIGAN
FRA 2	201102.	201102
Line 18	201102.	201102
1976 Increases	201102 x 1. = 201102	201102 x 1. = 201102

FRA 2 = Upgrades to Track Class II.

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LISTING OF INTERMEDIATE CALCULATIONS

1)	LUH	LOCOMOTIVE UNIT HOURS	300.00000	31)	RETNSV	RETURN ON NET SCRAP VALUE	39458.59425
2)	LUHC	LOCOMOTIVE UNIT HOURS COST	4917.00000	32)	MOWS	M O W SUPERINTENDENCE	2790.00000
3)	CH	CREW HOURS	300.00000	33)	TRANS	TRANS. SUPERINTENDENCE	116.37000
4)	CHC	CREW HOURS COST	9912.00000	34)	MCLAC	MOW CLERICAL SUPPORT, ACCIDE	991.76130
5)	SEC	STATION EMPLOYEE COSTS	0.00000	35)	TCLAC	TRANS. CLERICAL SUPPORT, ACC	379.92000
6)	FREAK	FREQUENCY DECIMAL NUMBER	.96154	36)	OBCM	OFF-BRANCH CAR MILES	244576.23048
7)	FQ	FREQUENCY WHOLE NUMBER	1.00000	37)	OBTTM	OFF-BRANCH TARE TON MILES	7560791.85326
8)	OBCMC	ON-BRANCH CAR MILE COSTS	702.72660	38)	OBNTM	OFF-BRANCH NET TON MILES	5806515.54283
9)	OBCDC	ON-BRANCH CAR DAY COSTS	12259.94000	39)	OBGTM	OFF-BRANCH GROSS TON MILES	13367307.39609
10)	OBFCC	ON-BRANCH FREIGHT CAR COSTS	12962.66660	40)	GTMC	GROSS TON MILE COSTS	45355.27399
11)	CM	CABOOSE MILES	1860.00000	41)	CIS	CARS RECEIVING IND. SWITCH	152.00000
12)	CMC	CABOOSE MILE COSTS	78.12000	42)	IS	INDUSTRY SWITCHING COSTS	4969.98960
13)	CBDAYS	CABOOSE DAYS	25.00000	43)	CI	CARS INTERCHANGED	700.00000
14)	CBDC	CABOOSE DAYS COST	217.50000	44)	ICSC	INTERCHANGE SWITCHING COST	9483.96000
15)	OBCAB	ON-BRANCH CABOOSE COSTS	295.62000	45)	NIS	NUMBER INTERTRAIN SWITCHES	2155.00000
16)	LOTSC	LOCAL TRAFFIC SWITCHING	0.00000	46)	ITSC	INTERTRAIN SWITCHING COSTS	11352.32450
17)	GT	GROSS TONS	70413.34000	47)	TSC	TOTAL SWITCHING COSTS	29146.41830
18)	GTC	GROSS TONS CLASS MILLIONS	.07041	48)	LOC	LOSS AND DAMAGE COST	3442.50216
19)	DMC	DIRECT MAINTENANCE COSTS	48378.60000	49)	ICSD	INTERCHANGE SWITCHING DAYS	349.96190
20)	IMC	INDIRECT MAINTENANCE FACTOR	.46220	50)	RTD	RUNNING TIME DAYS	483.82114
21)	NBMM	BRANCH MAINTENANCE	70739.18892	51)	ITSD	INTERTRAIN SWITCHING DAYS	1129.44058
22)	NBMO	SIDING/YARD TRACK MAINT.	3659.23134	52)	OBSD	OTR OFF-BRNCH SWITCHING DAYS	608.00000
23)	TTM	TOTAL TRACK MILES	19.50000	53)	OBCD	OFF-BRANCH CAR DAYS	2571.22362
24)	TSSV	GROSS SCRAP VALUE, STEEL	583293.75000	54)	OFBCDC	OFF-BRANCH CAR DAY COSTS	5517.70687
25)	TSGVT	GROSS SCRAP VALUE, GOOD TIES	0.00000	55)	OFBCMC	OFF-BRANCH CAR MILE COSTS	18264.53305
26)	TSVEPT	GROSS SCRAP VALUE F/P TIES	0.00000	56)	OFBFCC	OFF-BRANCH FRT CAR COSTS	30393.70261
27)	LSV	GROSS SALVAGE VALUE, LAND	67611.00000	57)	SCO	STATION CLERICAL	4080.93516
28)	GSV	GROSS SCRAP VALUE	650904.75000	58)	FRAI	UPGRADE TO TRACK CLASS I	60588.85623
29)	IDRC	DISMANTLE AND REMOVAL COSTS	175500.00000	59)	FRA2	UPGRADE TO TRACK CLASS II	201102.35873
30)	NSV	NET SCRAP VALUE	475404.75000	60)	DELTA	FRA2 LESS FRA1	140513.50250

FIGURE 15

FIGURE 16

LISTING OF INTERMEDIATE CALCULATIONS

1)	LUH	LOCOMOTIVE UNIT HOURS	300.00000
2)	LUHC	LOCOMOTIVE UNIT HOURS COST	1722.00000
3)	CH	CREW HOURS	300.00000
4)	CHC	CREW HOURS COST	0.00000
5)	SEC	STATION EMPLOYEE COSTS	0.00000
6)	FREAK	FREQUENCY DECIMAL NUMBER	.96154
7)	FO	FREQUENCY WHOLE NUMBER	1.00000
8)	OBCMC	ON-BRANCH CAR MILE COSTS	702.72660
9)	OBCDC	ON-BRANCH CAR DAY COSTS	12259.94000
10)	OBFCC	ON-BRANCH FREIGHT CAR COSTS	12962.66660
11)	CM	CABOOSE MILES	1860.00000
12)	CMC	CABOOSE MILE COSTS	78.12000
13)	CBDAYS	CABOOSE DAYS	25.00000
14)	CDBC	CABOOSE DAYS COST	0.00000
15)	OBCAB	ON-BRANCH CABOOSE COSTS	78.12000
16)	LOTSC	LOCAL TRAFFIC SWITCHING	0.00000
17)	GT	GROSS TONS	70413.34000
18)	GTC	GROSS TONS CLASS MILLIONS	.07041
19)	DMC	DIRECT MAINTENANCE COSTS	48378.60000
20)	IMC	INDIRECT MAINTENANCE FACTOR	.29180
21)	NBMM	BRANCH MAINTENANCE	62495.47548
22)	NBMQ	SIDING/YARD TRACK MAINT.	3208.50630
23)	TTM	TOTAL TRACK MILES	19.50000
24)	TSSV	GROSS SCRAP VALUE, STEEL	583293.75000
25)	TSVGT	GROSS SCRAP VALUE, GOOD TIES	0.00000
26)	TSVEPT	GROSS SCRAP VALUE F/P TIES	0.00000
27)	LSV	GROSS SALVAGE VALUE, LAND	67611.00000
28)	GSV	GROSS SCRAP VALUE	650904.75000
29)	TDRC	DISMANTLE AND REMOVAL COSTS	175500.00000
30)	NSV	NET SCRAP VALUE	475404.75000
31)	RETNSV	RETURN ON NET SCRAP VALUE	39458.59425
32)	MOWS	M.O.W. SUPERINTENDENCE	0.00000
33)	TRANS	TRANS. SUPERINTENDENCE	0.00000
34)	MCLAC	M.O.W. CLERICAL SUPPORT, ACCIDE	0.00000
35)	TCLAC	TRANSP. CLERICAL SUPPORT, ACC.	0.00000
36)	OBCM	OFF-BRANCH CAR MILES	244576.23048
37)	OBITM	OFF-BRANCH TARE TON MILES	7560791.85326
38)	OBNTM	OFF-BRANCH NET TON MILES	5806515.54283
39)	OBGTM	OFF-BRANCH GROSS TON MILES	13367307.39609
40)	GTMC	GROSS TON MILE COSTS	14028.85544
41)	CIS	CARS RECEIVING IND. SWITCH	152.00000
42)	IS	INDUSTRY SWITCHING COSTS	4969.98960
43)	CI	CARS INTERCHANGED	700.00000
44)	ICSC	INTERCHANGE SWITCHING COST	5835.55000
45)	NIS	NUMBER INTERTRAIN SWITCHES	2155.00000
46)	ITSC	INTERTRAIN SWITCHING COSTS	10217.07050
47)	TSC	TOTAL SWITCHING COSTS	26866.89571
48)	LDC	LOSS AND DAMAGE COST	2137.13522
49)	ICSD	INTERCHANGE SWITCHING DAYS	349.96190
50)	RTD	RUNNING TIME DAYS	483.82114
51)	ITSD	INTERTRAIN SWITCHING DAYS	1129.44058
52)	OBSD	OTR OFF-BRANCH SWITCHING DAYS	608.00000
53)	OBCD	OFF-BRANCH CAR DAYS	2571.22362
54)	OFBCDC	OFF-BRANCH CAR DAY COSTS	5517.70687
55)	OFBCDC	OFF-BRANCH CAR MILE COSTS	18264.53305
56)	OFBFCC	OFF-BRANCH FRT CAR COSTS	30393.70261
57)	SCO	STATION CLERICAL	0.00000
58)	FRA1	UPGRADE TO TRACK CLASS I	60588.85623
59)	FRA2	UPGRADE TO TRACK CLASS II	201102.35873
60)	DELTA	FRA2 LESS FRA1	140513.50250

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LINE QUESTIONNAIRE DATA ITEMS

Item 1)	CARD NUMBER ONE	1.000
Item 2)	RAILROAD CODE	622.000
Item 3)	FIRST STATE	MI.
Item 4)	SECOND STATE	
Item 5)	THIRD STATE	
Item 6)	SEGMENT CODE	0394
Item 7)	LINE LENGTH IN MILES	18.600
Item 8)	SINGLE TRACK MILES	18.600
Item 9)	MULTI-TRACK MILES	0.000
Item 10)	SIDING AND YARD MILES	.900
Item 11)	ANNUAL TRIPS	50.000
Item 12)	LOCOMOTIVES	1.000
Item 13)	RATED HORSEPOWER	1200.000
Item 14)	CREW SIZE	4.000
Item 15)	HOURS SERVING BRANCH	6.000
Item 16)	SERVING YARD TO BRANCH MILES	7.600
Item 17)	STATION EMPLOYEES	0.000
Item 18)	IM TUNNELS AND SUBWAYS	0.000
Item 19)	IM BRIDGE-TRESTLE-CULVERT	1.000
Item 20)	IM STATION + OFFICE BUILDINGS	0.000
Item 21)	IM ROADWAY BUILDINGS	0.000
Item 22)	IM WHARVES AND DOCKS	0.000
Item 23)	IM COAL/ORE WHARVES + DOCKS	0.000
Item 24)	IM TOFC/COFC TERMINALS	0.000
Item 25)	IM COMMUNICATIONS SYSTEMS	1.000
Item 26)	IM SIGNALS AND INTERLOCKERS	0.000
Item 27)	JOINT MAINTENANCE DR	0.000
Item 28)	JOINT MAINTENANCE CR	0.000
Item 29)	PERCENT TIES GOOD	0.000
Item 30)	OVRHD TRAFFIC EXPENSE	1.000
Item 31)	OVRHD TRANSP SUPERINTENDENCE	1.000
Item 32)	OVRHD SIGNALS + INTERLOCKERS	0.000
Item 33)	OVRHD STATIONERY + PRINTING	1.000
Item 34)	OVRHD INSURANCE	1.000
Item 35)	PROPERTY TAXES ON BRANCH	0.000
Item 36)	CARD NUMBER TWO	2.000
Item 37)	RAILROAD CODE	622.000
Item 38)	FIRST STATE	MI.
Item 39)	SECOND STATE	
Item 40)	THIRD STATE	
Item 41)	SEGMENT CODE	0394
Item 42)	NUMBER OF TIES TO FRA CLASS I	9000.000
Item 43)	MILES OF TRACK TO FRA CLASS I	0.000
Item 44)	NUMBER OF TIES TO FRA CLASS II	36400.000
Item 45)	MILES OF TRACK TO FRA CLASS II	5.000
Item 46)	NUMBER OF GRADE CROSSINGS	27.000
Item 47)	AUTHORIZED TIMETABLE SPEED	20.000
Item 48)	OVERHEAD BRIDGE CARLOADS	0.000

RAILROAD COST FACTOR DATA

CF 1)	LOCOMOTIVE COST PER HOUR	16.3900
CF 2)	TWO-MAN CREW COST PER HOUR	17.9900
CF 3)	THREE-MAN CREW COST PER HOUR	25.5100
CF 4)	FOUR-MAN CREW COST PER HOUR	33.0400
CF 5)	FIVE-MAN CREW COST PER HOUR	40.9900
CF 6)	STATION EMPLOYEE ANNUAL COST	15140.0000
CF 7)	CABOOSE COST PER MILE	.0420
CF 8)	CABOOSE COST PER DAY	8.7000
CF 9)	REGULAR INDIRECT MAINTENANCE COST FACTOR	.3834
CF 10)	VARIABLE MAINT. TUNNELS AND SUBWAYS	.0011
CF 11)	VARIABLE MAINT. BRIDGE-TRESTLE-CULVERT	.0426
CF 12)	VARIABLE MAINT. STATION + OFFICE BLDGS	0.0000
CF 13)	VARIABLE MAINT. ROADWAY BUILDINGS	0.0000
CF 14)	VARIABLE MAINT. WHARVES AND DOCKS	.0036
CF 15)	VARIABLE MAINT. COAL/ORE WHARVES + DOCKS	.0108
CF 16)	VARIABLE MAINT. TOFC/COFC TERMINALS	.0060
CF 17)	VARIABLE MAINT. COMMUNICATIONS SYSTEMS	.0362
CF 18)	VARIABLE MAINT. SIGNALS AND INTERLOCKS	0.0000
CF 19)	VARIABLE MAINT. JOINT MAINTENANCE DR	.0476
CF 20)	VARIABLE MAINT. JOINT MAINTENANCE CR	-.0361
CF 21)	STEEL, GROSS SCRAP VALUE PER MILE	29912.5000
CF 22)	GOOD TIES, CROSS SCRAP VALUE EACH	5.0000
CF 23)	FAIR/POOR TIES, GROSS SCRAP VALUE EACH	0.0000
CF 24)	DISMANTLING AND REMOVAL COST PER MILE	9000.0000
CF 25)	RATE OF RETURN ON NET SCRAP VALUE	.0830
CF 26)	MAINTENANCE OF WAY SUPERVISION	150.0000
CF 27)	TRANSPORTATION SUPERVISION	.3879
CF 28)	MOW-CLERICAL SUPPT, ACCDNT	.0205
CF 29)	STATION CLERICAL	4.7660
CF 30)	UPGRADING, TURNOUTS	1033.6000
CF 31)	UPGRADING, GRADE CROSSINGS	5367.0500
CF 32)	UPGRADING, COST PER TIE INSERTED	32.3800
CF 33)	UPGRADING, COST PER MILE OF TRACK.	33856.1000
CF 34)	CROSS TON-MILE UNIT COSTS	.0029
CF 35)	TERMINAL SWITCHING COST PER CARLOAD	32.6973
CF 36)	INTERCHANGE SWITCHING COST PER CAR	9.2679
CF 37)	IN-ROUTE SWITCHING COST PER CAR	5.2679
CF 38)	SYSTEM AVERAGE TRAIN SPEED	21.0629
CF 39)	TIES PER MILE	2816.0000
CF 40)	MAINTENANCE, SIDING AND YARD TRACKS	2939.0000
CF 41)	ACRES OF LAND PER TRACK MILE	7.2700
CF 42)	LAND VALUE PER ACRE	500.0000
CF 43)	TRANSP-CLERICAL SUPPT, ACCDNT	.3166
CF 44)	DUMMY	0.0000
CF 45)	DUMMY	0.0000
CF 46)	DUMMY	0.0000
CF 47)	DUMMY	0.0000
CF 48)	DUMMY	0.0000

FIGURE 17

622 Penn Central Railroad 0394 Grosvenor - Morenci Mi.

LINE QUESTIONNAIRE DATA ITEMS

Item 1)	CARD NUMBER ONE	1.000
Item 2)	RAILROAD CODE	622.000
Item 3)	FIRST STATE	MI.
Item 4)	SECOND STATE	
Item 5)	THIRD STATE	
Item 6)	SEGMENT CODE	0394
Item 7)	LINE LENGTH IN MILES	18.600
Item 8)	SINGLE TRACK MILES	18.600
Item 9)	MULTI-TRACK MILES	0.000
Item 10)	SIDING AND YARD MILES	.900
Item 11)	ANNUAL TRIPS	50.000
Item 12)	LOCOMOTIVES	1.000
Item 13)	RATED HORSEPOWER	1200.000
Item 14)	CREW SIZE	4.000
Item 15)	HOURS SERVING BRANCH	6.000
Item 16)	SERVING YARD TO BRANCH MILES	7.600
Item 17)	STATION EMPLOYEES	0.000
Item 18)	IM TUNNELS AND SUBWAYS	0.000
Item 19)	IM BRIDGE-TRESTLE-CULVERT	1.000
Item 20)	IM STATION + OFFICE BUILDINGS	0.000
Item 21)	IM ROADWAY BUILDINGS	0.000
Item 22)	IM WHARVES AND DOCKS	0.000
Item 23)	IM COAL/ORE WHARVES + DOCKS	0.000
Item 24)	IM TOFC/COFC TERMINALS	0.000
Item 25)	IM COMMUNICATIONS SYSTEMS	1.000
Item 26)	IM SIGNALS AND INTERLOCKERS	0.000
Item 27)	JOINT MAINTENANCE DR	0.000
Item 28)	JOINT MAINTENANCE CR	0.000
Item 29)	PERCENT TIES GOOD	0.000
Item 30)	OVRHD TRAFFIC EXPENSE	1.000
Item 31)	OVRHD TRANSP SUPERINTENDENCE	1.000
Item 32)	OVRHD SIGNALS + INTERLOCKERS	0.000
Item 33)	OVRHD STATIONERY + PRINTING	1.000
Item 34)	OVRHD INSURANCE	1.000
Item 35)	PROPERTY TAXES ON BRANCH	0.000
Item 36)	CARD NUMBER TWO	2.000
Item 37)	RAILROAD CODE	622.000
Item 38)	FIRST STATE	MI
Item 39)	SECOND STATE	
Item 40)	THIRD STATE	
Item 41)	SEGMENT CODE	0394
Item 42)	NUMBER OF TIES TO FRA CLASS I	9000.000
Item 43)	MILES OF TRACK TO FRA CLASS I	0.000
Item 44)	NUMBER OF TIES TO FRA CLASS II	36400.000
Item 45)	MILES OF TRACK TO FRA CLASS II	5.000
Item 46)	NUMBER OF GRADE CROSSINGS	27.000
Item 47)	AUTHORIZED TIMETABLE SPEED	20.000
Item 48)	OVERHEAD BRIDGE CARLOADS	0.000

RAILROAD COST FACTOR DATA

CF 1)	LOCOMOTIVE COST PER HOUR	5.7400
CF 2)	TWO-MAN CREW COST PER HOUR	17.7000
CF 3)	THREE-MAN CREW COST PER HOUR	25.0400
CF 4)	FOUR-MAN CREW COST PER HOUR	32.3800
CF 5)	FIVE-MAN CREW COST PER HOUR	40.1900
CF 6)	STATION EMPLOYEE ANNUAL COST	15140.0000
CF 7)	CABOOSE COST PER MILE	.0420
CF 8)	CABOOSE COST PER DAY	8.7000
CF 9)	REGULAR INDIRECT MAINTENANCE COST FACTOR	.2130
CF 10)	VARIABLE MAINT. TUNNELS AND SUBWAYS	.0011
CF 11)	VARIABLE MAINT. BRIDGE-TRESTLE-CULVERT	.0426
CF 12)	VARIABLE MAINT. STATION + OFFICE BLDGS	0.0000
CF 13)	VARIABLE MAINT. ROADWAY BUILDINGS	0.0000
CF 14)	VARIABLE MAINT. WHARVES AND DOCKS	.0036
CF 15)	VARIABLE MAINT. COAL/ORE WHARVES + DOCKS	.0108
CF 16)	VARIABLE MAINT. TOFC/COFC TERMINALS	.0060
CF 17)	VARIABLE MAINT. COMMUNICATIONS SYSTEMS	.0362
CF 18)	VARIABLE MAINT. SIGNALS AND INTERLOCKS	0.0000
CF 19)	VARIABLE MAINT. JOINT MAINTENANCE DR	.0476
CF 20)	VARIABLE MAINT. JOINT MAINTENANCE CR	-.0361
CF 21)	STEEL, GROSS SCRAP VALUE PER MILE	29912.5000
CF 22)	GOOD TIES, GROSS SCRAP VALUE EACH	5.0000
CF 23)	FAIR/POOR TIES, GROSS SCRAP VALUE EACH	0.0000
CF 24)	DISMANTLING AND REMOVAL COST PER MILE	9000.0000
CF 25)	RATE OF RETURN ON NET SCRAP VALUE	.0830
CF 26)	MAINTENANCE OF WAY SUPERVISION	150.0000
CF 27)	TRANSPORTATION SUPERVISION	.3879
CF 28)	MOW-CLERICAL SUPPT. ACCDNT	.0205
CF 29)	STATION CLERICAL	4.7660
CF 30)	UPGRADING, TURNOUTS	1033.6000
CF 31)	UPGRADING, GRADE CROSSINGS	5367.0500
CF 32)	UPGRADING, COST PER TIE INSERTED	32.3800
CF 33)	UPGRADING, COST PER MILE OF TRACK	33856.1000
CF 34)	GROSS TON-MILE UNIT COSTS	.0009
CF 35)	TERMINAL SWITCHING COST PER CARLOAD	32.6973
CF 36)	INTERCHANGE SWITCHING COST PER CAR	8.3365
CF 37)	IN-ROUTE SWITCHING COST PER CAR	4.7411
CF 38)	SYSTEM AVERAGE TRAIN SPEED	21.0629
CF 39)	TIES PER MILE	2816.0000
CF 40)	MAINTENANCE, SIDING AND YARD TRACKS	2939.0000
CF 41)	ACRES OF LAND PER TRACK MILE	7.2700
CF 42)	LAND VALUE PER ACRE	500.0000
CF 43)	TRANSP-CLERICAL SUPPT, ACCDNT	.3166
CF 44)	LOCOMOTIVE COST PER HOUR - REPLACEMENT	9.3900
CF 45)	2 MAN OVERTIME PER HOUR	19.1200
CF 46)	3 MAN OVERTIME PER HOUR	27.4000
CF 47)	4 MAN OVERTIME PER HOUR	35.6700
CF 48)	5 MAN OVERTIME PER HOUR	44.1600

FIGURE 18

Where:

CF(1) = \$16.39 (RC) - Figure 17

LUH = 300 hours (IC) - Figure 18

By substitution, we find that:

LUHC = \$16.39 x 300 = \$3917 which can be verified by consulting Figure 15.

The following Fortran IV statements have been placed within the viability analysis to remove those locomotive related costs which cannot be avoided with line abandonment.

```
ALCRLB
RLBX = 1
If (LUH/SEG(12).GE.2000) RLBX = ALCRLB
LUHC = CF(1) * LUH * RLBX
```

Where:

```
CF(44)  = $9.93         (RC) Figure 18
CF(1)   = $5.74         (RC) Figure 18
LUH     = 300 hours     (IC) Figure 16
SEG(12) = 1 locomotive  (LQ) Figure 18
```

This portion of the Michigan viability program indicates that if, when LUH is divided by SEG(12), the result is greater than or equal to 2000, the quotient of CF(44) ÷ CF(1) (that is ALCRLB) should be multiplied times the product of CF(1) x LUH. Since LUH ÷ SEG(12) equals 300, which is certainly less than 2000 hours, the Michigan Model comes to duplicate the USRA formula. LUHC = CF(1) x LUH = \$1722. (See Figure 16 for verification). The difference in the two methods then, in this case, stems solely from the utilization of two different CF(1)'s (Locomotive Cost Per Hour). In the case of the USRA CF(1) = \$16.39 and within the Michigan approach CF(1) = \$5.74. If the above mentioned quotient was greater than 2000 hours, of course CF(44) which equals \$9.93 would have been employed to account for the avoidability of both time and mileage as well as a complete unit - i.e., a locomotive. These differences, then, and all similar differences to be outlined below arose as a result of varying interpretations of which types of cost are truly avoidable with branch line abandonment. To illustrate which of the sub-costs within the component cost "Locomotive Cost Per Hour" have been reduced to reflect unavoidability, Figure 19 has been prepared. A dashed line under the column labeled "Michigan" indicates that no change has been made to that particular sub-cost. Worksheet 1 shows the data sources employed and the calculations made in the development of CF(1) and CF(44). These have been included to illustrate the complexity of each cost factor used in both the USRA and Michigan models. Although other worksheets are available for the cost factors modified by R. L. Banks, they are not included here.

2) CREW HOUR COST (CHC)

The following are the Fortran commands used by USRA to calculate CHC:

```
CH = SEG(11) * SEG(15)
CHC = CH * CF(KREW)
```

Where:

SEG(11) = 50 trips	(LQ) Figure 17
SEG(15) = 6 hours	(LQ) Figure 17
KREW = SEG(14) = 4 men	(LQ) Figure 17
CF(4) = $33.04	(LQ) Figure 17

Inserting each of these values into the formula, we can determine the CHC which is printed in Figure 15.

CH = 50 x 6 = 300

CHC = 300 x 33.04 = $9912.

R. L. Banks has included the following statement to remove those costs improperly included by USRA because they are not avoidable in those instances where certain minimum time and trip requirements are not met.

```
If ((SEG(11).LE.51) and (SEG(15).LE.8)) CHC = 0
```

	Locomotive Cost Per Hour			
	USRA		MICHIGAN	
Expense Element	Basis	Cost Per Hour	Basis	Cost Per Hour
Repair	System Average All Locomotives	$ 6.29	System Average Yard Locomotives	$ 2.85
Fuel	"	4.29	"	2.30
Rents	"	2.41	Unit Specific Avoidable	--
Payroll Taxes, Health & Welfare	"	1.02	System Average Yard Locomotives	0.44
Depreciation	"	0.90	Unit Specific Avoidable	--
Return on Investment	"	0.88	"	--
Indirect Maintenance	"	0.59	Function of Repair	0.15
Joint Maintenance of Equipment	"	0.01	Unit Specific Avoidable	--
Retirements	" Less Than $0.01	0.00	"	--
Unit Cost Without Locomotive Unit Reductions		$16.39		$ 5.74
Unit Costs of Locomotive Units		0.00 [4]		4.19
Unit Cost With Locomotive Unit Reductions		$16.39		$ 9.93

FIGURE 19

WORKSHEET 1

CALCULATION OF LOCOMOTIVE UNIT COSTS
(Cost Factors 1 and 44)

Item	Source	Amount
COST FACTOR 1		
1. Repairs	AR, Sch. 320, Col. (e), L 70 and L 72	________
2. Fuel and Servicing	AR, Sch. 320, Col. (e), L 116 and L 118	________
Payroll Tax Calculation:		
Health & Welfare Accounts		
3. M of W & S - 277	AR, SCH. 320, Col. (b), L 57	________
4. M of E - 335	AR, Sch. 320, Col. (b), L 86	________
5. Traffic - 359	AR, Sch. 320, Col. (b), L 103	________
6. Transportation - 409	AR, Sch. 320, Col. (b), L 134	________
7. Miscellaneous - 449	AR, Sch. 320, Col. (b), L 165	________
8. General - 456	AR, Sch. 320, Col (b), L 174	________
9. Total	L 3 through L 8	________
10. Ratio M of E to Total	L 4 ÷ L 9	________
11. Payroll Taxes	AR, Sch. 350, L 60 and 61	________
12. M of E Payroll Taxes	L 10 X L 11	________
13. Direct M of E Accounts	AR, Sch 320, Col. (b), L 70, L 71, 72, 73, 74, 75, 76 77, 78, 79 and 80	________
14. Locomotive Amount	(L 1 ÷ L 13) X L 12	________

WORKSHEET 1
(Continued)

Item	Source	Amount
Indirect Expenses		
15. Injuries & Insurance	AR, Sch. 320, Col. (e), L 83 and L 84	______
16. Health & Welfare - 335	AR, Sch. 320, Col. (e), L 86	______
17. Other M of E - 339	AR, Sch. 320, Col. (e), L 87	______
18. Total Indirect	L 5 + L 16 and 17	______
19. Direct Expenses	AR, Sch. 320, Col. (e), L 70 through L 80	______
20. Ratio Indirect/Direct	L 18 ÷ L 19	______
21. Indirect Expenses	L 1 X L 20	______
22. Yard Swtg. Miles	AR, Sch. 531, Col. (b), L 9	______
23. Yard Loco. Hours	L 22 ÷ the number 6	______
24. Cost Factor 1	(L 1 + L 2 + L 14 + L 21) ÷ L 23	______
COST FACTOR 44		
25. Retirements	AR, Sch. 328, Col. (e), L 1	______
26. Depreciation	AR, Sch. 330 (Col. (e), L 1 and L 2	______
27. Rent	AR, Sch. 300, Col. (e) L 14 - L 7	______
28. Gross Investment	AR, Sch. 211-N-2, L 38, Cols. (a + b + c + d + e)	______
29. Accrued Depreciation	AR, Sch. 211-D, L 30, Col. (g) + AR, Sch. 211-E, L 29, Col. (g) + Lesser RR's, AR, Sch. 285, Acct. 52, Col. (j)	______

WORKSHEET 1
(Continued)

Item	Source	Amount
30. Amortization Reserve	AR, Sch. 211-G, L 22, Col. (i)	______
31. Depreciated Investment	L 1 - (L2 + L 3)	______
32. Return on Investment	L 31 X 7.2%	______
33. Total Loco. Deprec.	AR, Sch. 330, Col. (b), L 1 and L 2	______
34. Freight Loco. Ratio	L 26 ÷ L 33	______
35. Freight Loco. Return	L 32 X L 34	______
36. Train Miles	AR, Sch. 531, Col. (b), L 6	______
37. Train Hours	AR, Sch. 531, Col. (b), L 30	______
38. Train Speed	L 36 ÷ L 37	______
39. Loco. Unit Miles Road Service	AR, Sch. 531, Col. (b) L 7	______
40. Loco. Unit Miles Train Switching	AR, Sch. 531, Col. (b), L 8	______
41. Loco. Unit Hours Road Service	L 39 ÷ L 38	______
42. Loco. Unit Hours Train Switching	L 40 ÷ the number 6	______
43. Ownership Costs	L 25 + L 26 + L 27 + L 35	______
44. Total Loco. Hours	L 23 + L 41 + L 42	______
45. Cost Factor 44	(L 43 ÷ L 44) + L 24	______

AR = Annual Report R-1.
Sch. = Schedule.
Col. = Column.
L = Line.

Source: Interstate Commerce Commission, Annual Report Form R-1.

Where:

SEG(11) = 50 trips
SEG(15) = 6 hours

Since the number of trips on the line is less than or equal to 51 and since the number of hours a locomotive serves the branch is less than or equal to 8, as this additional constraint dictates, CHC has been set to 0. This can be verified by reference to Figure 16. Again, unit savings in time, mileage or other resources may be saved by branch line abandonment only if the line is used a prescribed amount. According to R. L. Banks, this amount, in reference to CHC, is 51 trips and/or more than 8 hours of service.

3) ON-BRANCH CABOOSE CAR COST (OBCAB)

The USRA formulation for OBCAB is based on a simple aggregation of Caboose Mile Costs (CMC) and Caboose Day Costs (CABC) which may be found in the table of "Intermediate Calculations" for the USRA Model (See Figure 15.)

OBCAB = CMC + CABC

Where:

CMC = 78.12	(IC) Figure 15
CABC = 217.50	(IC) Figure 15

Therefore: OBCAB = 78.12 + 217.50 = 295.62 (See Figure 15.)

R. L. Banks again employs the avoidability argument as a basis for inserting a constraint into the USRA model. Unless the total hours a branch line is served exceeds 2000 hours, caboose day costs cannot be avoided and should, therefore, not be attributed to the operation of the branch. All caboose mile costs are avoidable with abandonment and were not modified. Banks included the following statement:

```
If (SEG(15) * SEG(11) .LT. 2000) CBDC = 0
```

Where:

SEG(15) = 6 hours	(LQ) Figure 18
SEG(11) = 50 trips	(LQ) Figure 18

Since 6 x 50 is less than 2000, CBDC has been set to zero. OBCAB has been reduced accordingly.

OBCAB = 78.12 + 0 = 78.12

This can be verified with reference to the table of IC - Figure 16. All of the various differences in the two accounting systems under the category "On-Branch Operating Costs" shown in Table 1 have now been discussed. We move, then, to a short explanation of the differences found within the category of "Normal Branch Maintenance Costs"

-- Normal Branch Maintenance Cost --

As can be seen in Table 1, both component costs within this category have been changed in moving from the USRA to the Michigan version of the viability analysis - i.e., NBMM and NBMO.

1) BRANCH MAINTENANCE (NBMM)

The USRA and Michigan formulations to calculate this component cost do not differ. What does vary, however, is the cost factor used as input to the formula. The value of "Regular Indirect Maintenance Cost Factor" CF(9) employed by USRA equals .3834 while the Michigan model equals .2130. Banks recalculated this factor removing those sub-costs which they considered to be unavoidable. Several of the more important Fortran statements used in this calculation are presented below. Although a few "steps" have been skipped which were used to develop variables utilized therein, one should gather a familiarity with the importance of CF(9) in making this cost estimation.

NBMM = DMC * (1. + IMC)

Where:

DMC =	48378.60	(IC) Figures 15 and 16
IMC	.4622	for USRA (IC) Figure 15
IMC	.2918	for Michigan (IC) Figure 16

For USRA then:

NBMM = 48378.60 x 1.4622 = 70413.34

And Michigan:

NBMM = 48378.60 x 1.4622 = 70413.34

Please turn to Figures 15 and 16 for verification. It should be noted that the reason IMC varies between accounting systems is basically because CF(9) which is used as a means of computing IMC varies by system.

2) SIDING/YARD TRACK MAINTENANCE (NBMO)

Like NBMM, NBMO varies by accounting system due solely to the change in CF(9), this should be more readily apparent because CF(9) is actually used in the formula without being transformed into another variable first. The formula used by both models is:

NBMO = (SEG(10)*CF(40)*(1.+CF(9))

Where for USRA:

SEG(10)	= .9	(LQ)	Figure 17
CF(40)	= 2939	(RC)	Figure 17
CF(9)	= .3834	(RC)	Figure 17

and for Michigan:

SEG(10)	= .9	(LQ)	Figure 18
CF(40)	= 2939	(RC)	Figure 18
CF(9)	= .2130	(RC)	Figure 18

Using this data as was done within the 1) USRA and 2) Michigan models, we find:

1) NBMO = .9 x 2939 x 1.3834 = 3659.23

2) NBMO = .9 x 2939 x 1.2130 = 3208.50

Again, see Figures 15 and 16 to validate these calculations. The next differences we note in Table 1 between the two accounting systems is in the category of "Branch Overhead Costs" and it is to a discussion of this category that we now turn.

-- Branch Overhead Costs --

In Table 1, we find that the Michigan accounting system sets each of the four component costs which comprise this category (MOWS, TRANS, MCLAC and TCLAC) equal to zero. Above, each component was discussed individually but since the logic underlying their removal from the accounting statement (i.e., Evaluation Report) is so similar they will be reviewed collectively. R. L. Banks, as has many others concerned with branch line abandonment, has stated that MOWS and TRANS costs are not avoidable unless the line is of a certain length and the time spent on it by a crew is of a certain duration. If these conditions are not met, MOWS and TRANS are set to zero. Given MOWS and TRANS are zero, MCLAC and TCLAC will also be zero since they are based on the two former costs. The formulas used in the USRA model are as follows:

```
MOWS   = CF(26) * SEG(7)
TRANS  = CF(27) * CH
MCLAC  = CF(28) * DMC
TCLAC  = CF(43) * CH * SEG(14)
```

The Michigan model includes the following constraints:

```
If (MOWS LT 7500)    MOWS = 0
If (TRANS LT 8500)   TRANS = 0
If (MOWS EQ 0)       MCLAC = 0
If (TRANS EQ 0)      TCLAC = 0
```

Where (for both models):

CF(26)	=	150	(RC)	Figures 17 and 18
CF(27)	=	.3879	(RC)	Figures 17 and 18
CF(28)	=	.0205	(RC)	Figures 17 and 18
CF(43)	=	.3166	(RC)	Figures 17 and 18
SEG(7)	=	18.6	(LQ)	Figures 17 and 18
CH	=	300	(IC)	Figures 15 and 16
DMC	=	48378.60	(IC)	Figures 15 and 16
SEG(14)	=	4	(LQ)	Figures 17 and 18

Using this data as input for the USRA formulas, we find:

MOWS	=	150 x 18.6	= 2790
TRANS	=	.3879 x 300	= 116.37
MCLAC	=	.0205 x 48378.60	= 991.76
TCLAS	=	.3166 x 300 x 4	= 379.92

These can be checked by consulting the tables of Intermediate Calculations. Since MOWS is less than (LT) 7500 and because TRANS is less than 8500, these costs are set to zero when the Michigan version of the analysis is performed. MCLAC and TCLAC are then, in turn, set to zero.

-- Off-Branch Operating Costs --

This is the last cost category of those listed in Table 1 to change by accounting system. Each of five component costs, with the exception of OFBFCC, have differing cost estimates when the two modeling systems are run.

1) GROSS TON MILE COSTS (GTMC)

The results of the USRA and Michigan calculations for this component cost differ solely because of the "Gross Ton-Mile Unit Cost" used by each. USRA used a factor of .0029 while the Michigan methodology employs a factor of .0009. R. L. Banks modified this cost factor for the Department to remove excess, unavoidable costs. The following are the formulas used by both models. Again, the only data that varies is the above mentioned cost factor.

OBGTM = OBTTM + OBNTM
GTMC = OBGTM * CF(34)

Where:

OBTTM	=	7560791.85	(IC)	Figures 15 and 16
OBNTM	=	5806515.54	(IC)	Figures 15 and 16
CF(34)	=	.0029 for USRA	(RC)	Figure 17
CF(34)	+	.000897 for Michigan	(RC)	Figure 18

Therefore:

OBGTM = 7560791.85 x 5806515.54 = 1336730.40

and for USRA

GTMC = 13367307.40 x .0029 = 38765.19

For Michigan

GTMC = 13367307.40 x .000897 = 11990.48

These component costs in Figures 15 and 16 have been increased by 1.17 to estimate 1976 cost increases.

2) TOTAL SWITCHING COSTS (TSC)

Like GTMC, TSC varies by accounting system as the result of changing cost factors. The USRA model employs an "Interchange Switching Cost Per Car"

CF(36) of 9.2628 while the Michigan methodology uses a cost of 8.3365. In addition, the Michigan accounting system uses an "In-Route Switching Cost Per Car" CF(37) of 4.7411 while USRA a factor of 5.2628. The formulas used to compute TSC are identical for each model.

ICSC = CI * CF(36)
ITSC = NIS * CF(37)
TSC = IS + ICSC + ITSC

Where for both models

CI	= 700	(IC)	Figures 15 and 16
NIS	= 2155	(IC)	Figures 15 and 16
IS	= 4969.98	(IC)	Figures 15 and 16

For USRA

CF(36)	= 9.2628	(RC)	Figure 17
CF(37)	= 5.2679	(RC)	Figure 17

and for Michigan

CF(36)	= 8.3365	(RC)	Figure 18
CF(37)	= 4.7411	(RC)	Figure 18

Therefore, the USRA model yields:

ICSC = 700 x 9.2628 = 6483.96
ITSC = 2155 x 5.2628 = 11352.33
TSC = 4969.98 + 6483.96 + 11352.33 = 22806.27

and for Michigan

ICSC = 700 x 8.3365 = 5835.55
ITSC = 2155 x 4.7411 = 10217.07
TSC = 4969.98 + 5835.55 + 10217.07 = 21022.61

Each TSC estimate appearing in Figures 15 and 16 have been increased by 1.278 to account for 1976 inflation rate (see Table 1).

3) LOSS AND DAMAGE COSTS (LDC)

USRA has charged the entire national system loss and damage cost to off-branch traffic for Interline traffic while the cost is, in actuality, shared between the involved roads. Banks has made an appropriate change in the

USRA accounting system by removing half of the loss and damage cost of that traffic classified as interline. The USRA calculates this cost with the following formula:

LDC = Total (K,2) * STCC (K,1)

The Michigan methodology includes the following statement:

LDC = LCD - (INTER (K,2) * STCC (K,1) * .5)

Brief mention has been made of the traffic matrices which are essential not only to this calculation but to most calculations made within the viability routine. Figures 20-A and 20-B show the traffic data as it is used within the program. This information remains the same regardless of the accounting system being employed. Again, notice that there are four separate traffic tables labeled Local, ConRail, Interline, and Total. The last one (i.e., Total) is a simple summation of the previous three. Traffic on a segment has been broken into three types for analytical purposes - cost factors are applied differently depending upon the type of traffic being studied. The nature of the traffic along a segment has much to do with the amount of cost incurred by the rail company as a result of operating the line.

In the above USRA loss and damage formula, a loss and damage factor STCC(K,1) is multiplied times the amount of total tonnage which is generated or attracted to this particular segment. Since the L&D estimate varies by commodity type, a new factor must be applied for each tonnage element of the "total" array. For example, Figure 20-B shows that 107 tons of commodity type 11 has either its O or D along this segment. A L&D factor is multiplied times this 107 tons and added to the next estimate. This is done until all elements have been factored and summed. Table 1 indicates that the USRA 1973 L&D estimate for this segment is $2,693.66. When half of the L&D estimate for Interline traffic is removed, the Michigan methodology indicates that the L&D cost on this line is reduced to $1672.25.

TRAFFIC AND REVENUE REPORT

================== LOCAL TRAFFIC ====================

STCC	CARS	TONS	$CONRAIL	$TOTAL	SHORT HAUL MILES
11	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.
26	0.	0.	0.	0.	0.
28	0.	0.	0.	0.	0.
32	0.	0.	0.	0.	0.
33	0.	0.	0.	0.	0.
34	0.	0.	0.	0.	0.
35	0.	0.	0.	0.	0.
40	0.	0.	0.	0.	0.
50	0.	0.	0.	0.	0.

================= CONRAIL TRAFFIC ================

STCC	CARS	TONS	$CONRAIL	$TOTAL	SHORT HAUL MILES
11	0.	0.	0.	0.	0.
24	0.	0.	0.	0.	0.
26	12.	62.	2076.	2076.	2904.
28	132.	5514.	98615.	98615.	39062.
32	1.	46.	979.	979.	327.
33	0.	0.	0.	0.	0.
34	5.	39.	1318.	1318.	1512.
35	2.	24.	346.	346.	210.
40	0.	0.	0.	0.	0.
50	152.	5685.	103334.	103334.	44015.

FIGURE 20-A

622 Penn Central Railroad   0394 Grosvenor - Morenci   Mi.

TRAFFIC AND REVENUE REPORT

Interline Traffic						Total Traffic					
STCC	CARS	TONS	$CONRAIL	$TOTAL	SHORT HAUL MILES	STCC	CARS	TONS	$CONRAIL	$TOTAL	SHORT HAUL MILES
11	2.	107.	435.	704.	520.	11	2.	107.	435.	704.	520.
24	10.	384.	2655.	15078.	2821.	24	10.	384.	2655.	15078.	2821.
26	0.	0.	0.	0.	0.	26	12.	62.	2076.	2076.	2904.
28	317.	16412.	76035.	286630.	63876.	28	449.	21926.	174650.	385245.	102938.
32	3.	99.	582.	1820.	780.	32	4.	145.	1561.	2799.	1107.
33	2.	50.	692.	2035.	1056.	33	2.	50.	692.	2035.	1056.
34	10.	79.	1648.	4554.	1516.	34	15.	118.	2966.	5872.	3028.
35	1.	14.	145.	307.	259.	35	3.	38.	491.	653.	469.
40	21.	1183.	2496.	7561.	966.	40	21.	1183.	2496.	7561.	966.
50	366.	18328.	84688.	318689.	71794.	50	518.	24013.	188022.	422023.	115809.

FIGURE 20-B

4) STATION CLERICAL (SCO)

Like some of the other component costs discussed above, SCO costs are removed from the Michigan accounting system when they are below a certain magnitude. The USRA formula is used in the Michigan approach, but is subject to this constraint of "minimum" magnitude.

SCO = (CF(29) * Total (50,1) + CF(29) *
Local (50,1) + CF(29) * ConRail (50,1)

Where:

CF(29) = 4.766 (RC) Figures 17 and 18
Total (50,1) = 518 cars
Local (50,1) = 0 cars
ConRail (50,1) = 152 cars

The double subscript on the total, local, and ConRail variables should be taken to mean "the fiftieth row, first column" of each traffic matrix. See Figures 20-A and 20-B.

Substituting the values:

SCO = 4.766 x 518 + 4.766 x 0 + 4.766 x 152 = 3193.22

The Michigan methodology includes the following:

If (SCO. LT. 3400) SCO = 0

Since SCO is less than 3400 in the above calculation, the Michigan accounting system sets this cost to zero.

All differences between the USRA and the Michigan methodologies have now been accounted for. If further detail is desired, one should consult the TASK-3 Report submitted by R. L. Banks and other manuals obtained from the USRA presently on file with the Statewide Transportation Planning and Procedures Section of this Department.

CONCLUSION

CONCLUSION

The Branch Line Evaluation Reports obtained from executing the USRA and Michigan versions of the line viability analysis differ as a result of programmatic and input file modifications made to the originals as sent to this Department by the USRA. These changes have been made, as noted above, to reflect this State's belief that the USRA has inflated estimated costs through a misapplication of the avoidable-unavoidable cost concept. From the Evaluation Reports presented one may conclude that the Michigan approach to line viability invariably reduces the estimated cost of operating and maintaining branch line facilities. The utilization of the Michigan Model in place of its USRA counterpart makes the ownership of certain segments of the bankrupt railroad seem more attractive than the USRA analysis has led many to believe.

Even when the Michigan Model is employed, however, many rail segments, as defined by the USRA, continue to be depicted as contributing heavily to the financial problems of the bankrupt railroads. Since traffic definition (i.e., Local, ConRail, Interline) are tied to the length of a segment and because costing procedures have been developed around traffic types, it was found that the way in which the rail network was divided into segments may strongly influence the apparent profitability of a line. An extremely long line may, for example, show a substantial loss in its entirety because a relatively small portion of it generates a fantastic loss. That is, if this one portion were removed, the majority of the line would generate a net profit for the rail company. Many states were forced to accept the USRA segmentation since they did not choose to redefine study links which would have required a remanipulation of the waybill file - a formidable task indeed. Fortunately, this Department developed techniques which permitted a disaggregation of the USRA segment into the so-called Michigan segmentation system. This system allowed state rail planners to isolate those sub-USRA segments which are responsible for making an entire line appear unprofitable when, in fact, this is not the case. "Cngtrf", a computer program was written to allow for further alteration of rail segments and their associated traffic and characteristic files. This program permits the rapid and efficient testing of proposed rail plans. Because the changing of traffic volumes along segments and altering the characteristics of segments affect community and environmental impacts, "Cngtrf" has become crucial to the entire railroad impact analysis process. See Figure 1 for the location of the program within this process.

This report has detailed many aspects of both the USRA and Michigan versions of the line viability analysis. Those who are interested in operationalizing this technique to conduct rail network evaluations of their own will find it, its companion, and its supporting reports of great interest. It should, however, be reiterated that the viability approach to rail financial impact analysis was adopted out of necessity. The time frame in which the state was required to submit a state rail plan was such that a conceptually superior technique could not be devised. The more obvious faults were removed, but the technique has remained weak. Perhaps its greatest value lies in that it has filled a critical gap in the state's ability to quickly evaluate alternate rail plans. Since these plans are of a short term nature, they are acceptable. When state rail planners begin to formulate long range plans, viability analysis must be revised so as to permit a true systems analysis. Many of the basic ideas employed in viability combined with the "Full Allocation" technique briefly mentioned in the Introduction should give state officials the resources needed to perform such an analysis.