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I R A P R O J E C T
INTER-REGIONAL TELECOMMUNICATIONS ACCOUNTING

FINAL REPORT ON THE FIRST PHASE OF THE PROJECT

prepared for and in collaboration with the
NATIONAL TELECOMMUNICATIONS BRANCH
DEPARTMENT OF COMMUNICATIONS

by

LE LABORATOIRE D'ECONOMETRIE
de L'UNIVERSITE LAVAL

and

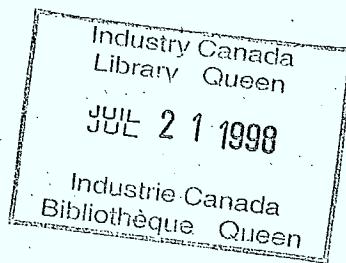
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Montreal

March 31, 1974

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IRA PROJECT

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first phase of the project

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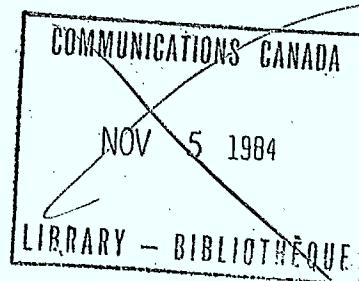
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FOREWORD

This Report contains a description of an Operational Research model constructed during the First Phase of the IRA Project. The purpose of the model is to simulate the financial consequences of various costing and accounting procedures and of various revenue sharing schemes concerning inter-regional telecommunications, each time with a given state of the network and its operating characteristics.

The results of the first simulation runs are reported herein. Contrary to the practice followed so far in the joint projects by the D.O.C., Sorès Inc. and le Laboratoire d'économétrie de l'Université Laval, this Final Report of the current phase complements but does not replace the Interim Report, owing mostly but not exclusively to the very tight schedule imposed independently of the will of the three participants. However, an effort has been made to make this Final Report as comprehensive and autonomous as possible.

Finally the reader will also find a discussion of the plans for the Second Phase of the Project and even beyond, although evidently these latter plans are treated in rather general terms.

The Report is not a comprehensive treatise on telecommunications engineering, accounting or, for that matter, Operational Research. Nor does it pretend to provide automatically solutions which could pretend to be "optimal" for the carriers and/or the regulatory agencies.

On the other hand it is to be viewed in a wider setting as a contribution towards the formulation of policies aiming at having an even more efficient telecommunications system, in keeping with the broad social, economic and political objectives of Canada.

ABSTRACT

This Final Report on the First Phase of the IRA Project contains a first description of the Inter-regional Telecommunications Model, by now operational, including the software, though not yet fully efficient.

Two of its blocks, the Operating Block and the Policy Simulation Block, especially the latter, are still in a rather rudimentary form.

A good deal of emphasis is put on the data requirements which would have to be satisfied to make the model truly realistic, and also on the nature of its outputs. In fact, apart from its main outputs which assist in the financial evaluation of the various sharing schemes, costing procedures, traffic, network configurations, etc. an important subproduct of the model is to serve as a framework for the collection and organization of the relevant data. The purposes of the model were stated in the Foreword which precedes this Abstract. The Report also contains the first results of simulation runs. The simulation results serve two purposes:

- to illustrate the possibilities of the model
- to provide the benchmarks

On the other hand one distinguishes "global simulations" involving the model as a whole from "local simulation" involving the Accounting Block only: these latter simulations accept the results of the Sharing Block and thus implicitly those of Costing and Operating Blocks and such additional inputs as may be required (indicated on the flowcharts in Section 4).

It is thus seen that the model explores aspects of inter-regional telecommunications primarily in accounting and financial terms. It is neither a demand for telecommunications model nor a corporate financing model.

Apart from the question of joint costs and of joint products and other indivisibilities, the main intellectual challenge of the present Project is the handling of the highly complex relations between average traffic on one hand, and peak traffic on the other, bearing in mind that revenues are generated essentially with reference to average traffic whereas costs are incurred to a very large extent with reference to peak traffic. The interfacing of this model and its successors with those of the HERMES series of models is also of considerable scientific interest.

RESUME

Ce Rapport Final de la première phase du Projet IRA contient la première description d'un modèle de la comptabilité des télécommunications inter-régionales, maintenant opérationnel y compris la programmerie, bien que inévitablement pas tout à fait efficace.

Deux (2) des blocs de ce modèle, le bloc traitant du réseau et du trafic d'une part et le "Policy Simulation Block" de l'autre, en particulier ce dernier, ne sont encore que sous une forme assez rudimentaire.

Un grand accent est mis sur les besoins en données qu'il faudrait satisfaire pour rendre le modèle vraiment réaliste, mais aussi sur la nature de ses sorties. En effet, à part les sorties principales qui concernent principalement l'évaluation financière des différents schémas de partage, les différentes procédures de calcul des coûts, du trafic et des configurations du réseau etc., un sous-produit important du modèle est qu'il puisse servir comme cadre pour la collecte et l'organisation des données pertinentes. Les objectifs du modèle se trouvent décrits dans le "foreword" qui précède le présent résumé.

Ce rapport contient également les premiers résultats des simulations. Les résultats des simulations en question servent:

- à illustrer les possibilités du modèle;
- à fournir les premiers résultats chiffrés auxquels les résultats des simulations subséquentes seront comparés.

D'autre part, on fait une distinction entre "simulations globales" faisant intervenir le modèle tout entier et les "simulations locales" ne faisant intervenir que le bloc comptable; ces dernières simulations acceptent le résultat du bloc des schémas de partage et ainsi implicitement les résultats du bloc où on fait le calcul de coûts et où on traite la configuration du réseau et du trafic ainsi que d'autres entrées d'inputs dont on pourrait avoir besoin (indiqué sur les organigrammes dans la Section 4).

Il est ainsi évident que le modèle explore divers aspects des télécommunications inter-régionales surtout du point de vue comptable et financier. Ce n'est ni un modèle de la demande pour les télécommunications ni un modèle du financement des corporations.

A part la question de coûts conjoints et de produits conjoints et autres indivisibilités, le défi intellectuel principal du présent Projet est la manipulation des relations hautement complexes qui existent entre le trafic moyen d'une part et le trafic de pointe de l'autre. On se souviendra que les revenus sont générés essentiellement par référence au trafic moyen tandis que les coûts sont encourus dans une très large mesure par rapport au trafic de pointe. L'inter-relation de ce modèle et de ses successeurs avec les modèles de la série HERMES offre aussi un intérêt scientifique considérable.

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1. INTRODUCTION

This is the Final Report of the First Phase on the building of a simulation model, called hereafter IRA, dealing with financial aspects of inter-regional telecommunications in Canada. It is to be stressed that this is the first building of what might eventually become a succession of perfectible models and thus certainly does not represent the final formulation of the thinking of the team members on this subject.

One important purpose of this Final Report is to identify and evaluate, although the latter is a hazardous task, the various options available concerning the Second Phase of the Project.

It is to be stressed that this whole project constitutes in a sense a new departure vis-à-vis the HERMES Project. The present phase of the Project, closed by March 31, 1974 represents no more than an exploratory effort. The numerical results which appear in this Report are to be considered as at best "semi-realistic" being based largely on real but seriously simplified data and in places on artificial (though reasonable) data and involving certain simplified procedures.

This Final Report in no way replaces the documents listed in Appendix A which indeed contain masses of information essential to the continuation of the Project. Moreover, this Report has to be read in conjunction with the Interim Report of December 1st, 1973.

The present Report represents the result of a combined effort by three participants whose formal responsibilities were spelled out in the various official documents and detailed sharing of the tasks handled by more or less informal exchanges. The tripartite team consisted of the following organizations given here with the names of the specialists involved:

Corporate and Financial Affairs Directorate of the National Telecommunications Branch:

Mr. J. A. Guérin

Mr. G. G. Henter

Miss M. R. Prentis

Mr. C. Lee has joined the team members by January 1974 in the place of Mr. N. Rasheed who leaves the D.O.C.

Sorès Inc., Montreal:

Mr. J. Cluchey

Mr. O. Eryasa

Mr. D. Geller

Mr. E. Manis

Mr. R. Riendeau

Laboratoire d'économétrie de l'Université Laval:

Mr. C. Autin
Mr. G. LeBlanc
Mr. T. Matuszewski

Being members of le Laboratoire, the following research assistants have worked more or less intensively on the Project:

Mr. F. Côté
Mr. C. Gilles
Mr. B. Paquet
Miss R. St-Jacques

2. SOME FURTHER PRINCIPAL CONSIDERATIONS

Although the IRA Project team started with a simple attempt to measure the effects on carriers of alternative sharing schemes, it has never lost sight of the possibility that this group of models is also to be used in the more or less distant future to help the D.O.C. in handling the following policy questions:

- I The financial viability of the carriers;
- II To see which analytic devices, including simulation, could be constructed to help to devise rational means of capital deployment and utilization;
- III Also, and this appears to be of great interest for D.O.C., the regulation of interprovincial rates; this leads to the question of cross subsidization of local versus long distance services. This again is not an area where the coming phase of the IRA Project ought to engage itself. However it might be useful if the models of the series were able to monitor the consequences of decisions taken in those areas. It is clear that this will have to go chiefly through the Operating Block although also the Costing Block might be involved here.
- IV It has also been agreed, although this has not been formulated with any precision, that a certain amount of conceptual work, and perhaps certain simulation tests, will be made concerning the planning over time. Still following the guideline established earlier, no formal optimization procedures over time will be contemplated but the problem will be handled by repeated simulations with interfacing between machine operations and human evaluations and decisions.

The long-term objectives of the Project remain the same as stated in the Interim Report of December 1st, 1973. One should expect a more detailed formulation of these objectives as time goes on. On the other hand one should not preclude in advance a gradual change in these objectives to take account of the rather rapid evolution of the realities of inter-regional telecommunications and of the policies which affect them.

The formulation of "objectives" as constraints remains as important as ever, especially as an instrument in the preparation of the elements of decision.

It appears inevitable that in the coming phase of the IRA Project the main outputs will continue to be simulated financial statements (plus certain "significant financial ratios").

Although certain additional types of outputs ought to be contemplated it is to be noted that the financial outputs are essential if only to enable us to judge the results of the various simulations on the likelihood of the survival of the system and of its various components, that is at the moment, at any rate, the individual members of the inter-regional system. On the other hand, it is possible that these financial indicators might be usefully accompanied by certain additional outputs such as other measures of performance and of social costs etc.

At this point at least two important questions arise. It would probably be premature to try to answer them now, but it might be helpful to state them: what emphasis ought to be put on the evaluation of the performance of the inter-regional telecommunication system, other than financial statements and other monetary indicators. The second question is: to what extent account ought to be taken of other than inter-regional telecommunications even if the latter constitutes the primary if not the exclusive area of interest.

It will be noted however that virtually all the work done so far: data collection and organization, conceptualization and software work have been linked to inter-regional telecommunications proper.

All this comes very close to the difficult problem of linking the accounting and the physical aspects of the problem and the problem which is both difficult and delicate of management rights and the evaluation of the social significance of performance. It would be only to follow the spirit of the collaboration between the D.O.C., and le Laboratoire d'économétrie, collaboration which goes back three full years, to proceed with utmost caution on this untrdden ground. However, there are reasons to believe that some real (i.e. operational and meaningful) progress could be attempted here with possibly some conceptual work being done already in the coming months. One possibly fruitful avenue to explore is the amazing interchangeability of constraints and arguments in the objective function. Some use of this approach is already being made in the current phase of the IRA Project. Broadly speaking, what this means is that indicators other than financial, that is indicators linked to the quality of service, survivability, the assumption of an appropriate posture vis-à-vis future developments, etc., may be handled either as objectives properly speaking or as constraints. It will be noted that the concepts of duality, first introduced in linear but now rapidly generalized to other kinds of mathematical or economic programming, make it possible to develop quantitative measures of performance in attaining the objectives of the wide variety just mentioned, as well as the corresponding trade-offs which are meaningful in a number of cases.

One might note here that recent econometric and Operational Research techniques make it possible to analyse and even to optimize certain large and complex system

without the necessity of going through the detailed and to some extent inevitably arbitrary procedures for allocating costs and measuring outputs (or rather contribution of the individual elements to the overall output of the system).

It is to be pointed out that to a large extent the detailed information required to produce some non-financial outputs is already generated within the model for the purposes for which the model is designed and thus one should not overestimate the resource commitment needed to produce these additional non-financial indicators. This will become even more the case as the interfacing of the IRA and HERMES groups of models progresses.

It is to be noted however that, where non-monetary and non-financial outputs are obtained it is inappropriate to use the term trade-off to describe relations between them. On the other hand the formulation of certain policy objectives as constraints and the use of the concepts of duality makes it possible to put certain money measures on qualitative characteristics of both inputs and outputs and also on the measure of performance of the system. Though of course for policy making purposes eventually, the calculation of the appropriate trade-offs will also involve human effort relying on more or less formal procedures. It will be remembered here that it has been agreed that the models of the IRA series will remain "man-machine" teams rather than fully automatic devices. In this manner, the models will be both more flexible and less costly to use. What we are trading off is essentially the mathematical elegance of optimal solutions against the excessive simplification and rigidity which these solutions would require if applied right across the board.

Whatever the lines of approach finally adopted, there appears to exist a clear consensus of all the participants in favour of simulation techniques even if certain optimization procedures are locally used in our work. Some of such optimization procedures may be both large and powerful such as the TRANCHE modules of the HERMES group of models.

It will be noted here that the HERMES group of models is perfectly capable of accepting additional financial constraints in so far as they take the form of linear equations or inequalities in real or in discrete variables. There is in fact no need to develop any additional software.

However, there is no question of optimization over the system as a whole. This topic has already been discussed on a number of other occasions and relevant documents are available. This should not preclude of course the use of local optimization procedures such as linear programming described elsewhere or for that matter of the TRANCHE modules just mentioned.

As things stand now the model cannot provide any information on the cross-subsidization between the local and long distance services on one hand and also

on the trade-offs between different types of services on the other, although the structuring of the model provides for the capability in this direction. It appears that this in itself is not a priority requirement, though the question is of considerable potential importance.

In so far as the question of the ownership pattern is concerned, it is not proposed that the question of non-telecommunication subsidiaries be brought in in the near future. However, the ownership in the inter-regional telecommunications area already gives rise to certain problems. For instance, certain routing patterns may be incompatible with certain ownership patterns. If one wants to simulate the effects of changes in routing patterns one has to consider the ownership structure of inter-regional telecommunications, even without going beyond this relatively narrow domain. This is closely related to the preceding point: how much emphasis and when is to be put on the notion of "enlarged networks".

It is pointed out that one of the major preoccupations of the D.O.C. is with intercarrier competition especially in areas which are highly competitive such as private lines and in particular data transmission as against public message traffic where there is virtually no competition. Again the question arises of the "enlarged networks" on the one hand and on the other hand of the possible non-compatibilities between the ownership patterns and rational routing arrangements.

Granted that cross-subsidization already mentioned above is potentially a very worthy object of investigation, it is by no means clear how does one go about handling this problem if he has no capability, and no data of course, for handling anything except inter-regional traffic in the narrow sense of the term. It will be noted however, that the cross-subsidization problem touches all the three long-term objectives of the Project as seen by the Department of Communications. If the D.O.C. decides to consider the cross-subsidization aspects of the problem they will also have to decide how much effort is to be devoted to:

- going into telecommunications other than inter-regional telecommunications properly speaking, that includes intra-regional but toll telecommunications, telecommunications between adjacent regions, and finally local services;
- the conceptualization required to handle the effects of cross-subsidization.

It might be noted in passing that cross-subsidization in itself is of no interest. Its importance lies in its being potentially perhaps a very visible and measurable manifestation of the practices and policies in force at present and of the policies contemplated whose effort will first, of course, have to be evaluated.

Concerning the internalization of simulations, this will clearly have to be left to some eventual future phase. On the one hand the mathematical properties of the model are very difficult to examine. What is more, any work in this direction will necessarily involve a very heavy conceptualization and software effort. Apart from these negative aspects there is also a real danger that the automation, so to say, of the simulation procedures at too early a stage of the building of a simulation model necessarily creates a danger of finding oneself in a straight jacket of rigid procedures.

It is clearly necessary to review frequently the earlier thinking concerning in particular the "Policy Simulation Block" in order to make it a more and more efficient device for preparing policy decisions and for producing measures of performance.

3. RESUME OF THE GENERAL LOGIC OF THE MODEL

The basic logic of the model, for the purposes of the First Phase remains almost entirely that described in the Interim Report of December 1st, 1973. The main blocks of the model are:

- Operating Block
- Costing Block
- Sharing Block
- Accounting Block
- Policy Simulation Block.

The basic outline of the logic is represented by the flow chart appearing in the Interim Report of December 1st, 1973. Detailed descriptions of the inputs, methodology and outputs and corresponding logic flowcharts are provided in Section 4 of this Report for the first four Blocks.

The Policy Simulation Block remains in an embryonic stage in the present phase of the Project. The Accounting Block serves among other things the purpose of local simulations, described elsewhere in this Report. On the other hand at present the Operating Block serves the purpose of accepting and manipulating certain categories of exogenous inputs and transmitting to the remainder of the model.

The interrelationships represented in the IRA all-inclusive model are approximations of the regulated yearly activities pursued by the inter-regional telecommunications carriers. From the initial state defined both with reference to the switching and physical networks with known values and property structures, different patterns of demand, cost calculations, sharing schemes and general rules are evaluated from the financial point of view, for each participating carrier and for the entire inter-regional community.

The Blocks mentioned above are the main sets of sub-models which are needed in this phase to simulate the financial consequences of the various configurations of arrangements listed elsewhere in this Report.

Operating Block

In this Block the switching and physical network, the traffic configuration (and the peak/average relationship), as well as routing patterns are defined for the model through data input and manipulation.

Costing Block

From the information transmitted from the Operating Block and from input cost functions, element unit costs per unit of usage, and element total costs are calculated, and company incurred costs are derived by summation.

Sharing Block

Based on outputs from the Operating and Costing Blocks, different revenue and cost sharing schemes are applied and the results transmitted to the Accounting Block. Firstly, annual stream revenues are calculated and secondly, settlement schemes are applied to distribute these revenues according to various costs (Costing Block) and sharing schemes. The output is the operating revenues for all carriers by each category of service.

Accounting Block

From the outputs of the preceding Blocks and with supplementary inputs, this Block builds financial statements and calculates "significant ratios" and solves financial simultaneous system of equations as well as goal programming problems.

4. PRINCIPAL BLOCKS AND THEIR INTERRELATIONSHIPS

4.1 Operating Block

This block constitutes the front end of the IRA Model and the starting point from which information can be fed into the Costing, Sharing and Accounting Blocks. The main components of the Operating Block are: the network configuration and ownership structure, the traffic configuration, the routing patterns, and, the average revenue structure which in fact is derived from the tariff structure. The program logic for this block is shown in Diagram I.

4.1.1 Network Configuration and Ownership Structure

The definition of the inter-regional network is a laborious task because a large portion of transmission and switching facilities is shared for both regional and inter-regional usage. The regions have been identified as the geographical service areas of the major telephone systems. To a large degree these areas coincide with provincial boundaries. The significant exception is Bell Canada which operates principally throughout Quebec and Ontario.

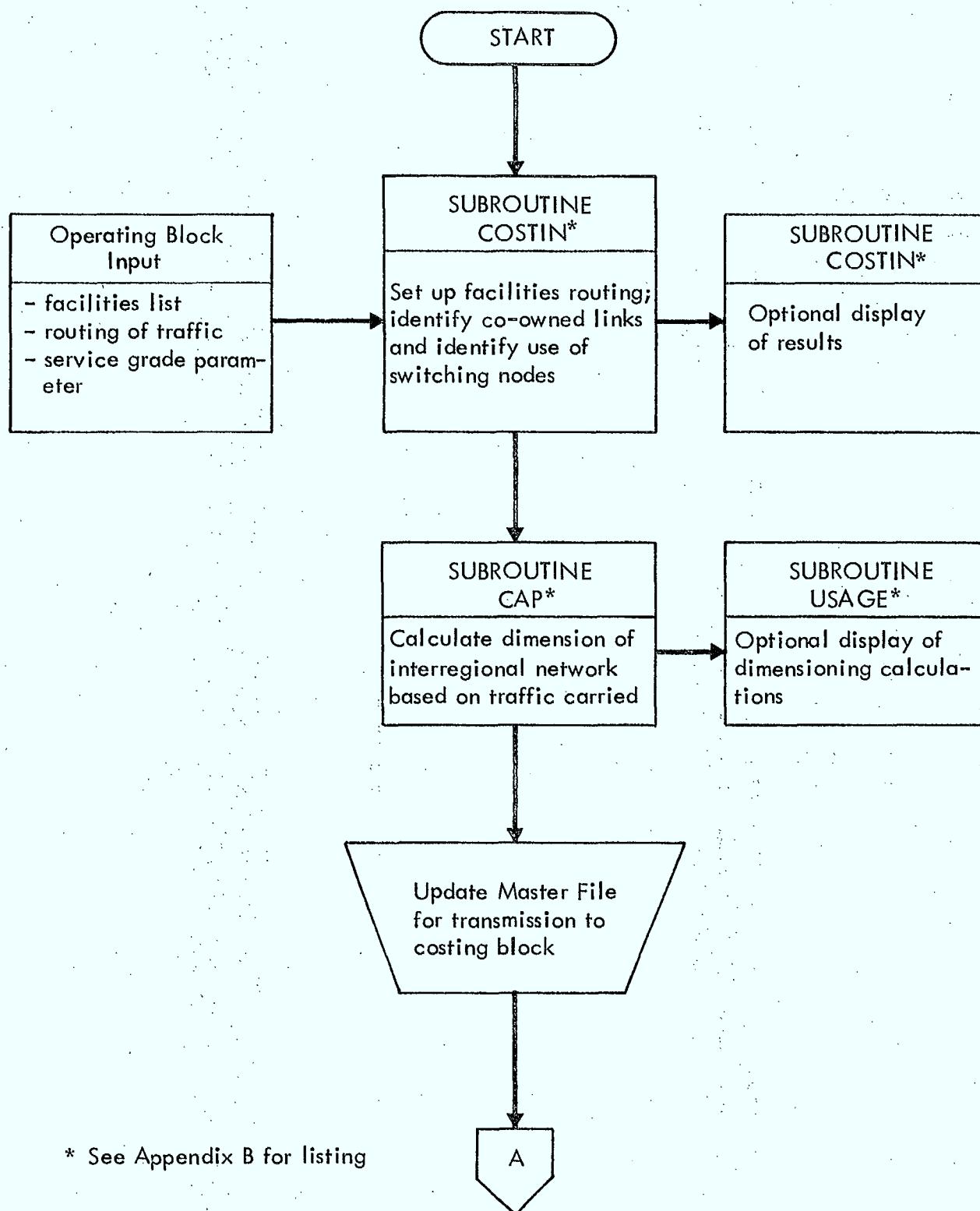
The first step consists in the definition of the inter-regional switching network which begins with the identification of the inter-regional trunk groups including finals, full and high usage groups. These inter-regional trunk groups provide a means to identify the nodes which will compose the inter-regional switching network. The definition of this latter network is reaching completion once you identify the switching hierarchy and quantify, for a given period, the existing trunking, intra-regional as well as inter-regional, which inter-connect all these points.

The method of approach described above has been used to define the inter-regional switching network for the end of the year 1970. This network which includes 60 nodes in a 4 level switching hierarchy is represented in Appendix C of the Interim Report on the IRA Project. Owing to the great complexity of providing traffic data and, above all, routing information for a 60 nodes network, given the time and resources constraints, we had to work with a reduced version of this more elaborated network. The reduced network in Appendix F which includes 24 nodes has been derived merely by dropping all switching nodes of level four and the relevant trunks. These remaining 24 points represent the major cities in Canada.

The reduced network is a subset of the TCTS network and does not provide yet for the interface with CN/CP and COTC switching facilities. Therefore, we did not have to split the total switching capacity of any node between different owners. When we introduce this refinement, the concept of the enlarged network, which consists in adding dummy nodes, will be used in order to fraction each switching node into as many distinct nodes as there are carriers at the same location.

DIA GRAM 1

Logic Flowchart
Operating Block (P1 - See Section 6)



* See Appendix B for listing

Nevertheless, the total switching capacity of each node had to be split between regional and inter-regional usage. A description of the computerized algorithm which solves this problem of separation is provided in the forthcoming sub-section on "Routing".

It is worth noting at this point that no attempt has been made so far in order to take into account the portion of the local switching equipment which is used at both ends of any inter-regional communication.

The second step consists in the definition, for the same period, of the transmission facilities network which subtends the reduced inter-regional switching network. Although, any micro-wave link crossing a regional boundary can, at that point, clearly be identified as an inter-regional facility, the problem of separating inter-regional from regional facilities remains for all other inter-regional links. Again, the computerized algorithm which solves this problem is described in the forthcoming sub-section on "Routing".

The inter-regional transmission facilities network which we defined for the end of the year 1970, comprises 39 nodes and includes only the major micro-wave routes of TCTS. The interface with the TELESAT system has not been provided for because the satellite was not in operation at that time.

The relevant information on the switching and transmission networks is provided to the computer on two different sets of data sheets whose contents are described below.

The first of these forms contains information on switching nodes of the toll switching network. The following items are included for each node.

1. A code word or name for the node (e.g. AO4)
2. A code number for the asset valuation function which is used to valuate the total toll facilities at this node.
3. Level of exchange in the switching hierarchy (not used explicitly in present version of software).
4. Total toll switching capacity in switched trunks (including Canada-U. S. trunks).

Information is provided here for inter-regional switching nodes only and not for nodes which are bypassed by inter-regional traffic.

The second of these forms contains information on the transmission links in the physical network.

This information includes the following items:

1. A code word or name for the link (e.g. 0104)
2. A code number for the asset valuation function which is used to value the toll facilities of the link.
3. Total transmission capacity measured in radio frequency channels (R.F.C.)
4. Total length in miles of the transmission facility (necessary since asset valuation functions are in 1000\$/mile).
5. Percentage indicating the % ownership of the westernmost partner in a transmission facility when this facility is co-owned (crosses a provincial boundary). This factor is established on the basis of the distances on each side of the border.

In co-owned transmission links the asset valuation and incurred cost per c.c.s. are split between the two companies involved using the data item 5) above.

In each of these sets of information, the cost function number refers to the asset valuation functions provided in the Costing Block which are used to value the existing transmission and switching assets. The item on total capacity for transmission facilities refers to the total regional and inter-regional transmission capacity per individual link which is measured in terms of R.F. Channels. The homologous item for switching facilities represents the total regional and inter-regional toll switching capacity which is measured in terms of switched trunks.

This information is used to establish a total asset valuation to which the Costing Block later applies a separation scheme in deriving the inter-regional asset valuation (refer to Section 4.2.1 for a complete description of the separation problem).

4.1.2 Traffic Configuration

The main categories of services considered at the inter-regional level are public messages, private lines and video program transmission. Owing to the lack of data, the traffic streams with U.S. and Overseas have not been included for the current phase of the project.

1. Public Message. Based on the number of existing point-to-point inter-regional trunks for the end of the year 1970, peak traffic has been estimated for each pair of points of the 24 node reduced network. The amount of offered public message traffic has been estimated by converting backwards from trunks to traffic, using the Poisson and Erlang-B formulae, given the blocking and overflow probabilities. The blocking probability on the final and full groups was set at 1%, and, the overflow probability on the high usage groups, at 10%. For the pairs of points which are not directly connected we have assumed, for each pair of nodes in different numbering plan area, a traffic smaller or equal to (\leq) what 7 high usage trunks can carried if engineered with an overflow probability of 10%; for each pair of nodes in the same numbering plan area, we have assumed a traffic smaller or equal to (\leq) what three high usage trunks can carried when engineered with the same overflow probability (10%).

A gravity model was then used to determine the exact level of traffic pertaining to each pair of these non-connected nodes.

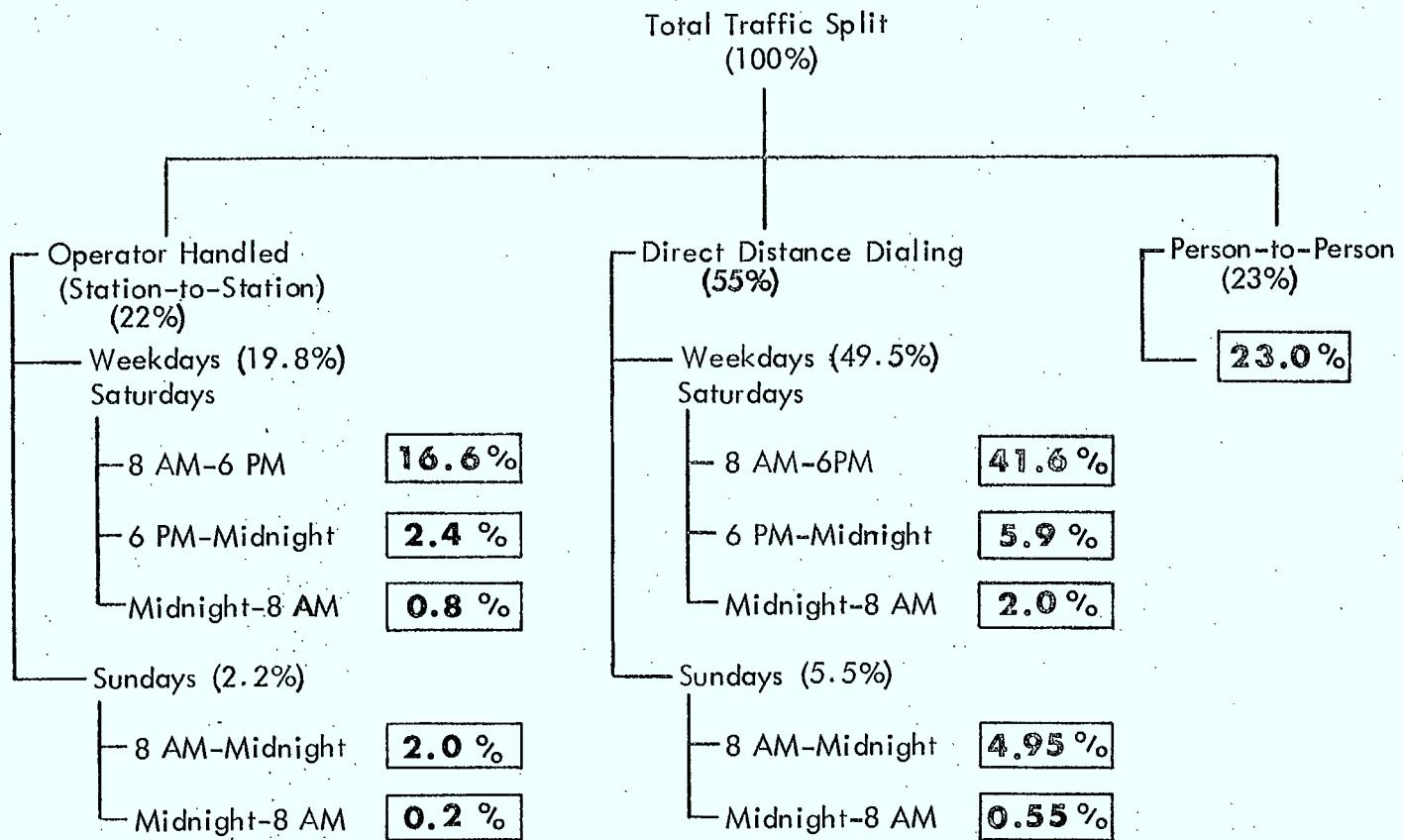
As outlined in the Interim Report, a more rigorous method of estimation of point-to-point traffic which will probably use a mathematical programming approach, should be developed in the next phase of the project.

The point-to-point traffic estimated with the procedure described above is the peak-hour traffic. But for the calculation of total annual revenue per stream (and carriers) we need to know the total annual traffic from peak in each stream. Using a standard traffic distribution (1) for a typical week day, comprising both residential and business traffic, the relationship between peak and total daily traffic has been approximated as being 11.33% (i.e. the peak-hour traffic represents on the average 11.33% of the total daily traffic). From another study (2) we then derived the average relationship between total week day traffic and total weekend traffic. This latter estimate showed us that on the average the total weekend represents 15.5% of the total weekday traffic. These two coefficients were further combined so as to give a factor of conversion that allows us to estimate total annual traffic from peak traffic.

The main weakness of this latter approach resides in the fact that we have applied the same 24 hour traffic distribution to all streams. This resulted in the derivation of a unique peak to total daily traffic ratio for all pairs of points. However, this approach was forced upon us by the severe lack of traffic data.

When we know the total annual traffic for a given stream, before we can proceed to the revenue calculation, we must know the traffic distribution by classes of calls Direct Distance Dialing, operator handled (Station-to-Station) and Person-to-Person and for different periods of the day. Based on the Trans-Canada telephone message study, cited previously a "tree" showing the total traffic Split has been estimated and is displayed below.

-
- (1) "Switching Systems" American Telephone and Telegraph Co., N.Y.
 - (2) Estimation of the price sensitivity of Trans-Canada telephone messages
Trans-Canada Toll Studies, Chief Statistician's Office, Bell Canada,
April 1972.



Firstly, the total traffic of 100% is split between Operator Handled (Station-to-Station) 22%, Direct Distance Dialing 55% and Person-to-Person 23%.

Secondly, these percentages were allocated based on a 90/10 split between weekday-Saturday and Sunday traffic and splits within these periods among 8 AM to 6 PM, 6 PM to Midnight and Midnight to 8 AM. This resulted in traffic splits for the 5 periods for both Operator Handled (Station-to-Station) and Direct Distance Dialing, and 1 full period for Person-to-Person or 11 splits of the total traffic for the 11 classes of calls or "branches". This traffic split vector of 11 values is used in the Sharing Block as mentioned below in Section 4.3.

2. Private Lines. The point-to-point inter-regional private lines have been estimated with a gravity model, given the total number of private lines region-to-region. Owing to the great diversity of services (e.g., radio program transmission, data transmission, teletypes, etc.) included under "private lines", the tasks of finding a tariff structure which is common to all those services was almost an impossible one. The problem has been bypassed by assuming that all private lines were "telephone private lines (voice)".

3. Video Program Transmission. This particular service is treated separately from private lines because of the indivisibility that characterizes the number of circuits required for the transmission of any program. This is important from the point of view of routing.

We have assumed that programs were transmitted from Vancouver, Toronto and Montreal to all nodes of the reduced networks. Each of those three sources has a one way T.V. Channel to all other nodes.

4.1.3 Routing Patterns

Owing to the non-availability of a computerized routing algorithm, the major challenge of the project at the level of the Operating Block consisted in generating manually the routing of traffic for all services between all pairs of points. Indeed, the combinatorial nature of the problem has rendered almost impossible the manual derivation of the routing of traffic for three services in a 60 nodes network (e.g. if we have one service and four routes per pair of points in a sixty nodes network, this would mean $7,080$ routes = $4 \sum_{n=1}^{60} N$ assuming the routing is symmetrical).

The routing techniques are different for public messages, private lines and video program transmission and consequently the routing formats vary slightly. What follows is concerned with the most interesting of these which only relates to public messages. In this latter case the routing procedure must start by identifying all possible routes for any given pair of points at the level of the switching network, given the switching hierarchy, the homing rules, the blocking and overflow probabilities and certain routing rules. An example of such routing rules is:

- A call originating in one ladder for another can be offered to a High Usage group only if that group terminates in an office in the ladder in which the called office is located;
- The above call must be delivered to the called ladder (not via a third ladder) and can move only down the hierarchy of that ladder.

Secondly, this routing procedure must identify for each route in the switching network the physical routing in the transmission facilities network. The format we have adopted for the compilation of the routing information on public message allows us to combine into one format the routing information collected at these different levels. As stated in the Interim Report, no information on routing is required for the calculation of revenue by stream (and carrier); whereas, for the calculation of cost per stream (and carrier) the routing information is essential. Therefore, what we finally have to identify for every pair of points is the routing of traffic with respect to the facilities network.

The routing information in the case of public message is arranged in the following manner:

1. Items of data for traffic stream

- originating node code name,
- terminating node code name,
- category of service (code number indicating whether service is telephone, private line, television, etc.),
- inter-regional both way traffic volume in c.c.s. for the peak hour,
- peak hour to average total annual traffic conversion factor, and
- number of physical routes in stream.

2. For each route within a traffic stream

- Percentage of traffic of stream using this route, derived from a correspondence between peak overflow probability and average overflow percentage using the Commonwealth Tableau shown in Section 5.2.
- List of element code names (nodes and links) in the physical route.
- For each segment of each route - a code indicating the use of the segment as a final full group or high usage group.

This information, along with the overflow probability and the final blocking probability for the peak hour (also input to model) is used to establish the dimension of the inter-regional network as a function of traffic.

This dimensioning involves the following steps:

First, we obtain peak traffic offered to a particular physical route in the following manner:

- All routes are identified as either high usage or final full routes.
- If peak overflow probability is P_o , the high usage routes are assumed to receive $100(1-P_o)\%$ of the offered peak traffic.
- The final/full routes are assumed to receive $100 P_o\%$ of the offered peak traffic.

High usage groups are dimensioned as a function of the peak traffic offered to this groups and the peak overflow probability using the Erlang B formula for traffic-to-trunks conversion. A discussion of the formula is given in Appendix H (Dimensioning Conversion Formulae).

Final groups are dimensioned as a function of peak traffic offered to this group and the final blocking probability using the Poisson formula for traffic-to-trunks conversion (See Appendix H. Dimensioning Conversion Formulae). Switching nodes in all routes are dimensioned assuming an average load of 21 c.c.s. per switched trunk.

High usage and final/full groups are dimensioned on a point-to-point basis.

When a particular element is used in more than one route, and in different traffic streams, the total number of circuits in its dimension is the sum of circuits required by pair of demand points. This summation is the last step in obtaining the dimension of the physical facilities in the elements of the inter-regional system.

It should be noted that the dimension of the inter-regional network is based on offered traffic without making provision for over-capacity. This is an area for more development since some parts of the real system seem to be over-dimensioned.

4.1.4 Tariff Structure

For this current phase, we have only been concerned with collection rates and no accounting rates and terminal charges have been specified anywhere. These tariff structures are used in the Sharing Block as mentioned below in Section 4.3.

In the case of public messages, the tariff structure has been developed for a call of an average duration of 5.5 minutes. The source for the rates is Bell Canada's General Tariff. The tariff structure for public message is presented in the tables below.

Distance Miles	Operator Handled Station-to-Station Calls				
	Weekdays			Sundays	
	8am-6pm (Mon-Sat)	6pm-midnight (Mon-Sat)	midnight-8am (Daily)	8am-midnight (Sun)	midnight-8am (Daily)
1-80	1.46	1.26	1.13	1.26	1.13
81-110	1.76	1.52	1.36	1.52	1.36
111-140	2.14	1.84	1.65	1.84	1.65
145-180	2.49	2.15	1.92	2.15	1.92
141-228	2.85	2.40	2.15	2.40	2.15
229-290	3.06	2.64	2.36	2.64	2.36
291-400	3.33	2.87	2.56	2.87	2.57
401-540	3.60	3.11	2.78	3.11	2.78
541-680	3.90	3.36	3.00	3.36	3.00
681-840	4.05	3.51	3.15	3.51	3.15
841-920	4.20	3.66	3.30	3.66	3.30
921-1200	4.35	3.81	3.45	3.81	3.45
1201-1450	4.50	3.96	3.60	3.96	3.60
1451-1675	4.65	4.11	3.75	4.11	3.75
1676-1900	4.80	4.26	3.90	4.26	3.90
1901-over	4.95	4.41	4.05	4.41	4.05

Distance (Miles)	Direct Distance Dialing					Person to Person	
	Weekdays		Sundays				
	8am-6am (Mon-Sat)	6pm-midnight (Mon-Sat)	midnight-8am (Daily)	8am-midnight (Sun)	midnight-8am (Daily)		
1-80.	1.39	.97	.70	.97	.70	2.26	
81-110.	1.68	1.18	.84	1.18	.84	2.74	
111-144.	2.02	1.41	1.01	1.41	1.01	3.29	
145-180.	2.31	1.62	1.16	1.62	1.16	3.84	
181-228.	2.60	1.82	1.30	1.82	1.30	4.29	
229-290.	2.84	1.99	1.42	1.99	1.42	4.71	
291-400.	3.07	2.15	1.54	2.15	1.54	5.13	
401-540.	3.30	2.31	1.65	2.31	1.65	5.55	
541-680.	3.60	2.52	1.80	2.52	1.80	6.00	
681-840.	3.90	2.73	1.80	2.73	1.80	6.45	
841-920.	4.20	2.94	1.80	2.94	1.80	6.90	
921-1200.	4.50	3.15	1.80	3.15	1.80	7.35	
1201-1450.	4.80	3.36	1.80	3.36	1.80	7.80	
1451-1675.	5.10	3.57	1.80	3.57	1.80	8.25	
1676-1900.	5.40	3.78	1.80	3.78	1.80	8.70	
1901-over	5.70	3.99	1.80	3.99	1.80	9.15	

As we get more information on the distribution of calls by average holding time, the number of these matrices will increase correspondingly.

In the case of voice private lines, the tariff matrix used is the one of CN/CP which is almost identical with the TCTS tariff structure. The tariff structure used for voice private lines is shown below.

Rate-Distance (Miles)	Monthly Charge
101-110	\$ 451.00
111-121	472.00
122-133	496.00
134-146	521.00
2746-2925	2,805.00
2926-3115	2,815.00
over 3115	2,825.00

At last, concerning television program transmission, the average price of a one way T. V. Channel per mile of micro-wave per year is estimated to be approximately \$ 700. This estimate is based on the 1973 CBC annual report which shown on page 52 the "coverage cost per mile of micro-wave leased from carriers" as being \$ 704. In addition, an internal study of D.O.C. done by V. Lee Chong (1) dated December 19, 1973, quotes a study by Kenneth Logan and Associates where the cost per one way channel (of Trans Canada quality) per mile per year assuming a 30 mile hop would be approximately \$ 700.

(1) Ref: CATV Micro-wave Cost Functions, V. Lee Chong, December 1973.

4.2 Costing Block

4.2.1 General Methodology

In this part of the model we estimate the unit cost of capital and operation at the element (node or link) level in the physical network. To that end, we begin by estimating the value of assets employed in the provision of inter-regional telecommunications services as a function of the amount of inter-regional traffic offered to the telecommunications system. Unfortunately published data on the size of telecommunication facilities is grouped into the two categories of local facilities and long distance facilities (toll facilities) and this latter category of facility serves both inter-regional traffic and regional long-distance traffic. We are therefore faced with a separation problem in the valuation of the assets serving the inter-regional telecommunications market. Further, in estimating the costs incurred by each carrier in the provision of inter-regional service again, due to the joint use of facilities, we have a separation problem. In this case, we have to separate the costs of operation by some reasonable scheme, and allocate the capital costs more or less arbitrarily in order to obtain a unit cost of use for each element of the physical network.

For this phase, we have selected a simple procedure based on average costing methods. However during the next phase, we will attempt to develop more sophisticated costing methods including those based on the principle of causal responsibility using the important notion of incremental costing as distinct from average costing.

The program logic for this block is shown in Diagram 2.

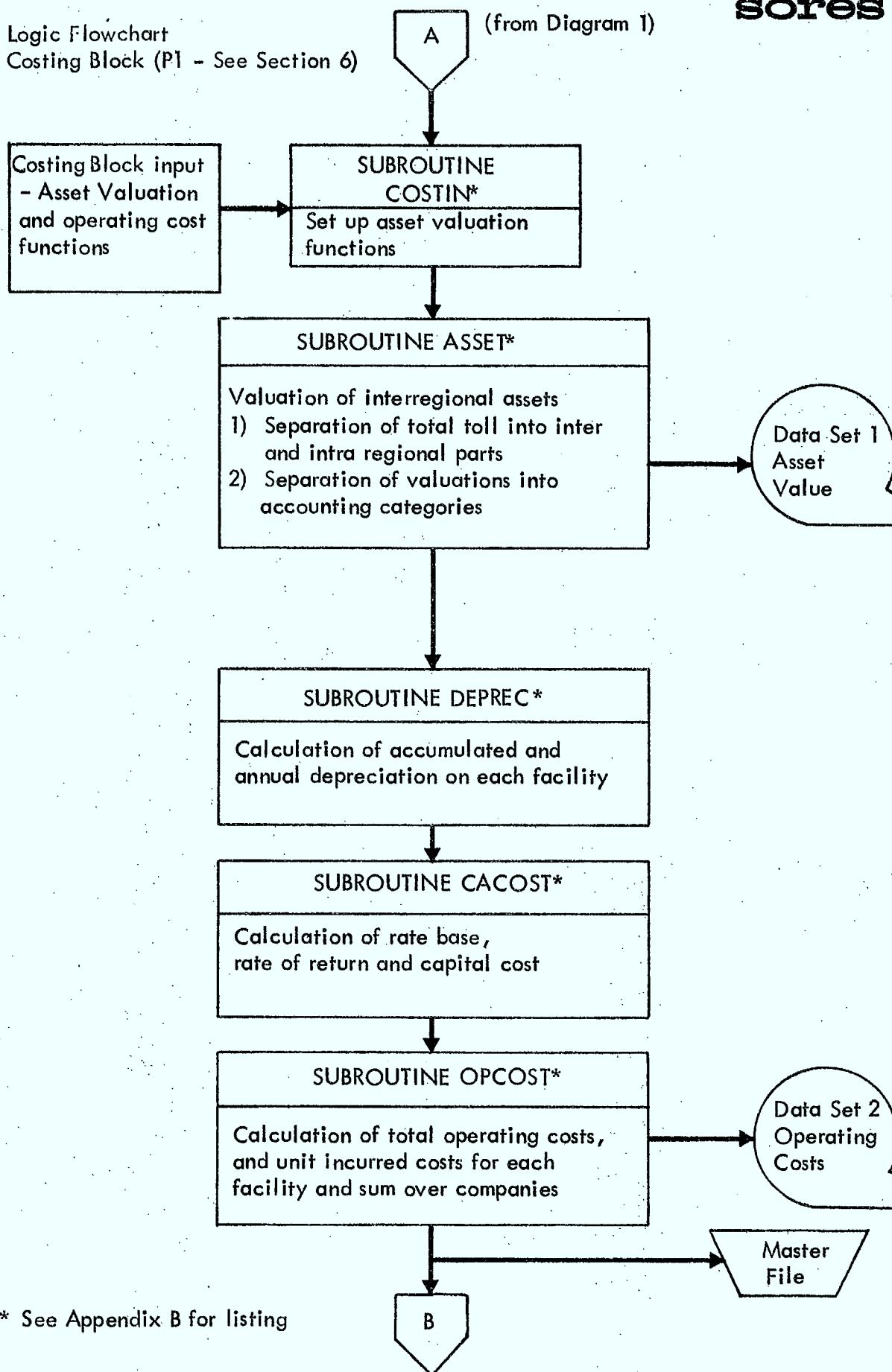
The computation of costs at the element level is derived from:

- a) The computation of asset value of facilities involved in inter-regional switching and transmission operations;
- b) The estimation of capital costs;
- c) The estimation of operating costs.

We review the procedures involved in each of these three steps below.

- a) For the computation of asset values of facilities, the valuation functions used are the step functions shown in Diagrams 3, 4, 5, 6 and 7 following. The functions are for the following facilities:
 - DIAGRAM 3: Transmission by Microwave (channel size = 1200 circuits)
 - DIAGRAM 4: Transmission by Microwave (channel size = 960 circuits)
 - DIAGRAM 5: Transmission by Microwave (channel size = 600 circuits)

Logic Flowchart
Costing Block (P1 - See Section 6)



* See Appendix B for listing

DIAGRAM 3

TCTS MICROWAVE
RFC = 1200

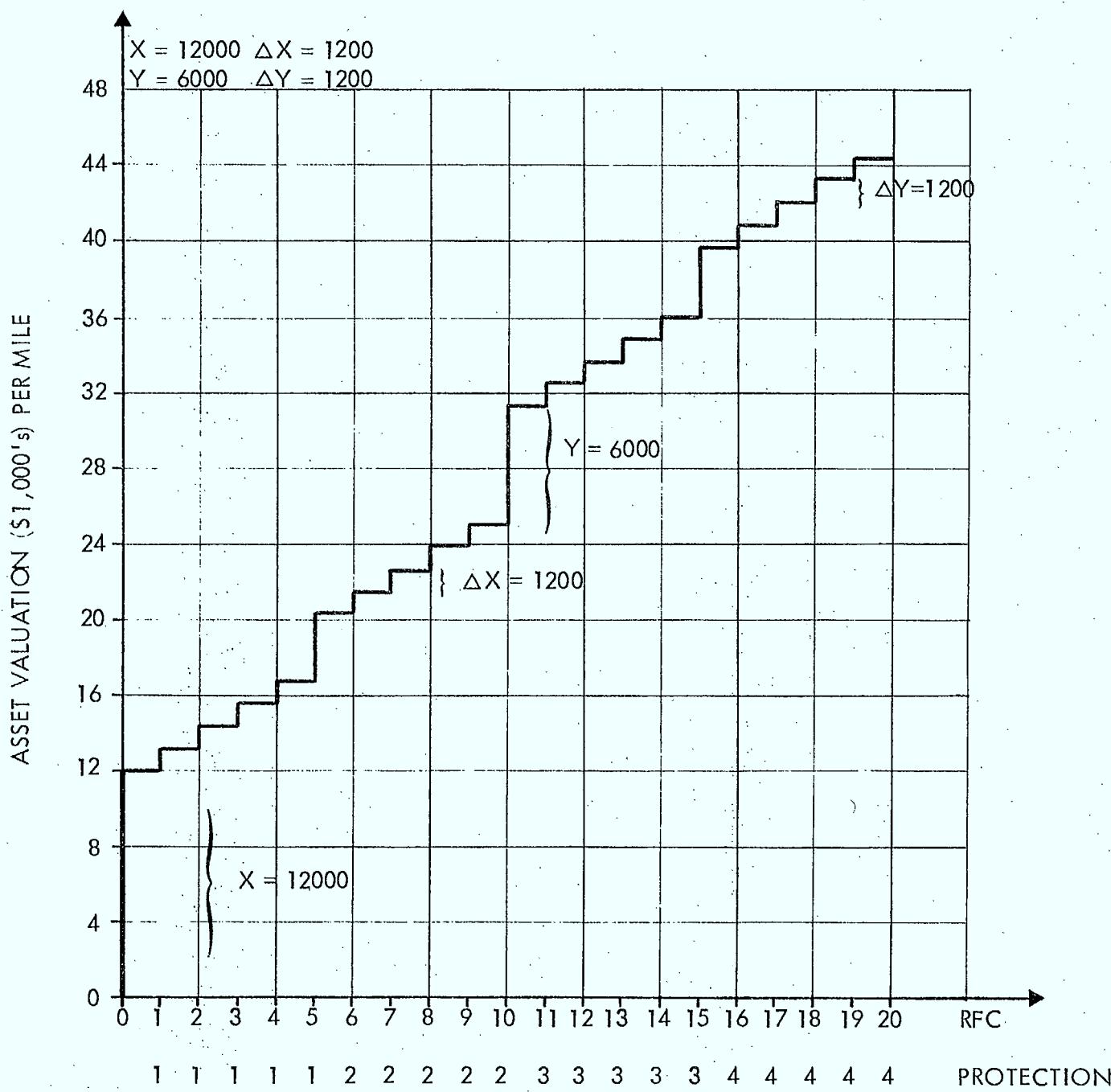


DIAGRAM 4

TCTS MICROWAVE
RFC = 960

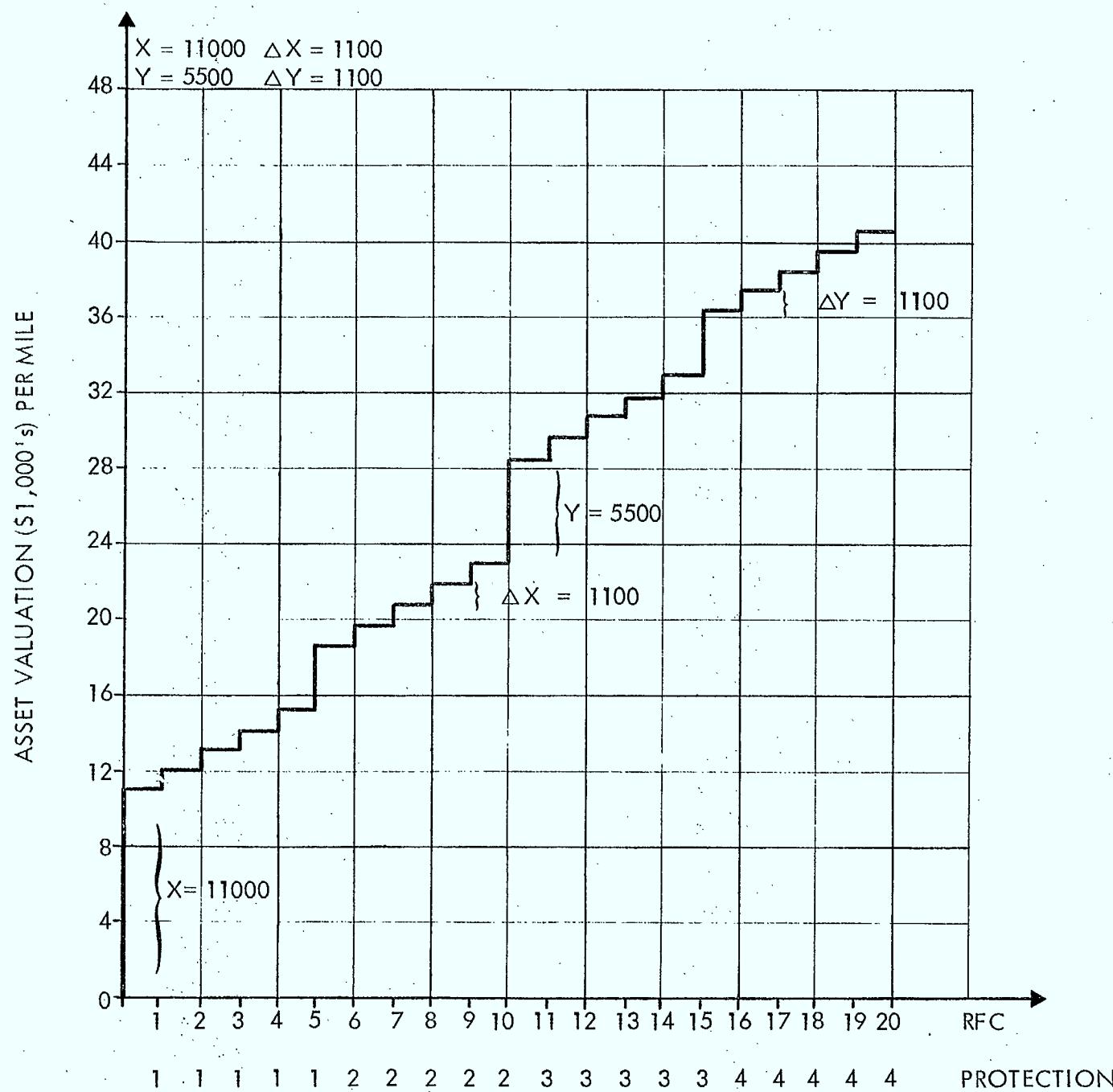


DIAGRAM 5

TCTS MICROWAVE
RFC = 600

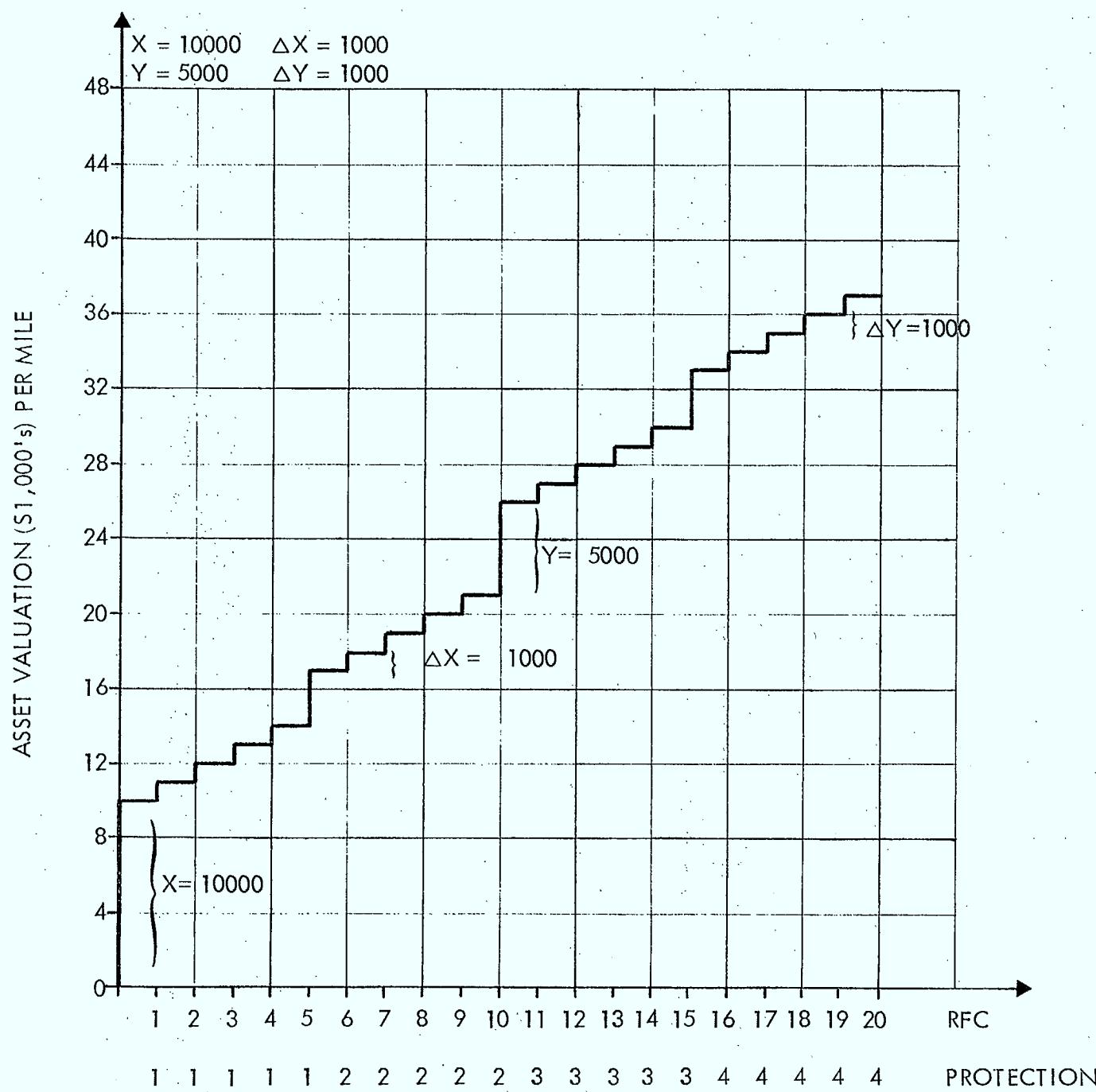


DIAGRAM 6

TCTS MICROWAVE
RFC = 480

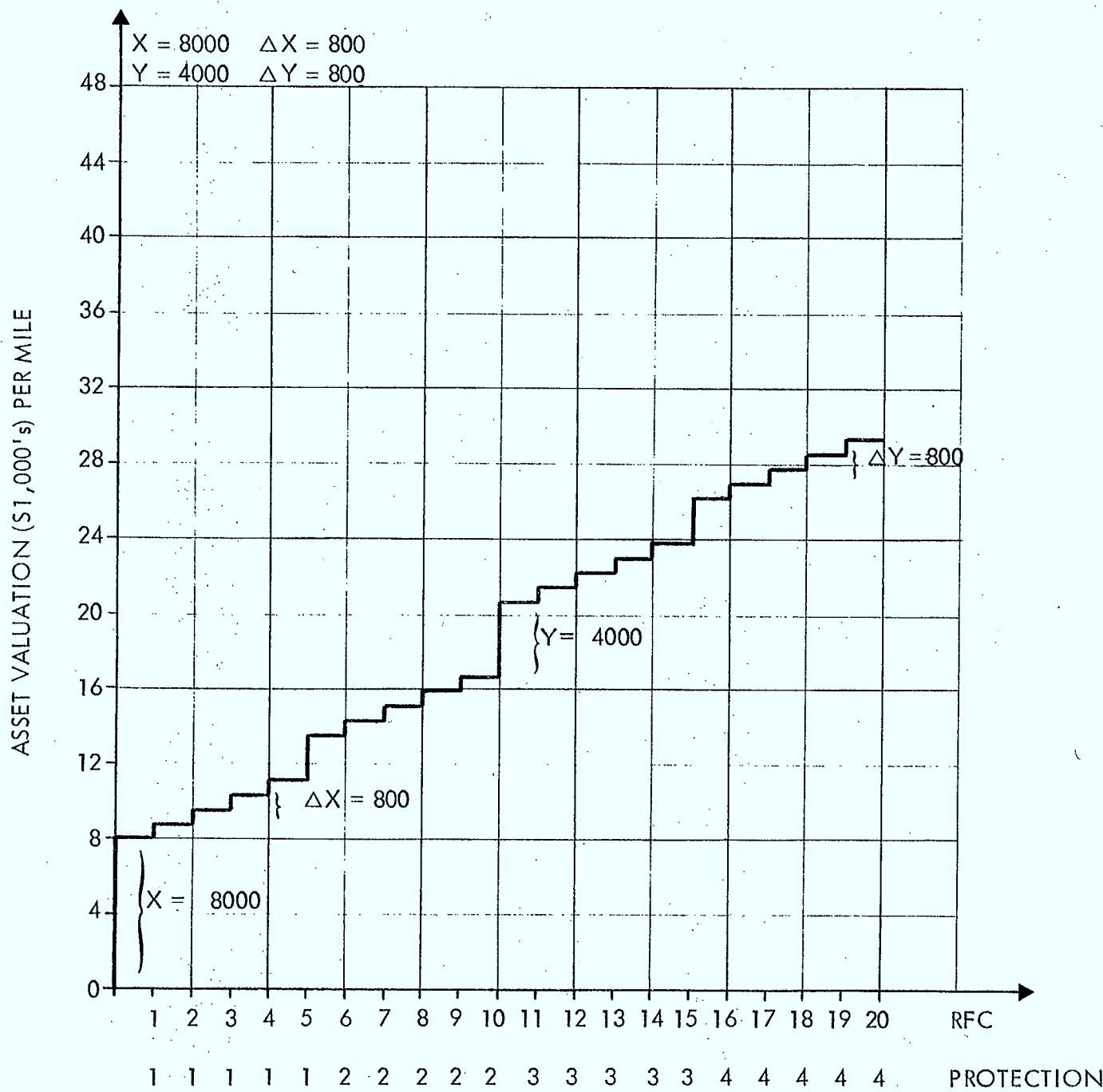
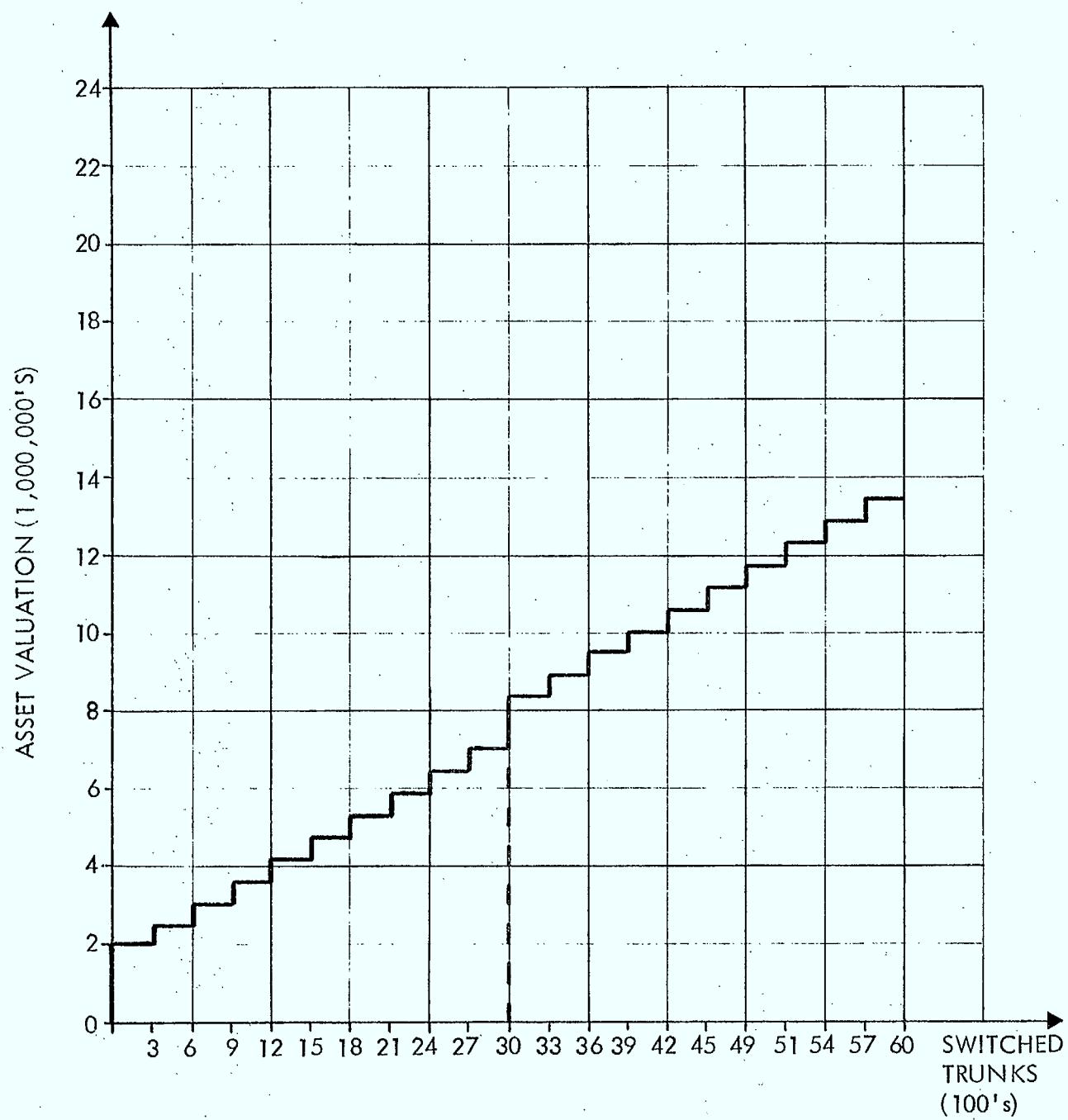


DIAGRAM 7

SWITCHING



- DIAGRAM 6: Transmission by Microwave (channel size = 480 circuits).
- DIAGRAM 7: Switching Equipment

These functions give asset valuation (ordinate) as a function of the number of installed radio frequency channels or switched trunks (abscissa) and are constructed to include all investments required for a particular operation (transmission for the first four functions; switching for the last. That is, the asset value obtained contains an estimation of the value of land, building, station equipment, and general equipment as well as transmission or switching equipment, the first items being reflected mainly in the large initial step, X, of the function, and in the large supplementary step at eleven channels, Y, while the cost of transmission or switching equipment proper is reflected in each incremental step. (ΔX or ΔY).

The software has a built-in capacity to accept a composite index to enable the valuation of assets to reflect different methods of valuation including historical costs, replacement costs, reproduction costs and trended original costs.

Considering the fact that these functions are the sole sources of valuation for the assets of the inter-regional system, it is evident that a disaggregation problem arises when we wish to convert this information to financial information for the carrier's Balance Sheet. The Balance Sheet breakdown of assets is by categories of:

- 1) Switching equipment
- 2) Transmission equipment
- 3) Station equipment
- 4) General equipment
- 5) Buildings, and
- 6) Land

To obtain the value of equipment in this breakdown we must i) disaggregate the value of switching facilities into its component parts of switching equipment, station equipment, general equipment, buildings and land; ii) disaggregate the value of transmission facilities similarly and iii) obtain the value of station equipment, general equipment, buildings and land by summing respective items in i) and ii).

The value of switching equipment, or transmission equipment is obtained directly from i) and ii). The disaggregations of step i) and ii) are based on ratios shown (with their sources) in Table 17 of Appendix G.

The problem of separation of the assets used for inter-regional operations and those used for regional long distance service is mentioned above. In this

version of the software the problem is handled as follows. The program takes, as data, the total toll switching capacity for the nodes and the total transmission capacity for the links, regional as well as inter-regional. This total capacity is used with the valuation functions to establish a total toll investment valuation. The amount of this valuation to be attributed to the inter-regional sector is calculated as a proportion (for each element) as follows:

Let $K(x)$ be the cost function

X_1 is total toll capacity of the element (trunks or circuits)

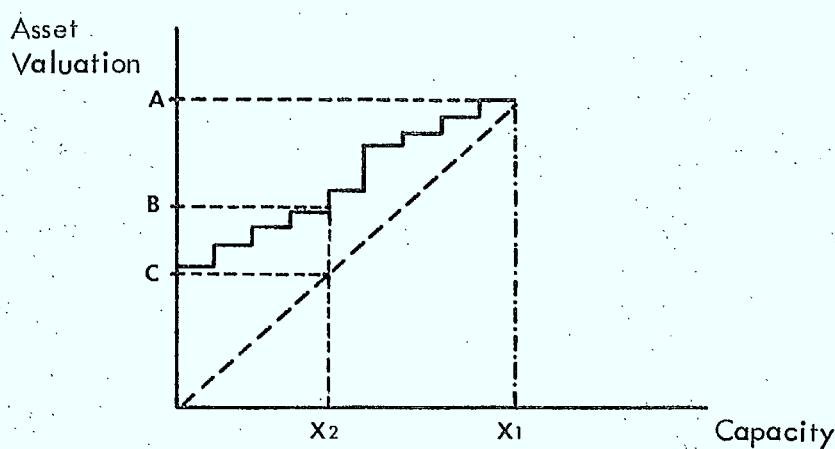
X_2 is the calculated inter-regional dimension (trunks or circuits) (this calculated capacity is based on peak traffic as outlined in Section 4.1)

X_2 is less than X_1

The valuation of the assets for the capacity X_2 are obtained by the formula

$$V = K(X_1) \frac{X_2}{X_1} , \text{ where } K \text{ is the relevant cost function.}$$

This is equivalent to a valuation as shown in the following diagram at point C



That is, the inter-regional element with capacity X_2 , is not valued at $K(X_2)$ (at point B), which involves imputing all fixed investment to inter-

regional services, but rather at point C which involves inputting only a proportionate part of fixed investment to inter-regional facilities. This method, of course, is an average costing method. For a multi-period model, it will be important, as mentioned above, to establish the incremental costs of growth due to expansion in inter-regional traffic. However, for sunk costs (the equipment already in place) we have little choice but to separate the costs on an average basis as is done here.

- b) The estimation of capital cost is done in two steps:
 - i) estimation of accumulated depreciation reserve and annual depreciation for each element of the inter-regional system, and
 - ii) calculation of cost of capital as a percentage of the net rate base.
- The calculation of accumulated depreciation is done for each element using the following formula:
 - Accumulated Depreciation Reserve = Asset at Cost x (1 - Life Expectancy/Average Life) x (1 - Net Salvage Fraction). This is based on the ASL method of depreciation.
 - The variable "Life Expectancy/Average Life", which is normally based on survival curves for different facility classes is here fixed at .75; a figure selected as representative of the telecommunications industry. In future development, survival curves will be incorporated, and the calculation of "Life Expectancy/Average Life" will be refined. The variable "Net Salvage Fraction" is an exogenous input. At present, some work has been done on the incorporation of equal life group depreciation methods and accelerated depreciation methods. (double declining balance and sum-of-years-digits). However, further conceptualization and consolidation is necessary in this area. Annual depreciation is estimated as a fraction of total asset at cost for each element. This fraction reflects the average age of the element in question, and is given as input.

Cost of capital is calculated as a percent rate of return on the net rate base, the latter being derived from a calculation of total asset at cost, less accumulated depreciation plus a provision for working capital. The rate of return for each carrier is a function of desired rate of return on equity, average long term interest rates applying to the carriers debt, the debt capital ratio and tax rate; all of these being exogenous inputs to the model, variable for each carrier.

- c) Operating costs are estimated using proportional cost functions. We obtain costs in the categories - maintenance, marketing and commercial, traffic,

property and non-income taxes, and other expenses by applying percentages to the at cost value of each element of the inter-regional system. These percentages vary from company to company, and are shown in Table 17 of Appendix G. By this method we are implicitly assuming that operating cost in each of the 5 categories are fixed percentages of total company asset at cost, and the amount of operating cost attributed to each element of the inter-regional system is in the same proportion to total operating costs as the proportion of element asset value to total company asset at cost. This is an arbitrary rule which may be improved upon in future development. Furthermore, since the element asset value is based on the amount of offered traffic (through the dimensioning process in the Operating Block, Section 4.1), the allocation of operating costs, being related to value, is therefore related to usage.

4.2.2 Inputs and Outputs

To summarize the above notions, a list of inputs and outputs of the cost block is provided.

The inputs are as follows:

- 1) For each element - the specification of the asset valuation function to be used.
- 2) For transmission links - the length of the link and a specification of the fractional split in cases of co-owned links.
- 3) For switching nodes - the number of fixed installations (i.e. number of buildings) at the node.
- 4) A specification of the asset valuation functions in terms of the following parameters:
 - number of R.F. channels in system 1
 - number of R.F. channels in system 2
 - Radio Frequency channel size
 - protection parameter
 - value of first step in system 1 (X)
 - value of additional steps in system 1 (ΔX)
 - value of first step in system 2 (Y), and
 - value of additional steps in system 2 (ΔY).
- 5) Valuation index for adjustment of the valuation according to the age of the facility, to permit different methods of value estimation.
- 6) Proportional cost functions and other financial parameters for each carrier for the calculation of incurred costs. (a complete list is shown in Table 17 of Appendix G).

7) Net salvage information for each carrier including:

- ratio of salvage to element asset value
- ratio of cost of removal to element asset value, or
- ratio of net salvage to element asset value

The outputs of the cost block are shown in full detail in Section 5.3. The principal results produced are the following:

- 1) Element unit costs in 1000's \$/c.c.s.
- 2) Total incurred costs for each element
- 3) Total incurred costs for each carrier including categories of:

- maintenance,
- marketing and commercial,
- traffic,
- property and non-income taxes,
- other expenses,
- depreciation, and
- cost of capital.

- 4) Inter-regional balance sheet items in the following categories:
 - switching equipment,
 - transmission equipment,
 - station equipment,
 - general equipment,
 - buildings, and
 - land.

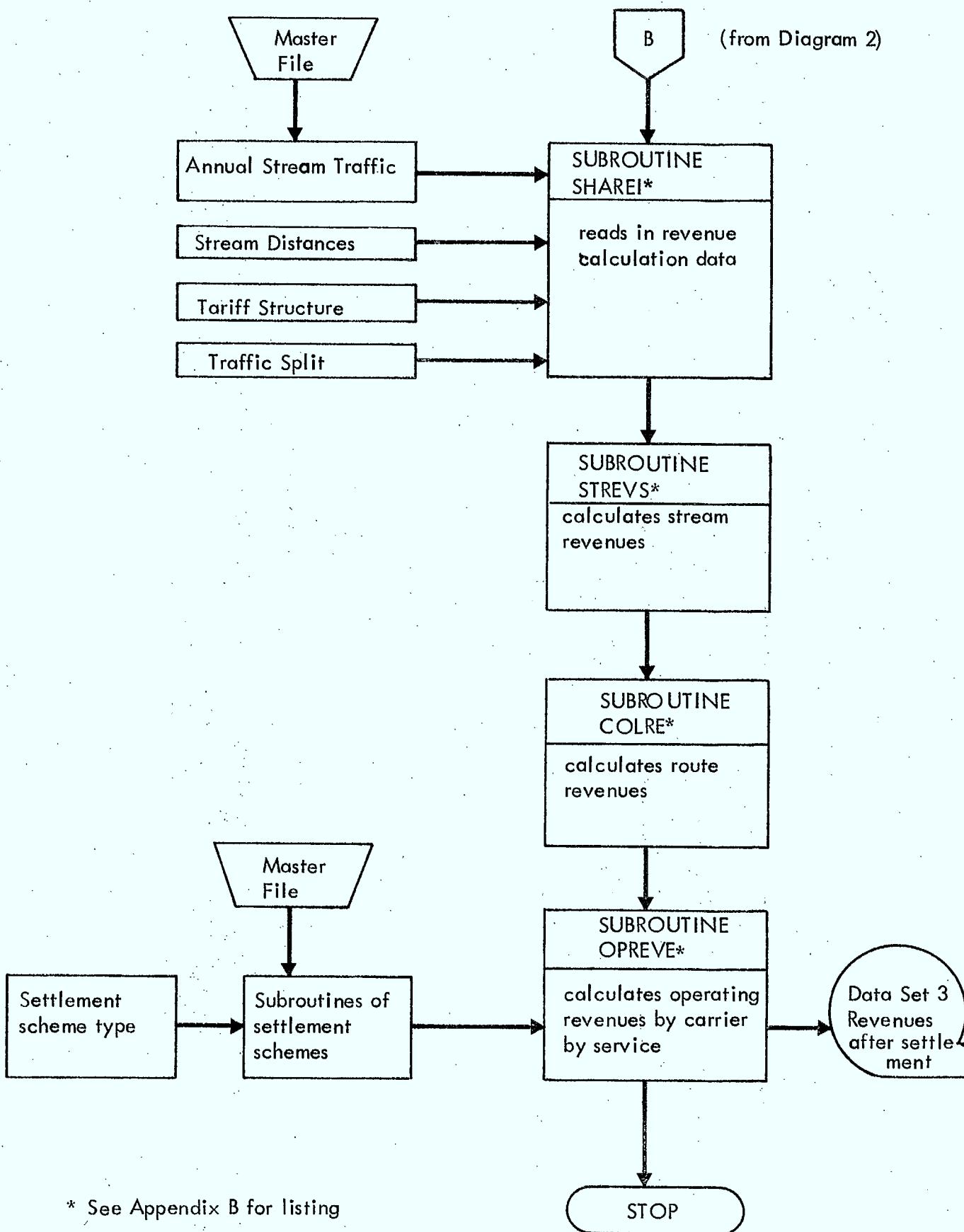
for the items:

- assets at cost,
- accumulated depreciation,
- additions,
- retirements,
- annual depreciation,
- salvage, and
- cost of removal.

4.3 Sharing Block

In this block the operating revenues after settlement for all carriers by category of service are calculated. The program logic for this block is shown in Diagram 8.

Logic Flowchart
Sharing Block (P1 - See Section 6)



* See Appendix B for listing

The input for this block is 1) the average annual total traffic for all streams which is calculated endogenously in the Operating Block; and 2) exogenous revenue calculation data (stream distances, tariff structure and traffic splits). For each stream, the annual stream revenue is calculated in the following manner. The total traffic (based on 5.5 minutes holding time) from the operations block is split into categories of direct distance dialing, operator handled and person-to-person for certain times of the day and for Sundays versus week days. For each of these categories a tariff rate or more correctly a revenue for 5.5 minutes is applied according to the stream distance to calculate stream revenue. The traffic split and tariff rates are discussed in detail in Section 4.1. Operating Block.

Everytime two or more carriers are involved in transmitting messages, settlement schemes are applied in order to share the generated stream revenues. Four categories of settlement exist according to the geographical situation:

- i) adjacent members
- ii) three or more TCTS members
- iii) Canada-U. S. (TCTS and A.T. & T.)
- iv) Canada-overseas.

A fifth category, negotiated settlements, can be applied for COTC-Domestic carriers (TCTS and CN/CP) and CN/CP-Western Union (Canada-U. S.). For negotiated settlements the results of applying the settlements, i.e. the revenue for each member is all that is required. In this first phase of IRA, the stream revenues applicable to categories of settlement i) and ii) were shared according to four basic settlement schemes:

- 1) Full Division Scheme
- 2) Commonwealth Type of Settlement Plan
- 3) Old Commonwealth Settlement Scheme
- 4) Mixed Settlement Schemes

These schemes are described in the Interim Report, December 1, 1973 (pp. 15-17). With the exception of the Full Division Scheme (TCTS) the remaining three are available for simulation purposes.

The Old Commonwealth Scheme distributes revenue for all streams in proportion to total incurred costs for each carrier. This scheme (and TCTS) do not require unit costing and facilities routing and effectively are not based on usage on a stream-by-stream basis.

The Commonwealth and Mixed Schemes are based on usage, that is, the terminal and transit partners are identified in each stream and appropriate costs are calculated based on facility utilization and unit costs provided by the operating and cost blocks. These asset values and incurred costs, calculated for routes and streams, are the basis for the allocation of costs and the sharing of revenues according to the particular scheme.

→ The output of this block for any settlement scheme, is the total operating revenue distributed to each carrier for its inter-regional activities.

4.4 Accounting Block

In contrast to the "costing" included in the cost and sharing activities, the accounting activities are concerned with the application of telecommunication financial accounting logic for the purpose of preparing the customary financial statements, and for generating significant ratios and indicators.

The inputs for this block are from two sources: firstly, cost and sharing input for inter-regional activities is provided endogenously within the program, and secondly, the balance of inter-regional financial input and all regional financial input is provided exogenously to the program. The program logic for this block is shown in Diagram 9.

An integral part of the Accounting Block logic consists of simulations based on simultaneous accounting equations using linear and non-linear programming. These simulations reflect certain "what if" situations and their effects on financial statements and financial indicators. This area is detailed in Sections 5.4 and 5.5.

4.4.1 Data

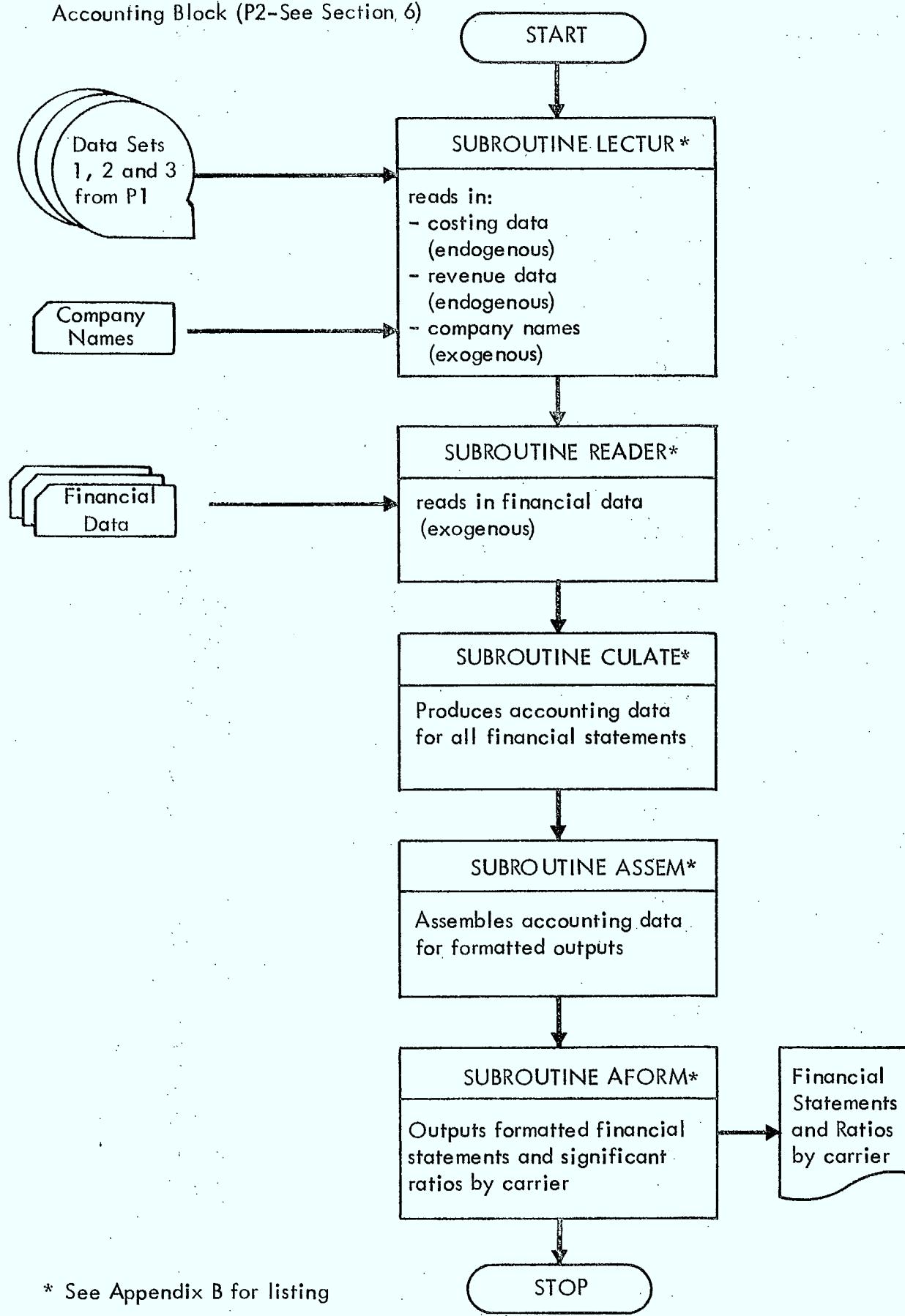
In conformance with the basic principles of the accounting logic employed in the IRA Model, the basic information required for the Accounting Block comprises the asset and liability data at the beginning of the period and the changes during the period. The changes also include the revenues generated and the expenses incurred during the period. Working around this basic principle the IRA team made consistent efforts to define and generate data at the lowest possible level of details e.g. asset values by category of plant at the level of elements. This approach is also intended to be maintained in the future development and accordingly it is planned to make additional efforts to identify data at the "grass root" level where it was not possible to do so in the first phase of the project.

The most important data category is the information related to the physical assets, namely data reflecting their initial state at the beginning of the period and the changes (additions and retirements) during the period. The basic asset data by plant category provide the direct base for the computation of depreciation

DIAGRAM 9

sorēs inc.

Logic Flowchart
Accounting Block (P2-See Section 6)



expense, accumulated depreciation, elements of deferred taxes and, in the current phase of the project at any rate, of the operating expense. The physical assets represent the predominant majority of the total assets which also include the other assets e.g. current assets and deferred charges. The total assets are to be matched with the total liabilities. These are predominantly determined by the capital structures and the deferred credit - primarily deferred taxes if applicable - positions of the companies. Accordingly, the total liabilities are composed of the data representing the status at the beginning of the period and of the changes during the period. The changes are the results of the financing sourcing schemes and of the availability of funds from operations during the period.

The basic logic of the accounting block was structured around the above characteristics. The precise conformance with the rules of accounting was assured by including in the logic the principal algorithms describing the accounting process. All data were categorized into defined terms as shown on Tables 1 to 8 of Appendix G. The definitions of the categories are implicitly given by the inter-relations of the data elements as structured in the financial statements and by the underlying accounting algorithms. This procedure was designed to permit precise definitions of the data elements required as input and relating the input to the outputs from the calculations.

Tables 1 to 9 of Appendix G represent the input requirements, at the level of the Accounting Block, for the purpose of performing computations, and for the generation of financial statements and significant ratios of inter-regional activities. It will be noted that for the computations pertaining to the inter-regional activities endogenous information is also provided from the Costing and the Sharing Blocks. Table 17 of Appendix G represents the accounting type input data required for computations in the Costing Block.

Tables 1 to 9 and 17 of Appendix G are examples of data pertaining to the operation of BC Tel. It is to be noted that the data represented in Appendix G is not actual information reported by the company. The data is the result of a series of preliminary estimates for the purpose of designing and testing the Accounting Block, and to a limited extent the Costing Block, of the IRA Model in the first phase of the project.

As a first approach to provide initial data, the company totals were split into regional and inter-regional data using various estimates and by necessity certain arbitrary decisions. It was assured, however, throughout this process of data "manufacturing" that through the application of the IRA accounting logic both the inter-regional and the regional sets, and the data elements therein, conform to the conventional accounting rules in their own rights. This initial split was necessary, in addition to the requirements for the design of the accounting logic, to create an initial benchmark to which subsequent results of finer separations and data tuning, and the results of sample simulations may be compared.

"Splitting" of companies' total values of financial information into inter-regional (IR) and regional (R) sectors is the first step for the construction of input data base for the Project. The financial information contained in the Annual Reports to Shareholders of companies under consideration, though inadequate on its own, constitutes the majority of the pre-split data. We utilized most of this information directly or indirectly. However, all values were categorized according to our Accounting Block logic which is expressable with a closed equation system.

In order to move from the beginning to the end of the period and in order to make the Regional Data comparable and indeed compatible with the inter-regional information, we additionally need splits (i.e., from the companies' total) of information on plant at cost at the beginning of year, gross additions, retirements, costs of removal, salvage values, annual depreciation rates, accumulated depreciation at the beginning of year by the following categories of equipment and facilities: switching, transmission, station apparatus, general equipment, building, land and plant under construction. The last two items require no data on retirements, costs of removal, etc. i.e. on items of depreciation accounting.

Revenue breakdowns and splits into R and IR categories are required by services e.g. public message, private lines and program transmission.

In order to enhance the degree of manoeuvrability of the IRA Model in terms of policy simulations, depreciation, CCA'S, income taxes and deferred income tax are treated in the IRA as endogenous variables, the values of which are to be calculated and also to be variable. Development of such calculations requires information on CCA rates by classes, net additions of plant by classes, UCC at the beginning of year by CCA classes and, additional expensing of costs for tax purposes (Δ Expenses).

Availability of Data:

For all practical purposes the only actual data available at this time is that contained in the Annual Reports (to the shareholders or to the public) of the companies. This information is the aggregate result of the overall company operations. In practical terms this information does not contain any one of the basic information elements or break-downs required as input into the IRA Model. The only exception to this general status is the case of Bell Canada where due to the frequent rate hearing procedures more actual information at lower levels of details was available. However, the only indication as to break-downs between regional and inter-regional operations available to the IRA team consisted of the totals of the assigned plant and assigned expenses of the member company's within TCTS in the context of the full division of revenue schemes for the year 1970, and of the TCTS revenues-after division. This information was provided

by TCTS to D.O.C. It should be noted, however, that even this information is claimed by TCTS as not representative as to true separations of assets and costs. Furthermore, the TCTS assigned investments and expenses also include the terminal portions of the inter-regional operations, while in the first phase of IRA, at any rate, the required data in question is that pertaining to the inter-regional switching and transmission network only. As an additional observation worth noting, the TCTS assigned investments and expenses excluded that portion pertaining to adjacent members' traffic, while the IRA considerations also included this activity.

Due to the lack of actual data the laborious tasks of "manufacturing" the required data had to be undertaken within the activities of Phase One of the IRA Project. Consequently, the numerical results produced in the IRA Phase One sample calculations are not to be viewed directly as representative of real life.

However, the data manufacturing process enabled the IRA team to design and test the basic logic of the model and to give indications of various sensitivities, the directions and orders of magnitude of changes which resulted of various simulations with the manufactured data.

Replacement of Missing Data:

- 1) Allocating plant at cost into IR & R sectors and among plant categories:

Consultations with D.O.C. experts, collation of and comparisons with more readily available U.S. data persuaded the IRA team to accept TCTS assigned investment as a first estimate of IR plant at cost. Based on this reasoning the carriers' total plant at cost at the beginning of year was split between IR and R sectors, the TCTS Assigned Investments being used as IR values. Distribution of these plant values among plant categories was done, by necessity, through employing arbitrary decisions. The IR plant at cost, that is TCTS assigned investments, was distributed among categories in the following proportions: Switching 35%; Transmission 55%; Station Equipment, zero %; General equipment 2%; Buildings 7%; and Land 1%. The regional counterparts were determined simply as the remainders of company total values less IR values calculated with the above ratios by categories. The company totals of plant by categories were available through the courtesy of Statistical Information Directorate, NTB, D.O.C.

- 2) The annual depreciation expenses and accumulated depreciation balances were calculated, using categories of plant at cost data and depreciation rates based on Bell Canada's data, and based on the experience of D.O.C. experts. Inputs on additions, retirements and net salvage values were constructed on the basis of similar procedure.
- 3) The allocation of operating revenues into IR and R sectors was done on a basis consistent with the allocation of plant. The TCTS allocated revenues (after

revenue divisions) were accepted as the IR revenues. These IR revenues were further distributed among types of services using proportions of the company total revenues, with the exception that no local service revenues were attributed to the IR sector. The differences between company totals and the IR assigned revenues by each revenue class yielded the regional revenues.

- 4) The Total Operating Expenses allocated to the IR sector were calculated, with some adjustments, based on the ratios of IR plant at cost to company total plant at cost for each company. The Total Operating Expenses by company were allocated among expense items based on the distribution pattern of the company's total expenses. The differences between the company totals and the IR expenses by expense items yielded the Regional sector expenses by items.
- 5) Current Income taxes and Current deferred income taxes totals for the companies were taken from Annual Reports. However, in order to ensure manoeuvrability kr introducing different tax schemes, the current income taxes and deferred income taxes for the normalized case and the current income taxes for flowthrough company were treated as calculable, using the algorithms illustrated in Tables "A" and "B" of Appendix G; with appropriate assumptions on Expenses and CCA rates based on data available from Bell and BC. Tel. and based on the experience of D.O.C. experts.
- 6) The calculation of the Average Interest Rate (AIR) of the outstanding debt at the beginning of the period, and the interlocking calculations with New Debt (during the period) and the interest rate on new debt (NIR) are shown on Table "C" of Appendix G.

4.4.2 Generation of Financial Statements and Significant Ratios

The following sequential steps were followed in order to generate financial statements (Income Statement, Balance Sheet, Retained Earnings and Source and Uses of Funds) and Significant Ratios:

- 1) Based on endogenous inter-regional input the inter-regional income statement was generated in part until "Income before income taxes and debt - service charges". Based on exogenous regional input, the regional income statement was completely generated.
- 2) Based on endogenous inter-regional asset data and applying standard methods of calculating end of year assets at costs, accumulated depreciation and cost less accumulated depreciation, the inter-regional assets, beginning and end of year, of the Balance Sheet were generated in full. Similarly, based on exogenous regional input the regional Assets, beginning and end of year, were generated in full.

- 3) Inter-regional capital cost allowance and deferred taxes (based on Alternative 2; see Interim Report, Appendix F) were calculated using exogenous ratios e.g. to calculate undepreciated capital cost at beginning of year and using previously calculated values such as "Total Telephone Plant at Cost". Regional deferred taxes were provided exogenously.
- 4) The regional liabilities, beginning of year, were all inputted exogenously. The inter-regional total liabilities beginning of year, was equated to inter-regional total assets, beginning of year, (calculated in step 2). These inter-regional total liabilities were then split into its components (e.g. current liabilities, total debt) in the same proportion as regional total liabilities at the beginning of the year. N.B.: Owing to this proportionate splitting and computer truncation certain figures may not add up within statements and insignificant imbalances occur.
- 5) Certain inter-regional end of year values needed in the next step were calculated in proportion to regional values and the ratio of inter-regional assets to regional assets. These are repayments of long term debt and increase in sinking fund assets, current liabilities and other deferred credits. Inter-regional end of year deferred taxes were calculated based on step 3, and exogenous initial and prior deferred taxes.
- 6) At this point five inter-regional values 1) end of year debt, 2) end of year equity 3) net income and 4) increase in capital stock equity and 5) increase in total debt could only be solved by simultaneous accounting relationships. Five relationships reflecting accounting equations and the debt capital ratio were used. Four of these are identical to the simultaneous linear equations used in Section 5.4 (equations 2-5). Equation 1 (Section 5.4), equating Sources and Uses of Funds, could not be employed since some end of year assets and liabilities were not yet calculated and a fifth equation was developed. This fifth equation which balanced end of year Total Assets and Total Liabilities (=Equity + Debt + all other Liabilities) is equivalent to the Source and Uses of Funds equation which effectively reflects all changes during the year in Assets and Liabilities. The constants for these five relationships were previously calculated and therefore are available to solve for these five inter-regional values.
- 7) Once the increase in total debt was calculated in the previous step, debt service charges and income taxes were calculated and the inter-regional income statement completed.
- 8) Once net income was calculated in the previous step the inter-regional Retained Earnings Statement was completed. The regional Retained Earnings Statement was also completed.

- 9) Inter-regional retained earnings, end of year, was calculated based on the Retained Earnings Statement. The difference between total equity, end of year and retained earnings, yielded the capital stock, end of year, which was split in the same proportion as the beginning of year. Similarly component of total debt, end of year, were split in the same proportion as the beginning of the year. This completed the inter-regional and regional, Liabilities, end of year, of the Balance Sheet.
- 10) The change in Working Capital during the year was calculated based on the completed Balance Sheet. The change in Miscellaneous, was calculated based on miscellaneous items not appearing elsewhere in the Source and Uses of Funds Statement but reflecting changes in the Balance Sheet. The items are deferred charges, other deferred credits, net salvage value (salvage value - cost of removal), other adjustments (net) and share issue expense. At this point the inter-regional and regional Source and Uses of Funds Statements were completed.
- 11) The company total financial statements were all completed by summing over inter-regional and regional elements.
- 12) The significant ratios were calculated for inter-regional and company total financial data.

4.4.3 Outputs

The outputs from this first section of the Accounting Block are the four financial statements:

- 1) Income Statement
- 2) Balance Sheet
- 3) Retained Earnings Statement
- 4) Source and Uses of Funds

for the activities of the carriers based on:

- 1) Inter-regional activities
- 2) Regional activities
- 3) Company total

Samples of these statements are shown in Section 5.3. In addition, 27 significant ratios were calculated based on these financial statements and other exogenous input such as the number of telephones. These ratios are explained in Table A below, which is included with a sample, both of which are shown in Section 5.3.

5. SIMULATIONS

5.1 General considerations

The development of the model in terms of distinct but interrelated blocks, each performing a precise function, allows a great flexibility in the use of the model as a simulation tool. Indeed, simulation runs are possible at the level of each of the four main blocks (Operating, Costing, Sharing, Accounting) through the variations of the input variables, initial state parameters, and/or the computational logic (e.g. various depreciation algorithms). One might note at this point that although the IRA Model is primarily a simulation model, local optimization is possible particularly at the Accounting Block level. Although the name of the Project (Inter-regional Accounting Model) indicates a strong emphasis on the accounting side, it is worth noting that the functioning of the whole model relies on a fairly extensive definition of the premises (network, traffic, ..., costing, sharing) on which the actual inter-regional system is operated.

At the level of the Operating Block, the variations may bear on the network configurations, ownership structure, routing pattern (e.g. changes in the routing rules and overflow probabilities), tariff structures and traffic configuration. It must be kept in mind that traffic, routing and network are three interrelated components of the model which cannot be varied independently of each other. (Appendix E). In the Costing Block, one might envisage various methods of defining and allocating the costs associated with the provision and operations of the inter-regional network. The predominance of joint costs may also call for the testing of different methods of separation. The simulation exercise at the level of the Sharing Block is done through the variations of the settlement schemes used in the sharing of costs and revenues arising from the provision, operation and use of the inter-regional network. In the Accounting Block, changes may bear on different accounting methods concerning among other things, depreciation, taxes (including the treatment of deferred taxes) and capitalizing versus expensing, and on the different methods of financing. It is to be noted that the effects of all changes in each of the blocks must ultimately be reflected through the financial statements produced by the model for each of the carriers.

A fifth block, the Policy Simulation Block, will be developed during the coming phase. One cannot be sure to what extent this latter block will have a distinct physical existence from the software point of view as the other blocks now have. Moreover, although policy problems (see Section 2) have been identified, there do not exist any apparent unanimous quantitative criteria permitting evaluation of the results of the simulations. Thus, it is clear that the IRA Model in its present form is not an optimizing model.

As far as the logic is concerned, the IRA Model is a deterministic representation of the annual inter-regional telecommunication activities. In each block, we can identify those input variables which are under governmental control and those which are not. The simulations with these two categories of inputs are interesting in the sense that the results with the first category can be interpreted as the consequences of modifications of the governmental policies. The results obtained with the second category are interesting from the point of view of a potential user of the model who wish to know the conditional impacts on some endogeneous variables, given some changes in the inputs occasioned by some external effects.

5.2 A plan of simulation for the current phase

The simulations discussed in this section refer to simulations which are possible in the Operating and Sharing Block. The first series of simulation runs are accomplished with the intention of demonstrating the capabilities of the software, and testing the sensitivity of various outputs to changes in the input parameters. In a model of this size, there are a great many parameters which can be modified and hence some choice has to be made. In these simulation runs, a distinction is made between descriptive parameters on one hand and simulation factors on the other. In the former category we include parameters such as tax rates, interest rate on long term debt and other financial parameters which can be modified but which are essentially descriptive parameters. In the latter category we include factors that are subject to decisions of policy. These include items such as the overflow probability, the rates charged and the types of settlement schemes used. Accordingly the first series of simulations deal mainly with these simulation factors.

The effects of these simulations are reflected on the cost allocations and revenue shares of the carriers in the present phase. The consequential impacts on the financial statements would be obtained by processing these results through the Accounting Block.

The plan of simulation for these runs is then as follows:

1. Operating Block: Overflow probability: In this series of runs we vary the overflow probability on the high usage groups from 10% to 50%.

To accomplish this simulation we use the following correspondence table for automatically switched traffic (Source: Commonwealth Telecommunications Bureau).

Busy hour overflow %	Average daily overflow %
10	2
20	5
30	8
40	14
50	20

This correspondence table is interpreted to mean that, when the high usage groups are defined for, say, 30% overflow in the peak hour, the traffic which overflows in an average day would be 8% of the total daily traffic. In the software this correspondence is used as follows:

The busy hour overflow percentage is used in the dimensioning of the high usage groups, and the average daily overflow percentage is used to determine average traffic on different routes of one traffic stream, which in turn determines the weighting factors used to obtain stream unit costs from route unit costs.

We note that it is also desirable to simulate changes in final blocking probability since this is a much more significant measure of the grade of service, but due to software complications and to the fact that we do not have a table similar to the above, for final blocking probabilities, we are unable to vary the final blocking probability in the model. The effects of variations in overflow probability alone will be measured in asset values and incurred costs.

2. Costing Block: No simulations originate in this block and the parameters involved are mainly used to produce the benchmark values.
3. Sharing Block: Types of settlement schemes: In this series of runs we test the following settlement schemes:
 - i) Commonwealth method
 - ii) Old Commonwealth method
 - iii) Mixed Schemes (4 a i), 4 a II), 4 a iii) and 4 a iv)) which are described in the Interim Report of 1 Dec. 1973 (p. 17).
4. Sharing Block: Variations in tariff structure: A series of variations in tariff structure were tried. It should be noted that, although the tariff structure is defined in the Operating Block, its principal impact computationally occurs in the Sharing Block. For this reason, these simulations, although touching on an element of the Operating Block can be considered as simulations in the Sharing Block.
 - i) Increase (decrease) of rates for all calls travelling less than 540 miles coupled with a decrease (increase) of rates for all calls travelling over 540 miles.
 - ii) Increase (decrease) of rates for 1) station to station operator handled office hour calls, and, 2) direct dialed office hour calls travelling less than 540 miles coupled with a simultaneous decrease (increase) of rates in the same categories for calls travelling over 540 miles.

- iii) Increase (decrease) of rates for station to station operator handled office hour calls travelling less than 540 miles coupled with a simultaneous decrease (increase) for direct dialed office hour calls travelling over 540 miles.
- iv) Increase (decrease) of rates for direct dialed office hour calls travelling less than 540 miles coupled with a simultaneous increase in rates for station-to-station operator handled office hour calls travelling over 540 miles.

Effects of these variations are measured on revenues under the assumption of completely inelastic demand, since the model is not equipped to handle elastic demand automatically.

5. Sharing Block: A simple elasticity test: In this series of runs we assume that rates for all person to person calls increase by a percentage A, and that at the same time the number of person to person calls decreases by the percentage B. These lost calls are assumed to shift to other categories in 3 possible ways:

- i) 100% station to station operator handled.
- ii) 100% direct distance dialing.
- iii) 50% station to station operator handled and 50% direct distance dialing.

Effects of these variations will be measured on total revenue share of each carrier.

6. Accounting Block: Simulations in this Block are described in Section 5.4.

5.3 First simulation and results of simulation

5.3.1 First simulation: benchmark

In the present section the computer results of a benchmark run are displayed with explanatory annotations where necessary.

The first two pages display 1) the input tariff matrix for telephone traffic, and 2) the result in terms of revenue shares for the 4 carriers (in 1000's of dollars).

The subsequent 4 pages give a summary of results in the Operating, Costing and Sharing Blocks of the model, one page for each carrier.

This summary includes a display of certain input parameters, and of the various endogenous results including:

- 1) Operating revenue (net revenue after revenue sharing calculations)
- 2) Estimated inter-regional asset items of different equipment categories
- 3) Estimated operating and capital costs for the two operations of switching and transmission
- 4) For all elements, a detailed breakdown of items such as total capital, and operating costs, dollar investment per unit of traffic carried, and dollar capital and operating cost per unit of traffic carried.

These results demonstrate the power of the model to produce detailed statistics on all the components of an inter-regional system.

The following series of printed outputs include full financial statements for B.C. Telephone, and income statements for the other three carriers in this example. These statements are obtained from the model via the processing of endogenous results on the inter-regional system, and the integration with the exogenous data on the regional system. The model has the facility to produce full financial statements, as shown, for any particular simulation scenario. However, due to the bulkiness of these printouts, the following sub-section on simulation does not include computer printouts. The relevant information is extracted from these printouts and displayed in tabular formation. These consolidated results (for many simulation scenarios) will of course be produced automatically when the model is developed to the point of automatic simulation.

There is, however, one important remark to make on a certain aspect of the results. It is evident when comparing the two figures 1) total midyear inter-regional assets and 2) total revenue share, that an imbalance occurs. In every case, revenue exceeds assets. This is not due to a mistake in the program, but due to the fact that, the data base of the program represents a subset of the inter-regional operations. The missing items are, among others:

- 1) Non-inclusion of television, and private line services in calculation of assets required and revenue generated. The net effect of this inclusion would be a relatively large increase in assets and a not-so-large increase in revenue.
- 2) Local equipment assets are not evalued as part of the inter-regional system.
- 3) Long distance services (telephone) to the North are not included in the network. These lines represent relatively small amounts of revenue, but large investments.

Furthermore, as been pointed out previously, the dimensioning of the inter-regional network is based on the (separation) assumption of full utilization of the system in the peak periods. Considerations of over-capacity would tend to raise estimated assets without changing revenue.

It is relatively certain, therefore, that when further data and improved methods of separation are incorporated in the model, that the results will better reflect the asset base in comparison with levels of revenue.

TARIFF MATRIX-TELEPHONE SERVICE
RATES FOR 5.5 MIN. CALLS BY CATEGORY OF CALL AND DISTANCE

CALL CATEGORY	DISTANCES - UPPER LIMIT IN MILES OF RATE CATEGORY														SPLIT		
	80.	110.	144.	180.	228.	290.	400.	540.	680.	840.	920.	1200.	1450.	1675.	1900.	2000.	
1	1.46	1.76	2.14	2.49	2.85	3.06	3.33	3.60	3.90	4.05	4.20	4.35	4.50	4.65	4.80	4.95	0.166
2	1.26	1.52	1.84	2.15	2.40	2.64	2.87	3.11	3.36	3.51	3.66	3.81	3.96	4.11	4.26	4.41	0.023
3	1.13	1.36	1.65	1.92	2.15	2.36	2.57	2.78	3.00	3.15	3.30	3.45	3.60	3.75	3.90	4.05	0.008
4	1.26	1.52	1.84	2.15	2.40	2.64	2.87	3.11	3.36	3.51	3.66	3.81	3.96	4.11	4.26	4.41	0.020
5	1.13	1.36	1.65	1.92	2.15	2.36	2.57	2.78	3.00	3.15	3.30	3.45	3.60	3.75	3.90	4.05	0.022
6	1.29	1.66	2.02	2.31	2.60	2.84	3.07	3.30	3.60	3.90	4.20	4.50	4.80	5.10	5.40	5.70	0.416
7	0.97	1.18	1.41	1.62	1.82	1.99	2.15	2.31	2.52	2.73	2.94	3.15	3.36	3.57	3.78	3.99	0.059
8	0.70	0.84	1.01	1.16	1.30	1.42	1.54	1.65	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	0.020
9	0.97	1.18	1.41	1.62	1.82	1.99	2.15	2.31	2.52	2.73	2.94	3.15	3.36	3.57	3.78	3.99	0.049
10	0.70	0.84	1.01	1.16	1.30	1.42	1.54	1.65	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	0.005
11	2.26	2.71	3.29	3.84	4.29	4.71	5.13	5.55	6.00	6.45	6.90	7.35	7.80	8.25	8.70	9.15	0.230

LEGEND

Call category

1	Operator Handled Station-to-Station Calls	Monday to Saturday, 8 a.m. to 6 p.m.	1
2	Operator Handled Station-to-Station Calls	Monday to Saturday, 6 p.m. to midnight	50
3	Operator Handled Station-to-Station Calls	Monday to Saturday, Midnight to 8 a.m.	
4	Operator Handled Station-to-Station Calls	Sundays 8 a.m. to midnight	1
5	Operator Handled Station-to-Station Calls	Sundays, Midnight to 8 a.m.	
6	Direct Distance Dialing	Monday to Saturday 8 a.m. to 6 p.m.	
7	Direct Distance Dialing	Monday to Saturday 6 p.m. to midnight	
8	Direct Distance Dialing	Monday to Saturday, Midnight to 8 a.m.	
9	Direct Distance Dialing	Sundays 8 a.m. to midnight	
10	Direct Distance Dialing	Sundays, Midnight to 8 a.m.	
11	Person to person		

RESULTS OF APPLICATION OF SETTLEMENT SCHEMES

TOTAL REVENUE FOR ALLOCATION-- £3253.41

SETTLEMENT SCHEME CODE 2 2 2 2 REVENUES BY CARRIER 14496.29 20789.59 18297.96 9669.21

LEGEND

Settlement Scheme Code

2 Commonwealth Scheme

LEGEND

Abbreviations

M & C	Marketing and Commercial expenses
N.R. Base	Net Rate Base
N-IN. Tax	Property and other non income taxes
\$ K & O	Thousands of dollars capital and operating cost
\$ INV/CCS	Thousands of dollars invested per c.c.s. carriers
\$ INV/CCS/M	Thousands of dollars invested per c.c.s. carried per mile
\$ K & O/CCS	Thousands of dollars capital and operating cost per c.c.s. carried
\$ K & O/CCS/M	Thousands of dollars capital and operating cost per c.c.s. carried per mile
TOCIR	Total toll circuits
IRCIR	Dimensional inter-regional circuits
TO.TR.	Total switching capacity (trunks)
IR.TR.	Inter-regional switching capacity (trunks)
RFC	Radio frequency channel size
CF	Asset valuation function
SL	Average service life
AGE	Average age

DESCRIPTIVE INPUT PARAMETERS :

TAX RATE = C.47312
 RATE OF RETURN ON EQUITY = 7.89%
 RATE OF RETURN (EXTERNAL-DEFAULT OPTION) = 0.0 %
 RATE OF RETURN (INTERNAL CALCULATION) = 10.43%
 DEBT CAPITAL RATIO = C.55820
 INTEREST RATE ON LONG TERM DEBT = 6.84%
 DEPRECIATION METHOD: SWITCHING EQUIPMENT : STRAIGHT LINE(ASL)
 : TRANSM. EQUIPMENT : STRAIGHT LINE(ASL)
 ALLOWANCE FOR WORKING CAPITAL = 0.11%

	SWING CF	TRANS CP.
% OF GROSS ASSET VALUE FOR MAINTENANCE	5.3200	5.3200
% MARKDOWN	1.6100	1.6100
% TRAFFIC EXP	2.1700	2.1700
% OTHER EXP	2.8200	2.8200
% NCN-INC TAX	C.9600	C.9600
% CHANGE TO TOTAL PLANT TYPE AT COST	FEES	RETS
-SWITCHING	E.8700	C.8100
-TRANSMISSION	4.0400	C.5600
-STATION EQUIP	C.0	C.0
-GENERAL EQUIP	C.3200	C.0400
-BUILDINGS	1.1200	C.1500
-LAND	C.C600	

--OPERATING REVENUE IS 14496.29 C.0 0.0 (Thousands of Dollars)

--ASSETS---IN THOUSANDS OF DOLLARS

	AT COST	ACC-DEP	ADDS	RETS	ANN-DEP	SALVAGE	REMOVAL	AT COST	NET	Y/O/YEAR
-SWITCHING	2391.60	597.90	144.03	20.10	122.68	0.0	0.0	2453.57	1794.33	15/33
-TRANSMISSION	594.15	248.54	40.08	5.73	50.59	0.0	0.0	1011.73	727.89	1
-STATION EQUIP	C.0	0.0	0.0	0.0	0.0	0.0	0.0	C.0	C.0	
-GENERAL EQUIP	76.50	19.23	0.25	0.03	3.85	0.0	0.0	77.01	55.86	
-BUILDINGS	268.23	67.06	3.02	C.40	13.48	0.0	0.0	269.53	195.74	
-LAND	38.49	0.02						38.50	38.50	
--TOTAL	3765.37	932.72	188.19	26.26	190.59	0.0	0.0	3250.24	2822.32	

--OPERATING AND CAPITAL COSTS--- In thousands of dollars

	MAINT	M&E	TRAFFIC	CTHER	N-IN-TAX	DEPREC.	CAP COST	N.R.BASE	TCT INC COST
-SWITCHING	145.03	43.89	59.16	78.51	26.17	134.95	208.88	2001.5	696.60
-TRANSMISSION	59.80	18.10	24.39	32.38	10.79	55.65	85.92	823.5	287.03

-SWITCHING NODES SUMMARY

LAB.	AGE	SL	TO-TR	IR-TR	IRCCS	ASSETS	ACC-DEP	ANN-DEP	\$KED	\$INV/CCS	\$KED/CCS
AC2	5	20	2067.	418.	8854.5	2626.63	634.92	130.02	671.16	0.2966	0.0758
A03	5	20	430.	10.	206.9	99.56	24.07	4.93	25.44	0.4812	0.1230
A05	5	20	241.	C.	0.0	C.0	0.0	0.0	0.0	0.0	
A07	5	20	277.	0.	0.0	C.0	0.0	C.0	C.0	0.0	

-TRANSMISSION LINKS SUMMARY

LAE.	CF	AGE	SL	RFC	TOCIR	IRCIR	IRCCS	ASSETS	AC-DEP	AN-DEP	\$KED	\$INV/CCS/M	\$KED/CCS/M	MI	\$INV/CCS	\$KED/CCS
0100	2	5	20	960	960	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0103	1	5	20	1200	1200	144	3952.53	374.39	91.16	18.53	95.59	0.000364	0.000093	260.0	C.054721	C.C24186
0102	2	5	20	960	3840	192	4923.47	92.95	22.63	4.60	23.73	0.000145	0.000037	130.0	C.018878	C.C4820
0104	3	5	20	600	1200	6	94.50	6.60	1.61	0.33	1.69	0.000582	0.000149	120.0	C.069039	C.017832
0107	2	5	20	560	3840	198	5017.57	157.05	38.24	7.77	40.10	0.000147	0.000038	213.0	C.031297	C.C07591
0105	2	5	20	960	2880	139	4021.92	286.66	69.81	14.19	73.20	0.000158	0.000040	450.0	C.071279	C.C18200
0108	2	5	20	960	3840	198	5017.57	112.81	27.47	5.58	26.80	0.000147	0.000038	153.0	C.022481	C.C05740
0106	1	5	20	1200	1200	139	4021.92	37.04	9.02	1.83	9.46	0.000346	0.000038	26.0	C.005210	C.C2352
0109	2	5	20	960	3840	198	5017.57	56.63	13.75	2.80	14.46	0.000147	0.000038	76.0	C.011285	C.C22881

DESCRIPTIVE INPUT PARAMETERS :

TAX RATE = C.0

RATE OF RETURN ON EQUITY = C.0 %

RATE OF RETURN (EXTERNAL-DEFAULT OPTION) = C.0 %

RATE OF RETURN (INTERNAL CALCULATION) = 5.72%

DEBT CAPITAL RATIO = 0.90030

INTEREST RATE ON LONG TERM DEBT = 6.35%

DEPRECIATION METHOD: SWITCHING EQUIPMENT : STRAIGHT LINE(ASL)

: TRANSM. EQUIPMENT : STRAIGHT LINE(ASL)

ALLOWANCE FOR WORKING CAPITAL = 5.61%

	SWING CP	TRANS CP.
% OF GROSS ASSET VALUE FOR MAINTENANCE	3.9700	3.9700
% MARKDOWN	1.4200	1.4200
% TRAFFIC EXP	1.6600	1.6800
% OTHER EXP	3.1570	3.1570
% NON-INC TAX	0.4600	0.4600

% CHANGE TO TOTAL PLANT TYPE AT CCST	ADDS	RETS
-SWITCHING	7.2200	1.5100
-TRANSMISSION	4.0000	0.8200
-STATION EQUIP	2.7900	0.5800
-GENERAL EQUIP	0.3000	0.0600
-BUILDINGS	1.7100	0.3500
-LAND	0.0700	

--OPERATING REVENUE IS 20789.59 C.0 C.0 C.0 (Thousands of Dollars)

--ASSETS--IN THOUSANDS OF DOLLARS

	AT COST	ACC.DEP	ADDS	RETS	ANN.DEP	SALVAGE	REMOVAL	AT COST	NET
-SWITCHING	5206.07	1301.52	350.26	81.65	268.01	C.0	C.0	5360.28	3924.75
-TRANSMISSION	1051.16	262.79	42.72	8.56	53.40	C.0	C.0	1068.04	778.55
-STATION EQUIP.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-GENERAL EQUIP	142.69	35.67	0.43	0.05	7.14	C.0	C.0	142.86	103.62
-BUILDINGS	496.62	124.15	8.55	1.75	25.00	C.0	C.0	500.02	363.36
-LAND	71.41	0.05						71.43	71.43
--TOTAL	6967.93	1724.13	442.01	92.65	353.56	C.0	C.0	7142.62	5241.70

--OPERATING AND CAPITAL COSTS-- In thousands of dollars

PAINT	M&C	TRAFFIC	CTHER	N-IN.TAX	DEPREC.	CAP COST	N.R.BASE	TOT INC COST	
-SWITCHING	236.45	84.57	100.06	166.03	27.40	294.82	263.82	4614.7	1195.14
-TRANSMISSION	47.11	16.85	19.94	37.46	5.46	58.74	52.36	915.8	237.92

--SWITCHING NODES SUMMARY

LAB.	AGE	SL	TC.TR	IR.TR	IRCCS	ASSETS	ACC.DEP	ANN.DEP	\$KED	\$INV/CCS	\$KEC/CCS
BC2	5	20	1966.	478.	10116.6	4074.64	981.59	201.69	817.64	0.4028	0.0808
B05	5	20	1545.	204.	4314.0	1881.27	453.20	93.12	377.51	0.4361	0.0275

-TRANSMISSION LINKS SUMMARY

LAB.	CF	AGE	SL	RFC	TOCIR	IRCIR	IRCCS	ASSETS	AC.DEP	ANN.DEP	\$KED	\$INV/CCS/M	\$KED/CCS/M	NI	\$INV/CCS	\$KEC/CCS
0156	1	5	20	1200	1200	139	4021.92	247.90	60.44	12.27	49.70	0.000346	0.000069	178.3	0.061636	0.012357
0159	2	5	20	960	3840	198	5017.57	14.16	3.45	0.70	2.84	0.000147	0.000029	19.2	0.002821	0.000566
0201	4	5	20	480	3360	89	2758.33	30.51	7.44	1.51	6.12	0.000123	0.000025	90.0	0.011062	0.002218
0202	2	5	20	960	960	109	2259.66	93.67	22.84	4.64	18.78	0.000553	0.000111	75.0	0.041452	0.003111
0203	1	5	20	1200	6000	179	4393.74	48.11	11.00	2.23	5.04	0.000114	0.000023	90.0	0.010266	0.002058
0204	1	5	20	1200	9600	263	6941.06	97.80	23.85	4.84	19.61	0.000081	0.000016	175.0	0.014090	0.002825
0208	4	5	20	480	1920	288	6653.39	165.32	45.18	9.17	37.15	0.000234	0.000047	118.8	0.027883	0.005584
0207	1	5	20	1200	1200	229	6048.68	226.70	55.27	11.22	45.45	0.000379	0.000076	99.0	0.037475	0.007514
0206	3	5	20	600	1800	139	4021.92	245.56	59.87	12.16	49.23	0.000230	0.000046	265.0	0.061055	0.012241
0205	2	5	20	960	960	0	0.0	C.0	C.0	C.0	C.0	0.0	0.0	185.0	C.0	C.0

DESCRIPTIVE INPUT PARAMETERS :

TAX RATE = 0.0
 RATE OF RETURN ON EQUITY = 3.15%
 RATE OF RETURN (EXTERNAL-DEFAULT OPTICAL) = 0.0 %
 RATE OF RETURN (INTERNAL CALCULATION) = 6.21%
 CEET CAPITAL RATIO = 0.69440
 INTEREST RATE ON LONG TERM DEBT = 7.56%
 DEPRECIATION METHOD: SWITCHING EQUIPMENT : STRAIGHT LINE(ASL)
 : TRANSM. EQUIPMENT : STRAIGHT LINE(ASL)
 ALLOWANCE FOR WORKING CAPITAL = 3.77%

	SWING CF	TRANS CP.
X OF GROSS ASSET VALUE FOR MAINTENANCE =	3.5500	3.5500
X MARKDOWN =	1.3400	1.3400
X TRAFFIC EXP =	2.1600	2.1600
X OTHER EXP =	2.2200	2.2200
X NON-INC TAX =	0.2500	0.2500
X CHANGE TO TOTAL PLANT TYPE AT COST	ADDS RETS	
-SWITCHING	4.1800	1.8500
-TRANSMISSION	2.3000	1.0200
-STATION EQUIP	1.6000	0.7100
-GENERAL ECLIP	0.1700	0.0700
-BUILDINGS	0.9900	0.4700
-LAND	0.0300	

--OPERATING REVENUE IS 18297.96 C.O C.O C.O (Thousands of Dollars)

--ASSETS-- IN THOUSANDS OF DOLLARS

	AT COST	ACC.DEP	ADDS	RETS	ANN.DEP	SALVAGE	REMOVAL	AT COST	NET
-SWITCHING	4589.31	1147.33	194.05	86.66	232.15	0.0	0.0	4642.93	3379.53
-TRANSMISSION	1127.21	281.80	26.05	11.70	56.72	0.0	0.0	1134.40	824.24
-STATION EQUIP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-GENERAL EQUIP	128.33	32.08	0.22	0.05	0.42	0.0	0.0	128.40	93.10
-BUILDINGS	442.22	112.06	4.45	2.11	22.47	0.0	0.0	449.39	326.10
-LAND	64.19	0.02						64.20	64.20
--TOTAL	6357.25	1573.27	224.87	100.76	317.76	0.0	0.0	6419.30	4667.16

--OPERATING AND CAPITAL COSTS-- In thousands of dollars

	PAINT	M&C	TRAFFIC	OTHER	AN-IN.TAX	DEFREC.	CAP COST	N.R.BASE	TOT INC COST
-SWITCHING	183.14	69.13	111.43	114.53	12.90	255.36	242.90	3910.1	989.39
-TRANSMISSION	44.75	16.89	27.23	27.98	3.15	62.39	59.25	953.8	241.64

--SWITCHING NODES SUMMARY

LAB.	AGE	SL	TC.TR	IR.TR	IRCCS	ASSETS	ACC.DEP	ANN.DEP	\$KED	\$INV/CCS	\$KED/CCS
C02	5	20	1375.	500.	10761.3	4357.05	1066.85	215.68	835.62	0.4049	0.0777
C03	5	20	526.	96.	2038.4	801.77	196.32	39.69	153.77	0.3933	0.0754

-TRANSMISSION LINKS SUMMARY

LAB.	CF	AGE	SL	RFC	TOCIR	IRCIR	IRCCS	ASSETS	AC.DEP	AN.DEP	\$KED	\$INV/CCS/M	\$KED/CCS/M	MI	\$INV/CCS	\$KED/CCS
0258	4	5	20	480	1920	288	6653.35	376.25	92.57	18.62	72.13	0.000234	0.000045	241.2	0.056550	0.010641
0257	1	5	20	1200	1200	229	6048.62	460.27	113.24	22.78	88.24	0.000379	0.000073	201.0	0.076094	0.014526
0305	1	5	20	1200	2400	105	2851.75	33.62	8.27	1.66	6.45	0.000202	0.000039	58.2	0.011769	0.002260
0302	2	5	20	960	960	105	2851.75	180.46	44.40	8.93	34.60	0.000422	0.000081	150.0	0.063280	0.012131
0304	1	5	20	1200	4800	134	3233.45	39.63	9.75	1.96	7.60	0.000135	0.000026	91.0	0.012256	0.002350
0303	1	5	20	1200	3600	266	6630.84	170.23	41.08	8.43	32.63	0.000160	0.000031	160.0	0.025673	0.004922

DESCRIPTIVE INPUT PARAMETERS :

TAX RATE = C.C

RATE OF RETURN ON EQUITY = 7.91%

RATE OF RETURN (EXTERNAL-DEFAULT CPTICK) = 0.0 %

RATE OF RETURN (INTERNAL CALCULATION) = 4.50%

DEET CAPITAL RATIO = 0.85590

INTEREST RATE ON LONG TERM DEBT = 3.65%

DEFRECIATION METHOD: SWITCHING EQUIPMENT : STRAIGHT LINE(ASL)

: TRANSM. EQUIPMENT : STRAIGHT LINE(ASL)

ALLOWANCE FOR WORKING CAPITAL = 2.56%

SWING CP TRANS CP.

X OF GROSS ASSET VALUE FOR MAINTENANCE = 4.7800 4.7800

X MARKDOWN = 1.4000 1.4100

X TRAFFIC EXP = 1.9800 1.9800

X OTHER EXP = 2.0900 2.0900

X NCA-INC TAX = 0.4200 0.4200

X CHANGE TO TOTAL PLANT TYPE AT COST ACCNE RETS

-SWITCHING 4.8300 1.1600

-TRANSMISSION 2.7200 0.7900

-STATION EQUIP C.C 0.0

-GENERAL EQUIP C.0500 C.1300

-BUILDINGS 0.4600 0.1600

-LAND C.0200

--OPERATING REVENUE IS 9669.21 0.0 C.C C.C (Thousands of Dollars)

--ASSETS--IN THOUSANDS OF DOLLARS

	AT COST	ACC.DEP	ADDNE	RETS	ANN.DEP	SALVAGE	REMOVAL	AT COST	NET
-SWITCHING	2059.16	514.79	101.32	24.60	104.88	0.0	0.0	2057.52	1530.29
-TRANSMISSION	466.05	116.51	12.60	3.76	23.53	0.0	0.0	470.57	342.29
-STATION EQUIP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-GENERAL EQUIP	57.09	14.27	0.03	0.07	2.85	0.0	0.0	57.07	41.37
-BUILDINGS	199.45	49.86	0.92	0.32	9.99	0.0	0.0	199.75	144.90
-LAND	28.53	0.0	0.0	0.0	0.0	0.0	0.0	28.54	28.54
--TOTAL	2810.29	695.44	115.07	28.76	141.25	0.0	0.0	2853.45	2087.39

--OPERATING AND CAPITAL COSTS--- In thousands of dollars

	MAINT	M&C	TRAFFIC	CTHER	N-IN.TAX	CEPREC.	CAP CCST	N.R.BASE	TCT INC CEST
-SWITCHING	111.40	32.63	46.15	48.71	9.79	115.36	78.81	1749.4	442.84
-TRANSMISSION	24.99	7.37	10.35	10.93	2.20	25.88	17.63	391.4	99.36

--SWITCHING NODES SUMMARY

LAB.	AGE	SL	TC.TR	IR.CIR	IRCCS	ASSETS	ACC.DEP	ANN.DEP	\$K80	\$INV/CCS	\$K80/CCS
D04	5	20	1152.	267.	6085.2	2330.59	567.18	115.36	442.84	0.3830	0.0728

-TRANSMISSION LINKS SUMMARY

LAB.	CF	AGE	SL	RFC	TOCIR	IRCIR	IRCCS	ASSETS	AC.DEP	AN.DEP	\$K80	\$INV/CCS/M	\$K80/CCS/M	MI	\$INV/CCS	\$K80/CCS
0355	1	5	20	1200	2400	105	2851.75	48.36	11.87	2.39	9.19	0.000202	0.000038	82.8	0.016965	C.003224
0354	1	5	20	1200	4800	134	3233.49	73.60	18.05	3.64	13.99	0.000135	0.000026	169.0	0.022761	C.004325
0402	3	5	20	600	1200	105	2251.75	259.86	63.75	12.86	49.38	0.000337	0.000064	270.0	0.091124	C.017316
0403	2	5	20	960	3240	134	3233.49	74.85	18.36	3.71	14.22	0.000154	0.000029	150.0	0.023148	C.004355
0406	2	5	20	960	960	105	2851.75	66.17	16.23	3.28	12.57	0.000422	0.000080	55.0	0.023263	0.004409

0.23915977E+04 C.59415224E+C3 C.C 0.76901733E+C2 0.262226C7E+03
 0.3849324CE+02 C.59789917E+C3 C.24853831E+C3 C.C 0.192254C3E+02
 0.67056564E+02 C.C 0.144C3078E+C3 C.40875C0CE+02 0.0
 0.24643058E+00 C.301E7721E+C1 0.23102880E-C1 C.20095521E+02 0.572E80C8E+01
 0.0 C.30803E48E-C1 C.4C430045E+CC C.C C.12267824E+03
 0.50586182E+02 C.C 0.38504725E+C1 C.1347667EE+02 C.C

Below are the financial statements; that is the Income Statement, Balance Sheet, Retained Earnings Statement and Source and Uses of Funds Statements for B.C. Telephone, 1971. These 4 statements are presented for 1) inter-regional activities, 2) regional activities, and 3) company total activities and the Significant Ratios for 1) inter-regional and 2) company total.

The inter-regional statements are based primarily on endogenous input from the Costing and Sharing Blocks. For this reason there exist imbalances among the relative orders of magnitude of assets, operating revenues and operating costs.

It is to be observed that the results produced are not to be taken as indicative with respect to real life conditions since for the above mentioned reasons the inter-regional assets are understated relative to revenues. Moreover, the expenses are correspondingly understated since these are derived as proportions of the understated asset base. Additional relevant remarks are:

- 1) Net Operating Revenue is large relative to the asset base because total operating revenues is on the high side and operating expenses are on the low side. Hence when other income (net) is exogenously added in (zero dollars in this phase) and debt service charges and income taxes are calculated in the standard fashions the net income is still high relative to the asset base.
- 2) Plant under Construction for the inter-regional assets is provided exogenously and hence is not in the same relative order of magnitude as the other assets. This can be ameliorated through better "tuning" in the future phases.
- 3) Capital Stock at end of year is significantly lower because the large net income is used to greatly increase retained earnings and simultaneously greatly reduce capital stock. This phenomenon comes about because end of year equity, net income and retained earnings are first calculated (in the solution of simultaneous equations) and the small difference between the equity and retained earning, that is, capital stock is then distributed between preferred and common stock.

The regional statements are based fully on exogenous input. Hence the orders of relative magnitude of costs, revenues and assets are realistic. These statements are displayed because they are combined with the inter-regional statements to produce the company total statements and the reader can find the breakdown of company total figures in the appropriate inter-regional and regional statements.

The significant ratios are displayed for B.C. Telephone only. The meanings for the 27 ratios are provided in Table A. It is worthwhile explaining that the Percent Return on Equity, S.R. no 24, equal to 174% and Percent Return on Capital, S.R. no 25, equal to 80%, are both very high for the inter-regional activities because of the high net income relative to the low base of average total shareholders

B C T E L
SIGNIFICANT RATIOS - 1 9 7 1
INTER REGIONAL = COMPANY TOTAL

SR# 1	2.39513 :	0.25714
SR# 2	0.0 :	0.13081
SR# 3	2.32084 :	0.11833
SR# 4	0.05501 :	0.04128
SR# 5	0.05536 :	0.03783
SR# 6	0.03058 :	0.04764
SR# 7	0.27862 :	0.21371
SR# 8	0.28571 :	0.18786
SR# 9	0.17002 :	0.23663
SR#10	0.00836 :	0.02294
SR#11	0.00604 :	0.02446
SR#12	0.00431 :	0.02236
SR#13	2.28482 :	0.08131
SR#14	*****:(1)	-0.04065
SR#15	*****:	-2.82636
SR#16	0.00587 :	0.68907
SR#17	0.00723 :	1.64183
SR#18	0.04606 :	0.68379
SR#19	0.01370 :	0.20481
SR#20	0.01277 :	0.18527
SR#21	0.06438 :	0.06933
SR#22	0.54099 :	0.54125
SR#23	0.44209 :	0.44179
SR#24	1.73828 :	0.09442
SR#25	0.80440 :	0.08041
SR#26	41.60640 :	2.98191
SR#27	22.39650 :	2.07792

- (1) These asterisks '*****' represent significant ratios which are not applicable on an inter-regional basis.

TABLE A - Significant Ratios

Number	Nomenclature	Unit of Measurement(1)	Numerator	Denominator
SR no 1	Per Plant Total Revenue	\$	Total Operating Revenue	Average Total Telephone Plant in Service
SR no 2	Per Plant Exchange Revenue	\$	Local Service Revenue	Average Total Telephone Plant in Service
SR no 3	Per Plant Toll Revenue	\$	Total Toll Service Revenue	Average Total Telephone Plant in Service
SR no 4	Depreciation Expense Required per plant (Switching)	\$	Depreciation Expense - Switching	Average Depreciable plant in service - switching
SR no 5	Depreciation Expense required Per Plant (Transmission)	\$	Depreciation Expense - Transmission	Average Depreciable plant in service - Transmission
SR no 6	Depreciation Expense required per plant. (Total Plant)	\$	Depreciation Expense - Total Plant	Average Depreciable plant in service - Total Plant
SR no 7	Plant Average Age Indicator (Switching)	Year	Accumulated Depreciation - Switching	Telephone Plant in Service - Switching (end of year)
SR no 8	Plant Average Age Indicator (Transmission)	Year	Accumulated Depreciation - Transmission	Telephone Plant in Service - Transmission (end of year)
SR no 9	Plant Average Age Indicator (Total Plant)	Year	Accumulated Depreciation - Total	Telephone Plant in Service - Total (End of Year)
SR no 10	Plant Retirement Ratio - Switching	%	Plant Retired - Switching	Telephone Plant-Switching (End Beginning of Year)
SR no 11	Plant Retirement Ratio - Transmission	%	Plant Retired - Transmission	Telephone Plant - Transmission (Beginning of Year)
SR no 12	Plant Retirement Ratio - Total	%	Total Plant Retired	Total Telephone Plant (Beginning of Year)
SR no 13	Average Capital Productivity	Number	Gross Operating Revenue + Uncollectibles	Average Total Plant
SR no 14	Net Capital Productivity (Net Value Added on Capital)	Number	Gross Operating Revenue + Uncollectibles Minus Wages	Average Total Plant
SR no 15	Average Labor Productivity	\$	Gross Operating Revenue + Uncollectibles Minus Wages	Total employees
SR no 16	Average Cost per Telephone	\$	Total Telephone Plant (End of Year)	Total telephone in Service (End of Year)

(1) Note: - \$'s from financial statements are in \$1000's
 - %'s are expressed in decimal format (e.g. .10 = 10%)

Number	Nomenclature	Unit of Measurement(1)	Numerator	Denominator
SR no 17	Current cost per telephone added	\$	Construction Expenditure	Increase in total telephone in Service (End of Year)
SR no 18	Operating Ratio	Number	Operating Expense	Total Operating Revenue
SR no 19	Maintenance expense required per revenue	%	Maintenance expense	Total Operating Revenue
SR no 20	Depreciation expense required per Revenue	%	Depreciation Expense	Total Operating Revenue
SR no 21	Percent Average Embedded debt cost	%	Debt Service charges	Average long term debt
SR no 22	Debt-Capital Ratio	%	Average long term debt	Average Total Capitalization
SR no 23	Percent equity - Total Capitalization Ratio	%	Average Total Shareholders' capital	Average Total Capitalization
SR no 24	Percent Return on Equity	%	Net Income (End of Year)	Average Total Shareholders' Capital
SR no 25	Percent Return on Total Capital	%	Net Income plus interest charge (End of Year)	Average Total Capitalization
SR no 26	Times interest charges earned before tax	Number	Net Income + Income Tax + Debt Service Charge	Debt Service Charge
SR no 27	Times interest charges earned after tax	Number	Net Income + Debt Service Charge	Debt Service Charge

(1) Note: - \$'s from financial statements are in \$1000's
 - %'s are expressed in decimal format (e.g. .10 = 10%)

capital for Percent Return on Equity, S.R. no 24, and similarly for net income plus interest charges divided by average total capital for Percent Return of Total Capital (S.R. no 25). This is due to the understatement of asset values. These Inter-regional Percent Returns will also be made more realistic with better tuning in future phases, particularly through a better assessment of the asset base. For the Company Total Percent Returns, the Return on Equity, S.R. no 24, equals 9.4%, and Return on Capital, S.R. no 25, equals 8.0%, which are realistic results since these company total ratios are based to a very high proportion on realistic regional values. Significant Ratio no 14, Net Capital Productivity and Significant Ratio no 15, Average Labor Productivity, are both negative because the numerators for both equals gross operating revenue + uncollectibles - wages. Since wages are provided exogenously and independently in Table 17 (see Appendix G) and gross operating revenue and uncollectibles are calculated, this numerator being negative could not be anticipated and this serves to show the capabilities of the program even through further "tuning" is required.

The Inter-Regional Income Statements for Alberta, Saskatchewan and Manitoba Telephone companies are also displayed below. The complete displays of all 4 financial statements for 3 activities would be too lengthy and the complete B.C. Telephone financial statements and significant ratios provide a sample of what is produced in full by the program.

B C T E L
INTER REGIONAL
INCOME STATEMENT - 1971

(\$1000's)

REVENUE :

INTER TOLL - PUBLIC MESSAGE			14496
- PRIVATE LINES			0
- PROGRAM TRANSMISSION			0
			0
INTRA-TOLL			0
TOTAL TOLL			14496
LOCAL			0
OTHER			594
LESS UNCOLLECTIBLES			(130)

TOTAL OPERATING REVENUE			14960

EXPENSES :

	INTER-REGIONAL	REGIONAL
	SWITCHING	TRANSMISSION

MAINTENANCE	145	60	0	205
TRAFFIC	59	24	0	83
COMMERCIAL & MARKETING	44	18	0	62
OTHER EXPENSES	79	32	0	111
TAXES OTHER THAN INCOME TAXES	26	11	0	37
DEPRECIATION	135	56	0	191
	-----	-----	-----	-----
OPERATING EXPENSES	486	201	0	689
				(689)

NET OPERATING REVENUE		14271
-----------------------	--	-------

OTHER INCOME(NET) :

DIVIDEND FROM SLESIDIARIES		******(1)
INCOME FROM OTHER INVESTMENTS		*****
MISCELLANEOUS INCOME		*****

INCOME BEFORE INCOME TAXES AND DEBT-SERVICE CHARGES		14271
--	--	-------

INCOME TAXES:		6589
---------------	--	------

INCOME BEFORE DEBT SERVICE CHARGES DEBT SERVICE CHARGES :		7682
--	--	------

LONG TERM DEBT OTHER AMORTIZATION OF LONG TERM DEBT ASSET		***** ***** *****
		343

INCOME BEFORE EXTRAORDINARY ITEM		7339
----------------------------------	--	------

EXTRAORDINARY ITEM :		*****
----------------------	--	-------

NET INCOME		7339
------------	--	------

(1) These asterisks, '*****', represent a detailed level of breakdown not available in this phase but will be in future phases. This applies for all financial statements.

B C T E L
INTER REGIONAL
BALANCE SHEET - 1971

(\$1000's)

ASSETS				LIABILITIES			
AT BEGINNING OF YEAR :		AT END OF YEAR :		AT BEGINNING OF YEAR :		AT END OF YEAR :	
TELE. PROPERTY							
		COST LESS		COST LESS		SHRLDRS CAP.	
	AT COST	ACC. DEP	ACC. DEP	AT COST	ACC. DEP	ACC. DEP	
SWITCHING	2392	598	1794	2516	701	1815	CAP. STOCK PREF. 1245 300
TRANSMISSION	994	249	745	1029	294	735	CAP. STOCK COM. IN. PR. 2157 482
STAT.EQUIP.	C	C	0	C	C	0	RET'D NC EARNINGS 810 3348
GEN.EQUIP.	77	19	58	77	23	54	:: TOTAL EQUITY 4313 4131
BUILDINGS	268	67	201	271	80	191	:: DEBT
LAND	38		38	38		38	:: ADVAN. FRM GVT 0 0
PLANT UNDER CONSTR.	2266		2266	2527		2527	:: L.T.D. & BONDS 5069 4884
TOTAL	6035	933	5102	6458	1098	5360	:: NOTES PAYABLE 358 344
							:: TOTAL DEBT 5427 5229
INVESTMENTS							
SUBSIDIARY CO.	*****	*****				TOTAL CAPITAL	9740 9360
CTHER	*****	*****					
	210			405		CURRENT LIAB.	
CURRENT ASSETS							
CASH & TEMP. INVES.	*****	*****				ACCT. PAYABLE	*****
ACCT.RECEIVABLE	*****	*****				DIV.PREFERRED	*****
MAT SUPPLIES	*****	*****				DIV CCYCN	*****
PREPAYMENTS	*****	*****				ACCURED TAXES	*****
	3928			4636		ACCURED INTRSTS	*****
						ADV.EIL.FCR SERV.	*****
						TRFR TO GVT OWNERS	*****
DEFERRED CHARGES						DEFERRED TAXES	
UNAMCR.L.T.D.EXPEN.	*****	*****				INCOME TAX	*****
CTHER	*****	*****				UNAMOR.INV.T.CRED	*****
	1807			693		OTH.DEF'D CRED.	
						OTHER	0 0
TOTAL ASSETS	11047			11094		TOTAL LIABILITIES	11047 11093

E C T E L
INTER REGIONAL
RETAINED EARNINGS STATEMENT - 1 9 7 1 (\$1000'S)

NET INCOME	7339
PREFERRED SHARE DIVIDENDS	(1317)
NET INCOME AFTER PREFERRED DIVIDENDS	6022
COMMON SHARE DIVIDENDS	3029
TRANSFERS TO GOVERNMENT OWNERS	0
	(3029)
INCOME RETAINED	2993
SHARE ISSUE EXPENSE	(35)
OTHER ADJUSTMENTS (NET)	-420
BALANCE END OF YEAR	2538

B C T E L
INTER REGIONAL

SOURCES AND USES OF FUNDS STATEMENT - 1971

(\$1000'S)

SOURCES:

NET INCOME	7239
DIVIDEND AND TRANSFERS TO GOVERNMENT OWNERS	(4346)
INCOME RETAINED	2993
DEFERRED INCOME TAX - CURRENT	105
- PRIOR	321
DEPRECIATION AND OTHER NON CASH CHARGES (NET)	426
TOTAL SOURCES FROM OPERATIONS (NET)	191
ADDITIONS TO LONG TERM DEBT	377
LESS REPAYMENT OF LONG TERM DEBT AND INCREASE IN SINKING FUND ASSETS	(575)
NET INCREASE IN LONG TERM DEBT BORROWINGS	-198
PREFERRED AND COMMON STOCK ISSUED	-2720
MISCELLANEOUS	659
REDUCTIONS OF WORKING CAPITAL	C
TOTAL SOURCES OF FUNDS	1351

USES:

GROSS CONSTRUCTION EXPENDITURES	449
LESS CHARGES NOT REQUIRING FUNDS	(C)
NET CONSTRUCTION EXPENDITURE	449
INVESTMENTS	195
MISCELLANEOUS	C
INCREASE OF WORKING CAPITAL	706
TOTAL USES OF FUNDS	1350

B C T E L
REGIONAL
INCOME STATEMENT - 1971

(\$1000'S)

REVENUE :

INTER TOLL - PUBLIC MESSAGE		59527
- PRIVATE LINES		9805
- PROGRAM TRANSMISSION		700
		0
INTRA-TOLL		70032
TOTAL TOLL		93444
LOCAL		6722
OTHER		(1472)
LESS UNCOLLECTIBLES		

TOTAL OPERATING REVENUE 166726

EXPENSES :

	INTER-REGIONAL SWITCHING	REGIONAL TRANSMISSION	
MAINTENANCE	0	0	37416
TRAFFIC	0	0	15272
COMMERCIAL & MARKETING	0	0	11334
OTHER EXPENSES	0	0	20289
TAXES OTHER THAN INCOME TAXES	0	0	6762
DEPRECIATION	0	0	33840
OPERATING EXPENSES	0	0	124913
			(124913)

NET OPERATING REVENUE 43813

OTHER INCOME (NET) :

DIVIDEND FROM SUBSIDIARIES	*****
INCOME FROM OTHER INVESTMENTS	*****
MISCELLANEOUS INCOME	*****

1423

INCOME BEFORE INCOME TAXES
AND DEBT-SERVICE CHARGES 45236

INCOME TAXES: 11451

INCOME BEFORE DEBT SERVICE CHARGES 33785
DEBT SERVICE CHARGES :

LONG TERM DEBT	*****
OTHER	*****
AMORTIZATION OF LONG TERM DEBT ASSET	***** 19613

INCOME BEFORE EXTRAORDINARY ITEM 14172

EXTRAORDINARY ITEM : *****

NET INCOME 14172

B C T E L
REGIONAL
BALANCE SHEET - 1971

(\$1000'S)

ASSETS

::

LIABILITIES

AT BEGINNING OF YEAR : AT END OF YEAR :

AT BEGINNING OF YEAR :

AT END OF YEAR :

TELE. PROPERTY

SHRLDRS CAP.

	AT COST	ACC. DEP	COST LESS	AT COST	ACC. CEP	COST LESS	AT COST	ACC. CEP	SHRLDRS CAP.	CAP. STOCK PREF.	106511	66425	73247
SWITCHING	259458	54591	204867	293335	62525	230810	293335	62525	SHRLDRS CAP.	CAP. STOCK PREF.	106511	66425	73247
TRANSMISSION	151303	27745	123558	171047	32032	139015	171047	32032	SHRLDRS CAP.	CAP. STOCK PREF.	106511	66425	73247
STAT. EQUIP.	171794	64591	107203	194232	70948	123284	194232	70948	SHRLDRS CAP.	RET'NG EARNINGS	29996	43566	43566
GEN. EQUIP.	14212	6210	8002	16068	6789	9279	16068	6789	SHRLDRS CAP.	TOTAL EQUITY	212532	212532	234265
BUILDINGS	45056	4650	44406	55461	5937	49524	55461	5937	SHRLDRS CAP.	DEBT	C	C	C
LAND	2387		2387	2702		2702	2702		SHRLDRS CAP.	ADVAN. FROM GVT	C	C	C
PLANT UNDER CONSTR.	16621		16621	18532		18532	18532		SHRLDRS CAP.	NOTES PAYABLE	17682	17682	19743
TOTAL	664831	157787	507044	751377	178231	573146	751377	178231	SHRLDRS CAP.	TOTAL DEBT	267912	267912	297140
									SHRLDRS CAP.	TOTAL CAPITAL'N	460844	460844	531405

INVESTMENTS

CURRENT LIAB.

SUBSIDIARY CO.	*****	*****	ACCT. PAYABLE	*****	*****
OTHER	*****	*****	DIV. PREFERRED	*****	*****
	1567		DIV. COMMNCN	*****	*****
		3018	ACCRUED TAXES	*****	*****
CURRENT ASSETS			ACCRUED INTRSTS	*****	*****
CASH & TEMP. INVES	*****	*****	ACV. EIL. FOR SERV.	*****	*****
ACCT. RECEIVABLE	*****	*****	TRFR TD GVT OWNERS	*****	*****
MAT. SUPPLIES	*****	*****			
PREPAYMENTS	*****	*****			
	29265			20126	26408
DEFERRED CHARGES			DEFERRED TAXES		
UNAMCR. L.T.D. EXPEN.	*****	*****	INCOME TAX	*****	*****
OTHER	*****	*****	UNAMCR. INV. T. CRED	*****	*****
	7453			44359	56057
TOTAL ASSETS	545329		OTH. DEF'D CRED.		
		615870	OTHER	0	0
				0	0
TOTAL LIABILITIES	545329			545329	615870

E C T E L
REGIONAL

RETAINED EARNINGS STATEMENT - 1 9 7 1 (\$1000'S)

NET INCOME	14172
PREFERRED SHARE DIVIDENDS	(3074)
NET INCOME AFTER PREFERRED DIVIDENDS	11098
COMMON SHARE DIVIDENDS	6465
TRANSFERS TO GOVERNMENT OWNERS	0
	(6465)
INCOME RETAINED	4633
SHARE ISSUE EXPENSE	(81)
OTHER ADJUSTMENTS (NET)	-980
BALANCE END OF YEAR	3572

B C T E L
REGIONAL

SOURCES AND USES OF FUNDS STATEMENT - 1971 (\$1000'S)

SOURCES:

NET INCOME	14172
CIVIDEND AND TRANSFERS TO GOVERNMENT OWNERS	(9529)
INCOME RETAINED	4633
DEFERRED INCOME TAX - CURRENT	9324
- PRICR	2275
DEPRECIATION AND OTHER NON CASH CHARGES (NET)	11695
TOTAL SOURCES FROM OPERATIONS (NET)	33840
ADDITIONS TO LONG TERM DEBT	61203
LESS REPAYMENT OF LONG TERM DEBT AND INCREASE IN SINKING FUND ASSETS	(31975)
NET INCREASE IN LONG TERM DEBT BORROWINGS	29228
PREFERRED AND COMMON STOCK ISSUED	17761
MISCELLANEOUS	2805
REDUCTIONS OF WORKING CAPITAL	3006
TOTAL SOURCES OF FUNDS	102972

USES:

GROSS CONSTRUCTION EXPENDITURES	101520
LESS CHARGES NOT REQUIRING FUNDS	(0)
NET CONSTRUCTION EXPENDITURE	101520
INVESTMENTS	1451
MISCELLANEOUS	0
INCREASE OF WORKING CAPITAL	0
TOTAL USES OF FUNDS	102971

B C T E L
COMPANY TOTAL

INCOME STATEMENT - 1971

(\$1000'S)

REVENUE :

INTER TOLL - PUBLIC MESSAGE		74023
- PRIVATE LINES		9605
- PROGRAM TRANSMISSION		700
INTRA-TOLL		0
TOTAL TOLL		84528
LOCAL		93444
OTHER		7316
LESS UNCOLLECTIBLES		(1602)
TOTAL OPERATING REVENUE		183686

EXPENSES :

	INTER-REGIONAL SWITCHING	REGIONAL TRANSMISSION		
MAINTENANCE	145	60	37416	37621
TRAFFIC	59	24	15272	15355
COMMERCIAL & MARKETING	44	18	11334	11396
OTHER EXPENSES	79	32	20289	20400
TAXES OTHER THAN INCOME TAXES	26	11	6762	6799
DEPRECIATION	135	56	33840	34031
OPERATING EXPENSES	488	201	124913	125602 (125602)

NET OPERATING REVENUE

58084

OTHER INCOME(NET) :

DIVIDEND FROM SUBSIDIARIES	*****
INCOME FROM OTHER INVESTMENTS	*****
MISCELLANEOUS INCOME	*****

1423

INCOME BEFORE INCOME TAXES
AND DEBT-SERVICE CHARGES

59507

INCOME TAXES:

18040

INCOME BEFORE DEBT SERVICE CHARGES
DEBT SERVICE CHARGES :

41467

LONG TERM DEBT	*****
OTHER	*****
AMORTIZATION OF LONG TERM DEBT ASSET	***** 19956

INCOME BEFORE EXTRAORDINARY ITEM

21511

EXTRAORDINARY ITEM :

NET INCOME

21511

B C T E L
COMPANY TOTAL
BALANCE SHEET - 1971

(\$1000'S)

ASSETS

::

LIABILITIES

AT BEGINNING OF YEAR : AT END OF YEAR :

:: AT BEGINNING OF YEAR :

AT END OF YEAR :

TELE. PROPERTY

COST LESS

AT COST ACC.·DEP ACC.·DEP

AT COST ACC.·DEP

ACC.·DEP

COST LESS ::

ACC.·DEP

SHRLDRS CAP.

CAP. STOCK PREF.

\$7770

73547

CAP. STOCK COM. IN. PR.

106668

117932

RET'D ND EARNINGS

4CECE

46916

SWITCHING

AT COST

261850

ACC.·DEP

55189

ACC.·DEP

206661

AT COST

295851

ACC.·DEP

63226

ACC.·DEP

232625

::

TRANSMISSION

::

152297

ACC.·DEP

27594

ACC.·DEP

124303

AT COST

172076

ACC.·DEP

32326

ACC.·DEP

139750

STAT. EQUIP.

::

171794

ACC.·DEP

64591

ACC.·DEP

107203

AT COST

194232

ACC.·DEP

70948

ACC.·DEP

123284

GEN. EQUIP.

::

14289

ACC.·DEP

6229

ACC.·DEP

ECEC

AT COST

16145

ACC.·DEP

6812

ACC.·DEP

9333

BUILDINGS

::

49324

ACC.·DEP

4717

ACC.·DEP

44607

ACC.·DEP

55732

ACC.·DEP

6C17

ACC.·DEP

49715

ACC.·DEP

::

LAND

ACC.·DEP

2425

ACC.·DEP

2425

ACC.·DEP

2740

ACC.·DEP

2740

ACC.·DEP

2740

PLANT UNDER CONSTR.

ACC.·DEP

18887

ACC.·DEP

16687

ACC.·DEP

21059

ACC.·DEP

21059

ACC.·DEP

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E C T E L
C O M P A N Y T O T A L
R E T A I N E D E A R N I N G S S T A T E M E N T - 1 9 7 1 (\$ 1 0 0 0 ' S)

NET INCOME	21511
PREFERRED SHARE DIVIDENDS	(4391)
NET INCOME AFTER PREFERRED DIVIDENDS	17120
COMMON SHARE DIVIDENDS	5494
TRANSFERS TO GOVERNMENT OWNERS	0
	(5494)
INCOME RETAINED	7626
SHARE ISSUE EXPENSE	(116)
OTHER ADJUSTMENTS (NET)	-1400
BALANCE END OF YEAR	6110

B C T E L
COMPANY TOTAL

SOURCES AND USES OF FUNDS STATEMENT - 1971 (\$1000's)

SOURCES:

NET INCOME	21511
DIVIDEND AND TRANSFERS TO GOVERNMENT OWNERS	(13885)
INCOME RETAINED	7626
DEFERRED INCOME TAX - CURRENT	5429
- PRIOR	2696
DEPRECIATION AND OTHER NON CASH CHARGES (NET)	12125
TOTAL SOURCES FROM OPERATIONS (NET)	34031
ADDITIONS TO LONG TERM DEBT	53782
LESS REPAYMENT OF LONG TERM DEBT AND INCREASE IN SINKING FUND ASSETS	(32550)
NET INCREASE IN LONG TERM DEBT BORROWINGS	61580
PREFERRED AND COMMON STOCK ISSUED	29030
MISCELLANEOUS	15041
REDUCTIONS OF WORKING CAPITAL	3464
TOTAL SOURCES OF FUNDS	3006

USES:

GRDSS CONSTRUCTION EXPENDITURES	101969
LESS CHARGES NOT REQUIRING FUNDS	(0)
NET CONSTRUCTION EXPENDITURE	101969
INVESTMENTS	1646
MISCELLANEOUS	0
INCREASE OF WORKING CAPITAL	706
TOTAL USES OF FUNDS	104321

A G T
INTER REGIONAL
INCOME STATEMENT - 1972

(\$1000's)

REVENUE :

INTER TOLL - PUBLIC MESSAGE	20790
- PRIVATE LINES	0
- PROGRAM TRANSMISSION	0
INTRA-TOLL	0
TOTAL TOLL	20790
LOCAL	0
OTHER	0
LESS UNCOLLECTIBLES	(0)
TOTAL OPERATING REVENUE	20790

EXPENSES :

	INTER-REGIONAL SWITCHING	REGIONAL TRANSMISSION	
MAINTENANCE	236	47	0
TRAFFIC	100	20	0
COMMERCIAL & MARKETING	85	17	0
OTHER EXPENSES	188	37	0
TAXES OTHER THAN INCOME TAXES	27	5	0
DEPRECIATION	295	59	0
OPERATING EXPENSES	931	185	0
			1116 (1116)

NET OPERATING REVENUE 19674

OTHER INCOME(NET) :

DIVIDEND FROM SUBSIDIARIES	*****
INCOME FROM OTHER INVESTMENTS	*****
MISCELLANEOUS INCOME	*****
	859

**INCOME BEFORE INCOME TAXES
AND DEBT-SERVICE CHARGES** 20533

INCOME TAXES: 0

INCOME BEFORE DEBT SERVICE CHARGES 20533
DEBT SERVICE CHARGES :

LONG TERM DEBT	*****
OTHER	*****
AMORTIZATION OF LONG TERM DEBT ASSET	***** 0
INCOME BEFORE EXTRAORDINARY ITEM	20533

EXTRAORDINARY ITEM : *****

NET INCOME 20533

SASK TEL
INTER REGIONAL
INCOME STATEMENT - 1971

(\$1000'S)

REVENUE :

INTER TOLL - PUBLIC MESSAGE		18296
- PRIVATE LINES		0
- PROGRAM TRANSMISSION		0
INTRA-TOLL		0
TOTAL TOLL		18296
LOCAL		0
OTHER		0
LESS UNCOLLECTIBLES		()
TOTAL OPERATING REVENUE		18298

EXPENSES :

	INTER-REGIONAL	REGIONAL	
	SWITCHING	TRANSMISSION	
MAINTENANCE	183	45	0
TRAFFIC	111	27	0
COMMERCIAL & MARKETING	69	17	0
OTHER EXPENSES	115	28	0
TAXES OTHER THAN INCOME TAXES	13	3	0
DEPRECIATION	255	62	0
OPERATING EXPENSES	746	182	0
			928 (928)

NET OPERATING REVENUE **17370**

OTHER INCOME(NET) :

DIVIDEND FROM SLESIDIARIES	*****
INCOME FROM OTHER INVESTMENTS	*****
MISCELLANEOUS INCOME	*****
	604

INCOME BEFORE INCOME TAXES **17974**
AND DEBT-SERVICE CHARGES

INCOME TAXES:

INCOME BEFORE DEBT SERVICE CHARGES	17974
DEBT SERVICE CHARGES :	

LONG TERM DEBT	*****
OTHER	*****
AMORTIZATION OF LONG TERM DEBT ASSET	***** 0

INCOME BEFORE EXTRAORDINARY ITEM **17974**

EXTRAORDINARY ITEM : *********

NET INCOME **17974**

M T S
INTER REGIONAL
INCOME STATEMENT - 1971

(\$1000's)

REVENUE :

INTER TOLL - PUBLIC MESSAGE	9669
- PRIVATE LINES	0
- PROGRAM TRANSMISSION	0

INTRA-TOLL

TOTAL TOLL

LOCAL

OTHER

LESS UNCOLLECTIBLES

0

0

0

0

(0)

TOTAL OPERATING REVENUE

\$669

EXPENSES :

	INTER-REGIONAL	REGIONAL	
	SWITCHING	TRANSMISSION	
MAINTENANCE	111	25	0
TRAFFIC	46	10	0
COMMERCIAL & MARKETING	33	7	0
OTHER EXPENSES	49	11	0
TAXES OTHER THAN INCOME TAXES	10	2	0
DEPRECIATION	115	26	0
OPERATING EXPENSES	364	81	0
			445 (445)

NET OPERATING REVENUE

\$224

OTHER INCOME(NET) :

DIVIDEND FROM SUBSIDIARIES	*****
INCOME FROM OTHER INVESTMENTS	*****
MISCELLANEOUS INCOME	*****

606

**INCOME BEFORE INCOME TAXES
AND DEBT-SERVICE CHARGES**

\$830

INCOME TAXES:

INCOME BEFORE DEBT SERVICE CHARGES

\$830

DEBT SERVICE CHARGES :

LONG TERM DEBT

OTHER

AMORTIZATION OF LONG TERM DEBT ASSET

0

INCOME BEFORE EXTRAORDINARY ITEM

\$830

EXTRAORDINARY ITEM :

NET INCOME

\$830

5.3.2 Results of simulations

These results are divided into 4 sets of results corresponding to the simulations listed in the plan in section 5.2.

It should be noted that these results are displayed in order to indicate the potential of the model only. Because the model is not completely adapted (due to incomplete data or other reasons) to handle the types of simulation suggested here, we have abstained from drawing conclusions concerning the inter-regional system from these results, since any such exercise would be prone to errors at this stage.

The first round of simulations concerns the Operating Block of the Model. In this set of runs we modify overflow probabilities as mentioned in Section 5.2. All other things being constant we obtain the results shown in Tables 1 through 5 showing the effects of these changes for each carrier on:

- 1) Transmission equipment asset valuation
- 2) Switching equipment asset valuation
- 3) Total asset valuation
- 4) Incurred costs in switching operations
- 5) Incurred costs in transmission operations.

The second round of simulations concerns different possible settlement schemes in the Sharing Block of the Model as described in the plan in Section 5.2.

The Table 6 shows the effects of the variation of settlement schemes on the revenue share of each carrier after settlement.

In the following series of runs, also concerning the Sharing Block, (Section 5.2, item 4i)), we vary rates for all categories of calls travelling under 540 miles by the percentage P, and simultaneously vary rates for all calls travelling over 540 miles by the percentage -P. We obtain the results shown in Table 7. (All revenues are allocated under the Commonwealth Scheme.)

The second series of runs, as described above, (Section 5.2, item 4ii)), involves varying rates for operator handled station to station office hour calls travelling less than 540 miles by a percentage P, and at the same time varying rates for calls of this type travelling over 540 miles by the percentage -P. The results obtained are shown in Table 8.

The third series of runs, as described above, (Section 5.2, item 4ii)), involves the same type of rate variation as in the previous set of runs, applied to the

category of direct dialed office hour calls. The results are shown in Table 9.

The series of runs described in Section 5.2 as item 4 iii) gives the results shown in Table 10. In this case, a variation of P % in rates for shorter distance station-to-station operator handled office hour calls is coupled with an equal but opposite variation in rates for longer distance direct dialed office hour calls.

The series of runs, (Section 5.2, item 4 iv)), wherein a variation of P % in rates for shorter distance direct dialed office hour calls is coupled with an equal but opposite variation in rates for longer distance station-to-station operator handled office hour calls, give the results shown on Table 11.

The series of runs described as a simple elasticity test in Section 5.2 was carried out as follows. From the document "Estimation of the price sensitivity of Trans-Canada Toll Studies, Telephone Messages, Trans-Canada (Bell Canada)", we estimate that the price elasticity of number of person-to-person calls is .05 which is an aggregate figure obtained as a weighted average of figures in several relevant sub-categories. This means that the ratio of B to A (where B and A are as described in Section 5.2, item 5) is .05. In the following runs A is taken to be 55% and B is taken as 5%. We then have 3 cases of results, as shown in Table 12.

These cases are:

Case 1 All 13% lost calls in Person-to-Person return to the system as station-to-station operator handled calls

Case 2 All 13% lost calls in Person-to-Person return to the system as Direct Distance Dialing calls.

Case 3 Cost calls in Person-to-Person return to the system, half in station-to-station operator handled, half as Direct Distance Dialing Calls.

The effects of these changes are shown on total TCTS revenues before sharing among partners.

TABLE 1

Operating Simulations
(Operating Block: Overflow Probability)

Peak overflow probability	Average overflow	Effects on Total Transmission Assets (Compared to Benchmark)							
		B.C.		Alta		Sask.		Man.	
		Assets	% ch.	Assets	% ch.	Assets	% ch.	Assets	% ch.
10% (Benchmark)	2%	1,012		1,068		1,134		470	
20%	5%	941	- 7.0	1,027	- 4.4	1,106	- 2.5	425	- 9.6
30%	8%	880	-13.0	987	-7.6	1,101	-2.9	392	-16.6
40%	14%	833	-17.7	963	-9.8	1,100	-3.0	370	-21.2
50%	20%	813	-19.6	965	-9.6	1,121	-1.1	351	-25.3

TABLE 2

Operating Simulations
(Operating Block: Overflow Probability)

Peak overflow probability	Average overflow	Effects on Total Switching Assets (Compared to Benchmark)							
		B.C.		Alta.		Sask.		Man.	
		Assets	% ch.	Assets	% ch.	Assets	% ch.	Assets	% ch.
10% (Benchmark)	2%	2,454		5,360		4,643		2,098	
20%	5%	2,459	0.20	5,460	1.9	4,932	6.2	2,098	0.0
30%	8%	2,465	0.44	5,560	3.7	5,220	12.4	2,098	0.0
40%	14%	2,470	0.65	5,660	5.6	5,509	18.6	2,098	0.0
50%	20%	2,476	0.30	5,760	7.5	5,798	24.8	2,098	0.0

TABLE 3

Operating Simulations
(Operating Block: Overflow Probability)

Peak overflow probability	Average overflow	Effects on Total Assets (Compared to Benchmark)							
		B.C.		Alta.		Sask.		Man.	
		Assets	% ch.	Assets	% ch.	Assets	% ch.	Assets	% ch.
10% (Benchmark)	2%	3,850		7,143		6,419		2,853	
20%	5%	3,778	-1.8	7,201	-0.8	6,709	-4.5	2,802	-1.7
30%	8%	3,716	-3.4	7,275	-1.8	7,024	-9.4	2,767	-3.0
40%	14%	3,670	-4.7	7,360	-3.0	7,344	-14.4	2,741	-3.9
50%	20%	3,654	-5.1	7,473	-4.6	7,688	-19.8	2,721	-4.6

TABLE 4

Operating Simulations
(Operating Block: Overflow Probability)

Peak overflow probability	Average overflow	Effects on Costs Incurred in Switching Operations (Compared to Benchmark)							
		B.C.		Alta.		Sask.		Man.	
		Assets	% ch.	Assets	% ch.	Assets	% ch.	Assets	% ch.
10% (Benchmark)	2%	697		1,195		989		443	
20%	5%	698	0.1	1,217	1.8	1,051	6.2	443	0.0
30%	8%	700	0.4	1,240	3.7	1,112	12.4	443	0.0
40%	14%	701	0.5	1,262	5.6	1,174	18.7	443	0.0
50%	20%	703	0.9	1,284	7.4	1,236	25.0	443	0.0

TABLE 5
Operating Simulations
(Operating Block: Overflow Probability)

Peak overflow probability	Average overflow	Effects on Total Incurred in Transmission Operations (Compared to Benchmark)							
		B.C.		Alta.		Sask.		Man.	
		Assets	% ch.	Assets	% ch.	Assets	% ch.	Assets	% ch.
10% (Benchmark)	2%	287		237		242		99	
20%	5%	267	- 7.0	227	- 4.2	236	- 2.4	90	- 9.0
30%	8%	250	-12.9	220	- 7.2	235	- 2.8	83	-16.2
40%	14%	236	-17.8	215	- 9.3	234	- 3.3	78	-21.2
50%	20%	231	-19.5	215	- 9.3	239	- 1.2	74	-25.2

TABLE 6
Revenue Simulations
(Sharing Block: Types of Settlement Schemes)

	Effects on Revenue Share (Compared to Benchmark)							
	B.C.		Alta.		Sask.		Man.	
	Rev.	% ch.	Rev.	% ch.	Rev.	% ch.	Rev.	% ch.
Commonwealth (Benchmark)	14,496		20,789		18,297		9,669	
Old Commonwealth	14,849	+ 2.4	21,634	+ 4.1	18,584	+1.5	8,185	-15.3
Mixed 4 a i)*	11,967	-17.4	23,313	+12.1	19,936	+9.0	8,037	-16.8
Mixed 4 a ii)	12,844	-11.4	22,630	+ 8.8	19,761	+8.0	8,018	-17.1
Mixed 4 a iii)	12,423	-14.3	23,145	+11.3	19,710	+7.7	7,976	-17.5
Mixed 4 a iv)	12,423	-14.3	23,145	+11.3	19,710	+7.7	7,976	-17.5

* See Interim Report for description of these mixed schemes.

TABLE 7

Revenue Simulations
(Sharing Block : Variations in tariff structure)

All calls		Effects on Revenue (Compared to Benchmark)									
		British Columbia		Alberta		Saskatchewan		Manitoba		Total I.R. Rev.	
% Change in rates for shorter distance calls	% Change in rates for longer distance calls	Revenue	% Ch.	Revenue	%	Revenue	% Ch.	Revenue	% Ch.	Revenue	%
3%	-3%	14538	0.28%	21168	1.82%	18534	1.30%	9637	-0.33%	63878	0.99%
2%	-2%	14524	0.19%	21042	1.22%	18455	0.86%	9648	-0.22%	63669	0.66%
1%	-1%	14510	0.09%	20916	0.6%	18376	0.44%	9659	-0.10%	63462	0.33%
0% (Benchmark)	0%	14496	.0%	20789	.0%	18297	0.0%	9669	0.0%	63253	0.0%
-1%	1%	14482	-0.09%	20663	-0.6%	18219	-0.42%	9680	+0.11%	63045	-0.33%
-2%	2%	14468	-.19%	20537	-1.22%	18141	-0.85%	9691	+0.23%	62837	-0.66%
-3%	3%	14454	-.28%	20411	-1.82%	18062	-1.28%	9701	+0.33%	62629	-0.99%

TABLE 8

Revenue Simulations
(Sharing Block : Variations in tariff structure)

Station-to-Station Operator handled Office hour calls		Effects on Revenue (Compared to Benchmark)									
		British Columbia		Alberta		Saskatchewan		Manitoba		Total	
% Change in rates for shorter distance calls	% Change in rates for longer distance calls	Revenue	% Ch.	Revenue	% Ch.	Revenue	% Ch.	Revenue	% Ch.	Revenue	% Ch.
3	-3	14504	.05%	20851	.29%	18336	.21%	9665	-.04%	63358	.17%
2	-2	14502	.04%	20830	.19%	18324	.15%	9666	-.03%	63323	.11%
1	-1	14498	.01%	20810	.10%	18311	.07%	9668	-.01%	63288	.05%
0 (Benchmark)	0	14496		20789		18297		9669		63253	
-1	1	14493	-.02%	20768	-.10%	18285	-.06%	9671	.02%	63218	-.06%
-2	2	14491	-.03%	20748	-.19%	18272	-.14%	9672	.03%	63183	-.11%
-3	3	14488	-.05%	20727	-.29%	18259	-.21%	9673	.04%	63148	-.17%

TABLE 9
Revenue Simulations
(Sharing Block : Variations in tariff structure)

Direct dialed Office hour calls		Effects on Revenue (Compared to Benchmark)									
		British Columbia		Alberta		Saskatchewan		Manitoba		Totals	
% Change in rates for shorter distance calls	% Change in rates for longer distance calls	Revenue	% Ch.	Revenue	% Ch.	Revenue	% Ch.	Revenue	%	Revenue	% Ch.
3	-3	14510	.10%	20929	.67%	18384	.47%	9656	-.13%	63480	.
2	-2	14506	.06%	20882	.44%	18356	.32%	9661	-.08%	63404	.24%
1	-1	14501	.03%	20836	.23%	18327	.16%	9665	-.04%	63329	.12%
0 (Benchmark)	0	14496	0.0%	20789	0.0%	18297	0.0%	9669	0.0%	63253	0.0%
-1	1	14492	-.03%	20743	-.22%	18269	-.15%	9674	.05%	63178	-.12%
-2	2	14486	-.06%	20696	-.44%	18240	-.31%	9678	.09%	63101	-.24%
-3	3	14482	-.10%	20650	-.67%	18211	-.47%	9682	.13%	63026	-.36%

TABLE 10

Revenue Simulations
(Sharing Block : Variations in tariff structure)

% Change in rates for shorter distance Station-to-Station office hour calls	% Change in rates for longer distance D.D.D. office hour calls	Effects on Revenue (Compared to Benchmark)									
		British Columbia		Alberta		Saskatchewan		Manitoba		Totals	
		Revenue	% Ch.	Revenue	% Ch.	Revenue	% Ch.	Revenue	% Ch.	Revenue	% Ch.
3	-	14461	-.24%	20824	.16%	18302	.02%	9629	-.41%	63216	-.06%
2	-2	14472	-.16%	20813	.11%	18300	.02%	9642	-.27%	63228	-.04%
1	-1	14488	-.05%	20801	.05%	18299	.01%	9658	-.11%	63241	-.02%
0 (Benchmark)	0	14496		10789		18297		9669		63253	
-1	1	14508	.08%	20777	-.05%	18296	-.005%	9682	.13	63265	.02%
-2	2	14520	.16%	20766	-.11%	18295	-.01%	9696	.27	63278	.04%
-3	3	14532	.25%	20754	-.17%	18293	-.02%	9709	.41	63290	.06%

TABLE 11

Revenue Simulation
(Sharing Block : Variations in tariff structure)

% Change in rate for shorter distance D.D.D. office hour calls	% Change in rate for longer distance Station-to-station operator handled calls	Effects on Revenue (Compared to Benchmark)									
		British Columbia		Alberta		Saskatchewan		Manitoba		Totals	
		Revenue	% Ch.	Revenue	% Ch.	Revenue	% Ch.	Revenue	% Ch.	Revenue	% Ch.
3	-3	14554	.40%	20956	.80%	18419	.67%	9692	.23%	63622	.58%
2	-2	14535	.26%	20901	.54%	18379	.45%	9685	.16%	63499	.39%
1	-1	14516	.14%	20845	.27%	18338	.22%	9677	.08%	63376	.19%
0 (Benchmark)	0	14496		20789		18297		9669		63253	
-1	1	14476	-.14%	20734	-.26%	18257	-.22%	9661	-.08%	63130	-.19%
-2	2	14458	-.26%	20679	-.53%	18217	-.43%	9654	-.15%	63007	-.39%
-3	3	14438	-.40%	20623	-.80%	18177	-.66%	9646	-.24%	62884	-.58%

TABLE 12

Revenue Simulation
(Sharing Block: A simple elasticity test)

	TCTS Revenues	
	(Effects on Revenues compared to Benchmark)	
	Revenue	% Change
Benchmark	63,253	
Case 1	74,680	+ 18.06 %
Case 2	74,635	+ 17.99 %
Case 3	74,654	+ 18.02%

5.4 Use of Simultaneous Linear Equations

As we have said before (see Sub-Section 4.4), the Accounting Block serves two purposes. The first one is to process in a manner consistent with the internal logic of the model, the results provided by the preceding three blocks. The second purpose is to simulate locally the effects of the modifications of certain variables, known for this purpose as exogeneous, on certain other variables, known as endogeneous variables. In principle, these "local simulations" take, as given, some of the results of the preceding blocks. This latter objective is reached using two different approaches: use of simultaneous linear equations and use of what is called goal programming. In the subsequent phase of the Project, we intend to work at a finer level of detail by disaggregating some variables, to introduce more equations and/or constraints and to integrate more closely these two methodologies with those of the other blocks. The present sub-section discusses the first approach by presenting the equations and explaining the motivation behind each of the simulations. The next sub-section presents the second approach.

The system of equations, of which some are, in fact, accounting identities, used is the following: it contains four (4) equations and three (3) ratios of variables. The system becomes linear if variables in the denominator are taken as fixed or if the values of the ratios are obtained from the preceding equations: in this latter case the system becomes what is known as "block-linear". The first equation represents the sources and uses of funds, the second is taken from the income statement and the last equalities are the definition of equity and debt respectively. In so far as the ratios are concerned, they represent the debt-capital ratio, the rate of return on equity and the rate of return on capital.

Below are the variable and parameter names and the abbreviations to be used:

<u>Variable Name</u>	<u>Abbreviation</u>
1. Net Income	Net Inc.
2. New Equity	New Equity
3. New Debt	New Debt
4. Dividends	DIV
5. Operating Revenue	OPRV
6. Equity	Equity
7. Debt	Debt
8. Debt-Capital Ratio	DCR
9. Rate of Return on Equity	RORE
10. Rate of Return on Capital	RORC

Parameter Name	Abbreviation
11. Depreciation	Depr.
12. Deferred Taxes	Def. Tax
13. Additions	Add.
14. Constant	Const.
15. Operating Expenses (fixed)	OPXP
16. Tax Rate	Tax Rate
17. Equity (beginning of year)	Equity _o
18. Debt (beginning of year)	Debt _o

Equation 1: Net Inc. + Depr. + New Equity (Gross) + New Debt (Gross)
= Dividends + Gross Construction Exp + Const₁.

Const₁ comprises the sum of the following:

- Deferred Taxes - Deferred Credits + Deferred Charges + Current Assets - Current Liabilities - Net Salvage Value + Share Issue Expense - Other Adjustments (Net) + Repayments of L.T.D. and Increase in Sinking Fund Assets + Investment.

Equation 2: Net Inc. = (1-tax rate) (OPRV - OPXP - Depr. - Const₂ - Const_{2A} * New Debt) + Other Income.

Const₂ represents Debt Service Charges due to debt outstanding at the beginning of year minus half of the repayment, the Debt Service Charges = Const_{2A} * New Debt, where Const_{2A} is one half of the interest rate on new bonds.

Equation 3: Equity = Equity_o + Net Inc. - DIV + New Equity - Const₃

Const₃ represents the Share Issue Expenses minus Other Adjustments (Net).

Equation 4: Debt = Debt_o + New Debt (Gross) - Const₄.

Const₄ consists of Repayment of long term debt and increase in sinking fund assets.

Equation 5: DCR =
$$\frac{\text{Debt}}{\text{Equity} + \text{Debt}}$$

Equation 6: RORE =
$$\frac{\text{Net Inc.}}{\text{Equity}}$$

Equation 7: RORC =
$$\frac{\text{Net Inc.} + \text{Const}_2 + \text{Const}_{2A} * \text{New Debt}}{\text{Equity} + \text{Debt}}$$

The simultaneous equations to date contain four (4) equations and three (3) ratios, involving ten (10) endogeneous variables and eleven (11) exogeneous variables. By knowing the values of these exogeneous variables and by assigning values to three variables in the equation system, solutions for values of the other seven variables can be obtained. One can notice that, by definition, ratios are non-linear relations: however, for our particular system, once we fix three endogeneous variables, the system becomes completely linear. The data and the results of ten (10) simulations (described below) performed for B.C. Tel. for the 1971 fiscal year appear in the Appendix D. Also, a program in APL language is displayed in Appendix C. This method also makes it possible to calculate impact multipliers, for instance the marginal effect of a change in the interest rate on revenue requirements (as discussed in Appendix D). It will be noted that those simulations represent only a small sample of what the simulation technique developed for IRA would be capable of doing.

The following are explanatory notes pertaining to the simulations. One can remark that for all simulations considered, the endogeneous variable DIV is assigned an historical value, in other words, it is treated as exogeneous.

- a) Simulation 1: The selected variables are New Debt, DIV and OPRV. DIV and OPRV are given historical values while the New Debt is set at zero reflecting the condition when debt financing is not available for one reason or another. Other things being equal the solution for the values of other variables is sought in this scenario.
- b) Simulation 2: Same as 1 above, but with the assumption of a 5% general increase in rates, i.e. in OPRV.
- c) Simulation 3: Similar to 1 above, but reflecting the condition when equity financing is not available, i.e. financing must be obtained from internally generated funds and from long term debt.
- d) Simulation 4: Same as 3 above, but coupled with a 5% general increase of the revenue.
- e) Simulation 5: The simulation variables involved are New Equity, DIV and RORE (Rate of Return on Equity). New Equity and DIV are assigned at historical values and with these constraints, that particular condition is examined when the desired RORE is 8% versus the historical value of 7.53%.

- f) Simulation 6: The same as 5 above, but also reflecting the condition that equity financing is not available.
- g) Simulation 7: The simulation variables are New Debt, DIV and RORC (Rate of Return on Capitalization). The New Debt and DIV are assigned historical values while the desired RORC is set at 7.5% versus the 6.98% historical value.
- h) Simulation 8: Same as 7 above, but reflecting the condition that New Debt financing alternative is not available.
- i) Simulation 9: Simulation variables are DIV, DCR (Debt Capitalization Ratio) and RORC. DIV and RORC are maintained at historical values while DCR is set at .50 to reflect the desire of the Company to "improve" the DCR.
- j) Simulation 10: Same as 9 above, but also reflecting the condition when the desired RORC is increased to 7.5% versus 6.98% historical value.

5.5 Goal Programming Approach

With the preceding approach, it is difficult to ascertain whether the sign of the endogenous variables in a given simulation will be positive or negative. However, it is evident that some variables have to satisfy the non-negativity constraint, for example, the operating revenue variable. This is only one advantage of goal programming approach versus that of simultaneous equations approach. A second one, even more important than the first, is that it permits to take account of objectives as constraints. In effect, for some reasons the regulatory authority may decide to fix upper and lower bounds on the debt-capital ratio, or on other variables or ratios; knowing these constraints, the carrier may try to do the best, i.e. to optimize an objective function where appear slack variables. The slack variables represent, in a sense, the failure to achieve the specific goals other than the straight optimization. The ratios of coefficients of these slack variables can be interpreted as marginal rates of substitution, that is, trade-offs between two slack variables.

These slack variables are bounded on both sides, the upper bound representing a desired value for the carrier, and the lower bound, the lowest acceptable value. It is in the interest of the carrier to be as close as possible to the desired value. If there exists more than one constraint, and consequently more than one objective, the carrier reveals its preference by assigning weights to the slack variables. A regulatory authority itself can impose several constraints. The approach adopted makes it

possible, in the first place, to verify that its decisions are internally consistent and in the second place, to take into account several points of view at the same time, such as those of the carriers, of the customers and of the Government, by assigning appropriate coefficients or weights in the objective function. Below is described a simulation in detail. The main purpose of this is to illustrate the proceeding. This simulation will, in fact, be applied to the data of the B.C. Tel. for 1971 fiscal year. The results of this simulation and the other ones are given in Appendix D.

- a) Simulation 11: First of all, we give admissible ranges for the variables DIV, OPRV, RORE and DCR. For the first three, the lower bounds are set at their historical values (in our illustration, these historical values are taken from the financial statements of B.C. Tel., 1971) and for DCR the historical value is taken as its upper bound. The upper bounds for the first three variables and the lower bound for the fourth one are given as follows. We have the following constraints set, plus the first three equalities of the preceeding sub-section.

13,885	DIV	14,500
199,892	OPRV	210,000
.0753	RORE	.08
.5	DCR	.5592

As we have said before, we now add slack variables to these constraints: these variables will all be defined as non-negative a priori. Any slack variable may enter with either a positive or negative coefficient into the objective function. For each added constraint, there are two slack variables, corresponding to the upper and lower bound respectively.

$$\begin{aligned} \text{DIV} + d_1 &= 14,500 \\ \text{DIV} - d_2 &= 13,885 \\ \text{OPRV} + d_3 &= 210,000 \\ \text{OPRV} - d_4 &= 199,892 \end{aligned}$$

For the ratios RORE and DCR since linear constraints only are concerned, the procedure is as follows:

$$\begin{aligned} \text{Net Inc.} - .08 \text{ Equity} &= 0, \\ \text{Net Inc.} - .0753 \text{ Equity} &= 0, \end{aligned}$$

and by adding slack variables,

$$\begin{aligned} \text{Net Inc.} - .08 \text{ Equity} + d_5 &= 0, \\ \text{Net Inc.} - .0753 \text{ Equity} - d_6 &= 0, \end{aligned}$$

Doing the same for the ratio D.C.R.,

$$\begin{aligned} \text{Debt} = .5592 (\text{Debt} + \text{Equity}) + d_7 &= 0, \\ \text{Debt} = .5 (\text{Debt} + \text{Equity}) - d_8 &= 0. \end{aligned}$$

First of all, the coefficients of all the variables in the objective function, including the slack variables, are in dollars or commesurate units. For the objective function, the following is proposed: The coefficients are, of course, arbitrary or, more precisely, they reflect the preferences of the carrier or of the regulatory authority.

$$(\text{MAX}) z = (d_2 - d_1) + 2(d_4 - d_3) + 2(d_6 - d_5) + (d_8 - d_7)$$

From this relation, one can see that the weight of preference assigned to the target ranges of the OPRV and RORE is twice of the weight assigned to DIV and DCR. This reflects the conditions when for various reasons an increase in the RORE is required with limitations in the possible rate increase which the company may be able to obtain or implement. The secondary targets express the desire to improve the DCR and the DIV. It is likely that these are necessary to attain the higher proportion of New Equity required for the targeted improved D.C.R. The reader can notice that the signs of the slack variables which appear in the objective function are precisely opposite of those which accompany the corresponding slack variables in the constraints. The reason is the following: other things being equal, one prefers for the OPRV to be as close as possible of its upper bound or, in other words, to minimize the "distance" between the optimal value of OPRV and the desired value.

The details and the motivation for the other simulations are as follows:

- b) Simulation 12: Same as 11 above, but giving equal weights to all the four targets.
- c) Simulation 13: Same as 11 above, except that rather than setting a desired range that particular condition is examined where an increase in the proportion of equity financing is sought, i.e. higher than the historical value which in this instance represent the lower bound for New Equity.

- d) Simulation 14 : Same as 13, but giving equal weights to all the four targets.
- e) Simulation 15 : In this simulation, it is proposed to set the lower bounds for DIV and RORE at the historical values expressing the desire for increase (the upper bounds are given in the same values as for the simulations discussed above). These targets are intended to be attained by limiting the external financing to historical value in the case of New Equity and to \$50m in the case of New Debt - meaning that these values should not exceed the upper bounds. This scenario is intended to simulate the condition when the available external financing is limited to certain values and the company is aiming for financing from operations a larger proportion of the total requirements coupled with a ceiling on RORE which is imposed for one reason or another. Double weights are assigned to the limitation on New Debt capital and to the attainment of RORE in a given range.
- f) Simulation 16 : Same as 15 above, but giving equal weights to all the four targets.
- g) Simulation 17 : This simulation is a combined scenario of all the variables for which ranges have been previously defined in one scheme trying to find an optimal solution. The weights attached to the variables OPRV, DCR and RORE are twice as large as those attached to New Equity, New Debt and DIV.
- h) Simulation 18 : Same as 17 above, but equal weights are given to all the variables involved.

The results of the simulations described above are presented in the Appendix D. There is also given some results about the parametrization of the coefficients in the objective function and the parametrization in the right-hand side of the constraints. For each of the coefficients and for each component of the right-hand side vector of the constraints, we give a range of values. These ranges must be interpreted in the following manner. Keeping constant all of the parameters, except one, we determine the two values between which the initial optimal solution remains optimal. We then see the sensitivity of the solution to the values of the coefficients in the objective function, for example, and this may be interesting for a governmental authority who may have not a precise idea of the ponderations of the different targets. However, we have to notice that every modification is a marginal one in the sense that we keep constant all but one parameter, and also that the sensitivity results depend in a crucial way on the result of the initial program. Finally, we also compute the dual variables (or the "opportunity costs") associated with the constraints.

We can supply some interpretations for these variables; however, we prefer to put some more reflections on this subject in the Second Phase of the project, in order to be able to give a precise economic meaningful interpretation of these variables.

Although it may be pointed out already that the dual variables associated with the optimal solution are no more than "tangential" indicators: they point out the directions of change and make it possible to calculate the corresponding trade-offs, but only in the neighbourhood of the optimal solution.

6. SOFTWARE CONSIDERATIONS

6.1 Structural Design-Hardware Software Context

The IRA Model Software (Version I) was developed and designed for use on an on-line conversational terminal connected to McGill University System for Interactive Computing ("MUSIC"), a time sharing system based on the IBM System 370/158 hardware. All programming was accomplished in FORTRAN IV G with limited use being made of WATFIV. This hardware/software system has full interactive capabilities (including APL), but only restricted use of these capabilities are used in the present programmed version of the model, since FORTRAN IV is not essentially an interactive programming language. Storage and access of disc data files and program library files was used to a great extent. Coded source data and source programs were transferred to disc storage via card decks. At present, execution of the program is entirely from disc, without physical card input (Note that in the following flow charts, input coded as card input refers to card images stored on disc). The IRA software can be accessed from the D.O.C. offices in Ottawa by telephone linkage to McGill University Computing Centre thereby assuring that computer results are simultaneously available to D.O.C. and SORES despite the distance between the two.

6.2 Structural Design - The Internal Architecture

In this section we make reference to Diagrams 10 and 11 below which represent a structural flow chart. The IRA Model software, consisting of the four principal model blocks (outlined in Section 4 of this Report) is set up into two autonomous programmed entities which communicate via disc storage of data. The first autonomous program (called P1) groups together the three processing Blocks - Operating, Costing and Sharing; the second autonomous program (called P2) contains the Accounting Block.

The reasons for this separation are several. Firstly, the division into autonomous programs provides automatically the facility to interrupt processing at the end of P1 to survey results, and make intermediate decisions before processing the results into a set of financial statements in P2. Secondly, the component block of P1 have their base in cross-sectional data for telecommunications carriers, because cost sharing and revenue sharing are activities involving the entire system, whereas the data base for P2 is longitudinal - involving detailed financial data for carriers, one at a time. This dichotomy makes the P1-P2 split a natural and facilitating one from the data handling point of view. Thirdly, the amounts of data used in processing the network technical operations are large compared to the compact results which are produced, and the same is true of the Accounting Block.

DIAGRAM 10

IRA Model Structural Flowchart
(Operating, Costing and Sharing Blocks)
(P1)

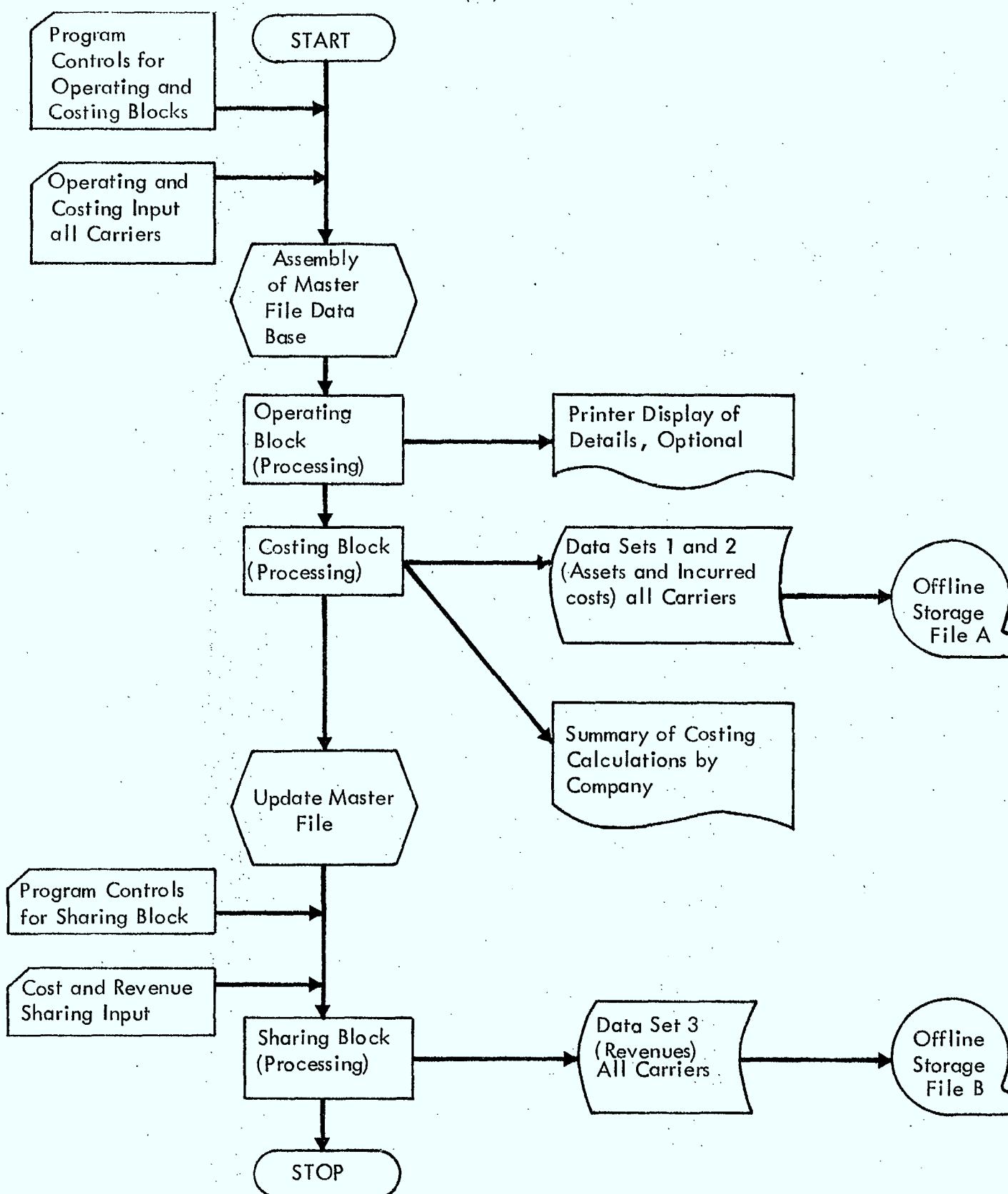
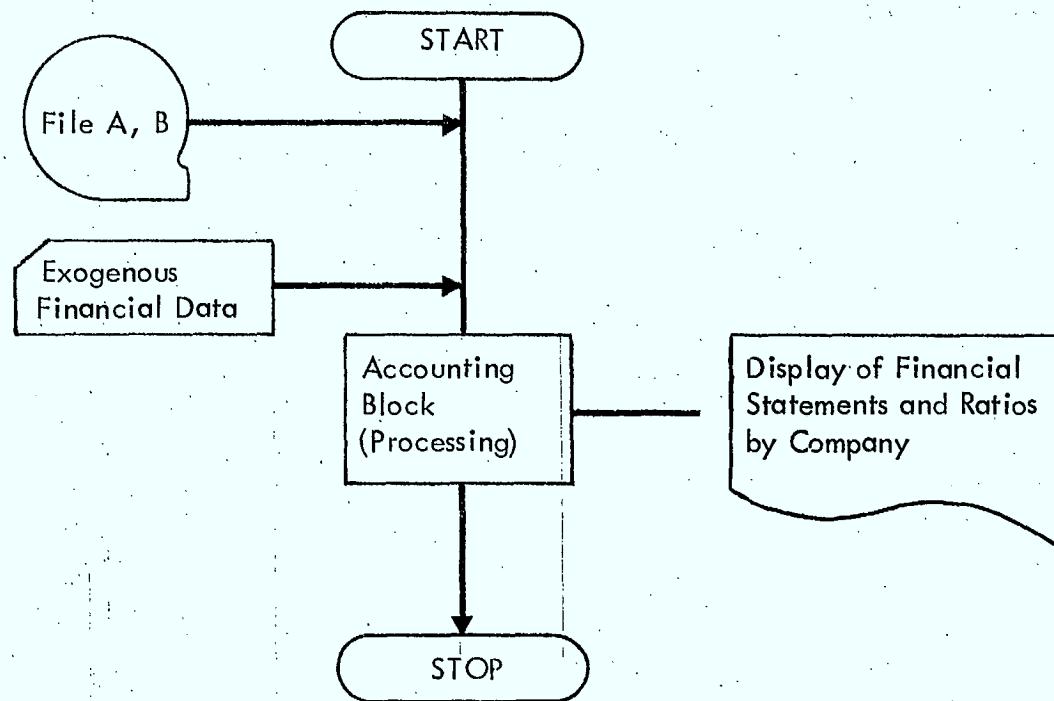


DIAGRAM 11

IRA Model Structural Flowchart
(Accounting Block)
(P2)



This type of situation is best handled in two steps since memory space requirements are reduced.

The data handling backbone of the software is a master file data base created in memory and updated after completion of each processing block. This data base consists mainly of:

- i) a repertory list of all physical facilities used in the inter-regional system (with relevant data on these facilities), and
- ii) a repertory list of all traffic streams including data regarding physical routing of traffic.

At the end of the processing sequence P1, the costs and revenue data required by the program P2 are assembled into data areas and transferred to disc file storage. After examining the results of P1, the user has the option of running P2 with the newly created disc file, or destroying the disc file.

The sequence of operations in P1, is then as follows (See Diagram 10):

- 1) Input of program control parameters
- 2) Input of operating and costing data
- 3) Assembly of this data from various formats into the master file format
- 4) Operating Block processing (dimensioning of the inter-regional system)
(See Section 4.1)
- 5) Costing Block processing (valuation of inter-regional assets, estimation of capital and operating costs (See Section 4.2)
- 6) Updating of master file
- 7) Input of revenue calculation data (tariffs, traffic splits, distances).
- 8) Processing of Sharing Block (revenue calculations i.e. application of settlement schemes)(See Section 4.3)

In steps 5 and 8, disc file data sets are created for use in P2. In steps 4, 5 and 8 printed reports are generated.

The program P1 is capable of repeating some operations in the Sharing Block, without repeating the calculations of the Operating and Costing Blocks. (See Section 4.3).

The sequence of operations in P2, is as follows (See Diagram 11):

- 1) Input from disc file of operating costs, assets and revenues
- 2) Input of supplementary inter-regional and complete regional financial data
- 3) Processing of Accounting Block (See Section 4.4)
- 4) Display of financial statements and ratios by company.

6.3 Flexibility

The overall design of the software is modular. That is, the software consist of the following parts:

- i) the superstructure which handles data input, output and internal communication between blocks, and
- ii) the processing blocks which control the computations of each of the four activities of operating, costing, sharing and accounting.

Each processing block produces output as a printed display and/or data results for transmission to subsequent blocks.

The flexibility of this arrangement arises from the fact that the processing blocks are independent entities which can be modified, enlarged, or replaced without redesigning the software superstructure. Therefore, it is expected that the superstructure will not require revisions during the second phase of the project. In this sense, the first phase of software development involved a large fixed investment which will not be necessary in the subsequent phases. Developments of subsequent phases will centre around refinements in the methods of calculations of results in various activities, and hence will lead to modifications in the processing blocks only; and not in the superstructure.

7. THE SECOND PHASE OF THE PROJECT

7.1 General considerations

Experiences with such large scale models show that the interactions between conceptualization, development and usage are necessary to obtain a more satisfactory approximation of the phenomena considered. After some general considerations, a few words will be said on the consolidation phase as well as on the envisaged extensions; finally a discussion about the required data will close the section.

We recall that IRA Model is a joint undertaking. Several members of the team had to learn in a considerable detail about the functioning and the accounting in telecommunications. Moreover, the model itself being a detailed one, the behavior leading to the computed results can really be understood only if the user is familiar with the detailed logic of the model. The developments and extensions will therefore be faster, all other things being equal, if the team is kept together.

The general problem definition has already been stated several times. More specifically, the problem for the Second Phase is described in greater detail in the D.O.C., NTB, Fin. & Corp., preliminary Draft Contract Proposal with l'Université Laval dated February 18, 1974 as follows:

The IRA Model is to be a fully fledged simulation model designed to evaluate the financial impact on the participating carriers of the inter-regional common system of:

- different traffic configurations, routing patterns, tariff structure, network configurations and ownership structures,
- different methods of cost calculation,
- different sharing schemes,
- different accounting methods,
- and of different means of regulating inter-regional telecommunications carriers.

Correspondingly, the IRA Model can be divided into five main modules or blocks which are: the Operating Block, Costing Block, Sharing Block, Accounting Block, and Policy Simulation Block.

During the first phase of the IRA project, although the main parameters of all blocks were identified as well as the nature of their inter-relationships, the bulk of the effort mainly concerned the Accounting and Sharing Blocks, and, to a lesser degree, the Costing Block.

Although it is by no means easy to draw a clear demarcation line between the consolidation of the earlier results on the one hand and the extensions on the other, the discussion which follows will retain this distinction while, at the same time it will respect the basic logic of the model with its articulation and with its major blocks. Thus the question of the Second Phase will be treated simultaneously in two dimensions: consolidation as opposed to extensions but with reference to the principal components.

Depending, of course, on the resources available, one could perhaps envisage the continuation of the IRA Project into its Second Phase as basically at two levels:

- development work aimed at perfecting and rendering truly operational the results obtained in the First Phase,
- at first largely exploratory but also partly development work (especially in the later stages of the Second Phase) aiming at once at broadening the methodology already conceptualized, making it more precise and detailed and finally linking it to other instruments of simulation, or, more generally instruments for preparing the elements of decision.

It ought to be considered to put more emphasis than in the past on the model and its possibilities as a device for obtaining more and better organized information chiefly from the carriers of course but also from other sources.

To some extent there is a choice to be made, and this decision will finally have to be made by the D.O.C. between on the one hand a more simplified network and more elaborate procedures leading to less realistic results of course, and on the other hand a more elaborate network with necessarily more simplified procedures. Now it is clear that the distinction between the two options is not as clear as it might appear at first sight. However, it requires a certain amount of reflection and ought to be borne in mind while guiding the work in the forthcoming phase.

7.2 Consolidation

7.2.1 General remarks

To some extent of course it all depends on how one defines the exploratory work on one hand and the consolidation of the results already achieved on the other.

It is clear, however that in so far as Sorès is concerned the consolidation part of the effort will constitute the bulk of their contribution to the second phase whereas in case of Laval, the exploratory work may be not the bulk but in any case a very large part of the contribution.

It appears inevitable that in the coming phase of the Project IRA the main outputs will continue to be simulated financial statements (plus certain "significant financial ratios"). However, we ought to consider whether it would not be desirable to reflect also on the possibility of defining and making operational certain additional performance indicators. All this brings us close to the difficult problem of linking the accounting and the physical aspects of the problem and the problem which is both difficult and delicate of management rights and the evaluation of the social significance of performance. All this will require a heavy additional effort concerning the planning and carrying out of simulations. Le Laboratoire d'économétrie de l'Université Laval will have to do a good deal of further work on the planning of simulation.

Among the characteristics of any simulations plan will be the elimination of self contradictory simulations on the one hand and, on the other hand of the simulations which appear to be of no significance. (Reference is made to page 33 of the Interim Report of December 1973).

7.2.2 Consolidation of the Operating Block

It is clear that the simulations of the effects of changes in the operating activities should have a high priority. In fact the strengthening of the Front End (that is Operating Activities Block) is a sine-qua-non condition for any objective we may have in mind in the coming phase.

It has been agreed to cut down the list of policy variables concerning the Operating Block in the new version of the IRA Model basically to the following:

- ownership, operating and interaction (this includes network interconnections and relations between the physical and switching networks). This also includes the hierarchical status and the routing rules.
- the quality of service
- traffic configurations under extremely simple demand hypotheses but possibly already with the introduction of the time zones and by the same token of the time of day traffic matrices.
- tariffs.

7.2.3 Costing Block

It appears that the Costing Block of the model will require some considerable elaboration. The consolidation will involve the incorporation of additional or more refined data, and relevant improvements in the concepts used (This is distinct from more elaborate work discussed in Section 7.3.3).

At present, the Costing Block contain a number of simplifying assumptions which are discussed below, and which represent limitations on the model.

- 1) The presently used valuation functions do not contain a provision for the valuation of terminating and local facilities. According to estimates, this asset value represents roughly 20% of the total inter-regional asset value. In future this can be improved through a reestimation of the valuation functions used as data.
- 2) A limited number of valuation functions are used, excluding notably co-axial transmission facilities and electronic switching equipment. Again, improvements in this area require the inclusion of more refined data in the model, since software is equipped to handle these refinements.
- 3) The valuation of assets via cost functions reflects the investment value of such assets as of 1970 or 1971. Since equipment costs in telecommunications have declined somewhat over the past 20 years, it could be of some use to "index" the valuation functions to better reflect the "historical cost" of equipment installations as a function of the age of equipment.
- 4) An averaging method is used in separation of the asset values of jointly used facilities. Inclusion of more sophisticated techniques including the incremental techniques would require more conceptualization as noted above (See Section 4.2.1)
- 5) Operating costs are estimated as percentages of total assets at cost. In the case of traffic expenses, it may be more realistic to develop some other techniques which reflect the variation in cost due to variations in traffic. Development in this area requires further conceptualization.
- 6) In estimating accumulated depreciation on various equipment classes, a fixed "life expectancy" parameter has been applied. In future, this parameter may be tied directly to survival curves for equipment classes and to their age life mix.

7.2.4 Consolidation of the Sharing Block

This will mainly consist in the introduction in a detailed fashion of the Full Division of Revenues scheme in the Sharing Block. It will also have to be

recognized that this will require complementary expansion of the Operating Block so that assets providing regional service will be represented in the computations also permitting the reflection of costing and cost separation schemes yet to be included in the Costing Block.

7.2.5 Consolidation of the Accounting Block

The consolidations in this block although obviously involving some software developments, remain the main responsibility of the D.O.C. as far as basic advice for conceptualization is concerned. For example, the internal consistency of the results of this block must be improved. Care will be taken so that the outputs reflect as closely as possible the actual costs including those resulting from the various separation schemes.

The present status of "local simulations" is treated at some length in Section 5 and the proposed extensions in Sub-section 7.3.

7.3 Extensions

7.3.1 General remarks

To a large extent this second part of the work of the Second Phase will have to be done on a "best-effort" basis. It is understood that neither in the current phase nor in the coming phase will there be a demand or a "corporate financing" model in the proper sense. It is also understood that in the Second Phase, that is in 1974/1975, we shall be largely concerned with "filling in" with more realistic data the framework put together in the First Phase of the IRA Project.

On the other hand we will be undertaking some extensions from the base established during this phase. Demand studies including the responsiveness of demand to rate changes and to the quality of service changes will have fairly low priority. In fact, no work will be done along these lines and within the framework of the IRA Project at least in the Second Phase, except where it will be necessary to make some very simple assumptions concerning the demand while carrying out other types of simulations.

Concerning the use of macro variables it might be preferable to build or to simulate trends in detailed data (as detailed as possible). It is to be noted that both in the construction of HERMES group of models and in the organization of data for the Costing and Accounting Blocks of the IRA group of models the work is done from the bottom up so that we work with detailed data expressed first in physical terms and therefore it should not be too difficult to develop procedures concerning the trends over time in those detailed variables. There is no reason of course why we should not have recourse to certain macro variables to put the results of the model in the right prospective.

Concerning the problem of the ownership pattern, we do not intend to propose that the question of non-telecommunication subsidiaries be brought in. However, the ownership in the inter-regional telecommunications area already gives rise to certain problems. For instance, certain routing patterns may be incompatible with certain ownership patterns. If one wants to simulate the effects of changes in routing patterns one has to make some decisions concerning the ownership structure of inter-regional telecommunications, even without going beyond this relatively narrow domain.

This is related to the preceding point: how much emphasis is to be put on the notion of "enlarged networks", which is obviously relevant to the extensions of the Operating Block.

7.3.2 Extensions of the Operating Block

This will comprise, among other things, the development of new computerized procedures and a considerable adaptation of existing ones:

- i) for the estimation of point-to-point traffic given the existing point-to-point trunks in the switching network special attention will have to be given to Canada-U. S. and Canada-overseas traffic streams.
- ii) for the derivation of routing information for each stream by category of services in the switching network and in the facilities network. As a minimum requirement, assuming that the physical routing of the direct routes would still be provided manually, we nevertheless need to develop some kind of a "chain builder" algorithm for the automatic determination of the physical routing of the switching routes. (Ref. Commonwealth model).

Note that in this Second Phase we will have to work with a much finer classification of services (e.g., including specifically data transmission, teletype, ...) and the routing laws are likely to vary from one category of services to another. It is also important, from the point of view of cross-subsidization and other related analysis, that the classification of services used matches the one actually used for the collection of revenue by the carriers.

- iii) for the derivation of the micro-wave transmission facilities network given a set of pairs of points and in conjunction with the radio-reg. data-bank (Ref. PILMI, Route programs)*.

The capability of varying the level of traffic for certain categories of streams, and services, in order to test within a given settlement scheme the financial impact of such changes on the various partners (or on the inter-regional authority)

* This requires the adaptation of these programmes developed by others and obviously the introduction of economic considerations in the chain builder.

supposes the capability of altering the existing network, of identifying the new routing and of calculating the variations in the assets values. This capability is a main requirement in IRA II and should be acquired through the utilization of the HERMES Models to this extent considered prudent by all parties.

We must remember that traffic, routing and network are three inter-related components of the IRA Model which cannot be varied independently of each other. In this respect, the potential use of the HERMES Models shall be clarified. It is worth noting, at this point, that the simulations intended for the project will necessarily involve the use of the enlarged network technique (e.g., different carriers at the same geographical nodes, Full Division Settlement Scheme).

In a broader context, the exact nature of the potential linkage of HERMES and IRA in both directions will also have to be determined i.e.:

- capital expansion
 - routing information
 - financial information
- } HERMES → IRA
- IRA → HERMES

In the HERMES → IRA relation, as an additional aspect, the question of "spare" capacities and the financial implications will require explanation and inclusion in the algorithm. In the context of the IRA → HERMES relation, we specifically think of more representative cost functions to reflect the financial realities of actual operations and the rules of costing, accounting, and sharing, as well as the impacts of certain operating and corporate structures. Such linkage will have to be provided in a manner considering among other things, time and resource constraints.

Another problem which remains to be solved concerns the determination of the peak load to total load ratio. Assuming that we have 24 hours traffic profiles for each stream in both direction we could then calculate a unique ratio for each stream. But this is the whole nature of this problem: the availability of traffic data. In the absence of comprehensive data some rational basis of "manufacturing" will have to be found. If differences in time zones and their impact on the routing pattern are to be taken into account (even if routing arrangements remain fixed), twenty-four hour traffic profiles are required. But the first approach to the peak/average traffic ratio might require daily profiles involving say 4 periods. Sensitivity analysis could then be undertaken in order to see how the shape of the traffic distribution for each stream influences the total cost incurred and the total revenue collected by the various partners, under the assumption of a constant tariff matrix. In the broader

sense we are thinking here of the shapes of traffic distribution curves and of the factors influencing the shapes but without a fully fledged demand model. A solution to this problem would permit the comparisons of the costs of the peak and the average traffic. Analyses of the implications of cost sharing schemes based on various degrees of peak and average cost responsibilities would also become possible, as well as analyses of cost responsibilities of different services. Related to this idea, it will be necessary to write into any future arrangements phases explicitly stating that the area of interest (inter-regional telecommunications) is not to be interpreted as precluding analysis, and also data gathering, in other areas which appear pertinent. It will be noted that some ground work in this direction has been, or is being, done in the current Phase of the IRA Project, especially with reference to the "Operating Activities" simulations.

7.3.3 Extensions of the Costing Block

This section is first of all concerned with the expansion of the actual Costing Block as formulated during the First Phase to include the vintage of facilities, valuation, taxation, additional depreciation algorithms as well as algorithms relating to operating expenses.

Secondly, on a much broader scale, this sub-section concerns some theoretical work to be done at the exploratory level with regard to the development of a sub-model for the allocation of joint costs based on mathematical programming or some other mathematical technique. (1) During the Second Phase, we intend to explore the possibility of building a sub-model from which such cost functions shall be derived in a more rigorous manner. It is clear however that more realistic cost functions will have to be used but they will still remain for a long time based on a modular approach: we cannot afford to have a specific cost function for every single element of the network. Such a sub-model shall be integrated in the future into the IRA Model. The objective of this proposed sub-model will be to determine the costs for individual categories of services, both in terms of total output as of a certain time and in terms of incremental output in a joint production environment; where the service categories are further subdivided into geographical, operational, jurisdictional, corporate and like entities. It will be important to identify the output (the services) in physical as well as in financial terms. The determination of the input requirements in physical terms has a particular significance. It is perceived that the physical input requirements will be determined in terms of additional plant units required for given configurations of incremental outputs (e.g. from a HERMES type Model) in a given joint production environment. The plant units

(1) Ref: - Project X description (Guérin, Henter)
- Telecom. Research group, Study 6, Bell Canada.

are perceived as "building blocks" defined by dividing up the structures and facilities into fine units from which any configuration of plant can be constructed by taking the required number of them. The plant units will be made up from material and labour components, i.e., material and labour units which may be expressed in non-financial terms. The non-financial expressions of labour and material units in relation to plant units are expected to hold true over a considerable length of time. The expressions and relationships would only change as a consequence of changes in technology, which consequences could be estimated and thereby taken into account in projection type analyses.

The non-financial terms can subsequently be associated with financial terms estimated over projection periods, e.g., when the cost of a particular construction activity is estimated, which is to take place a number of years in the future. In this context, the material units could be associated with projected labour costs. The pricing of the labour component would give consideration to expected efficiency, location, size of the undertaking and similar parameters. First cost of the construction activity estimated along these lines could then be associated with the capacity expansion and operating cost algorithms, and with the applicable financial parameters related to corporate structure and operating environments to yield the costs of service output.

It is envisaged that a sub-model performing functions as described above shall be developed to perform the cost activities in a more sophisticated fashion.

Reference is made to page 14 of the Interim Report of December 1st, 1973. It is agreed that we shall be aiming at cost and output measures by element and by type of service. This is obviously a desirable extension although it has to be clearly understood that it involves heavy effort of data collection and organization of data in that format. The data by type of services gives inevitably rise to a whole series of problems relative to the peak/average traffic since the time profiles are not the same. This may have in the long run important repercussions on the dimensioning of the network and hence on the bulk of the costs since the peak periods for different types of services in general do not coincide.

7.3.4 Extensions of the Sharing Block

The inclusion of the Full Division of Revenues Scheme which represents a major extension will have considerable repercussions on the Costing Block, both at the level of conceptualization and on the software development. Among other things, this will involve "horizontal" rather than residual calculations of unit cost for every element of the network and for every type of service. Where schemes involve sharing based on routing, explicit mention of the relations between the actual routing and the routing used for revenue sharing purposes should, perhaps, be more open to discussion.

It is worth while to add that schemes involving the Central Agency as a separate entity will also be considered.

It will be remembered that among the ultimate objectives of the Project are inducement to the rational deployment of capital and efficient operation of the network, subject to various constraints.

We should also envisage different configurations of sharing schemes and operating activities and of course costing, and accounting procedures.

7.3.5 Extensions of the Accounting Block

This will principally take the form of:

- i) an expansion of the initial system of equations,
- ii) an integration of each carrier system of equations into a general system of equations via the use of common constraints ("contraintes de liaison") in order to obtain optimal solutions for the whole aggregate of carriers. Linear goal programming covering all carriers would be a step in the good direction. The dual variables associated with any solution could be interpreted as "social scarcity values". In some cases, it is intended to explore the possibility of stating the problem in non-linear form. It is in this context that a limited volume of assistance might be sought from le Département d'informatic de l'Université Laval, who have had experience in handling large systems of simultaneous quadratic equations.
- iii) transforming the accounting block into a multi-period module to permit comparative analyses for a number of years in the future; given the initial conditions which describe the starting state of the accounting system of an economic entity (one carrier or a set of carriers) and given the path of the purely exogenous and instrument variables, the computer can produce a time series of future state. It is to be understood that is simulation and not optimization.

Although this block is an integral part of the IRA Model and represents the final stage of the calculations by the model, advantage has been seen in also providing the Accounting Block as an on-line routine to be used in a "conversational" manner. This routine is to be used either by running it separately or as a sub-routine of the main model.

The logic could accommodate in the course of carrying out simulations the application of different accounting methods, in particular with respect to the following:

- depreciation
- taxes (including treatment of deferred taxes)
- different methods of capitalizing versus expensing
- different financing schemes.

Note the relations of this block to the Policy Simulation Block.

7.3.6 The Policy Simulation Block

This is the fifth block of the model. Its development would require, among other things, the determination of:

- i) what governmental policies are to be investigated; for example, we want to simulate on:
 - various modes of operations, roles and objectives of the hypothetical inter-regional authority
 - various scenarios of the inter-faces between CN/CP and TCTS, TELSAT and TCTS, COTC and TCTS.
- ii) what physical, financial or accounting parameters may be selected as decision criteria most relevant to the policies selected (e.g., certain combinations of grade of service and capital budget constraints).

Obviously, this determination must be in line with the principal long-term objectives of the IRA Project which are:

- the rationalization of capital deployment and of the capacity expansion of telecommunication facilities; the problem of over-capacity in the inter-regional network is particularly relevant here.
- the rationalization of the tariff policy.
- the study of cross-subsidization between services, between carriers, between regional and inter-regional operations.
- the rationalization of operating activities; for example, this may involve the questions of the ownership structure and/or the corporate structure of some or all the carriers.

As already mentioned in Section 2. "Some Further Principal Considerations", it will be considered to include among the outputs of the Policy Simulation Block not only financial statements and "significant financial ratio" but also some other indicators.

It is to be noted however that the financial outputs are essential if only to enable us to judge the results of the various simulations on the likelihood of the survival of the system and of its various components that is at the moment, at any rate, individual members of the inter-regional system. On the other hand, we agree that these financial indicators might be usefully accompanied by other measures of performance and of social costs. We seemed to agree to give relatively high priority to this option.

Finally, it is clear that it is still too early to attempt to deal with demand for inter-regional and perhaps other telecommunications and in particular with the impact of the rates and of the quality of service on demand.

7.3.7 Interfacing with the HERMES group of models

The eventual integration of the IRA group, or series, of models, with those of the HERMES group raises a whole new type of possible extensions of the work done so far. Some exploratory work on these lines is already being done at Le Laboratoire d'économétrie de l'Université Laval alongside the work of the IRA Project as such.

Two questions arise here. The first relates to the degree of automation envisaged for the interfacing of the two groups of models. The second has to do with the integration of individual modules as against the integration of the two whole models. One will note that certain parts of the HERMES Models can be of considerable use for the purposes of the IRA group of models, for instance, the module CHARGE of HERMES III Model to handle the routing problems. More generally the CHARGE module could be used to establish the relation between the switching and the facilities networks. It will be remembered that revenues arise with respect to the first (in so far as public switched traffic is concerned) whereas the costs are incurred predominantly with respect to the second.

It will also be noted that the HERMES Models can readily accept in financial constraints provided they respect certain fairly general conditions. In particular, these financial constraints may refer to the network as a whole or any part of the network such as for instance the elements belonging to a particular carrier. One might also point out here that there still exists no User's Manual of the HERMES III Model.

It is clear that the integration of these two groups of models will require heavy software effort and also a considerable amount of conceptualization work.

7.4 Data required

It is one thing to specify an exhaustive range of data required and it is quite another thing to get the data. A great level of detail in this exercise of data specification might be superfluous if we are going to manufacture most of it ourselves. You can only build so much in height on a weak foundation! The carrier's cooperation at this stage has become a necessity for the success of whole project.

It is understood that in the coming phase, that is from April 1974 to March 1975, we shall be largely concerned with "filling in" with more realistic data the framework put together in the first phase of the IRA Project.

The data required can be specified at the level of each block.

Operating Block

The transmission and switching networks will have to be updated. No problem is foreseen with the transmission network. However, concerning the switching network, we might have to estimate it using annual rates of growth and assuming that the trunking configuration stayed the same. The CN/CP, COTC and TELSAT switching and transmission facilities will have to be included and the conditions of their interface with TCTS shall be defined. In the same way, the interface of the inter-regional network with the U.S. will have to be defined. A portion of the local switching equipment will have to be included if we are to simulate the application of the Full Division Scheme. As much as possible, all of the work outlined above shall be done at the level of the elaborated network (1) and not at the level of the reduced network (24 nodes).

On the traffic side, concerning public messages, ideally we shall have for each stream the total annual volume of traffic as well as the 24 hours traffic profile for a typical weekday of the busy season. The percentage distribution of traffic according to type of calls (i.e. D.D.D., Stn. to Stn. and Per. to Per.) shall also be available on a stream basis. Moreover, we shall have the distribution of traffic by classes of holding time.

Concerning private lines, we might want to further disaggregate this category into telephone private lines, teletype, data services, radio program transmission and other services. This disaggregation might represent a lot of work in terms of data gathering. Moreover, it does entail some serious complications for the future routing algorithm; more precisely, we are thinking about the routing of data traffic. A decision will have to be taken here regarding whether or not this supplementary effort is warranted. In any event, point-to-point private lines will be required.

(1) Ref.: Appendix "C" of the Interim Report on the IRA Project.

Data is also required for television program transmission network, which will specify the capacity in use by source to all terminal points.

Finally, traffic data by category of services is also needed for Canada-U.S. and Canada-Overseas type of streams.

An updated tariff structure, which will match the traffic categories and distribution just outlined, is also needed. In the case of public message, the major changes will consist in the adaptation of the tariff matrix to reflect the duration of the calls. Apart from the collection rates which we already have, we might want to introduce some accounting rates and terminal charges.

Costing Block

The asset cost functions for transmission and switching facilities should be reevaluated and if possible updated. On the switching side, we definitely need a greater number of cost functions in order to reflect more adequately the particularities of the switching equipment from one node to another.

In the current phase of the IRA Project, operating expenses were purely a function of total asset. In this coming phase, the operating expenses shall be made a function of both plant investment and traffic volume. For example, in TCTS 70% of the total assigned expenses are related to the assigned plant investment and 30% to the volume of business.

Sharing Block

The simulation of the Full Division Scheme calls for a heavy data requirement at the level of the plant assigned, particularly with regard to the local equipments. This will also have an important impact on the formulation of the Accounting and Operating Blocks.

Accounting Block

The Phase II activities in the Accounting Block will primarily feature the further developments and refinements of costing and accounting methods, including depreciation methods, current and deferred tax calculations and treatments, expansions and refinements of the accounting algorithms in the block, and multi-period and comparative and analysis.

In order to effect this program and to obtain financial results reflecting the real life conditions, data as represented by Appendix "G", and which to a substantial extent were fabricated by necessity in Phase I, will be required. Moreover, further disaggregation of the data elements will be necessary. The most important

class of the data requirements is that relating to physical assets. We will require the schedules of assets by classes of plant categories: gross additions, retirements, adjustments and surviving balances on an historical basis broken down by individual vintages of the asset categories. The corresponding historical life characteristics, gross salvage and cost of removal data will also be required by account -vintage-category. In addition to the book asset information as described above, the undepreciated capital cost allowance bases and applicable CCA rates will be required. Statement of reconciliation of net income with taxable income should also be available for processing the deferred tax calculations on factual basis with respect to differences between capitalization and expensing for book and tax purposes.

On the liability side, details of the debt calculations: maturities, repayment schedules, interest rates, sinking fund provisions etc. will be required along with information relating to the equity portion of capitalization such as conversions, redemptions and the like which would have bearing on the longer term financial alternatives, particularly for the purpose of the multi-period analysis.

It will be further required to obtain the accounting information in segregations between the regional and the inter-regional sectors as required by the settlement schemes under consideration (e.g. for the full division of revenue plan the details of the derivation and the make-up of the assigned assets and expenses will be required).

Finally, in order to include in the IRA Model CN/CP, TELSAT and COTC, as well as other possible carriers (e.g. Quebec Telephones and Edmonton Telephones) the same information for these corporations will also have to be obtained.

A

APPENDIX A

List of papers circulated since December 1st, 1973

Texts provided by the Department of Communications

- Lettre de G. Henter à T. Matuszewski, du 4 janvier 1974
- Draft Notes concerning the Second Phase of the IRA Project, D.O.C., February 6, 1974.
- Draft Contract Proposal (With Laval University), D.O.C., February 18, 1974
- "Listing of Equations of the IRA Accounting Module for Simulation Purposes with Input Data References", D.O.C., March 5, 1974

Texts provided by Sorès

- "Planning of Activities (Contribution #1)", December 3, 1973
- Lettre de E.G. Manis à T. Matuszewski du 6 décembre 1973
- Simulation Considerations (Contribution #1), Taxonomy of Models and Terminology, December 6, 1973
- Lettre de E.G. Manis à G. Henter, 10 décembre 1973;
- "Data Handling and Control in the IRA Program", January 2, 1974

Texts provided by Le Laboratoire d'économétrie

- "Note on Peak Load "Total Load Ratio Estimates", C. Autin, December 12, 1973
- Lettre du 13 décembre 1973 de T. Matuszewski à G. Henter
- "Notes non structurées concernant les règles de dépréciation", B. Paquet, 20 décembre 1973
- "Simulations dans le bloc comptable", G. LeBlanc, 8 janvier 1974
- "Discussion notes concerning the Eventual 1974-75 Phase of the IRA Project", T. Matuszewski, February 5, 1974
- "Reflections about the Draft Notes, D.O.C., February 6, 1974", C. Autin et G. LeBlanc, February 18, 1974

Notes of Meetings

- Notes d'une réunion tenue le 20 novembre 1973 à l'Université Laval, T. Matuszewski
- Notes of a Meeting with Sorès, held in Ottawa, December 14, 1973, M.N. Rasheed
- Compte-rendu de la réunion du 12 janvier 1974, C. Autin
- Notes de la réunion du 27 février (Montréal), T. Matuszewski
- Notes of a Meeting held in Ottawa, February 6, 1974, T. Matuszewski.

APPENDIX B

PROGRAM LISTINGS

C-----
C IRAMAIN
C-----
C----- MASTR1 CONTAINS FACILITIES AND ROUTING DATA
0001 COMMON/MASTR1/IFAC(50,8),RFAC(50,30),IRCUTE(50,40),
1 RHCUTE(50,4),NFAC,NROUTE
C----- MASTR2 CONTAINS ASSET COST FUNCTIONS AND RELATED DATA
0002 COMMON/MASTR2/CFUNAB(10,20),CHUNCR(10,20),CEFL(20),NFSIZ(10,3),
1 PLAND(2),PSTAT(2),PGEC(2),FELIL(2)
C----- MASTR3 CONTAINS INDEXING INFORMATION
0003 COMMON/MASTR3/IR,IK,ICWNR,IELEM1,ICESFN,ISLIFE,IFACAC,IDEFAL,
1 IFACCL,IELEM2,INCAP,IACCAF,INAINT,IMARK,ITRAF,
2 ICHEX,IPFTAX,INTAX,IDIST,IGAVF,ITRCAP,
3 ISALV,IREMV,IRETR,IGAV,IADEF,IANCP,INAV,IGAVP,
4IASUN,IIINUN,ILAND,ILANCP,ISTAT,ISTATF,IGEC,IGECP,
5 IEUIL,IBUILP,ISTATM,IGECM,IELILM,IGAVM,ITCTIN,
6 JRINS,JCS,JFINR,JSTIND,JUNIT,JISTF,JTRAFF,JTRAFFS,
7 JREV,KKC,KFE,NCAR,JCSENV,ITCCAF,JCIMEN,JTRAFF
0004 COMMON/MASTR4/ASSET(15,7,6)
C----- MASTR5 CONTAINS DEFAULT FINANCIAL DATA ON COMPANY BASIS
0005 COMMON/MASTR5/FINDAT(10,30),IFINCT(15,2),E
C----- MASTR6 CONTAINS INCURRED COSTS (DATA SET 2)
0006 COMMON/MASTR6/CFKCCS(15,10,2)
C----- MASTR7 CONTAINS OPERATING REVENUE /CARRIER/SERVICE (DATA SET 3)
0007 COMMON/MASTR7/CFGREV(15,5)
C----- MASTR8 CONTAINS SETTLEMENT AND OTHER CONTROL PARAMETERS
0008 COMMON/MASTR8/NES(4)
C----- MASTR9 CONTAINS OPERATING PARAMETERS
0009 COMMON/MASTR9/HOLD,PLCSS,PCVER,CCNV
C----- MPRCON CONTAINS PRINT CONTROLS
0010 COMMON/MPRCON/ICON(20)
C-----
0011 CALL CCSTIN
C----- C S T I N G E L C K -----
C THE FOLLOWING SUBROUTINES FORM THE COSTING BLOCK OF IRA.
C THEY OPERATE ON MASTER FILE INPUT, ACCESSED THROUGH COMMON
C BLOCKS, AND STORE OUTPUT DATA IN OTHER COMMON BLOCKS.
C (COSTING OF INTERREGIONAL COMMON SYSTEM)
C-----
0012 C STEP 1 CROSS CHECK ROUTING AND FACILITY DATA FOR
C POSSIBLE ADDITIONS ARISING FROM CHANGES IN TRAFFIC
CALL CAP
0013 C STEP 1A DISPLAY DETAILED RESULTS OF DIMENSIONING
IF(ICON(1).NE.0)CALL LSAGE
0014 C STEP 2 CALCULATE CROSS ASSET VALUES AT COST USING COST FUNCTIONS
CALL ASSETS
0015 C STEP 3 CALCULATE ACCUM. AND ANN. DEPRECIATION (OUTPUT DATA SET 1)
CALL DEPREC
0016 C STEP 4 CALCULATE COST OF MONEY COMPONENT
CALL CACOST
0017 C STEP 5 CALCULATE COMPONENTS OF OPERATING COST(OUTPUT DATA SET 3)
CALL OPCOST
C----- E N D O F C O S T I N G -----

C-----
C-----SHARING BLOCK-----
C THE FOLLOWING SUBROUTINES FORM THE SHARING BLOCK OF IRA.
C THEY OPERATE ON THE MASTER FILE INPUT, ACCESSED THROUGH
C COMMON BLOCKS, AND STORE DATA IN OTHER COMMON BLOCKS.
C (CALCULATION OF INTERREGIONAL OPERATING REVENUES)
C-----

0018 C STEP 1 THIS SUBROUTINE READS INPUT FOR SHARE BLOCK
CALL SHAREI
0019 C STEP 2 CALCULATES STREAM REVENUES
CALL STREAM
C STEP 3 THIS SUBROUTINE CALCULATES OPERATING REVENUES
0020 CALL CPREVE
0021 CALL SUMMARY
0022 CALL ARCHIV(NCAR)
0023 STEP
0024 END

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NOLIST, NODECK, LOAD, NOMAP, NOTEST
OPTIONS IN EFFECT NAME = MAIN LINECAT = 56
STATISTICS SOURCE STATEMENTS = 24, PROGRAM SIZE = 000220
STATISTICS NO DIAGNOSTICS GENERATED

```
0001      SUBROUTINE ARCHIV(NCAR)
0002      CCNNCN/MASTR4/ASSET(15,7,6)
0003      CCNNCN/MASTR6/CFKCCS(15,10,2)
0004      CCNNCN/MASTR7/CFGREV(15,5)
0005      DC S M=1,2
0006      IF(M.EQ.1)IC=1C
0007      IF(M.EQ.2)ID=6
0008      WRITE(IC,501)NCAR
0009      WRITE(IC,500)((ASSET(I,J,K),K=1,6),J=1,7),I=1,NCAR)
0010      WRITE(IC,500)((CPKCCS(I,J,K),K=1,2),J=1,1C),I=1,NCAR)
0011      WRITE(IC,500)((CPGREV(I,K),K=1,5),I=1,NCAR)
0012      S CONTINUE
0013      SCC FORMAT(5E15.8)
0014      501 FCRMAT(14)
0015      RETURN
0016      END
```

```
*OPTIONS IN EFFECT* NOTERM, ID, EBCDIC, SOURCE, NOLIST, NODECK, LCA0, NOMAP, NCTEST
*OPTIONS IN EFFECT* NAME = ARCHIV , LINECNT = 56
*STATISTICS* SOURCE STATEMENTS = 16, PROGRAM SIZE = 000390
*STATISTICS* NO DIAGNOSTICS GENERATED
```

```
0001      SLERGUTINE POISS(TRAFF,PLLOSS,NCIR,PXX)
0002      DIMENSION A(5),E(5)
0003      DATA A/.5.9781,5.44EE,4.EC29,4.E3E1,4.19EC/
0004      1, B/1.2669,1.2253,1.2218,1.2030,1.2/
0005      C DATA FOR LIN APPROX OF FCISSEN FORMULA EYOND 30 ERLS.
0006      C DATA GIVEN FOR PR. LCSS = .01, .02, .03, .04, .05.
0007      C SLERGUTINE TO DETERMINE NUMBER OF CIRCUITS IN A FINAL GROUP ROUTE
0008      C FOR A FIXED PROBABILITY OF LOSS(PLLOSS) AND OFFERED TRAFFIC IN ERLANGS(TRAFF)
0009      IS=TRAFF
0010      IF(TRAFF.GT.PLLOSS)GC TC 1
0011      NCIR=1
0012      IF(TRAFF.LT..3000E-5)NCIR=0
0013      RETURN
0014      1 IF(TRAFF.GT.30) GC TC 4
0015      IS=IS+1
0016      SUM=1.
0017      ISM1=IS-1
0018      DO 2 J=1,ISM1
0019      2 SUM=SUM+(TRAFF**J)/FACTC(J)
0020      DEN=SUM+TRAFF**IS/(FACTC(IS)*(1.-TRAFF/IS))
0021      PO=1./DEN
0022      PXX=1.-PO
0023      DO 3 I=1,IS
0024      3 PXX=PXX-(TRAFF**I)*PO/FACTO(I)
0025      IF(PXX.GT.PLLOSS)GC TC 1
0026      NCIR=IS
0027      RETURN
0028      4 DO 5 IM=1,5
0029      X=IM*.C1-PLLOSS
0030      5 IF(ABS(X).LE..005) GC TC 6
0031      6 CONTINUE
0032      6 NCIR = A(IM)+B(IM)*TRAFF+.5
0033      PXX =0.0
0034      RETURN
0035      END
```

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NCLIST, NCDECK, LCAO, NOMAP, NOTEST

OPTIONS IN EFFECT NAME = POISS , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 30, PROGRAM SIZE = 00046A

STATISTICS NO DIAGNOSTICS GENERATED

```
0001      FUNCTION FACTO(N)
0002      IF(N.GT.0)GO TO 1
0003      FACTO=1
0004      RETURN
0005      1 IF(N.GT.10)GO TO 3
0006      FACTO=1
0007      DO 2 I=1,N
0008      2 FACTO=I*FACTO
0009      RETURN
0010      3 X = N
0011      FACTO=SQRT(2*3.14159)*X**(X+.5)*EXP(-X+.5/(12.*X))
0012      RETURN
0013      END
```

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NOLIST, NCDECK, LCAAD, NCMAP, NCTEST

OPTIONS IN EFFECT NAME = FACTO , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 13, PROGRAM SIZE = 000290

STATISTICS NO DIAGNOSTICS GENERATED

```
0001      SLCRLTINE ERLANG(TRAFF,PC,NCIR,PXX)
C      A SLERCLTINE TO CALCULATE NO. OF CIRCUITS OF F.U. OR FULL
C      GRCLS FOR GIVEN PROB. OF OVERFLOW (PC) AND GIVEN TRAFFIC
C      IN ERLANGS (TRAFF)
0002      PXX = 1.0000000000
0003      K = C
0004      IF (TRAFF.LT.0.0005) GO TO 21
0005      20 K = K+1
0006      PXX = (TRAFF*PXX)/(K+TRAFF*PXX)
0007      IF(PXX.GT.PD) GO TO 20
0008      21 NCIR = K
0009      RETURN
0010      END

*OPTIONS IN EFFECT* NCTERM,IC,EBCDIC,SOURCE,NOLIST,NODECK,LCAD,NCMAP,NCTEST
*OPTIONS IN EFFECT* NAME = ERLANG , LINECNT = 56
*STATISTICS* SOURCE STATEMENTS = 10,PROGRAM SIZE = 0001F6
*STATISTICS* NO DIAGNOSTICS GENERATED
```

```

0001      SUBROUTINE USAGE
0002      C ROUTINE TO DISPLAY USAGE DETAIL FOR EACH ELEMENT
0003      COMMON/MASTR1/IFAC(50,6),RFAC(50,30),RCUTE(50,40),
0004      1          RRCUTE(50,4),NFACT,NRCUTE
0005      COMMON/MASTR3/IR,IW,ICWNR,IELEM1,ICCSFN,ISLIFE,IFACAG,IDEFAL,
0006      1          IFACCL,IELEM2,IACAF,IACCAF,IMAINT,IMARK,ITRAF,
0007      2          ICHRE,IFTAX,INTAX,ICDIST,IGAVF,ITRCAF,
0008      3          ISALV,IREMV,IRETR,IGAV,IACDP,IANDP,INAV,IGAVP,
0009      4         IASUN,IINUN,ILANC,ILANDF,ISTATF,ISTATP,IGEG,ICEQP,
0010      5          IELIL,IEUILP,ISTIF,IGECH,IEUILW,IGAVM,ITCTIN,
0011      6          JRINS,JCS,JFINR,JSTIND,JUNIT,JISTF,JTRAFF,JTRAFFS,
0012      7          JREV,KBC,KFB,KCAR,JCSERV,ITCCAP,JCIMEN,JTRAFFP
0013      COMMON/MASTR9/HOLD,PLCSS,PCVER,CCNV
0014      DIMENSION DISP(6,30),ICISP(2,20)
0015      DATA IPLUS//+  /
0016      PRINT 500
0017      DO 50 K=1,NFACT
0018      M=0
0019      DO 25 IX=1,30
0020      DISP(4,IX)=0
0021      25 DISP(1,IX)=0
0022      DO 40 J=1,NROUTE
0023      JLAST=J1STF+IRCUTE(J,JFINR)-1
0024      DO 30 L=J1STF,JLAST
0025      IF(K.EQ.IROUTE(J,L)) GO TO 35
0026      30 CONTINUE
0027      GO TO 40
0028      35 M=M+1
0029      ICISP(1,M)=IFAC(IRROUTE(J,J1STF),IELEM1)
0030      IDISP(2,M)=IFAC(IRROUTE(J,JLAST),IELEM1)
0031      I=JCIMEN-1
0032      ISM=0
0033      36 I = I+2
0034      ISM=ISM+IRROUTE(J,I)
0035      IF(ISM.LT.L-J1STF+1)GO TO 36
0036      I=I-1
0037      IF(IRROUTE(J,I).EQ.IPLUS)DISP(1,M)=RRCUTE(J,JTRAFFP)
0038      IF(IRROUTE(J,I).NE.IPLUS)DISP(4,M)=RRCUTE(J,JTRAFFP)
0039      40 CCNTINUE
0040      IF(M.EC.0)GO TO 50
0041      PRINT 501, IFAC(K,IELEM1)
0042      501 FORMAT(//T10,"OPERATIONS BLOCK - USAGE AND DIMENSIONING DETAIL",
0043      1 T20,"NODE OR LINK",T34,"TRAFFIC STREAM",T64,"PEAK CCS")
0044      501 FFORMAT//T24,A4,T36,"C" D",TEC,"HUCCS CIRCS",7X,"X"
0045      1 T77,"FI.CCS CIRCS",7X,"X"
0046      SM = 0
0047      SM1=0
0048      SM2=0
0049      SM3=0
0050      SM4=0
0051      DO 41 IX=1,M
0052      T =DISP(4,IX)/36.
0053      CALL PGSS(T,PLCSS,NCIR,PXX)
0054      DISP(S,IX)=NCIR

```

```
0044      IF(IFAC(K,IELEN2).EQ.0)DISP(5,IX)=T/CCN
0045      T=DISP(1,IX)/36.
0046      CALL ERLANE(T,PCVER,MCIR,PXX)
0047      DISP(2,IX)=MCIR
0048      IF(IFAC(K,IELEN2).EQ.0)DISP(2,IX)=T/CCN
0049      SM3=SM3+CISP(1,IX)
0050      SM4=SM4+CISP(4,IX)
0051      SM1=SM1+CISP(2,IX)
0052      41 SM2=SM2+CISP(5,IX)
0053      SM=SM1+SM2
0054      DO 42 IX=1,M
0055      DISP(3,IX)=DISP(2,IX)*100./SM
0056      42 DISP(6,IX)=DISP(5,IX)*100./SM
0057      DO 44 IX=1,M
0058      IF(DISP(1,IX).LT..CCCCC)GO TO 43
0059      PRINT 502,1DISP(1,IX),1DISP(2,IX),DISP(1,IX),DISP(2,IX),DISP(3,IX)
0060      GC TO 44
0061      43 PRINT 503,1DISP(1,IX),1DISP(2,IX),DISP(4,IX),DISP(5,IX),DISP(6,IX)
0062      44 CONTINUE
0063      SM1P=SM1*100./SM
0064      SM2P=SM2*100./SM
0065      PRINT 504,SM3,SM1,SM1P,SM4,SM2,SM2P,SM
0066      S0 CONTINUE
0067      RETURN
0068      502 FORMAT(T34,A4,2X,A4,T50,3(F7.2,2X))
0069      503 FORMAT(T34,A4,2X,A4,T72,3(F7.2,2X))
0070      504 FORMAT(T34,'TOTALS   ',T49,3(F8.2,1X),T77,3(F8.2,1X)
1 ,5X,F8.2)
0071      END
```

OPTIONS IN EFFECT NOTERM,1D,EBCDIC,SCURCE,NCLIST,NODECK,LCAC,NOMAP,NOTEST

OPTIONS IN EFFECT NAME = USAGE , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 71,PROGRAM SIZE = 00CCCC

STATISTICS NO DIAGNOSTICS GENERATED

```

0001      SUBROUTINE SUMMARY
0002      C ROUTINE PRINTS A CCST ELCCK SUMMARY OF CALCULATIONS
0003      COMMON/MASTR1/IFAC(5C,E),RFAC(5C,3C),IRCLTE(50,4C),
0004      I          RFCLTE(5C,4),NFAC,NRCUTE
0005      COMMON/MASTR2/CFLNAB(1C,20),CFLNCR(10,20),DEFL(20),NFSIZ(1C,3),
0006      I          PLAND(2),PSTAT(2),PGEC(2),PBLIL(2)
0007      COMMON/MASTR3/IF,IN,ICBNR,IELEM1,ICCSFN,ISLIFE,IFACAG,IDEFAL,
0008      I          IFACCL,IELEM2,INCAF,IAECAF,IMAIN,IARK,ITRAF,
0009      I          ICTHEX,IPTRAX,INTAX,ICDIST,IGAVF,ITRCAF,
0010      I          ISALV,IREPV,IRETR,IGAV,IACTEP,IANDEF,INAV,IGAVP,
0011      I          IASUN,IXINN,ILANL,ILANCP,ISTAT,ISTATP,IGEG,IGEGP,
0012      I          IELIL,IELILP,ISTATW,IGEGW,IEUILW,IGAVW,ITCTIN,
0013      I          JFINS,JCS,JFINR,JSTIND,JUNIT,JISTF,JTRAF,JTRAFFS,
0014      I          JRREV,KWC,KFE,NCAR,JCSERV,ITCCAP,JCIMEN,JTRAFFP
0015      COMMON/MASTR4/A(15,7,E)
0016      COMMON/MASTR5/F(1C,3C),IFI(15,2),E
0017      COMMON/MASTR6/C(15,1C,2)
0018      COMMON/MASTR7/CF(15,E)
0019      DIMENSION IDATE(4),ITIME(2), NAMES(4,1C), IDEP(5,4), C(2), SW(2),
0020      I          RR(2), AX(9), X(6,2)
0021      DATA IDEP/'STRA','IGHT',' LIN','E(EL','G') ','DCUE','LE 0',
0022      I          'ECLI','NING',' ','SLW-','CF-Y','EARS',' -DIG','ITS ',
0023      I          'STRA','IGHT',' LIN','E(AS','L') '/
0024      DATA NAMES/'BC T','ELEF','HCNE',' ','ALEE','RTA ','GOVT',
0025      I          'TEL','SASK',' ','GC','VT T','EL ','MARI','TCBA','TEL',
0026      I          'SYS','BELL',' CAN','ADA ','17*4H' /
0027      DO 30 J=1,NCAR
0028      CALL TSDATE (1, IDATE)
0029      CALL TSTIME(1,ITIME)
0030      PRINT 500,(NAMES(I,J),I=1,4),IDATE,ITIME
0031      500 FORMAT(//'"1",T32,"CCST ELCCK SUMMARY",T53,4A4,T87,4A4,T10E,2A4/)
0032      R=F(J,4)/(1.-F(J,1))*(1.-F(J,2))+F(J,3)*F(J,2)
0033      PRINT 501,F(J,1),F(J,4),F(J,5),R,F(J,2),F(J,3),(IDEP(I,IFI(J,1))
0034      I ,I=1,5),(IDEP(I,IFI(J,2)),I=1,5),F(J,KNC)
0035      501 FORMAT(T15,'DESCRIPTIVE INPUT PARAMETERS :'
0036      1T17,'TAX RATE = ',F7.5/
0037      2T17,'RATE OF RETURN ON EQUITY = ',2PF6.2,'%'/
0038      3T17,'RATE OF RETURN (EXTERNAL-DEFAULT OPTION) = ',F6.2,'%'/
0039      3T17,'RATE OF RETURN (INTERNAL CALCULATION) = ',F6.2,'%'/
0040      4T17,'DEBT CAPITAL RATIO = ',2PF7.5/
0041      5T17,'INTEREST RATE ON LONG TERM DEBT = ',2PF6.2,'%'/
0042      6T17,'DEPRECIATION METHOD: SWITCHING EQUIPMENT : ',5A4/
0043      7T17,' : TRANS. EQUIPMENT : ',5A4/
0044      8T17,'ALLOWANCE FOR WORKING CAPITAL = ',F6.2,'%' )
0045      PRINT 502,(F(J,I),I=6,15)
0046      502 FORMAT(T68,8HSW"NG OF,T69,"TRANS CP."/>
0047      1T17,'% OF GROSS ASSET VALUE FOR MAINTENANCE = ',2PF8.4,3X,F8.4/
0048      2T17,'% MARKETCMM = ',F8.4,3X,F8.4/
0049      3T17,'% TRAFFIC EXP = ',F8.4,3X,F8.4/
0050      4T17,'% OTHER EXP = ',F8.4,3X,F8.4/
0051      5T17,'% NON-INC TAX = ',F8.4,3X,F8.4)
0052      PRINT 503,(F(J,I),F(J,I+6),I=16,20),F(J,21)
0053      503 FORMAT(T17,% CHANGE TO TOTAL PLANT TYPE AT COST    ADDNS     RETS*
0054      1/T38,'-SWITCHING',T5E,2PF8.4,2X,F8.4/

```

```

2 T38, "TRANSMISSION", TSS, F8.4, 2X, F8.4/
3 T38, "STATION ECLIP", TSS, F8.4, 2X, F8.4/
4 T38, "GENERAL ECLIP", TSS, F8.4, 2X, F8.4/
5 T38, "BUILDINGS", TSS, F8.4, 2X, F8.4/
6 T38, "LAND", TEE, F8.4)

0024      DC 18 IX=1,9
0025      1E AX(IX)=C
0026      DC 19 IX=1,6
0027      DC 19 KX=1,7
0028      19 AX(KX)=A(J,KX,IX)+AX(KX)
0029      DC 13 JX=1,6
0030      DC 13 JY=1,2
0031      13 X(JX,JY)=0.
0032      DO 14 JX=1,6
0033      X(JX,2)=A(J,1,JX)-A(J,2,JX)+.5*(A(J,3,JX)-A(J,4,JX)-A(J,5,JX))
0034      14 X(JX,1)=A(J,1,JX)+.5*(A(J,3,JX)-A(J,4,JX))
0035      DO 23 JX=1,6
0036      AX(8)=X(JX,1)+AX(8)
0037      23 AX(9)=X(JX,2)+AX(9)
0038      PRINT 505, (DP(J,K), K=1,4)
0039      505 FORMAT(" --OPERATING REVENUE IS", 2X, 4F11.2)
0040      PRINT 504, ((A(J,K,I), K=1,7), X(I,1), X(I,2), I=1,5), A(J,1,6)
0041      1, A(J,3,6), X(6,1), X(6,2), (AX(K), K=1,9)
0042      504 FORMAT(" --ASSETS-- IN THOUSANDS OF DOLLARS", T92, "MIDYEAR")
1T23, "AT COST ACC.CEF     ACCRS     RETS AM.CEF SALVAGE",
2* REMOVAL AT CCST     NET"
3T7, "SWITCHING", T24, 7(F7.2,2X), F7.2,2X, F8.2/
4T7, "TRANSMISSION", T24, 7(F7.2,2X), F7.2,2X, F8.2/
5T7, "STATION ECLIP", T24, 7(F7.2,2X), F7.2,2X, F8.2/
6T7, "GENERAL ECLIP", T24, 7(F7.2,2X), F7.2,2X, F8.2/
7T7, "BUILDINGS", T24, 7(F7.2,2X), F7.2,2X, F8.2/
8T7, "LAND", T24, F7.2,142,F7.2,1T7, F7.2,2X, F8.2/
9T7, "--TOTAL", T23, 7(F8.2,1X), 1X, F7.2,2X, F8.2)

0043      SW(1)=C
0044      SW(2)=C
0045      RB(1)=C
0046      RB(2)=C
0047      DC 20 K=1,NFAC
0048      IF(IFAC(K,1OWNER).NE.J) GO TO 20
0049      M=1
0050      IF(IFAC(K,TELEM2).NE.C) M=2
0051      SW(M)=SW(M)+RFAC(K,ITCTIN)
0052      RB(M)=RB(M)+RFAC(K,INAV)*(1.+F(J,KWC))
0053      20 CONTINUE
0054      SW1=0
0055      TR1=0
0056      DC 21 K=1,6
0057      SW1=SW1+C(J,K,1)
0058      21 TR1=TR1+C(J,K,2)
0059      C(1)=SW(1)-SW1
0060      C(2)=SW(2)-TR1
0061      PRINT 505, ((C(J,K,I), K=1,6), C(I), RB(I), SW(I), I=1,2)
0062      505 FORMAT(" --OPERATING AND CAPITAL COSTS---")
1T25, "MAINT    REC    TRAFFIC    CTHR    N-IN.TAX    DEPREC."

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```

2" CAP CEST N.R.EASE TCT INC CEST"/
3T7,"-SWITCHING",T23.7(FE.2,2X),FS.1,2X,FE.2/
4T7,"-TRANSMISSION",T23.7(FE.2,2X),FS.1,2X,FE.2)

0062      PRINT SCE
0063      506 FORMAT(/" --SWITCHING NODES SUMMARY"/" LAB. AGE SL TO-TR",
1" IR-TR  IRCCS ASSETS ACC-DEF AN-DEP $K&C $INV/CCS ",0
2," $K&C/CCS")
0064      DO 25 K=1,NFAC
0065      IF(IFAC(K,ICOWNER).NE.J)GO TO 25
0066      IF(IFAC(K,IELEM2).NE.C)GO TO 26
0067      PRINT 507,IFAC(K,IELEM1),IFAC(K,IFACAE),IFAC(K,ISLIFE),
1 RFAC(K,ITCCAP),RFAC(K,INCAP),RFAC(K,ITRCAP),RFAC(K,IGAVE)
2 ,RFAC(K,IACDEP),RFAC(K,IANCEF),RFAC(K,ITCFIN),RFAC(K,IASUN),
3 RFAC(K,IINLN)
0068      507 FORMAT(1X,A4,2X,I2,2X,I2,2X,FE.0,2X,FS.0,2X,F7.1,4(2X,F7.2),
1 2X,FS.0,2X,FS.0)
0069      25 CONTINUE
0070      26 PRINT S1C
0071      S10 FFORMAT(/" -TRANSMISSION LINKS SUMMARY"/" LAB. CF AGE SL RFC "
2,"TCCIR IRCIR IRCCS ASSETS AC-DEF AN-DEP $K&C $INV/CCS "
3,"CCS/M $K&C/CCS/M NI $INV/CCS $K&C/CCS")
0072      DO 27 K=1,NFAC
0073      IF(IFAC(K,ICOWNER).NE.J.OR.IFAC(K,IELEM2).EQ.0)GO TO 27
0074      AS=RFAC(K,IASUN)/RFAC(K,IDIST)
0075      AT = RFAC(K,IINLN)/RFAC(K,IDIST)
0076      IJK=RFAC(K,INCAF)
0077      IJL=RFAC(K,ITCCAP)
0078      PRINT 508,IFAC(K,IELEM1),IFAC(K,ICCSFN),IFAC(K,IFACAE),IFAC(K,
1 ISLIFE),NFSIZ(IFAC(K,ICCSFN),3),IJL,IJK,
2 RFAC(K,ITRCAP),RFAC(K,IGAVF),RFAC(K,IACDEP),RFAC(K,IANCEP),
3 RFAC(K,ITOTIN),AS,AT,RFAC(K,ICDIST),RFAC(K,IASUN),FFAC(K,IINUN)
0079      508 FFORMAT(1X,A4,3(2X,I2),1X,I4,2(2X,I4),2X,F7.2,4(2X,F7.2),2(2X,FS.6)
2, 2X,FS.1,2(2X,FS.6))
0080      27 CONTINUE
0081      30 CONTINUE
0082      RETURN
0083      END

```

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NCLIST, NODECK, LOAD, NCMAP, NCTEST

OPTIONS IN EFFECT NAME = SUMMARY , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 83, PROGRAM SIZE = .001888

STATISTICS NO DIAGNOSTICS GENERATED

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C-----  

C      RCLTINE TO CALCULATE ASSET VALUES FROM ASSET COST FUNCTIONS  

C-----  

0001      SUBROUTINE ASSETS  

0002      COMMON/MASTR1/IFAC(50,5),RFAC(50,30),IRCLTE(50,40),  

0003          RFCLTE(50,4),NFAC,NRCLTE  

0004      COMMON/MASTR2/CFLNAE(10,20),CFLNCR(10,20),DEFL(20),NFSIZ(10,3),  

0005          PLANC(2),PSTAT(2),PGEC(2),PELIL(2)  

0006      COMMON/MASTR3/IF,IW,ICWNER,IELEM1,ICCSFN,ISLIFE,IFACAG,IDEFAL,  

0007          IFACCL,IELEM2,INCAF,IACCAF,IMAIN,IMARK,ITRAF,  

0008          ICTHEX,IPTEX,INIA,ICIST,IGAVF,ITRCAP,  

0009          ISALV,IREMV,NEUIL,IGAV,IACTEP,IANDEF,INAV,IGAVP,  

0010          IASLN,IIINUN,ILAND,ILANDE,ISTAT,ISTATF,IGEG,IGEGP,  

0011          IECLIL,IECLILP,IESTATM,IGECM,IELILK,IGAVM,ITCTIN,  

0012          JRINS,JCS,JFINR,JSTIND,JUNIT,JISTF,JTRAFF,JTRAFS,  

0013          JRREV,KWC,KFE,KCAR,JCSEERV,ITCCAP,JDIVEN,JTRAFF  

0005      COMMON/MASTR4/FINDAT(10,30),IFINDAT(15,2),E  

0006      COMMON/MPRCON/ICCN(20)  

C-----  

0007      DO 240 K=1,NFAC  

0008      IF(RFAC(K,ITRCAP).LT..0005)GC TC 240  

C      SELECT REQUIRED COST FUNCTION  

0009      L = IFAC(K,ICCSFN)  

C      NO OF STEPS IN FN IS M1  

0010      M1 = NFSIZ(L,1)  

0011      DC 200 M = 1,M1  

C      FOR EACH STEP OF FUNCTION SEARCH FOR ASCIISSA  

0012      IF(CFUNAE(L,M).GE.RFAC(K,ITCCAF)) GC TC 205  

0013      200 CONTINUE  

C      CAPACITY EXCEEDS LIMIT OF FUNCTION GIVEN  

0014      WRITE(IW,500)RFAC(K,ITCCAF),L,K  

0015      500 FFORMAT(1X,'CAPACITY ',F8.0,' EXCEEDS COST FN ',I2,'FCR',I2)  

0016      STOP  

C      STEP FOUND, OBTAIN VALUE, SPLIT INTO CATEGORIES  

0017      205 DEF = DEFL(IFAC(K,IFACAG))/DEF(1)  

0018      CIS=1  

0019      IF(IFAC(K,IELEM2).NE.0)DIS=RFAC(K,ICIST)  

0020      TI=C  

0021      IF(IFAC(K,IELEM2).EQ.0)TI=CFUNCR(L,1)*(RFAC(K,NEUIL)-1)  

0022      R=(CFUNCR(L,M)+TI)/RFAC(K,ITCCAF)*DIS  

0023      IC=IFAC(K,ICWNER)  

0024      T=RFAC(K,INCAF)*R  

0025      ISW=2  

0026      IF(IFAC(K,IELEM2).EQ.0)ISW=1  

0027      JSW=ISW+15  

0028      KSW=ISW+21  

0029      RFAC(K,IGAVF)=T  

0030      RFAC(K,ILAND)=T*PLANC(ISW)*(1.-.5*FINDAT(IC,21))  

0031      RFAC(K,ILANDP)=T*PLANC(ISW)*FINDAT(IC,21)  

0032      RFAC(K,IGEC)=T*PGEC(1SW)*(1.-.5*(FINDAT(IC,19)-FINDAT(IC,25)))  

0033      RFAC(K,IGECP)=T*PGEC(1SW)*FINDAT(IC,19)  

0034      RFAC(K,IGECM)=T*PGEC(1SW)*FINDAT(IC,25)  

0035      RFAC(K,ISTAT)=T*PSTAT(1SW)*(1.-.5*(FINDAT(IC,18)-FINDAT(IC,24)))  

0036      RFAC(K,ISTATP)=T*PSTAT(1SW)*FINDAT(IC,18)

```

0037 RFAC(K,ISTATM)=T*FSTAT(ISW)*FINCAT(IC,24)
0038 RFAC(K,IELIL)=T*FEUIL(ILW)*(1.-E*(FINCAT(IC,20)-FINCAT(IC,26)))
0039 RFAC(K,IELILP)=T*FEUIL(ILW)*FINCAT(IC,20)
0040 RFAC(K,IELILM)=T*FEUIL(ILW)*FINCAT(IC,26)
0041 RFAC(K,IGAV)=T*(1.-FLAND(ISW)-FGEC(ISW)-FSTAT(ISW)-FEUIL(ISW))
1 *(1.-E*(FINCAT(IC,JSW)-FINCAT(IC,KSW)))
0042 RFAC(K,IGAVP)=T*(1.-FLAND(ISW)-FGEC(ISW)-PSTAT(ISW)-PBUIL(ISW))
1 *FINCAT(IO,JSW)
0043 RFAC(K,IGAVM)=T*(1.-FGEC(ISW)-PSTAT(ISW)-PEUIL(ISW))*
1 FINCAT(IC,KSW)
0044 VALMYR = RFAC(K,IGAV)+RFAC(K,ILAND)+RFAC(K,ISTAT)+RFAC(K,IGEG)
1 +RFAC(K,IEUIL) +.5C*(RFAC(K,IGAVP) + RFAC(K,ILANDP) +
2 RFAC(K,ISTATP) +RFAC(K,IGECF)+RFAC(K,IEUILF)-RFAC(K,IGAVM)
3 -RFAC(K,ISTATM)-RFAC(K,IGECM)-RFAC(K,IEUILM))
0045 RFAC(K,IASLN) = VALMYR/RFAC(K,ITRCAF)
0046 RFAC(K,IGAVF) = VALMYR
0047 240 CCNTINLE
0048 IF(ICON(3).EQ.C)RETURN
0049 WRITE(IW,SCGG)
0050 FCRMAT(//'* RESULTS OF VALUATION OF ASSETS*/*, LIST SHOWS*.
1* #, OWNER, NAME, CAP, EBG, CF YR., ACEN, CAP, RETD CAP*/*
2* ASSETS FOR YEAR SB CR TR, LAND, ST EC, G EC, ELEGS*/*
0051 CO 575 L=1,NFAC
0052 575 WRITE(IW,SCCI)L,IFAC(L,OWNER),IFAC(L,IELEM1),RFAC(L,INCAP),
1 RFAC(L,IADCAP),RFAC(L,IRETR),RFAC(L,IGAV),RFAC(L,ILAND),
2RFAC(L,ISTAT),RFAC(L,IGEC),RFAC(L,IELIL),RFAC(L,IGAVP),
3 RFAC(L,ILANDP),RFAC(L,ISTATP),RFAC(L,IGECF),RFAC(L,IEUILP),
4 RFAC(L,IGAVM),RFAC(L,ISTATM),RFAC(L,IGECM),RFAC(L,IEUILM),
5RFAC(L,IGAVF),RFAC(L,IASLN)
0053 5001 FCRMAT(2X,12,2X,I2,2X,A4,3F10.2,5X,5F1C.2/45X,5F10.2/49X,
1F1C.2,1CX,3F10.2,2X,F10.2,F12.4)
0054 RETURN
0055 END

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NCLIST, NCDECK, LCAD, NCAP, NCTEST

OPTIONS IN EFFECT NAME = ASSETS , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 55, PROGRAM SIZE = C00024

STATISTICS NO DIAGNOSTICS GENERATED

0001 SLRCUTINE CAP
C RCLTINE TO CALCULATE THE DIMENSIONS OF INTERREGIONAL FACILITIES
C USES POISSON CONV. FOR FINAL GROUPS, ERLANG FOR H.L. AND FULL GROUPS
C CALCULATES LOAD ON GIVEN ROUTES OF ONE STREAM USING PRCB OF OVERFLW
C THIS ROUTINE TO BE REPLACED BY "CHARGE" ROUTINE FROM HERMES
C IN PHASE II OF IRA

0002 CCMMCN/MASTR1/IFAC(50,8),RFAC(50,30),IRROUTE(50,40).
1 RROUTE(50,4),NFACT,NRCUTE
0003 COMMON/MASTR3/IR,IN,ICOWNER,IELEM1,ICCSFN,ISLIFE,IFACAG,ICEPAL,
1 IFACCL,IELEM2,INCAP,IACCAF,IMINT,IMARK,ITRAF,
2 ICTHEx,IFTAX,INTAX,ICIST,IGAVF,ITRCAP,
3 ISALV,IREMV,IRETR,IGAV,ICACDF,IANDEF,INAV,IGAVP,
4 IASLN,IIINLN,ILANC,ILANDP,ISTAT,ISTATP,IGEG,IGECP,
5 IEUIL,IBUILP,ISTATM,IGECM,IBUILM,IGAVM,ITOTIN,
6 JFINS,JCE,JFINR,JSTIND,JUNIT,J1STF,JTRAFF,JTRAFS,
7 JRREV,KLC,KFE,KCAR,JCSERV,ITCCAP,JCIMEN,JTRAFF

0004 CCCOMMON /MASTR9/FCLD,PLCSS,POVER,CONV
0005 CCMCN/PRCCN/ICCN(20)
0006 DIMENSION IT(5),TDLK(5)
0007 DATA IPLUS/*+ */

C-----

0008 IST = 0
0009 DO 10 J=1,NRCUTE
C ROUTINE TO CALCULATE LOAD ON EACH ROUTE AT PEAK
C CALCULATION USES INDICATOR OF FIRST SEGMENT ONLY
0010 IF(IROUTE(J,JSTIND).EQ.IST) GO TO 15
0011 IST=IST+1
0012 JCLD=J-1
0013 TSLM=0
0014 NFJ=0
0015 NRT=J-1
0016 NRJ=NRT+1
0017 NRJ=NRJ+1
0018 TSLM=TSLM+RRROUTE(NRT,JTRAFF)
0019 IT(NRJ)=IRROUTE(NRT,JDIMEN)
0020 IF(NRJ.LT.IROUTE(J,JRINS)) GO TO 16
0021 ICN=0
0022 DO 17 JMX=1,NRJ
0023 IF(IT(JMX).EQ.IPLUS)ICN=ICN+1
0024 17 CONTINUE
0025 DO 18 JMX=1,NRJ
0026 PRCB=1.-POVER
0027 IF(ICN.EQ.NRJ)PRCE=1
0028 IF(IT(JMX).EQ.IPLUS.AND.ICN.NE.0)TDLK(JMX)=TSUM*PRCE/ICN
0029 PRC = POVER
0030 IF(ICN.EQ.0)PRC=1
0031 IF(IT(JMX).NE.IPLUS.AND.ICN.NE.NRJ)TDLK(JMX)=TSUM*PRC/(NRJ-ICN)
0032 18 CONTINUE
0033 19 RROUTE(J,JTRAFF)=TDLK(JX)
0034 DO 2110 J=1,NRCUTE
0035 TRAFF=RRROUTE(J,JTRAFF)/36.
0036 CALL PCISS(TRAFF,PLCSS,NCIRFI,FXX)
0037 CALL ERLANG(TRAFF,POVER,NCIRHI,FXX)
0038

```
0039      CIFSW=TRAF/CCNY
0040      K3=IRCLTE(J,JFIR)4JISTF-1
0041      DO 2111 K=JISTF,K3
0042      IF(IFAC(IRCLTE(J,K),IELEM2),EC,C)GC TC 25
0043      ISUM=C
0044      IP=JDIVEN-1
21  0045      IP=IP+2
0046      ISUM=ISUM+IRCUTE(J,IP)
0047      IF(ISUM.LE.K+1-JISTF)GC TO 21
0048      IPX=IP-1
0049      NCIR=NCIRFI
0050      IF(IRCUTE(J,IPX),EC,IFLLS)NCIR=NCIRHI
0051      RFAC(IRCLTE(J,K),INCAF)=RFAC(IRCUTE(J,K),INCAP)+NCIR
0052      GE TC 20
0053      25 RFAC(IRCLTE(J,K),INCAF)=RFAC(IRCUTE(J,K),INCAP)+CIRSB
0054      20 RFAC(IRCLTE(J,K),ITRCAP)=RFAC(IRCUTE(J,K),ITRCAP)+RRROUTE(J,JTRAFF)
0055      2111 CONTINUE
0056      2110 CONTINUE
0057      IF(ICGN(2),EC,C)RETURN
0058      WRITE(IV,5000)
0059      5000 FORMAT(///* DIMENSIONING OF FAC. /* LIST PREVIOUS *.
1*, CNAME, NAME, TOTAL CAPACITY *.
2*, DIMENSION IN CIRCLITS*,* DIMENSION IN CCS*.
3* AND COST FUNCTION CODE*)
0060      EC 500 L=1,NFAC
0061      500 WRITE(IV,5001)L,IFAC(L,ICRER),IFAC(L,IELEM1),RFAC(L,ITOCAP),
1 RFAC(L,INCAF),RFAC(L,ITRCAP),IFAC(L,ICCSFN)
0062      5001 FORMAT(SX,I2,5X,I2,5X,A4,3(SX,F10.2),5X,I2)
0063      RETURN
0064      END

OPTIONS IN EFFECT: NCTERM,IC,EBCDIC,SOURCE,NCLIST,NCDECK,LCAD,NCMAP,ACTEST
OPTIONS IN EFFECT: NAME = CAP , LINECNT = 56
STATISTICS: SOURCE STATEMENTS = 64,PROGRAM SIZE = C0096B
STATISTICS: NO DIAGNOSTICS GENERATED
```

C-----
 C A SUBROUTINE TO CALCULATE DEPRECIATION ON A FACILITY BASIS
 C LSES S/R DELG, DSLVYD, ECLLELE
 C-----

0001 SLERCUTINE DEPREC
 0002 DIMENSION V(4),VA(4),VN(4),A(12),E(12)
 0003 COMMON/MASTR1/IFAC(50,8),RFAC(50,30),IFACUTE(50,40),
 0004 I RCLLTE(50,4),NFACT,NRCLTE
 0005 COMMON/MASTR3/IR,IRN,IEHNER,IELEM1,ICCEFN,ISLIFE,IFACAG,IDEPAL,
 0006 1 IFACCL,IELEM2,INCAF,IAECAF,IAINT,IAKAR,ITRAF,
 0007 2 ICHEX,IAITAX,IAITAX,ICIST,IGAVF,ITRCAP,
 0008 3 ISALV,IREMV,IRETR,IGAV,IADEF,IANDEF,IAV,IGAVP,
 0009 4 IASLN,IIILN,ILAND,ILANDF,ISTAT,ISTATE,IGEC,IGECP,
 0005 5 IELIL,IELILP,ISTATH,IGECH,IELILM,IGAVM,ITCTIA,
 0006 6 JRLNS,JCS,JFINR,JSTEND,JUNIT,JISTF,JTRAFF,JTRAFFS,
 0007 7 JRREV,KWC,KFE,KCAR,JCSERV,ITCCAP,JCIMEN,JTRAFF
 0008 COMMON/MASTR4/ASSET(15,7,6)
 0009 COMMON/MASTR5/FINDAT(15,30),IFINDT(15,2),E
 0007 COMMON/WPRCCN/ICCN(20)
 0008 DIMENSION LW(7)
 0009 DATA LW//'CCST','AC,D','ADDN','PRETS','AN,D','SALV','REMV'/

C-----
 C THE FOLLOWING SWITCHING CODES ARE USED(CODED IFAC(K,DEPAL))

C-----
 C 1 - FOR ELG - STRAIGHT LINE CALCULATIONS
 C 2 - FOR SUM OF YEARS DIGITS CALCULATIONS
 C 3 - FOR DOUBLE DECLINING BALANCE CALCULATIONS
 C 4 - FOR ASL STRAIGHT LINE CALCULATIONS

C-----
 C FOR EACH FACILITY

0010 DC 200 K = 1,NFACT

0011 IA = IFAC(K,IFACAG)

0012 IB = IFAC(K,ISLIFE)

0013 ISW = 2

0014 IF(IFAC(K,IELEM2).EQ.0) ISW = 1

C-----
 C SWITCHING PARAMETER ISW = 1 FOR SWITCHING FACILITY

C-----
 C = 2 FOR TRANSMISSION FACILITY

0015 V(1) = RFAC(K,ISTAT)

0016 V(2) = RFAC(K,IGEC)

0017 V(3) = RFAC(K,IELIL)

0018 V(4) = RFAC(K,IGAV)

0019 VA(1) = RFAC(K,ISTATE)

0020 VA(2) = RFAC(K,IGECP)

0021 VA(3) = RFAC(K,IEUILF)

0022 VA(4) = RFAC(K,IGAVP)

0023 VM(1) = RFAC(K,ISTATH)

0024 VM(2) = RFAC(K,IGECH)

0025 VM(3) = RFAC(K,IELILM)

0026 VM(4) = RFAC(K,IGAVM)

0027 X = RFAC(K,IREMV)

0028 Y = RFAC(K,ISALV)

0029 IS=IFAC(K,IDEPAL)

0030 IF((IS.EQ.0))IS=IFINDT(IFAC(K,IEHNER),ISB)

0031 DC 5 I=1,4

0032 T = X * V(I)

0033 U = Y * V(I)

0034 IF((IS.EQ.1))CALL DELG(IA,IE,V(I),T,U,A(I),E(I))

```
0035      IF (IS.EQ.2) CALL DLSMYC (IA,IE,V(I),T,L,A(I),E(I))
0036      IF (IS.EQ.3) CALL DCULE (IA,IE,V(I),T,L,A(I),E(I))
0037      IF (IS.EQ.4) GO TO 6
0038      T = X * VA(I)
0039      U = Y*VA(I)
0040      II = I + 4
0041      IF (IS.EQ.1) CALL DELG(C,IE,VA(I),T,U,A(II),E(II))
0042      IF (IS.EQ.2) CALL DLSMYC(C,IE,VA(I),T,U,A(II),E(II))
0043      IF (IS.EQ.3) CALL DCULE (C,IE,VA(I),T,U,A(II),E(II))
0044      III = I + 8
0045      T = VM (I) * X
0046      U = VM(I)* Y
0047      IC = IE - 1
0048      IF (IS.EQ.1) CALL DELG(IC,IE,VA(I),T,U,A(III),E(III))
0049      IF (IS.EQ.2) CALL DLSMYC(IC,IE,VM(I),T,U,A(III),E(III))
0050      IF (IS.EQ.3) CALL DCULE (IC,IE,VM(I),T,U,A(III),E(III))
0051      GO TO 6
0052      C E(I)=V(I)*(1.-E)*(1.-Y+X)
0053      A(I)=V(I)*(1-Y+X)/IE
0054      II=I+4
0055      A(II)=VA(I)*(1-Y+X)/IE
0056      III=I+8
0057      A(III)=VM(I)*(1.-Y+X)/IE
0058      C CALCULATE ANNUAL DEPRECIATION FOR EACH FACILITY - ADD OVER 4 TYPES OF EQ.
0059      C RFAC(K,IANCEP) = RFAC(K,IACDEF) + A(I) + .5*(A(II)-A(III))
0060      C CALCULATE ACCUMULATED DEPRECIATION
0061      C RFAC(K,IACDEP) = RFAC(K,IACDEF)+E(I)
0062      C NOTE POSSIBLE REFINEMENT NECESSARY. EG SPLITTING YEAR INTO TWO
0063      C-----ASSEMBLY OF DATA SET 01
0064      ICCM = IFAC(K,ICBNER)
0065      CC 21 L = 1,4
0066      J = L + 2
0067      IF (L.EQ.4) J=IS6
0068      ASSET (ICCM,2,J)=ASSET (ICCM,2,J)*E(L)
0069      ASSET (ICCM,1,J) = ASSET (ICCM,1,J)+V(L)
0070      ASSET (ICCM,3,J) = ASSET (ICCM,3,J)+VA(L)
0071      ASSET (ICCM,4,J) = ASSET (ICCM,4,J)+VM(L)
0072      ASSET (ICCM,6,J)=ASSET (ICCM,6,J)+VM(L)*X
0073      ASSET (ICCM,7,J)=ASSET (ICCM,7,J)+VM(L)*Y
0074      L1 = L + 4
0075      L2 = L+8
0076      21 ASSET (ICCM,5,J) = ASSET (ICCM,5,J)+A(L)+.5*(A(L1)-A(L2))
0077      ASSET (ICCM,1,6)=ASSET (ICCM,1,6)+RFAC(K,ILANE)
0078      ASSET (ICCM,3,6) =ASSET (ICCM,3,6)+RFAC(K,ILANDP)
0079      20C CONTINUE
0080      IF (ICON(4).EQ.0) RETURN
0081      WRITE (IW,5000)
0082      5000 FFORMAT(" ASSETS IN DATA SET 01",//27X,"SWITCHING",5X,"TRANS",
0083                  17X,"ST.EQ.",6X,"GEN.EQ.",6X,"ELDGs",7X,"LANE")
0084      DO 500 J=1,NCAR
0085      DO 500 K=1,7
0086      500 WRITE (IW,5001) J,LN(K),(ASSET(J,K,L),L=1,6)
0087      5001 FFORMAT(" CO ",8,".I2",ITEM ",.A4,5X,6F12.2)
```

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0083 RETURN
0084 END

OPTIONS IN EFFECT NCTERM, ID, EBCDIC, SCURCE, NCLIST, NCDECK, LCAD, NCPAP, NCTEST

OPTIONS IN EFFECT NAME = DEPREC , LINECAT = 56

STATISTICS SOURCE STATEMENTS = 24, PROGRAM SIZE = 000E48

STATISTICS NO DIAGNOSTICS GENERATED

```
0001      SLERCLTINE DSUMYD(IAG,SLIFE,CVAL,REMCV,SALVGE,ANCREF,ACCDEF)
C      A SLERCLTINE TO CALCULATE ANNUAL DEPRECIATION AND ACCUMULATED
C      DEPRECIATION ON A SUM OF YEARS DIGITS METHOD
C      IAG - AGE OF INVESTMENT
0002      INTEGER SLIFE
C      SLIFE SERVICE LIFE
C      CVAL- ASSET VALUE
C      REMCV --COST OF REMOVAL
C      SALVGE-SALVAGE VALUE
C      ANCREP - ANNUAL DEPRECIATION
C      ACCDEF - ACCUMULATED DEPRECIATION
0003      SLNVD= SLIFE*(SLIFE+1.0)/2.0
0004      ACCDEF=C.0
0005      TVAL=CVAL+REMCV-SALVGE
0006      K = SLIFE + 1
0007      IF(IAG.EQ.0) GO TO 21
0008      DO 20 J=1,IAG
0009      K=SLIFE-J+1
0010      20 ACCDEF=ACCDEF+TVAL*K/SLNVD
0011      21 ANCREP= TVAL*(K-1.0)/SLNVD
0012      RETURN
C      -SLNVD = SUM OF yrs DIGITS
C      TVAL = NET VALUE OF INVESTMENT
0013      END
```

OPTIONS IN EFFECT: NOTERM, ID, EBCDIC, SOURCE, NCLIST, NCDECK, LLEAD, NCMAP, NCTEST
OPTIONS IN EFFECT: NAME = DSUMYD , LINECNT = 56
OSTATISTICS: SOURCE STATEMENTS = 13, PROGRAM SIZE = 0002CC
OSTATISTICS: NO DIAGNOSTICS GENERATED.

```
0001      SUBROUTINE DELG(IAG,SLIFE,CVAL,REMCV,SALVGE,ANDEP,ACCDP)
C      A SUBROUTINE TO CALCULATE ANNUAL DEPRECIATION AND ACCUM. DEPRECIATION
C      USING STRAIGHT LINE METHODS (USED IN ELG METHODS)
C
C      IAG - NO OF YEARS OF SERVICE OF INVESTMENT
C      SLIFE SERVICE LIFE (EXPECTED VALUE )
C      CVAL ASSET VALUE - HISTORICAL
C      REMCV COST OF REMOVAL
0002      INTEGER SLIFE
C      SALVGE SALVAGE VALUE.
C      ANDEP- ONE YEAR DEPR. ON ASSET VALUE
C      ACCDP ACCUMULATED DEPRECIATION TO BEGINNING OF PERIOD.
C      ANDEP=(1./SLIFE)* (CVAL+REMCV-SALVGE)
IF(IAG.GT.SLIFE)ANDEP=0.0
ACCDP=IAG* ANDEP
RETURN
0007      END
```

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NCLIST, NCDECK, LCAAD, RCMAP, ACTEST

OPTIONS IN EFFECT NAME = DELG , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 7, PROGRAM SIZE = 000216

STATISTICS NO DIAGNOSTICS GENERATED

```
0001      SUBROUTINE DCUBLE(IAG,SLIFE,CVAL,REMCV,SALVGE,ANNDEP,ACCDEP)
C   A SUBROUTINE TO CALCULATE ANNUAL AND ACCUMULATED DEPRECIATION
C   IN A DCUBLE DECLINING BASIS -SWITCHING TO STRAIGHT LINE AT MIDLIFE
C
C   IAG - AGE OF INVESTMENT
C   SLIFE-SERVICE LIFE
C   CVAL - ASSET VALUE
C   REMCV - COST OF REMOVAL
C   SALVGE- SALVAGE VALUE
C   ANNDEP - ANNUAL DEPRECIATION
C   ACCDEP - ACCUM. DEPRECIATION
0002      INTEGER SLIFE
0003      MID = INT((SLIFE+1)/2.)
0004      DBAL=CVAL+REMOVAL-SALVGE
0005      ACCDEP=C*0
0006      R = 2./SLIFE
0007      T = 1./(SLIFE-MID)
0008      IF(IAG.EQ.0) GO TO 11
0009      DO 10 J=1,IAG
0010      IF(J.GT.MID) GO TO 20
0011      ACCDEP=ACCDEP+ R*DBAL
0012      DBAL= DBAL*(1.-R)
0013      GO TO 10
0014      20 ACCDEP=ACCDEP+ T*DBAL
0015      10 CONTINUE
0016      IF(IAG.GE.SLIFE)GO TO 35
0017      IF(IAG.GT.MID)GO TO 30
0018      11 ANNDEP=R*DBAL
0019      RETURN
0020      30 ANNDEP= T*DBAL
0021      RETURN
0022      35 ANNDEP = 0.0
0023      RETURN
0024      END
```

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NCLIST, NCDECK, LCAC, NCMAP, NCTEST

OPTIONS IN EFFECT NAME = DCUBLE , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 24, PROGRAM SIZE = 000364

STATISTICS NO DIAGNOSTICS GENERATED

22

```
0001      SLRCUTINE CACSET
C   S/R TO CALCULATE NET RATE EASE AND RATE OF RETURN FOR FACILITY
C-----
0002      COMMON/MASTR1/IFAC(50,5),RFAC(50,30),IRELTC(50,40),
1          RCLTC(50,4),NFACT,NRCLTC
0003      COMMON/MASTR3/IR,IN,ICWNER,IELEM1,ICCSFN,ISLIFE,IFACAG,IDEPAL,
1          IFACCL,IELEM2,INCAF,IADCAF,IMAIN,IMARK,ITRAF,
2          ICHEX,IFTAX,INTAX,ICDIST,IGAVF,ITRCAF,
3          ISALV,IRENV,IRETR,IGAV,IACDEF,IANDEF,INAV,IGAVP,
4          IASLN,IIINL,ILANC,ILANDP,ISTAT,ISTATP,IGEC,IGCF,
5          IELIL,IEULIP,ISTATP,IGEW,IBUILN,IGAVM,ITOTIN,
6          JFINS,JCS,JFINR,JSTIND,JUNIT,JISTP,JTRAFF,JTRAFS,
7          JRREV,KWC,KFB,NCAR,JCSERV,ITCCAF,JCIMER,JTRAFF
0004      COMMON/MASTRS/FINDAT(10,30),IFINDT(10,2),E
C-----
C   CALCULATE COST OF MONEY COMPONENT OF CAPITAL CCST
0005      DC 50 K=1,NFACT
0006      IF(RFAC(K,ITRCAF).LT..CG05)GC TC 50
0007      J =IFAC(K,ICWNER)
0008      IF(FINDAT(J,5).GT.C.CC1) GC TC 20
C   APPLY HENTER'S FORMULA TO OBTAIN RATE OF RETURN
0009      RCR = FINDAT(J,4)*(1./(1.-FINDAT(J,1)))*(1.-FINDAT(J,2))
1          +FINDAT(J,3)*FINDAT(J,2)
0010      GC TC 30
0011      20  RCR = FINDAT(J,5)
C   FIND NET RATE EASE
0012      30  RFAC(K,INAV)=RFAC(K,IGAVF)-RFAC(K,IACDEF)-0.5*RFAC(K,IANDEF)
0013      RBNET = RFAC(K,INAV)*(1.+FINDAT(J,KWC))
C   KWC COLUMN GIVING PERC. FRCVNSICK FOR WORKING CAPITAL
C   CCST OF CAPITAL = ANN. DEPRECIATION + COST OF MONEY
0014      RFAC(K,ITOTIN) = RBNET*RCR + RFAC(K,IANDEF)
0015      50  CONTINUE
0016      RETURN
0017      END
```

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NCLIST, NCDECK, LCAD, NCMAP, NCTEST

OPTIONS IN EFFECT NAME = CACOST , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 17, PROGRAM SIZE = 000362

STATISTICS NO DIAGNOSTICS GENERATED

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0001      SUBROUTINE CPCCST
C S/R TO CALCULATE OPERATING COSTS(DATA SET 2) AND UNIT CP. CCSTS
C-----
0002      COMMON/MASTR1/IFAC(50,E),RFAC(50,30),IRCUTE(50,40),
1          RRCUTE(50,4),NFACT,NRCUTE
0003      COMMON/MASTR3/IF,IW,ICOWNER,IELEM1,ICCSFN,ISLIFE,IFACAG,IDEFAL,
1          IFACCL,IELEM2,INCAF,IACCAF,IMAIN,IMARK,ITRAF,
2          ICHEX,IPTAX,INTAX,ICIST,IGAVF,ITRCAF,
3          ISALV,IREMV,IRETR,IGAV,IACDEF,IANDEF,INAV,IGAVF,
4          IASUN,IIINUN,ILAND,ILANCF,ISTAT,ISTATF,IGEC,IGECP,
5          IELIL,IELILP,ISTATM,IGEM,IEUILN,IGAVF,ITCTIN,
6          JREV,JCS,JFINN,JSTINC,JUNIT,JSTF,JTRAFF,JTRAFS,
7          JRREV,KVC,KFB,NCAR,JCSERV,ITCCAP,JDIMEN,JTRAPP
0004      COMMON/MASTR4/FINDAT(IC,30),IFINDT(15,2),E
0005      COMMON/MASTR6/CPKCCS(15,10,2)
0006      COMMON/MFRCCN/ICON(20)
DIMENSION LL(2)
0007      DATA LL/'$WNG','TRAN'
0008      C      ROUTINE TO CALCULATE TOTAL AND UNIT INCURRED COST BY FACILITY
0009      DO 50 K=1,NFACT
0010      IF(RFAC(K,ITRCAF).LT..0005)GO TO 50
0011      C      SOURCE OF DATA 1--FINDAT(COMPANY) , 2--RFAC(FACILITY)
      IF(RFAC(K,IMAIN).GT..001) GO TO 40
0012      C      THIS OPTION SOURCE FINDAT
      J = IFAC(K,OWNER)
0013      ISW = 1
0014      IF(IFAC(K,IELEM2).NE.C)ISW = 2
0015      DO 56 M = 1,5
0016      N = 2*M + 3 + ISW
0017      T = FINDAT(J,N) * RFAC(K,IGAVF)
0018      OPKCCS(J,M,ISW) = CPKCCS(J,M,ISW) + T
0019      C      JTH COMPANY, MTH EXPENSE ITEM, KTH FACILITY
      SE RFAC(K,ITOTIN) = RFAC(K,ITCTIN) + T
0020      RFAC(K,IIINUN) = RFAC(K,ITCTIN)/RFAC(K,ITRCAF)
0021      OPKCCS(J,6,ISW)=CPKCCS(J,6,ISW)+RFAC(K,IANDEF)
0022      OPKCCS(J,7,ISW)=CPKCCS(J,7,ISW)+RFAC(K,ITCTIN)
0023      50  CONTINUE
0024      IF(ICON(5).EQ.0)GO TO 4505
0025      WRITE(IW,5000)
0026      5000 FORMAT(* OPERATING COSTS -- DATA SET 2*,//26X,
1"MAINT",7X,"MEC",7X,"TRAF",6X,"OTHER N.I.TAXES",4X,"DEPR")
0027      DO 500 J=1,NCAR
0028      DO 500 L=1,2
0029      500 WRITE(IW,5001)J,LL(L),(OPKCCS(J,K,L),K=1,6)
0030      5001 FORMAT(* CO # ",I2," FAC TYPE ",A4,6F10.2)
0031      4005 IF(ICON(6).EQ.C)RETURN
0032      C      WRITE(IW,5002)
C5002 FORMAT(* COSTS IN RFAC--LIST SHOWS #, NAME, AN DEF AC DEP IN COST-
C      1TOT & CCS, G,A,V,, N,A,V, *)
C      DC 501 L=1,NFACT
C 501 WRITE(IW,5003)L,IFAC(L,ICOWNER),IFAC(L,IELEM1),RFAC(L,IANDEF),
C      1RFAC(L,IACDEF),RFAC(L,ITCTIN),RFAC(L,IIINUN),RFAC(L,IGAVF)
C      2,RFAC(L,INAV)
C5003 FORMAT(1X,I2,2X,I2,2X,A4,3F10.2,F12.4,2F10.2)

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CPCCST

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0032 RETURN
0033 40 CONTINUE
C THIS OPTION SOURCE RFAC
C ATTENTION -- THIS OPTION NOT PROGRAMMED
0034 RETURN
0035 END

OPTIONS IN EFFECT NCTERM, ID,EBCDIC,SCURCE,NCLIST,NCDECK,LOAD,NCMAP,NCTEST

OPTIONS IN EFFECT NAME = CPCCST , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 35,PRCGRAM SIZE = C005D6

STATISTICS NO DIAGNOSTICS GENERATED

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0001      SLEROUTINE CCSTIN
0002      COMMON/MASTR1/IFAC(5C,2),RFAC(5C,3C),IRELUTE(5C,4C),
0003      1          RFLUTE(5C,4),RFAC,IRELUTE
0004      COMMON/MASTR2/CFLNAE(1C,2C),CFLNCR(1C,2C),DEFI(2C),NFSIZ(1C,3),
0005      1          FLANE(2),PSTAT(2),PGEC(2),FELIL(2)
0006      COMMON/MASTR3/IF,IW,ICNNR,IELEM1,ICCSFN,ISLIFE,IFACAG,ICEPAL,
0007      1          IFACCL,IELEM2,INCAF,IADCAF,IMAINT,IMARK,ITRAF,
0008      2          ICHTEX,IFTAX,INTAX,ICDIST,IGAVF,ITRCAF,
0009      3          ISALV,IENV,IRETR,IGAV,ICACDF,IANDEF,INAV,IGAVP,
0010      4         IASLN,IIINLN,ILANL,ILANCF,ISTAT,ISTATF,IGEG,IGECP,
0011      5          IELIL,IBUILP,ISTATM,IGECM,IELILM,IGAVM,ITCTIN,
0012      6          JRINS,JCS,JFINR,JSTIND,JUNIT,JISTF,JTRAFF,JTRAFFS,
0013      7          JRREV,KNC,KFE,NCAR,JCSEERV,ITCCAP,JCINEN,JTRAFF
0005      NAMELIST/IGHK/IR,IW,ICNNR,IELEM1,ICCSFN,ISLIFE,IFACAG,ICEPAL,
0006      1          IFACCL,IELEM2,INCAF,IADCAF,IMAINT,IMARK,ITRAF,
0007      2          ICHTEX,IFTAX,INTAX,ICDIST,IGAVF,ITRCAF,
0008      3          ISALV,IENV,IRETR,IGAV,ICACDF,IANDEF,INAV,IGAVP,
0009      4         IASLN,IIINLN,ILANL,ILANCF,ISTAT,ISTATF,IGEG,IGECP,
0010      5          IELIL,IBUILP,ISTATM,IGECM,IELILM,IGAVM,ITCTIN,
0011      6          JRINS,JCS,JFINR,JSTIND,JUNIT,JISTF,JTRAFF,JTRAFFS,
0012      7          JRREV,KNC,KFE,NCAR,JCSEERV,ITCCAP,JCINEN,JTRAFF
0006      COMMON/MASTR4/ASSET(15,7,6)
0007      COMMON/MASTR5/FINDAT(1C,30),IFINCT(15,2),E
0008      COMMON/MASTR6/CFKCCS(15,1C,2)
0009      COMMON/MASTR7/CFCREV(15,5)
0010      COMMON//1/REVEN(100),ASETST,INEGST(25,3),RNEGST(25,2),NNEGST,
0011      1 AVTRAF(100),DIST(1C),SPLIT(11),TARR(16,12)
0012      COMMON/MRCCDN/ICCN(2C)
0013      DIMENSION ID(55),JD(2C),RD(5),XD(5),INDEX(16),ITEMP(10),DUM(6,4)
0014      DATA INDEX//A    "  "B    "  "C    "  "D    "  "E    "  "F    "  "G    "
0015      1  "H    "  "I    "  "J    "  "K    "  "L    "  "M    "  "N    "  "O    "
0016      2  "X    "
0017      DATA IBLANK//    "  ,IPPLUS//+  "
0018      COMMON/MASTR9/HCLC,PLOSS,PCVER,CCNV
0019      IALPHA(1)=((I/16777216)-1)*16777216+((64*256*64)*256*64)
0020      IR=5
0021      IW=6
0022      READ(IR,8003)
0023      WRITE(IW,8003)
0024      READ(IR,8001)HOLD,PLOSS,PCVER,CCNV,E,PK5
0025      PK5=PK5*100
0026      READ(IR,5000)NCAR
0027      READ(IR,EC03)
0028      WRITE(IW,8003)
0029      READ(IR,5000)(ICCN(J),J=1,20)
0030      READ(IR,5000)ICNNR,IELEM1,ICCSFN,ISLIFE,IFACAG,ICEPAL,
0031      1          IFACCL,IELEM2,INCAF,IADCAF,IMAINT,IMARK,ITRAF,
0032      2          ICHTEX,IFTAX,INTAX,ICDIST,IGAVF,ITRCAF,
0033      3          ISALV,IENV,IRETR,IGAV,ICACDF,IANDEF,INAV,IGAVP,
0034      4         IASLN,IIINLN,ILANL,ILANCF,ISTAT,ISTATF,IGEG,IGECP,
0035      5          IELIL,IBUILP,ISTATM,IGECM,IBUILM,IGAVM,ITOTIN,
0036      6          JRINS,JCS,JFINR,JSTIND,JUNIT,JISTF,JTRAFF,JTRAFFS,
0037      7          JRREV,KNC,KFE,JCSEERV,ITCCAP,JCINEN,JTRAFF
0028      5000 FORMAT(40I2)

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```
0029      NELIL=IRETR
0030      J=C
0031      READ(IR,ECC3)
0032      WRITE(1B,ECC3)
C      READ IN NCDES DATA-----
0033      S J=J+1
0034      READ(IR,20C)(ID(I),I=1,3),RD(1),RD(2)
0035      ID1=IALPHA(ID(1))
0036      DC 10 K = 1,15
0037      IF(ID1.EQ.INDEX(K)) GO TO 120
0038      10 CONTINUE
0039      GO TO 40
0040      120 IFAC(J,ICWNER) = K
0041      RFAC(J,ITOCAP) = RD(1)
0042      IFAC(J,IELEM1) = ID(1)
0043      IFAC(J,IELEM2) = C
0044      RFAC(J,NEUIL)=RD(2)
C      ID(2) HIERARCHY NOT USED HERE
0045      IFAC(J,ICCSFN) = ID(2)
0046      GO TO 5
0047      40 NFAC = J - 1
0048      200 FORMAT(5X,A3,10X,I2.1GX,I2.4X,F8.0,F3.0)
C      READ IN LINKS-----
0049      READ(IR,8003)
0050      WRITE(1B,8003)
0051      J = NFAC
0052      E READ(IR,205)(ID(I),I=1,2),(RD(I),I=1,3)
0053      IC = ID(1)/100
0054      RD(3) = RD(3)/100
0055      IF(IC.LE.0.CR,IC.GE.16) GO TO 50
0056      J = J+1
0057      IFAC(J,ICWNER) = IC
0058      IFAC(J,IELEM1) =(ID(1)/1000+240)*16777216+(ID(1)/100-ID(1)/
11000*10+240)*65536+(ID(1)/10-ID(1)/100*10+240)*256 +
2*(ID(1)-ID(1)/10*10+240)
0059      ITE = IFAC(J,IELEM1)
0060      IFAC(J,ICOSFN) = ID(2)
0061      RFAC(J,ITOCAP) = RD(1)
0062      IFAC(J,IELEM2) = ITE
0063      IF(RD(3).LT.0.99995.AND.RD(3).GT.0.00005) GO TO 130
0064      RFAC(J,ICIST) = RD(2)
0065      GO TO 6
0066      130 RFAC(J,ICIST) = RD(2) * RD(3)
0067      J = J+ 1
0068      RFAC(J,ICIST) = RD(2)*(1.-RD(3))
0069      IFAC(J,ICWNER) = IC + 1
0070      IFAC(J,IELEM1) = ITE + S*256
0071      IFAC(J,ICOSFN) = ID(2)
0072      IFAC(J,IELEM2) = ITE + S*256
0073      RFAC(J,ITOCAP) = RD(1)
0074      GO TO 6
0075      50 NFAC = J
0076      205 FORMAT(4X,I4.10X,I2.8X,F4.0,3X,FS.0,5X,F3.0)
C      ROUTING-----
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```
0077      JS = 0
0078      J = 0
0079      READ(IR,8003)
0080      WRITE(IW,8003)
0081      READ(IR,210)(IC(I),I=1,4),(RD(I),I=1,3),(IC(I),I=5,17)
0082      210 FCRMAT(A3,1X,A3,1X,I2,1X,I2,1X,2F8.0,1X,F3.0,A2,1X,A1,
0083      15(1X,A3,A4),A2)
0084      220 FCRMAT(IC(1X,A3,A4))
C----- NEW STREAM INPUT -----
0085      SE IC=IALPHA(IC(1))
0086      IF(RD(2).LT..0CE)RD(2)=RKE
0087      IF(RD(2).GE..005)RKE=RD(2)
0088      DO 60 K = 1,15
0089      IF(IC.EQ.INDEX(K)) GC TO 230
0090      60 CCNT=1
0091      NRCUTE = J
0092      GO TO 605
0093      230 J = J+1
0094      JS = JS+1
0095      IRCLTE(J,JSTIND) = JS
0096      IRCUTE(J,JCSErv) = IC(3)
0097      IRCUTE(J,JRINS) = IC(4)
0098      AVTRAF(JS) = RD(2)*RD(1)/HOLE
0099      ID1=IALPHA(ID(2))
0100      DO 65 KK = 1,15
0101      IF(IC1.EQ.INDEX(KK)) GC TO 31
0102      65 CONTINUE
0103      31 IRCUTE(J,JCS) = 2
0104      IF(K.EC.KK-1.GR.K.EG.KK+1) IRCLTE(J,JCS) = 1
0105      JR = IRCLTE(J,JRINS)
0106      IF(JR.EQ.1)GO TO 109
0107      JL = J+1
0108      JN=J+JR-1
0109      DO 32 JJ = JL,JN
0110      JM = JJ-1
0111      IRCUTE (JJ,JRINS) =JR
0112      IRCUTE(JJ,JCSErv) =IRCLTE(JM,JSTIND)
0113      IRCUTE(JJ,JSTIND) = IRCLTE(JM,JSTIND)
0114      32 IRCUTE(JJ,JCS) = IRCUTE(JM,JCS)
C----- NEW RCLTE -----
0115      109 NR = 0
0116      110 IX = 7
0117      NR = NR + 1
0118      II = 0
0119      III = 1
C----- NEW SEGMENT OF ROUTE -----
0120      149 IX10 = IX+10
0121      IX29 = IX+29
0122      IF(ID(IX10).EQ.IELANK)GO TO 150
0123      READ(IR,220)(ID(I),I=IX10,IX29)
0124      150 DO 151 IN = IX,IX29
0125      I = IN
0126      IF(ID(IN).EQ.IELANK) GC TO 152
0127      151 CONTINUE
```

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```

C NC FALL THRU
0127 153 JC1 = JCIMEN + II
0128 JC2 = JCIMEN + III
0129 IRCLTE(J,JC1) = ID(6)
0130 IRCLTE(J,JD2) = I-7
0131 II = II + 2
0132 III = III+2
0133 IX = I-1
C READ NEXT CARD AND HOLD FOR PROCESSING DECISION
0134 READ(IR,210)(ID(I),I=1,4),(XC(I),I=1,3),(JD(I),I=5,17)
0135 IF(JD(5).NE.IBLANK) GO TO 160
0136 DO 154 JX = 7,17
0137 IXM = IX + JX - 7
0138 154 IC(IXM) = JD(JX)
0139 ID(6)=JD(6)
0140 GO TO 149
0141 160 CONTINUE
C STORE ROUTING INFORMATION
0142 JK = 0
0143 IJK=III-2
0144 JD1 = JCIMEN+1
0145 ITEMp(1)=IRCLTE(J,JD1)
0146 IF(IJK.EC.1) GO TO 78
0147 CC 79 JX=3,1JK,2
0148 JX3=IJK-JX+3
0149 JX1=JX3+JDIMEN
0150 JX2=JX1-2
0151 IRROUTE(J,JX1)=IRROUTE(J,JX1)-IRROUTE(J,JX2)
0152 79 ITEMp(JX3)=IRROUTE(J,JX1)
0153 78 ISOM=0
0154 JXX=JCIMEN-1
0155 DC 80 L=7,IX
0156 IF(L/2*2.EC.L) GO TO 85
C STORE NOTES
0157 DO 81 M=1,NFAC
0158 IF(IFAC(M,IELEM2).NE.C) GO TO 82
0159 IF(ID(L).EQ.IFAC(M,IELEM1))GO TO 82
0160 E1 CONTINUE
0161 GO TO 82
0162 82 JXX3=JXX-JDIMEN
0163 ITEMp(JXX3)=ITEMp(JXX3)-1
0164 GO TO 86
0165 82 IF(L-6-ISOM)E21,E22,E22
C ROUTINE REMOVES NCR-SWITCHING NOTES FROM LIST OF FACILITIES
0166 823 JXX=JXX+2
0167 JXX3=JXX-JDIMEN
0168 ISMOLD=ISOM+1
0169 ISOM=ISM+IRROUTE(J,JXX)
0170 GO TO 82
0171 822 JXX1=JXX-1
0172 JXX2=JXX+1
0173 IF(IRROUTE(J,JXX1).EQ.IRCUTE(J,JXX2).AND.IRCLTE(J,JXX1).EC.IPLUS)
1 GO TO 83
0174 GO TO 824

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```
0175      821 IF(L-6.GT.ISMCLE)GC TO E3
0176      824 JK=JK+1
0177      L1=JK+J1STF-1
0178      IRCUTE(J,L1)=M
0179      GC TO E0
0180
0181      85 JK=JK+1
0182      L1=JK+J1STF-1
0183      DC 86 M=1,NFAC
0184      IF(IFAC(M,IELEM2).EQ.C)GO TO E6
0185      IF(ID(L).EQ.0,IFAC(M,IELEM1).CR,IC(L)+176*16777216.EQ,IFAC(M,
0186      IELEM1)) GO TO E7
0187      86 CONTINUE
0188      M=M+1
0189      LT=L-6
0190      WRITE(IW,8006)LT,J,IC(L)
0191      8006 FORMAT(' THE ',I2,'TH FACILITY OF THE ',I2,'TH RCLTE(',
0192      1 A4,') NOT FOUND IN LIST CCST ASSIGNMENT ARBITRARY')
0193      87 IRCUTE(J,L1) =M
0194      IF(M.GE.NFAC)GC TO E6
0195      IM=ID(L)+5*256
0196      IN = IN+176*16777216
0197      M1=M+1
0198      IF(IM.EC,IFAC(M1,IELEM1).CR,IN.EC,IFAC(M1,IELEM1))GO TO 88
0199      GC TO E0
0200      88 JK=JK+1
0201      L1=L1+1
0202      IRCUTE(J,L1)=M1
0203      IF(L-6,LT,ISOM)GO TO IC1
0204      JXX=JXX+2
0205      ISMCLO=ISCM+1
0206      ISOM=ISCM+IRCUTE(J,JXX)
0207      JXX3=JXX-JCIMEN
0208      101 ITEMP(JXX3)=ITEMP(JXX3)+1
0209      EC CONTINUE
0210      DC 42 JX=1,IJK,2
0211      JX2=JX+JCIMEN
0212      42 IRCUTE(J,JX2)=ITEMP(JX)
0213      IROLTE(J,JFINR) =JK
0214      PRCUTE(J,JTRAF)=RC(1)*RC(3)/100.
0215      DC 111 I=6,17
0216      111 ID(I)=JD(I)
0217      RC(3)=XC(3)
0218      C   GO TO NEW RCLTE
0219      IF(NR.LT.IROUTE(J,JRINS))GO TO 112
0220      RC(2)=XC(2)
0221      RC(1)=XC(1)
0222      GO TO 56
0223      112 J = J+1
0224      GO TO 110
0225      605 IF(ABS(PK5-2).LT..000005)GO TO 608
0226      IST =C
0227      DO 6071 J=1,NRCLTE
0228      IF(IST.GE.IROUTE(J,JSTIND))GO TO 6071
0229      IST=IST+1
```

```
0226      NRJ=0
0227      NRT=J-1
0228      ICR=C
0229      606 NRJ=NRJ+1
0230      NRT=NRT+1
0231      IF(IRCUTE(NRT,JCIMEN).EQ.IPLLS)ICR=ICR+1
0232      IF(IRCUTE(NRT,JRINS).GT.NRJ)GC TO 606
0233      IF(ICR.EQ.C.CR.ICR.EQ.NRJ)GC TO 608
0234      X1=(10C.-PKE)/SE
0235      X2=PK5/2.
0236      DC 607 IXX=1,NRJ
0237      NRT=IXX+J-1
0238      IF(IRCUTE(NRT,JCIMEN).EQ.IPLUS)RRROUTE(NRT,JTRAF)=X1*RRROUTE
0239      1(NRT,JTRAF)
0239      IF(IRCUTE(NRT,JCIMEN).NE.IPLUS)RRROUTE(NRT,JTRAF)=X2*RRROUTE
0239      1(NRT,JTRAF)
0240      607 CCNTINLE
0241      6071 CCNTINLE
0242      ECE CCNTINLE
0243      IF(ICON(11).EQ.C)GC TO 636
0244      WRITE(IW,7007)
0245      7007 FORMAT(//1DISPLAY OF ROUTING DATA/2X,"S",2X,"ST",1X,
0246      1 "RT",1X,"SV",1X,"ST",1X,"FC",2X,"P",1CCS",10X,"FL & FIN")
0246      DC 6998 J=1,NRCLTE
0247      JLAST = J1STF+IRCUTE(J,JFINR)-1
0248      IV1 = JDIMEN+9
0249      6998 WRITE(IW,7008)J,IRCUTE(J,JSTINC),IRCUTE(J,JRINS),IRCUTE(J,JCSEVR)
0249      1,IRCUTE(J,JCS),IRCUTE(J,JFINR),RRROUTE(J,JTRAF),(IRCUTE(J,IV)
0249      2,IV=JCIMEN,IV1),(IRCUTE(J,N).N=J1STF,JLAST)
0250      7008 FORMAT(1X,E13.2X,F8.2,2X,5(A1,I3,1X)/1CX,"F",R= ",30I4)
0251      636 NF=NFAC+1
0252      DO 654 N=1,8
0253      654 IFAC(NF,N)=0
0254      DO 655 N=1,30
0255      655 RFAC(NF,N)=0.0
0256      READ(IW,8003)
0257      WRITE(IW,8003)
0258      849 READ(IW,8000)IFNC,X,DELX,Y,DELY,ICHISIZ,NCCH1,NCCH2,IPROT
0259      IF(IFNC.GT.20)GC TO 858
0260      J=IFNC
0261      IF(NOCH1.EQ.0)NCCH1=10
0262      IF(NOCH2.EQ.0)NCCH2=10
0263      IF(IPRCT.EQ.C)IPRCT=E
0264      DC 850 K=1,NOCH1
0265      DELK=0,C
0266      IF(DELK.EQ.IPRCT+1)DELK=1,C
0267      CFLNAB(J,K)=K*ICHISIZ
0268      850 CFLNOR(J,K)=X+(K-1)*DELX+DELK*2*DELX
0269      DC 851 K=1,NOCH2
0270      K1= NOCH1+K
0271      DELK=0,C
0272      IF(K.EQ.IPROT+1)DELK=1,C
0273      CFUNAB(J,K1)=ICHISIZ*K+CFLNAB(J,NOCH1)
0274      851 CFUNOR(J,K1)=CFLNOR(J,NOCH1)+Y+(K-1)*DELY+DELK*2*DELY
```

```
0275      NFSIZ(J,1)=NCCH1+NCCH2
0276      NFSIZ(J,2)=NCCH1+1
0277      NFSIZ(J,3)=ICHHSIZ
0278      DC 2EC K=1,NFAC
0279      IF(IFAC(K,IELEM2).EQ.C) GO TO 35C
0280      IF(IFAC(K,ICCSFN).NE.J) GO TO 35C
0281      RFAC(K,ITCCAP)=RFAC(K,ITCCAP)*ICHHSIZ
0282      35C CONTINUE
0283      GC TC E49
0284      8CCC FFORMAT(2EX,I2,4F10.0,I4,3I2)
0285      8EE READ(IR,E0C1)(DEFL(J),J=1,2)
0286      READ(IR,E0C1)(PSTAT(J),PGEC(J),FEUIL(J),PLAND(J),J=1,2)
0287      READ(IR,E0C3)
0288      WRITE(IW,E0C3)
0289      DC 253 J=1,KWC
0290      READ(IR,E0C2)(FINDAT(K,J),K=1,NCAR)
0291      853 CONTINUE
0292      8002 FFORMAT(13F6.0)
0293      8003 FFORMAT('
1
        ') )
0294      READ(IR,E0C3)
0295      WRITE(IW,8003)
0296      READ(IR,5000)(IFINOT(K,J),J=1,2),K=1,NCAR)
0297      8001 FFORMAT(2CF4.0)
0298      5004 FFORMAT(2F4.0)
0299      NSETST=IRGLTE(NFCLTE,JSTINC)
0300      NNEGST=C
0301      JX=1
0302      918 READ(IR,8003)
0303      WRITE(IW,8003)
0304      READ(IR,E0C8)IFTYPE,(DLW(IFTYPE,J),J=1,NCAR)
0305      IF(IFTYPE.LT.20) GO TO 919
0306      GO TO (920,921,922,923),JX
0307      920 IJX=IFACAG
0308      GC TO 93C
0309      921 IJX=ISLIFE
0310      GC TO 93C
0311      922 IJX=ISALV
0312      GC TO 940
0313      923 IJX=IREMV
0314      GO TO 94C
0315      930 DC 931 J=1,NFAC
0316      931 IFAC(J,IJX)=DUM(IFAC(J,ICCSFN),IFAC(J,ICWNER))
0317      GC TO 942
0318      94C DC 941 J=1,NFAC
0319      941 RFAC(J,IJX)=DUM(IFAC(J,ICCSFN),IFAC(J,ICWNER))
0320      942 JX=JX+1
0321      IF(JX.LE.4) GO TO 918
0322      8006 FFORMAT(12,10F4.0)
0323      RETURN
0324      END
```

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NCLIST, NODECK, LLOAD, NOMAP, NCTEST

OPTIONS IN EFFECT NAME = COSTIN , LINECAT = 56

0001 SUBROUTINE SHAREI
C READS SHARE BLOCK INPUT
C -TARIFF STRUCTURE MATRIX(TARR(16,12))
C -TOTAL ANAL STREAM TRAFFIC SPLIT VECTCR(SPLIT(11))
C -STREAM DISTANCE VECTCR(DIST)
0002 COMMON/W1/REVENL(100),NSETST,INEGST(25,3),RNEGST(25,2),NNEGST,
 1 AVTRAF(100),DIST(100),SPLIT(11),TARR(16,12)
0003 COMMON/NPRCON/ICCN(20)
0004 COMMON/W2/TREV
0005 READ(5,1)((TARR(I,J),J=1,12),I=1,16)
0006 1 FORMAT(11FE.2,F0.0)
C SAME SPLIT FOR ALL STREAMS
0007 READ(5,2)SPLIT
0008 2 FFORMAT(11FS.4)
0009 READ(5,3)(DIST(I),I=1,NSETST)
0010 3 FFORMAT(16FS.0)
0011 IF(ICCN(9).NE.0)PRINT 10,(TARR(J,12),J=1,16),(I,(TARR(J,I)
 1 , J=1,16),SPLIT(I),I=1,11)
0012 10 FFORMAT(*1//T40,'TARIFF MATRIX-TELEPCNE SERVICE'
 1 T30,'RATES FOR 5.5 MIN. CALLS BY CATECRY OF CALL AND DISTANCE'
 2 //T30,'DISTANCES - UPPER LIMIT IN MILES OF RATE CATECRY'
 3 ,T118,*SPLIT*/17,*CALL*,T19,16(F5,0,IX)/T5,*CATECRY*/
 4 (T9,I2,T20,16(F4.2,2X),T118,F6.3))
0013 IF(ICCN(12).NE.0)CALL SHDAT
0014 RETURN
0015 END

OPTIONS IN EFFECT NOTERM, ID,EBCDIC,SCURCE,NCLIST,NCDECK,LCAD,NCMAP,NCTEST

OPTIONS IN EFFECT NAME = SHAREI , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 15,PROGRAM SIZE = 0003F4

STATISTICS NO DIAGNOSTICS GENERATED

0001 SLROUTINE SHCAT
0002 COMMON/MASTR1/IFAC(50,E),RFAC(50,30),IRCLTE(50,4C)
1. RCLTE(50,4),NFAC,NRCUTE
0003 COMMON/MASTR3/IX(6C)
0004 COMMON/MASTR4/ASSET(1E,7,E)
0005 COMMON/MASTR6/CFKCCS(15,10,2)
0006 COMMON/MFRCCN/ICCN(2C)
0007 COMMON/W1/REVENL(10C),NSETST,INEGST(25,3),RNEGST(25,2),ANEGST
1. AVTRAF(100),CIST(1C),SPLIT(1I),TARR(1E,12)
0008 WRITE(10,300)IFAC,IRCLTE,NFAC,NRCUTE,IX,ICCN,NSETST
0009 NCAR=IX(5E)
0010 IASUN=IX(30)
0011 IINLN=IX(31)
0012 WRITE(10,301)RRCUTE,((ASSET(I,J,K),I=1,NCAR),J=1,7),K=1,6)
1. (((OPKCCS(I,J,K),I=1,NCAR),J=1,10),K=1,2),(RFAC(J,IASUN),
2. RFAC(J,IINLN),J=1,NFAC)
0013 300 FORMAT(2CA4)
0014 301 FORMAT(5E15.8)
0015 WRITE(10,301)(REVENU(J),J=1,NSETST),(AVTRAF(J),J=1,NSETST),
1. (DIST(J),J=1,NSETST)
0016 STOP
0017 END

OPTIONS IN EFFECT NOTERM,IC,EBCDIC,SCURCE,NCLIST,NCDECK,LCAD,NCMAP,NCTEST

OPTIONS IN EFFECT NAME = SHCAT , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 17,PROGRAM SIZE = 00043A

STATISTICS NO DIAGNOSTICS GENERATED

```
0001      SLERGLTINE STREVS
0002      C      CALCULATES STREAM REVENUES(RENVAL)
0003      COMMON//1/REVAL(1CC),NSETST,INEGST(25,3),RNEGST(25,2),NNEGST,
0004      1      AVTRAF(1CC),DIST(1CC),SPLIT(11),TARR(16,12)
0005      COMMON/NPRCCN/ICCN(2C)
0006      COMMON//2/TREV
0007      C      L=STREAM
0008      IF(ICCN(7).NE.0)PRINT 5
0009      5      FORMAT(/// ' STREAM', ' DISTANCE TARR CCMPCSITE ANN TRAF',
0010      1      ' ST REVENUE'/T16,' RCW',T21,' TARR, RATE')
0011      TREV=C
0012      DO 30 L=1,NSETST
0013      DO 10 I=1,IS
0014      IF(DIST(L).GT.TARR(I,12))GO TO 10
0015      C      M=TARRIF VECTOR (RCW) TO APPLY FOR DISTANCE
0016      M=I
0017      GC TO 20
0018      10     CONTINUE
0019      M=16
0020      20     CONTINUE
0021      SUM=C
0022      DO 25 I=1,11
0023      SUM=SUM+TARR(M,I)*SPLIT(I)
0024      C      SUM=CCMPCSITE TARRIF RATE
0025      REVENU(L)=SUM*AVTRAF(L)/1000.
0026      25     IF(ICCN(7).NE.0)WRITE(6,901)L,DIST(L),M,SUM,AVTRAF(L),REVENU(L)
0027      901    FORMAT(15,F10.2,15,F10.2,2X,F10.2)
0028      TREV=TREV+REVAL(L)
0029      30     CONTINUE
0030      IF(ICCN(7).NE.0)PRINT 35,TREV
0031      35     FORMAT(T15,'TOTAL',T43,F10.2//)
0032      RETURN
0033      END
```

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NCLIST, NCDECK, LCAC, NCMAP, NCTEST

OPTIONS IN EFFECT NAME = STREVS , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 27, PROGRAM SIZE = 00037C

STATISTICS NO DIAGNOSTICS GENERATED

```
0001      SUBROUTINE CCLRF(CCLREV)
0002      C      CONVERTS STREAM TO RCLTE REVENUE BY A XCF TRAFFIC
0003      DIMENSION CCLREV(1CC)
0004      COMMON/MASTR1/IFAC(50,2),RFAC(50,30),IFCLTE(50,40),
0005      1          RFCLTE(50,4),NFAC,NRCUTE
0006      COMMON/MASTR3/IR,IN,ICNTR,IELEM1,ICCSFN,ISLIFE,IFACAE,ICEFAL,
0007      1          IFACCL,IELEM2,INCAP,IACCAF,IMAIN,IMARK,ITRAF,
0008      2          ICHEX,IPTAX,INTAX,ICIST,IGAVF,ITRCAP,
0009      3          ISALV,IREMV,IREMR,IGAV,IACCEF,IANCEF,INAV,IGAVF,
0010      4         IASLN,INUN,ILANL,ILANCE,ISTAT,ISTATE,IGEC,IGECF,
0011      5          IELIL,IELILP,ISTATM,IGECM,IEUILM,IGAVM,ITCTIN,
0012      6          JRINS,JCS,JFINR,JSTIND,JUNIT,J1STF,JTRAFF,JTRAFS,
0013      7          JRREV,KYC,KFB,NCAJCSERV,ITCCAP,JCINEN,JTRAFFP
0014      COMMON/W1/REVEN(1CC),NSETST,INEGST(25,3),RNEGST(25,2),NNEGST,
0015      1          AVTRAF(1CC),DIST(1CC),SPLIT(11),TARR(16,12)
0016      I=0
0017      J=C
0018      I=I+1
0019      J=J+1
0020      NRINS=IRCUTE(I,JRINS)
0021      IA=I+NRINS-1
0022      TOTTR=C
0023      CC 5 K=I,IA
0024      5      TOTTR=TCTTR+RRCLTE(K,JTRAFF)
0025      REV=REVENU(IROLTE(I,JSTIND))
0026      DC 10 K=I,IA
0027      10      CCLREV(K)=REV*RFACUTE(K,JTRAFF)/TOTTR
0028      I=IA
0029      IF(I.LT.NRCUTE)CC 10
0030      IF(J.EQ.NSETST)RETURN
0031      WRITE(6,15)
0032      15      FORMAT(" ERROR WITH NUMBER OF SETTLED STREAMS")
0033      RETURN
0034      END
```

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SCURCE, NCLIST, NCHECK, LCAD, NCMAP, NCTEST

OPTIONS IN EFFECT NAME = CCLRE , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 24,PROGRAM SIZE = C00328

STATISTICS NO DIAGNOSTICS GENERATED

0001 C SLEROLTIME CFREVE
0002 C CALCULATES OPERATING REVENUE/CARRIER/SERVICE
COMMON/MASTR1/IFAC(5C,8),RFAC(5C,30),IRCLTE(5C,4C).
0003 1 RFCLTE(5C,4),NFAC,NRCLTE
COMMON/MASTR3/IF,IW,ICOWNER,IELEM1,ICCSFN,ISLIFE,IFACAG,IDEFAL,
1 IFACCL,IELEM2,IMCAF,IADCAF,IMAIT,IMARK,ITRAF,
2 ICTHEX,IFTAX,INTAX,ICIST,IGAVF,ITRCAP,
3 ISALV,IRENV,IRETR,IGAV,IACDEF,IANDEF,INAV,IGAVP,
4 IASLN,IIINN,ILAND,ILANCE,ISTAT,ISTATE,IGEG,IGECP,
5 IEUIL,IELILP,ISIATH,IGECH,IBLILW,IGAVM,ITCTIN,
6 JRINS,JCS,JFINR,JSTIND,JUNIT,JSTF,JTRAF,JTRAFFS,
7 JRREV,KWC,KFE,NCAR,JCSERV,ITECAF,JDIMEN,JTRAFF
COMMON/MASTR7/CFGREV(1E,5)
COMMON/WI/REVENL(1CC),NSETST,INEGST(2E,3),RNEGST(2E,2),NNEGST
1 AVTRAF(1CC),DIST(1CC),SPLIT(11),TARR(1E,12)
COMMON /MASTR8/NSS(4)
COMMON/NPRCDN/ICCN(2C)
COMMON/MASTR6/CFKCCS(1E,10,2)
COMMON/MASTR4/ASSET(1E,7,6)
COMMON/W2/TREV
DIMENSION COLREV(100),ICAR(15),RASVAL(1E),RINC(15),TDEUM(15)
DIMENSION ICARI(15),RAEVA1(15),RINC1(15)
CALL CCLRE(COLREV)
PRINT 7013,TREV
7013 FCRMAT('1',T20,'RESULTS OF APPLICATION OF SETTLEMENT SCHEMES'.
1 /T20,'TOTAL REVENUE FOR ALLOCATION--',2X,F12.2)
703 READ(IR,700)(NSS(J),J=1,4)
IF(NSS(1).GT.3C)RETURN
700 FCRMAT(4I2)
TTINC=0
DO S1 I=1,NCAR
RINC(I)=CPKCOS(I,7,1)+CPKCCS(I,7,2)
0022 91 TTINC=TTINC+RINC(I)
0023 BBAL=TREV-TTINC
0024 IF(NSS(1).EQ.1)GO TO 92
0025 IF(NSS(1).EQ.3)GO TO 94
0026 GO TO 97
0027 92 DO 93 I=1,NCAR
X=0
DO 925 INDEX=1,E
0030 925 X=X+ASSET(I,1,INDEX)+.5*(ASSET(I,3,INDEX)-ASSET(I,4,INDEX))
0031 93 RASVAL(I)=X
0032 CALL TCTS(NCAR,EEAL,RASVAL,TDEUM)
0033 GO TO 95
0034 94 CALL CLDCOM(NCAR,RINC,TTINC,BBAL,TDEUM)
0035 95 DO 96 I=1,NCAR
0036 96 OPGREV(I,1)=TDEUM(I)+RINC(I)
0037 GO TO 98
0038 97 CONTINUE
0039 DO 9 N=1,S
0040 DO 9 M=1,15
0041 9 OPGREV(M,N)=0.
0042 DO 70 I=1,NROUTE
0043 DO 905 K=1,15

37

```
0044      905  ICAR1(M)=0
0045      DC 10 M=1,15
0046      RINC(M)=0.
0047      10  RASVAL(M)=0.
0048      L=1
0049      JLASTF=J1STF+IRELTC(I,JFINR)-1
0050      DC 40 K=J1STF,JLASTF
0051      ICANEW=IFAC(IRELTC(I,K),IOWNER)
0052      IF(ICANEW.EQ.0)GC TC 40
0053      IF(K.GT.J1STF)GC TC 20
0054      ICAR(1)=ICANEW
0055      ICACLD=ICANEW
0056      GO TC 30
0057      20  IF(ICANEW.EQ.ICACLD)GC TO 30
0058      L=L+1
0059      ICAR(L)=ICANEW
0060      ICACLD=ICANEW
C   CUMULATES UNIT ASSET VALUES & INCLURRED COSTS/CARRIER
0061      30  RASVAL(L)=RASVAL(L)+RFAC(IRCUTE(I,K),IASUN)
0062      RINC(L)=RINC(L)+RFAC(IRCUTE(I,K),IINLN)
0063      40  CONTINUE
0064      IF(L.EQ.I)GO TC 69
0065      CAPA=RROLTE(I,JTRAFF)
0066      DC 41 M=1,L
0067      RASVAL(M)=RASVAL(M)*CAPA
0068      41  RINC(M)=RINC(M)*CAPA
0069      IF(L.LE.2)GC TC 44
0070      ICAR1(1)=ICAR(1)
0071      ICAR1(15)=ICAR(L)
0072      DO 413 M=2,14
0073      413 ICAR1(M)=0
0074      IP=1
0075      LM1=L-1
0076      DC 42 IX=2,LM1
0077      CO 415 M=1,IS
0078      IF(ICAR1(M).EQ.ICAR(IX))GC TC 42
0079      415  CONTINUE
0080      IP=IP+1
0081      ICAR1(IP)=ICAR(IX)
0082      42  CONTINUE
0083      DC 425 J=1,15
0084      SUM1=0
0085      SUM2=0
0086      IF(ICAR1(J).EQ.C)GC TO 426
0087      CO 423 IX=1,L
0088      IF(ICAR1(J).NE.ICAR(IX))GC TC 423
0089      SUM1=SUM1+RASVAL(IX)
0090      SUM2=SUM2+RINC(IX)
0091      423  CONTINUE
0092      RASVAL(J)=SUM1
0093      RINC(J)=SUM2
0094      425  CONTINUE
0095      L=0
0096      CO 43 IY=1,15
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88
0097 IF(ICAR1(IY).EQ.C)GC TO 43
0098 L=L+1
0099 ICAR(L)=ICAR1(IY)
0100 RASVAL(L)=RASVAL(IY)
0101 RINC(L)=RINC1(IY)
0102 43 CONTINUE
0103 44 CONTINUE
C SUMMING OF INURRED COSTS
0104 TINC=0.
0105 DO 45 M=1,L
0106 45 TINC=TINC+RINC(M)
BAL=CCLREV(I)-TINC
C NT=CATEGORY OF SETTLEMENT
0107 NT=IRCUTE(I,JCS)
C NN=SETTLEMENT SCHEME TYPE
0108 NN=NSS(NT)
C FOR MIXED SCHEMES FOR ADJACENT PARTNERS, REVENUE IS
C DISTRIBUTED ACCORDING TO 3 BASIC SCHEMES OR EQUALLY
NNM3=NN-2
0110 IF(ICCN(E).NE.0)WRITE(6,8888)NN,L,NT,NNM3,(ICAR(J),J=1,L)
0111 8888 FORMAT(4I5,1SI4)
0112 IF(L.EQ.2.AND.NN.GT.2)GC TO (E1,53,52,55,51,53,52,55),NNM3
0113 GO TO(51,52,53,54,54,54,54,54,54,52,54),NN
0114 51 CALL TCTS(L,BAL,RASVAL,TDELEM)
0115 GO TO 6C
0116 52 CALL COMM(L,TINC,CCLREV(I),TDELEM)
0117 GO TO 60
0118 53 CALL OLDCOM(L,RINC,TINC,BAL,TDELEM)
0119 GO TO 6C
0120 54 CALL MIXED(NN,L,RASVAL,RINC,TINC,BAL,TDELEM)
0121 GO TO 6C
0122 55 CONTINUE
C EQUAL FOR 2 ADJACENT PARTNERS
0123 TDELEM(1)=BAL/2.
0124 TDELEM(2)=BAL/2.
0125 60 CONTINUE
0126 DO 65 M=1,L
0127 65 OPGREV(ICAR(M),IRCUTE(I,JCSEV))=CPGREV(ICAR(M),IRCUTE(I,JCSEV))
1+TDELEM(M)+RINC(M)
GO TO 695
0128 69 OPGREV(ICAR(1),IRCUTE(I,JCSEV))=OPGREV(ICAR(1),IRCUTE(I,JCSEV))
1+CCLREV(I)
0129 695 CONTINUE
0130 70 CONTINUE
IF(ICON(E).NE.0)WRITE(6,887)
0131 887 FORMAT('CHECK1')
0132 75 CONTINUE
IF(NNEGST.EQ.0)GO TO 85
0133 DO 80 N=1,NNEGST
0134 IC1=INEGET(N,2)
0135 IC2=INEGST(N,3)
IS=INEGST(N,1)
0136 OPGREV(IC1,IS)=CPGREV(IC1,IS)+RNEGST(N,1)
0137 IF(IC2.GT.NCAR)GC TO 79

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0143 DPGREV(IC2,IS)=CFGREV(IC2,IS)+RNEGST(N,2)
0144 79 CONTINUE
0145 80 CONTINUE
0146 85 CONTINUE
0147 900 WRITE(6,901)(NSS(J),J=1,4),(CFGREV(I,1),I=1,NCAR)
0148 901 FORMAT(* SETTLEMENT SCHEME CCCC*,2X,4I3,2X,*REVENUES BY CARRI*,
1 *ER*,E(F11.2,1X))
0149 GO TO 703
0150 END

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SCURCE, NCLIST, NCDECK, LCAD, ACMAP, NCTEST

OPTIONS IN EFFECT NAME = CPREVE, LINECNT = 56

STATISTICS SOURCE STATEMENTS = 150, PROGRAM SIZE = C01356

STATISTICS NO DIAGNOSTICS GENERATED

0001 SUBROUTINE TCTS(L,EAL,RASVAL,TCLEM)
0002 DIMENSION RASVAL(15),TCLEM(15)
0003 TASVAL=C.
0004 DO 1 N=1,L
0005 1 TASVAL=TASVAL+RASVAL(N)
0006 DO 2 N=1,L
0007 2 TCLEM(N)=EAL*RASVAL(N)/TASVAL
0008 RETURN
0009 END

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NCLIST, NODECK, LCOL, NCAP, NCTEST

OPTIONS IN EFFECT NAME = TCTS . LINECNT = 56

STATISTICS SOURCE STATEMENTS = 9, PROGRAM SIZE = 0001CE

STATISTICS NO DIAGNOSTICS GENERATED

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0001      SUBROUTINE CCMM(L,TINC,CCLR,TELEM)
0002      DIMENSION TDLEM(15),ALREV(15),ALLEX(15)
0003      DO 1 N=1,L
0004      ALREV(N)=0.
0005      1    ALLEX(N)=0.
0006      ALLEX(1)=.5*TINC
0007      ALLEX(L)=.5*TINC
0008      ALREV(1)=.5*CCLR
0009      ALREV(L)=.5*CCLR
0010      DO 2 N=1,L
0011      2    TDLEM(N)=ALREV(N)-ALLEX(N)
0012      RETURN
0013      END
```

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NCLIST, NCDECK, LLOAD, NCMAP, NCTEST

OPTIONS IN EFFECT NAME = CCMM , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 13, PROGRAM SIZE = 000290

STATISTICS NO DIAGNOSTICS GENERATED

42
0001 SLRCUTING CLDCOM(L,RINC,TINC,EAL,TLEM)
0002 DIMENSION RINC(1E),TLEM(1E)
0003 DO I N=1,L
0004 1 TLEM(N)=BAL*RINC(N)/TINC
0005 RETURN
0006 END

OPTIONS IN EFFECT NCTERM,IC,EBCCIC,SOURCE,NCLIST,NCDECK,LCAD,NMAP,NTEST

OPTIONS IN EFFECT NAME = CLDCOM , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 6,PROGRAM SIZE = 6001EB

STATISTICS NO DIAGNOSTICS GENERATED

64
0001 SUBROUTINE MIXED(NN,L,RASVAL,RINC,TINC,EAL,TCLEM)
0002 DIMENSION RASVAL(15),RINC(15),TCLEM(15),RATIC(15),ALREV1(15)
0003 DC 1 N=1,L
0004 1 ALREV1(N)=C.
0005 FAC=1./3.
0006 ALREV1(1)=FAC*EAL
0007 ALREV1(L)=FAC*EAL
0008 BAL2=(1.-2.*FAC)*EAL
0009 NNM3=NN-3
0010 GO TO (10,20,30,40,10,20,30,40),NNM3
0011 C----ASSET BASED
0012 10 DO 13 N=1,L
0013 IF(NN.EQ.4)GO TO 11
0014 RATIO(N)=RASVAL(N)
0015 GO TO 13
0016 11 IF(N.EC.1.OR.N.EC.L)GO TO 12
0017 RATIO(N)=RASVAL(N)
0018 12 GC TC 13
0019 13 RATIC(N)=0.
0020 CONTINUE
0021 RSUM=C
0022 14 DC 14 N=1,L
0023 RSUM=RSUM+RATIO(N)
0024 15 DO 15 N=1,L
0025 TDEM(N)=ALREV1(N)+BAL2*RATIC(N)/RSUM
0026 RETURN
0027 C----INCURRED COST BASED
0028 20 DO 23 N=1,L
0029 IF(NN.EQ.5)GO TO 21
0030 RATIO(N)=RINC(N)
0031 GO TO 23
0032 21 IF(N.EC.1.OR.N.EQ.L)GO TO 22
0033 RATIO(N)=RINC(N)
0034 GO TO 23
0035 CONTINUE
0036 RSUM=0.
0037 24 DO 24 N=1,L
0038 RSUM=RSUM+RATIO(N)
0039 25 DC 25 N=L,L
0040 TDEM(N)=ALREV1(N)+EAL2*RATIO(N)/RSUM
0041 RETRN
0042 C----ALLOCATED COST BASED
0043 30 CONTINUE
0044 31 DC 32 N=1,L
0045 TDEM(N)=C.
0046 32 IF(L.EQ.3)GO TO 33
0047 TDEM(2)=.5*BAL2
0048 LM1=L-1
0049 TDEM(LM1)=.5*BAL2
0050 33 GO TO 34
0051 34 CONTINUE
0052 DO 35 N=1,L

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MIXED

DATE = TUE MAR 26, 1974

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```
0052      3S      TDLEM(N)=TDLEM(N)+ALREV1(N)
0053      RETURN
C-----EQUALLY DIVIDED
0054      40      AL=L
0055      IF(NN.EG.7)GC TO 42
0056      CC 41 N=1,L
0057      41      RATIC(N)=1./AL
0058      GC TO 44
0059      42      DC 435 N=1,L
0060      IF(N.EG.1.OR.N.EQ.L)EC TO 43
0061      RATIO(N)=1./(AL-2.)
0062      GC TO 435
0063      43      RATIO(N)=0.
0064      435     CONTINUE
0065      44      CCCONTINUE
0066      DC 45 N=1,L
0067      45      TDLEM(N)=RATIO(N)*BAL2+ALREV1(N)
0068      RETURN
0069      END
```

OPTIONS IN EFFECT NOTERM,IO,EBCDIC,SOURCE,NCLIST,NCDECK,LEAD,NCMAP,NCTEST

OPTIONS IN EFFECT NAME = MIXED , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 69,PROGRAM SIZE = C007E6

STATISTICS NO DIAGNOSTICS GENERATED

STATISTICS NO DIAGNOSTICS THIS STEP

46.15

/DATA

017000 BYTES USED

EXECUTION BEGINS 48.15

IRA PREMIERE PHASE DONNEES PREPAREES LE 7 FEV., AS PREPARED BY D.G.C.

-->INDEXING AND COLUMN ASSIGNMENTS DONE

-->NODE DATA INPUT/DONNEES SUR LES NOEUDS

-->LINK DATA INPUT/DONNEES SUR LES ARETES

-->ROUTING DATA/DONNEES SUR L'ACHEMINEMENT DES MESSAGES

```
0001      INTEGRL CIE
0002      CCMNCN/TRNY/NAME(E),LYEAR,KREC,KCDE(3,4)
0003      CCMNCN/KMPANY/CIE,CTRL
C STEPS ARE 1--LECTUR--READ ENDDGENCUS DATA
C          2-- CALCULATE READ EXGECUS DATA AND CALCULATE
0004      NCCMP = 4
0005      READ SS,NCAR
0006      55,FORMAT(I4)
0007      CALL LECTUR(NCAR)
0008      DC S CIE=1,NCCMP
0009      CALL CULATE
0010      CALL ASSEM
0011      5 CONTINUE
0012      STOP
0013      END
```

OPTIONS IN EFFECT NCTERM,TD,EBCDIC,SOURCE,NCLTST,NODECK,TCAD,NCFAP,NCTEST

OPTIONS IN EFFECT NAME = MAIN , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 13,PROGRAM SIZE = 00019C

STATISTICS NO DIAGNOSTICS GENERATED

FORTRAN IV G1 RELEASE 2.0

BLK DATA

DATE = TUE MAR 19, 1974

PAGE 0001

0001 BLOCK DATA
0002 COMMON/TRKY/NAME(5),IYEAR,KREG,KODE(3,4)
0003 COMMON/USUAL7/SR(2,27)
0004 DATA SR/54*99999999./
0005 DATA KODE/' INT', ' ', ' CCR', ' ER R', ' REGI', ' PANY' *
1 'EGIG', 'ONAL', ' TC', 'NAL ', ' ', 'TAL ' /
0006 END

OPTIONS IN EFFECT NCTERM, ID, EBCDIC, SOURCE, NCLIST, NCDECK, LCAO, NOMAP, NCTest

OPTIONS IN EFFECT NAME = BLK DATA, LINECNT = 56

STATISTICS NO DIAGNOSTICS GENERATED

47

```
0001      SUBROUTINE LECTUR(NCAR)
0002      REAL ASSET(15,7,6),CPCCS(15,10,2),CPGREV(15,5)
0003      INTEGER NAMES(15,5)
0004      COMMON /IICCIE/ NAMES
0005      COMMON /MASTR4/ ASSET
0006      COMMON /MASTR6/ CPCCS
0007      COMMON /MASTR7/ CPGREV

C
C     CE PROGRAMME LIT LES VALEURS DE ASSET,CPCCS ET CPGREV
C     ET EN MATEMPS DEFINIT LES NCNS DE COMPAGNIES .
C

0008      READ 99,((ASSET(I,J,K),K=1,6),J=1,7),I=1,NCAR)
0009      READ 99,((OPCCS(I,J,K),K=1,2),J=1,10),I=1,NCAR)
0010      READ 99,((OPGREV(I,K),K=1,5),I=1,NCAR)
0011      READ 97,((NAMES(I,J),J=1,5),I=1,15)

C
0012      DO 90 J=1,7
0013      DO 90 I=1,NCAR
0014      DO 90 K=1,6
0015      L=ASSET(I,J,K)+L
0016      90   ASSET(I,J,K)=L
0017      DO 91 I=1,NCAR
0018      DO 91 K=1,2
0019      DO 91 J=1,10
0020      L=OPCCS(I,J,K)+L
0021      91   OPCCS(I,J,K)=L
0022      DO 92 I=1,NCAR
0023      DO 92 J=1,5
0024      L=CPGREV(I,J)+L
0025      92   CPGREV(I,J)=L
0026      99   FORMAT(5E15.8)
0027      98   FORMAT(1E)
0028      97   FORMAT(5A4)
0029      RETURN
0030      END
```

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NCLIST, NCDECK, LCAO, RCMAP, NCTEST

OPTIONS IN EFFECT NAME = LECTUR , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 30, PROGRAM SIZE = 000500

STATISTICS NO DIAGNOSTICS GENERATED

```
0001      SUBROUTINE CULATE
0002      INTEGER S1(22,6),S2(27,6),S3(13,6),S4(9,6),S5(15,6),S6(7,6)
0003      INTEGER CIE,NAMES(15,5),NAME(5),KCDE(3,4),YEAR(4)
```

```
C
C
C      INCLUDE ICI LES DIMENSIONS ET/OU COMMEN A VENIR
C
C
```

```
0004      REAL T1(5,1),T2(6,9),T3(6,5),T4(6,6),T5(5,1),T6(15,6),SR(2,27)
0005      REAL OPGREV(15,5),CPCCS(15,10,2),ASSET(15,7,6)
0006      COMMON /MASTR4/ ASSET
0007      COMMON /MASTR6/ CPCCS
0008      COMMON /MASTR7/ OPGREV
0009      COMMON /USUAL1/ S1,T1
0010      COMMON /USUAL2/ S2,T2
0011      COMMON /USUAL3/ S3,T3
0012      COMMON /USUAL4/ S4,T4
0013      COMMON /USUAL5/ S5,T5
0014      COMMON /USUAL6/ S6,T6
0015      COMMON /USUAL7/ SR
0016      COMMON /TRNY/ NAME,IYEAR,KREG,KCDE,YEAR
0017      COMMON /KMPANY/ CIE,KTRL
0018      COMMON /IDCIE/ NAMES
```

```
C
C
C      INSERRER ICI LES TACHES DE DEBUT DU PRG.
C
```

```
0019      DC 10 I=1,22
0020      DC 10 J=1,6
0021      10  S1(I,J)=0
0022      DO 20 I=1,27
0023      DC 20 J=1,6
0024      20  S2(I,J)=0
0025      DO 30 I=1,13
0026      DC 30 J=1,6
0027      30  S3(I,J)=0
0028      DO 40 I=1,9
0029      DC 40 J=1,6
0030      40  S4(I,J)=0
0031      DO 50 I=1,15
0032      DC 50 J=1,6
0033      T6(I,J)=0
0034      50  S5(I,J)=0
0035      DO 60 I=1,7
0036      DC 60 J=1,6
0037      60  S6(I,J)=0
0038      DO 70 I=1,6
0039      DC 70 J=1,9
0040      70  T2(I,J)=0
0041      DC 80 I=1,6
0042      DC 80 J=1,5
0043      80  T3(I,J)=0
0044      DO 90 J=1,5
```

```

64
0045      90 NAME(J)=NAMES(CIE,J)
0046      CALL READER
C
C      INC. STMNT. / I.R. STEP-1
C
0047      S1( 1,4)=OPGREV(CIE,1)
0048      S1( 2,4)=OPGREV(CIE,2)
0049      S1( 3,4)=OPGREV(CIE,4)
0050      S1( 9,1)=OPCCS(CIE,1,1)
0051      S1( 9,2)=OPCCS(CIE,1,2)
0052      S1(10,1)=OPCCS(CIE,6,1)
0053      S1(10,2)=OPCCS(CIE,6,2)
0054      S1(11,1)=OPCCS(CIE,3,1)
0055      S1(11,2)=OPCCS(CIE,3,2)
0056      S1(12,1)=OPCCS(CIE,2,1)
0057      S1(12,2)=OPCCS(CIE,2,2)
0058      S1(13,1)=OPCCS(CIE,4,1)
0059      S1(13,2)=OPCCS(CIE,4,2)
0060      S1(14,1)=OPCCS(CIE,5,1)
0061      S1(14,2)=OPCCS(CIE,5,2)
0062      S1( 4,4)=S1(1,4)+S1(2,4)+S1(3,4)
0063      S1( 5,4)=0
0064      S1( 6,4)=S1(4,4)*T6( 9,6)
0065      S1( 7,4)=S1(4,4)*T6(10,6)
0066      S1( 8,4)=S1(4,4)+S1(5,4)+S1(6,4)-S1(7,4)
0067      DO 100 I=9,14
0068      S1(I,4)=S1(I,1)+S1(I,2)
0069      100 CCNTINUE
0070      S1(15,1)=KUMUL2(S1,22,9,1,1,9,14)
0071      S1(15,2)=KUMUL2(S1,22,9,2,1,9,14)
0072      S1(15,4)=S1(15,1)+S1(15,2)
0073      S1(16,4)=S1( 8,4)-S1(15,4)
0074      S1(18,4)=S1(16,4)+S1(17,4)
C
C      STOP FOR I.R.
C
C      START FOR REG.
0075      S1( 4,5)=KUMUL2(S1,22,1,5,1,1,3)
0076      S1( 5,5)=KUMUL2(S1,22,4,5,1,4,6)-S1(7,5)
0077      S1(15,5)=KUMUL2(S1,22,9,5,1,9,14)
0078      S1(16,5)=S1(8,5)-S1(15,5)
0079      S1(18,5)=S1(16,5)+S1(17,5)
C
C      STOP FOR REG.
C
C      ASSETS (B.S.) / I.R. STEP-2
C
0080      S2( 1,1)=ASSET(CIE,1,1)
0081      S2( 2,1)=ASSET(CIE,2,1)
0082      S2( 4,1)=ASSET(CIE,1,2)
0083      S2( 5,1)=ASSET(CIE,2,2)
0084      S2( 7,1)=ASSET(CIE,1,3)
0085      S2( 6,1)=ASSET(CIE,2,3)
0086      S2(10,1)=ASSET(CIE,1,4)

```

```

0087      S2(11,1)=ASSET(CIE,2,4)
0088      S2(13,1)=ASSET(CIE,1,5)
0089      S2(14,1)=ASSET(CIE,2,5)
0090      S2(16,1)=ASSET(CIE,1,6)
0091      DC 200 K=1,6
0092      I=3*(K-1)+1
0093      S2(I,4)=ASSET(CIE,1,K)+ASSET(CIE,3,K)-ASSET(CIE,4,K)
0094      IF(K.EQ.6) GO TC 200
0095      S2(I+1,4)=ASSET(CIE,2,K)+ASSET(CIE,5,K)-ASSET(CIE,4,K)
0096      S2(I+1,4)=S2(I+1,4)-ASSET(CIE,6,K)+ASSET(CIE,7,K)
0097      200  CONTINUE
C
0098      K=1
0099      300  DC 400 I=1,5
0100      S2(3*I,K)=S2(3*I-2,K)-S2(3*I-1,K)
0101      400  CONTINUE
0102      S2(18,K)=S2(1,K)+S2(4,K)+S2(7,K)+S2(10,K)+S2(13,K)
0103      S2(18,K)=S2(18,K)+S2(16,K)+S2(17,K)
0104      S2(19,K)=S2(2,K)+S2(5,K)+S2(8,K)+S2(11,K)+S2(14,K)
0105      S2(20,K)=S2(1E,K)-S2(19,K)
0106      S2(27,K)=S2(20,K)+S2(21,K)+S2(25,K)+S2(26,K)
0107      IF(K.EQ.1) GO TC 500
0108      IF(K.EQ.4) GO TC 600
0109      IF(K.EQ.5) GO TC 900
0110      K=4
0111      GO TO 300
0112      500  S2( 1,2)=T2(1,1)
0113      S2( 4,2)=T2(2,1)
0114      S2( 7,2)=T2(3,1)
0115      S2(10,2)=T2(4,1)
0116      S2(13,2)=T2(5,1)
C
0117      K=2
0118      GO TO 300
C
C      REG.
C
0119      600  S2( 1,5)=(-T2(1,1)+T2(1,2)-T2(1,3)+T2(1,4))/1
0120      S2( 4,5)=(-T2(2,1)+T2(2,2)-T2(2,3)+T2(2,4))/1
0121      S2( 7,5)=(-T2(3,1)+T2(3,2)-T2(3,3)+T2(3,4))/1
0122      S2(10,5)=(-T2(4,1)+T2(4,2)-T2(4,3)+T2(4,4))/1
0123      S2(13,5)=(-T2(5,1)+T2(5,2)-T2(5,3)+T2(5,4))/1
0124      700  DC 800 I=2,14,3
0125      J=(I+1)/3
C      TERM1=T2(1,8)*(2*T2(J,1)+T2(J,2)-T2(J,3)+T2(J,4))/2
0126      TERM1=T2(J,9)
C      TERM2=TERM1-T2(J,3)-T2(J,3)+T2(J,4)
0127      TERM2=T3(J,5)
0128      T2(K,9)=TERM1
0129      S2(I,5)=S2(I,2)+TERM2
0130      800  CONTINUE
0131      K=5
0132      GO TO 300
0133      900  CONTINUE

```

C
 C CALCULATION OF CCA & DEF. TAXES/E.Y. STEP 3
 C
 C I.R.
 C

0134 TTLAD=ASSET(CIE,3,1)+ASSET(CIE,3,2)+ASSET(CIE,3,3)
 0135 TTLAD=TTLAD+ASSET(CIE,3,4)+ASSET(CIE,3,5)
 0136 TTLAD=TTLAD+ASSET(CIE,3,6)+S2(17,4)-S2(17,1)
 0137 CCA=(S2(18,1)*T6(12,4)+TTLAD*T6(14,4))*T6(15,4)
 0138 DIT=(CCA-S1(10,4)+(S1(15,4)-S1(10,4))*T6(8,4))*T6(11,4)
 0139 SS(4,4)=DIT

C
 C R
 C
 0140 TAR=T2(1,2)+T2(2,2)+T2(3,2)+T2(4,2)+T2(5,2)
 0141 TAR=TAR+S2(16,5)-S2(16,2)+S2(17,5)-S2(17,2)
 0142 CCAR=(S2(18,2)*T6(13,5)+TAR*T6(14,5))*T6(15,5)
 0143 SS(4,5)=(CCAR-S1(10,5)+(S1(15,5)-S1(10,5))*T6(8,5))*T6(11,5)
 C PRINT 991,TTLAD,CCA,DIT,TAR,CCAR,SS(4,5)
 C991 FORMAT(' I.R. CEF TAXES',3F10.2/' REG. DEF TAXES',3F10.2)
 C
 C LIAB (BS)/B.Y. ST.4

C
 C
 C R
 C
 0144 S3(4,2)=KUMUL2(S3,13,1,2,1,1,3)
 0145 S3(8,2)=KUMUL2(S3,13,5,2,1,5,7)
 0146 S3(9,2)=S3(4,2)+S3(8,2)
 0147 S3(13,2)=KUMUL2(S3,13,9,2,1,9,12)
 0148 S3(13,1)=S2(27,1)
 0149 XNUM=S3(13,1)
 0150 XDEN=S3(13,2)
 0151 XRAT=XNUM/XDEN
 0152 DG 1000 I=1,12
 0153 S3(1,1)=S3(1,2)*XRAT
 0154 1000 CONTINUE

C
 C STEP 5
 C
 0155 S5(9,4)=SS(9,4)*XRATIC(S2(27,4),S2(27,5))
 0156 S3(10,4)=S2(27,4)*XRATIC(S3(10,2),S3(13,2))
 0157 S3(12,4)=S2(27,4)*XRATIC(S3(12,2),S3(13,2))
 0158 S3(11,4)=S3(11,1)+S5(4,4)+T6(12,4)

C
 C SIMULTANEOUS EQUATIONS STEP 6
 C
 0159 C1=(1.-T6(11,4))*(S1(8,4)-S1(15,4)-(S3(8,1)-S5(9,4)/2)*T6(4,4))
 0160 C1=C1+S1(17,4)
 0161 C2=S3(4,1)-(S4(2,4)+S4(4,4)+S4(5,4))-S4(7,4)+S4(8,4)
 0162 C3=S3(8,1)-S5(9,4)
 0163 C4=T6(7,4)
 0164 C5=S2(27,4)-(S3(10,4)+S3(11,1)+S5(4,4)+T6(12,4)+S3(12,4))
 0165 D=C4*C5

0166 EG=CL-C
 0167 RNC=D-S3(8,1)
 0168 RNI=C1-(1.-T6(11,4))*T6(5,4)*RNC/2
 0169 RNEG=EG.-RNI-C2
 0170 S3(4,4)=EG
 0171 S3(8,4)=D
 0172 S1(22,4)=RNI
 C PRINT 992,C1,C2,C3,C4,CS,D,EC,RNC,RNI,RNEG
 C992 FORMAT(' SIM ECHS: ',SF10.3/T15.SF10.3)
 C

C STEP 7
 C
 0173 S1(21,4)=(S3(8,1)-S3(9,4)/2)*T6(4,4)+RNC*T6(5,4)/2.
 0174 S1(19,4)=(S1(16,4)-S1(21,4))*T6(11,4)
 0175 S1(20,4)=S1(18,4)-S1(19,4)
 0176 S1(22,4)=S1(20,4)-S1(21,4)
 0177 S1(20,5)=S1(18,5)-S1(19,5)
 0178 S1(22,5)=S1(20,5)-S1(21,5)

C
 C STEP 6
 C
 0179 S4(1,4)=S1(22,4)
 0180 S4(1,5)=S1(22,5)
 0181 S4(3,4)=S4(1,4)-S4(2,4)
 0182 S4(3,5)=S4(1,5)-S4(2,5)
 0183 S4(6,4)=S4(3,4)-S4(4,4)-S4(5,4)
 0184 S4(6,5)=S4(3,5)-S4(4,5)-S4(5,5)
 0185 S4(9,4)=S4(6,4)-S4(7,4)+S4(8,4)
 0186 S4(9,5)=S4(6,5)-S4(7,5)+S4(8,5)

C
 C STEP 9
 C
 0187 S3(3,5)=S3(3,2)+S4(9,5)
 0188 S3(3,4)=S3(3,1)+ S4(9,4)
 0189 XRATE=XRATIO(S3(4,4)-S3(3,4),S3(1,1)+S3(2,1))
 0190 S3(1,4)=S3(1,1)*XRATE
 0191 S3(2,4)=S3(2,1)*XRATE
 0192 YRATE=XRATIO(S3(8,4),S3(8,1))
 0193 S3(5,4)=S3(5,1)*YRATE
 0194 S3(6,4)=S3(6,1)*YRATE
 0195 S3(7,4)=S3(7,1)*YRATE
 0196 S3(9,4)=S3(4,4)+S3(8,4)
 0197 S3(13,4)=KUMUL2(S3,13,9,4,1,9,12)
 0198 S3(4,5)=KUMUL2(S3,13,1,5,1,1,3)
 0199 S3(8,5)=KUMUL2(S3,13,5,5,1,5,7)
 0200 S3(9,5)=S3(4,5)+S3(8,5)
 0201 S3(13,5)=KUMUL2(S3,13,9,5,1,9,12)

C
 C STEP 10 DELTA W.C. & DELTA MISC
 C
 0202 IDWC1=S2(25,1)-S3(10,1)-(S2(25,4)-S3(10,4))
 0203 IF(IDWC1.GE.0)SE(13,4)=IDWC1
 0204 IF(IDWC1.LT.0)SE(6,4)=IDWC1*(-1)
 0205 IDWC2=S2(25,2)-S3(10,2)-(S2(25,5)-S3(10,5))

0206
 0207
 0208
 0209
 0210 901
 0211
 0212
 0213
 0214
 0215
 0216 902
 0217
 0218
 0219

```

IF(IDWC2.GE.0)SE(13,5)=IDWC2
IF(IDWC2.LT.0)SE(6,5)=IDWC2*(-1)
NSVIR=0
CC 901 K=1,5
NSVIR=NSVIR+ASSET(CIE,7,K)-ASSET(CIE,6,K)
IDMS1=S2(26,4)-S2(26,1)-(S3(12,4)-S3(12,1))-NSVIR-S4(8,4)+S4(7,4)
IF(IDMS1.GE.0)SE(5,4)=IDMS1
IF(IDMS1.LT.0)SE(12,4)=IDMS1*(-1)
NSVR=0
DO 902 I=1,5
  
```

```

NSVR=NSVR+T3(I,4)
IDMS2=S2(26,5)-S2(26,2)-(S3(12,5)-S3(12,2))-NSVR-S4(8,5)+S4(7,5)
IF(IDMS2.GE.0)SE(5,5)=IDMS2
IF(IDMS2.LT.0)SE(12,5)=IDMS2*(-1)
  
```

C
 C STEP 11
 C

```

0220       SE(1,4)=S1(22,4)
0221       SE(2,4)=S4(2,4)+S4(4,4)+S4(5,4)
0222       SE(3,4)=SE(1,4)-SE(2,4)
0223       SE(5,4)=T6(12,4)
0224       SE(6,4)=S1(10,4)+T6(6,4)
0225       SE(7,4)=KUMUL2(SE,15,3,4,1,3,6)
0226       SE(8,4)=RND+SE(5,4)
0227       SE(10,4)=SE(8,4)-SE(9,4)
0228       SE(11,4)=S3(1,4)+S3(2,4)-(S3(1,1)+S3(2,1))
0229       SE(14,4)=KUMUL2(SE,15,10,4,1,10,13)
0230       SE(15,4)=SE(7,4)+SE(14,4)
0231       SE(1,5)=S1(22,5)
0232       SE(2,5)=S4(2,5)+S4(4,5)+S4(5,5)
0233       SE(3,5)=SE(1,5)-SE(2,5)
0234       SE(5,5)=T6(12,5)
0235       SE(6,5)=S1(10,5)+T6(6,5)
0236       SE(7,5)=KUMUL2(SE,15,3,5,1,3,6)
0237       SE(10,5)=SE(8,5)-SE(9,5)
0238       SE(14,5)=KUMUL2(SE,15,10,5,1,10,13)
0239       SE(15,5)=SE(7,5)+SE(14,5)
  
```

C
 C STEP 12 I.R.
 C

```

0240       SE(1,4)=TTLAD
0241       SE(2,4)=C
0242       SE(3,4)=SE(1,4)-SE(2,4)
0243       SE(4,4)=S2(21,4)-S2(21,1)
0244       SE(7,4)=KUMUL2(SE,7,3,4,1,3,6)
  
```

C
 C REG.
 C

```

0245       SE(1,5)=TAR
0246       SE(3,5)=SE(1,5)-SE(2,5)
0247       SE(4,5)=S2(21,5)-S2(21,2)
0248       SE(7,5)=KUMUL2(SE,7,3,5,1,3,6)
  
```

C END OF LAST STEP

C
 C COL. 3 & 6
 C

0249 DC 1100 I=1,22
 0250 S1(I,6)=S1(I,4)+S1(I,5)
 0251 1100 CCNTINUE
 0252 DC 1200 I=1,27
 0253 S2(I,3)=S2(I,1)+S2(I,2)
 0254 S2(I,6)=S2(I,4)+S2(I,5)
 0255 1200 CCNTINUE
 0256 DC 1300 I=1,13
 0257 S2(I,3)=S3(I,1)+S3(I,2)
 0258 S3(I,6)=S3(I,4)+S3(I,5)
 0259 1300 CCNTINUE
 0260 DC 1400 I=1,9
 0261 S4(I,6)=S4(I,4)+S4(I,5)
 0262 1400 CCNTINUE
 0263 DO 1500 I=1,15
 0264 S5(I,6)=S5(I,4)+S5(I,5)
 0265 1500 CCNTINUE
 0266 DO 1600 I=1,7
 0267 S6(I,6)=S6(I,4)+S6(I,5)
 0268 1600 CCNTINUE

C
 C SIGNIFICANT RATIOS
 C

0269 K=4
 0270 I=1
 0271 1700 XTERM1=S1(18,K)
 XTERM2=S1(20,K)
 XTERM3=S1(16,K)-T6(1,K)
 XTERM4=S2(18,K)
 XTERM5=S6(1,K)
 XTERM4=S1(22,K)+S1(21,K)
 XTERM3=(S3(4,K)+S3(4,K-3)+S3(6,K)+S3(6,K-3))/2
 XTERM2=S1(16,K)-T6(1,K)+S1(7,K)
 XTERM1=(S2(18,K-3)+S2(18,K))/2
 SR(I,1)=XRATIO(S1(8,K),XTERM1)
 SR(I,2)=XRATIO(S1(5,K),XTERM1)
 SR(I,3)=XRATIO(S1(4,K),XTERM1)
 IF(I.EQ.1)SR(I,4)=XRATIO(S1(10,I),(S2(1,I)+S2(1,K))/2)
 IF(I.EQ.1)SR(I,5)=XRATIO(S1(10,2),(S2(4,I)+S2(4,K))/2)
 IF(I.EQ.2)SR(I,4)=XRATIO(S1(10,1)+T2(1,9),((S2(1,3)+S2(1,6))/2))
 IF(I.EQ.2)SR(I,5)=XRATIO(S1(10,2)+T2(2,9),((S2(3,4)+S2(4,6))/2))
 SR(I,6)=XRATIO(S1(10,K),XTERM1)
 SR(I,7)=XRATIO(S2(2,K),S2(1,K))
 SR(I,8)=XRATIO(S2(5,K),S2(4,K))
 SR(I,9)=XRATIO(S2(19,K),S2(18,K))
 IF(I.EQ.2)GO TO 7551
 SR(I,10)=ASSET(CIE,4,1)/S2(1,1)
 SR(I,11)=ASSET(CIE,4,2)/S2(4,1)
 SUMRET=0
 0295 DC 7550 KX=1,5
 0296 7550 SUMRET=SUMRET+ASSET(CIE,4,KX)

0297 SR(I,12)=SUMRET/S2(18,1)
0298 GC TO 7552
0299 7551 CONTINUE
0300 SR(I,10)=XRATIC(ASSET(CIE,4,1)+T2(1,3),S2(1,3))
0301 SR(I,11)=XRATIC(ASSET(CIE,4,2)+T2(2,3),S2(4,3))
0302 SUMTCT=SUMRET
0303 DC 7553 KX=1,5
0304 7553 SUMTCT = SUMTCT+T2(KX,3)
0305 SR(I,12)=SUMTCT/S2(18,3)
0306 7552 CONTINUE
C SR(I,10)=T2(1,3)/S2(1,1)
C SR(I,11)=T2(2,3)/S2(4,1)
C SR(I,12)=T2(6,3)/S2(18,1)
0307 SR(I,13)=XRATIC(S1(16,K),ITERM1)
0308 IF(I.EQ.1)GO TO 7554
0309 SR(I,14)=XRATIC(ITERM2,ITERM1)
0310 SR(I,15)=XRATIC(ITERM2,T6(2,6))
0311 7554 SR(I,16)=XRATIC(XTERM4,T6(3,6))
C SR(I,14)=XRATIC(ITERM2,ITERM1)
C SR(I,15)=XTERM3/T6(2,K)
0312 SR(I,17)=XTERM5/(T6(3,6)-T6(3,3))
0313 SR(I,18)=XRATIC(S1(15,K),S1(8,K))
0314 SR(I,19)=XRATIC(S1(9,K),S1(8,K))
0315 SR(I,20)=XRATIC(S1(10,K),S1(8,K))
0316 SR(I,21)=S1(21,K)/((S3(8,K-3)+S3(8,K))/2)
0317 SR(I,22)=XRATIO((S3(6,K)+S3(6,K-3))/2,ITERM3)
0318 SR(I,23)=XRATIC(S3(4,K)+S3(4,K-3),S3(9,K)+S3(9,K-3))
0319 SR(I,24)=XRATIC(S1(22,K),(S3(4,K)+S3(4,K-3))/2)
0320 SR(I,25)=XRATIC(ITERM4*2,S3(9,K)+S3(9,K-3))
0321 SR(I,26)=XTERM1/S1(21,K)
0322 SR(I,27)=XTERM2/S1(21,K)
0323 IF(K.EQ.6)GO TO 1800
0324 K=6
0325 I = 2
0326 GO TO 1700
0327 1800 CONTINUE
0328 RETURN
0329 END

OPTIONS IN EFFECT NOTERM,IC,EBCDIC,SOURCE,NCLIST,NODECK,LEAD,NOMAP,NCTEST

OPTIONS IN EFFECT NAME = CULATE , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 329,PROGRAM SIZE = 00364C

STATISTICS NO DIAGNOSTICS GENERATED

96

```
0001      SLERCUTINE READER
0002      INTEGER S1(22,6),S2(27,6),S3(13,6),S4(9,6),S5(15,6),S6(7,6)
0003      DIMENSION T1(5,1),T2(6,9),T3(6,5),T4(6,6),T5(5,1),T6(15,6)
0004      INTEGER IDUM(7),INDX(7)
0005      DIMENSION CLM(7)
0006      COMMON /USUAL/ S1,T1
0007      COMMON /USUAL2/ S2,T2
0008      COMMON /USUAL3/ S3,T3
0009      COMMON /USUAL4/ S4,T4
0010      COMMON /USUAL5/ S5,T5
0011      COMMON /USUAL6/ S6,T6
C
C      THIS PGM READS IN XGENOUS DATA FOR STMTS.
C
0012      10  READ 99,KOMP,NEST,NERW,(IDUM(I),I=1,7)
0013      IF(KOMP.EQ.0) RETURN
0014      IF(KOMP.EQ.99) GC TC 20
0015      GO TO (40,50,60,70,80,90) . NEST
C
0016      20  DC 30 I=1,7
0017      INDX(I)=IDUM(I)-3
0018      30  CONTINUE
0019      IF(NEST.GT.6) GC TC 100
0020      GO TO 10
C
C      ST. 1
C
0021      40  S1(NERW,4)=IDUM(INDX(1))
0022      S1(NERW,5)=IDUM(INDX(2))
0023      GO TO 10
C
C      ST. 2
C
0024      50  S2(NERW,1)=IDUM(INDX(1))
0025      S2(NERW,2)=IDUM(INDX(2))
0026      S2(NERW,4)=IDUM(INDX(3))
0027      S2(NERW,5)=IDUM(INDX(4))
0028      GO TO 10
C
C      ST. 3
C
0029      60  S3(NERW,2)=IDUM(INDX(1))
0030      S3(NERW,5)=IDUM(INDX(2))
0031      GO TO 10
C
C      ST. 4
C
0032      70  S4(NERW,4)=IDUM(INDX(1))
0033      S4(NERW,5)=IDUM(INDX(2))
0034      GO TO 10
C
C      ST. 5
C
0035      80  S5(NERW,5)=IDUM(INDX(1))
```

0036 GC TO 10
C
C ST. 6
C
0037 90 SE(NBRW,S)=IDUM(INDX(1))
0038 GC TO 10
C
C TABLES FCLLCW
C
0039 100 NEST=NEST-6
0040 GC TO (110,120,130),NEST
C
C TAELE-2 (ST. 7)
C
0041 110 READ 98,KOMP,IN,NEST,NBRW,(DUM(I),I=1,5)
0042 IF(IN.NE.0) GC TO 10
0043 T2(NBRW,1)=DUM(INDX(1))
0044 T2(NBRW,2)=DUM(INDX(2))
0045 T2(NBRW,3)=DUM(INDX(3))
0046 T2(NBRW,4)=DUM(INDX(4))
0047 T2(NBRW,5)=DUM(INDX(5))
0048 GO TO 110
C
C TABLE-3 (ST. 8)
C
0049 120 READ 97,KOMP,IN,NEST,NBRW,(DUM(I),I=1,7)
0050 IF(IN.NE.0) GO TO 10
0051 T3(NBRW,4)=DUM(INDX(1))
0052 T3(NBRW,5)=DUM(INDX(2))
0053 GO TO 120
C
C TAELE-6 (ST. 9)
C
0054 130 IF(NBRW.GE. 4) GC TO 140
0055 135 READ 96,KOMP,IN,NEST,NBRW,(DUM(I),I=1,6)
0056 GO TO 150
0057 140 IF(NBRW.EQ. 5) GC TO 135
0058 IF(NBRW.EQ.11) GC TO 135
0059 READ 95,KOMP,IN,NEST,NBRW,(DUM(I),I=1,6)
0060 IF(KC&F.EQ.0) RETURN
0061 150 GO 160 I=1,6
0062 T6(NBRW,I)=DUM(INDX(I))
0063 160 CONTINUE
0064 IF(NBRW.EC.3)GO TO 140
0065 GO TO 130
0066 99 FORMAT(I2,1X,I1,1X,I2,3X,7I10)
0067 98 FORMAT(I2,I1,I1,1X,I2,3X,3F10.0,F10.4,F10.0)
0068 97 FORMAT(I2,I1,I1,1X,I2,3X,7F10.0)
0069 96 FORMAT(I2,I1,I1,1X,I2,3X,6F10.0)
0070 95 FORMAT(I2,I1,I1,1X,I2,3X,6F10.6)
0071 END

OPTIONS IN EFFECT NOTERM,IC,EBCDIC,SOURCE,NCLIST,NCDECK,LCAD,NGMAP,NOTEST
OPTIONS IN EFFECT NAME = READER , LINECNT = 56

0001 FUNCTION KUMUL2(MAT,IC,I,J,INC,LI,LS)
0002 DIMENSION MAT(1)
0003 ISCM=0
0004 DO 10 K=LI,LS
0005 INL=K+IC*(J-1)
0006 IF(INC.EQ.2) INL=I+IC*(K-1)
0007 ISCM=ISCM+MAT(INL)
0008 10 CONTINUE
0009 KUMUL2=ISCM
0010 RETURN
0011 END

OPTIONS IN EFFECT NOTERM,IC,EBCDIC,SOURCE,NCLIST,NODECK,LCAC,NOMAP,NOTEST

OPTIONS IN EFFECT NAME = KUMUL2 , LINECNT = 56

STATISTICS SOURCE STATEMENTS = 11,PROGRAM SIZE = 000244

STATISTICS NO DIAGNOSTICS GENERATED

0001 FUNCTION XRATIC(XNUM, XDEN)
0002 XNUM=XNUM
0003 XDEN=XDEN
0004 XRATIC=XNUM/XDEN
0005 RETURN
0006 END

OPTIONS IN EFFECT NCTERM, IC, EBCDIC, SOURCE, NCLIST, NCDECK, LCAE, NOHAP, NCTEST

OPTIONS IN EFFECT NAME = XRATIC LINECNT = 56

STATISTICS SOURCE STATEMENTS = 6, PROGRAM SIZE = 000186

STATISTICS NO DIAGNOSTICS GENERATED

0001 SUBROUTINE ASSEM
0002 INTEGER VECRE,S1,S2,S3,S4,S5,S6,YEAR(4)
0003 COMMON/TRSS/NAT(8,6),NATA(12,2),MATL(24,2)
0004 COMMON/THIS/NAT(7,4),MATI(25)
0005 COMMON/TRSU/NATS(22)
0006 COMMON/TRRE/VECRE(10)
0007 COMMON/TRNY/NNCIE(5),LAN,KREG,KODE(3,4),YEAR
0008 COMMON/USUAL1/S1(22,6),T1(5,1)
0009 COMMON/USUAL2/S2(27,6),T2(6,9)
0010 COMMON/USUAL3/S3(13,6),T3(6,5)
0011 COMMON/USUAL4/S4(9,6),T4(6,6)
0012 COMMON/USUAL5/S5(15,6),T5(5,1)
0013 COMMON/USUAL6/S6(7,6),T6(15,6)
0014 COMMON/USUAL7/SR(2,27)
0015 C (I.S.)
0016 ISTARS=99999999
0017 K=4
0018 1900 DO 2000 I=1,7
0019 DO 2000 J=1,4
0020 2000 NAT(I,J)=0
0021 IF(K.NE.4)GO TO 2200
0022 2100 CONTINUE
0023 NAT(1,1)=S1(9,1)
0024 NAT(1,2)=S1(9,2)
0025 NAT(2,1)=S1(11,1)
0026 NAT(2,2)=S1(11,2)
0027 NAT(3,1)=S1(12,1)
0028 NAT(3,2)=S1(12,2)
0029 NAT(4,1)=S1(13,1)
0030 NAT(4,2)=S1(13,2)
0031 NAT(5,1)=S1(14,1)
0032 NAT(5,2)=S1(14,2)
0033 NAT(6,1)=S1(10,1)
0034 NAT(6,2)=S1(10,2)
0035 2200 CONTINUE
0036 NAT(1,3)=S1(9,5)
0037 NAT(2,3)=S1(11,5)
0038 NAT(3,3)=S1(12,5)
0039 NAT(4,3)=S1(13,5)
0040 NAT(5,3)=S1(14,5)
0041 NAT(6,3)=S1(10,5)
0042 IF(K.EQ.6)GO TO 2100
0043 2300 DO 2400 I=1,6
0044 DO 2400 J=1,3
0045 NAT(I,4)=NAT(I,4)+NAT(I,J)
0046 2400 CONTINUE
0047 DO 2500 J=1,4
0048 DO 2500 I=1,6
0049 NAT(7,J)=NAT(7,J)+NAT(I,J)
0050 2500 CONTINUE
0051 DO 2600 I=1,22
0052 MATI(I)=0
0053 2600 CONTINUE

```
0054      MATI(1)=SI(1,K)
0055      MATI(2)=SI(2,K)
0056      MATI(3)=SI(3,K)
C
0057      MATI(4)=C
C
0058      MATI(5)=SI(4,K)
0059      MATI(6)=SI(5,K)
0060      MATI(7)=SI(6,K)
0061      MATI(8)=SI(7,K)
0062      MATI(9)=SI(8,K)
0063      MATI(10)=SI(15,K)
0064      MATI(11)=SI(16,K)
0065      MATI(12)=ISTARS
0066      MATI(13)=ISTARS
0067      MATI(14)=ISTARS
0068      MATI(15)=SI(17,K)
0069      MATI(16)=SI(18,K)
0070      MATI(25)=SI(19,K)
0071      MATI(17)=SI(20,K)
0072      MATI(18)=ISTARS
0073      MATI(19)=ISTARS
0074      MATI(20)=ISTARS
0075      MATI(21)=SI(21,K)
0076      MATI(22)=SI(22,K)
0077      MATI(23)=ISTARS
0078      MATI(24)=SI(22,K)
C      END I.S.
0079      DO 2700 I=1,8
0080      DO 2700 J=1,6
0081      MAT(I,J)=0
0082      2700  CCNTINUE
0083      DO 2800 I=1,24
0084      DO 2800 J=1,2
0085      IF(I.LE.12)MATA(I,J)=0
0086      MAT(I,J)=0
0087      2800  CONTINUE
C      B.S.    ASS.
0088      N=I
0089      IF(K.EC.S)N=2
0090      IF(K.EC.6)N=3
0091      MAT(1,1)=S2(1,N)
0092      MAT(1,2)=S2(2,N)
0093      MAT(1,3)=S2(3,N)
0094      MAT(1,4)=S2(1,N+3)
0095      MAT(1,5)=S2(2,N+3)
0096      MAT(1,6)=S2(3,N+3)
0097      MAT(2,1)=S2(4,N)
0098      MAT(2,2)=S2(5,N)
0099      MAT(2,3)=S2(6,N)
0100      MAT(2,4)=S2(4,N+3)
0101      MAT(2,5)=S2(5,N+3)
0102      MAT(2,6)=S2(6,N+3)
0103      MAT(3,1)=S2(7,N)
```

0104 MAT(3,2)=S2(8,N)
0105 MAT(3,3)=S2(9,N)
0106 MAT(3,4)=S2(7,N+3)
0107 MAT(3,5)=S2(8,N+3)
0108 MAT(3,6)=S2(9,N+3)
0109 MAT(4,1)=S2(10,N)
0110 MAT(4,2)=S2(11,N)
0111 MAT(4,3)=S2(12,N)
0112 MAT(4,4)=S2(10,N+3)
0113 MAT(4,5)=S2(11,N+3)
0114 MAT(4,6)=S2(12,N+3)
0115 MAT(5,1)=S2(13,N)
0116 MAT(5,2)=S2(14,N)
0117 MAT(5,3)=S2(15,N)
0118 MAT(5,4)=S2(13,N+3)
0119 MAT(5,5)=S2(14,N+3)
0120 MAT(5,6)=S2(15,N+3)
0121 MAT(6,1)=S2(16,N)
0122 MAT(6,3)=S2(16,N)
0123 MAT(6,4)=S2(16,N+3)
0124 MAT(6,6)=S2(16,N+3)
0125 MAT(7,1)=S2(17,N)
0126 MAT(7,3)=S2(17,N)
0127 MAT(7,4)=S2(17,N+3)
0128 MAT(7,6)=S2(17,N+3)
0129 DO 2900 J=1,6
0130 DO 2900 I=1,7
0131 MAT(8,J)=MAT(8,J)+MAT(I,J)
0132 2900 CONTINUE
0133 MATA(1,1)=ISTARS
0134 MATA(1,2)=ISTARS
0135 MATA(2,1)=ISTARS
0136 MATA(2,2)=ISTARS
0137 MATA(3,1)=S2(21,N)
0138 MATA(3,2)=S2(21,N+3)
0139 DO 3000 I=4,7
0140 DO 3000 J=1,2
0141 MATA(I,J)=ISTARS
0142 3000 CONTINUE
0143 MATA(8,1)=S2(25,N)
0144 MATA(8,2)=S2(25,N+3)
0145 MATA(9,1)=ISTARS
0146 MATA(9,2)=ISTARS
0147 MATA(10,1)=ISTARS
0148 MATA(10,2)=ISTARS
0149 MATA(11,1)=S2(26,N)
0150 MATA(11,2)=S2(26,N+3)
0151 MATA(12,1)=S2(27,N)
0152 MATA(12,2)=S2(27,N+3)
0153 C B.S. LEAB
0154 DC 3100 I=1,10
0155 II=I
0156 IF(I.GE.7)II=I-1
 IF(I.EQ.7)GO TO 3100

```
0157      MATL(I,1)=S3(11,N)
0158      MATL(I,2)=S3(11,N+3)
0159      3100  CONTINUE
0160      DO 3200 I=11,17
0161      MATL(I,1)=ISTARS
0162      MATL(I,2)=ISTARS
0163      3200  CONTINUE
0164      MATL(18,1)=S3(12,N)
0165      MATL(18,2)=S3(12,N+3)
0166      MATL(19,1)=ISTARS
0167      MATL(19,2)=ISTARS
0168      MATL(20,1)=ISTARS
0169      MATL(20,2)=ISTARS
0170      MATL(21,1)=S3(11,N)
0171      MATL(21,2)=S3(11,N+3)
0172      MATL(22,1)=S3(12,N)
0173      MATL(22,2)=S3(12,N+3)
0174      MATL(23,1)=S3(12,N)
0175      MATL(23,2)=S3(12,N+3)
0176      MATL(24,1)=S3(12,N)
0177      MATL(24,2)=S3(13,N+3)
0178      DO 3300 I=1,22
0179      3300  MATS(I)=C
          C   S + U OF FUNDS
0180      N=N+3
0181      MATS(1)=SS(1,M)
0182      MATS(2)=SS(2,M)
0183      MATS(3)=SS(3,M)
0184      MATS(4)=SS(4,M)
0185      MATS(5)=SS(5,M)
0186      MATS(6)=MATS(4)+MATS(5)
0187      MATS(7)=SS(6,M)
0188      MATS(8)=SS(7,M)
0189      MATS(9)=SS(8,M)
0190      MATS(10)=SS(9,M)
0191      MATS(11)=SS(10,M)
0192      MATS(12)=SS(11,M)
0193      MATS(13)=SS(12,M)
0194      MATS(14)=SS(13,M)
0195      MATS(15)=SS(15,M)
0196      MATS(16)=S6(1,M)
0197      MATS(17)=S6(2,M)
0198      MATS(18)=S6(3,M)
0199      MATS(19)=S6(4,M)
0200      MATS(20)=S6(5,M)
0201      MATS(21)=S6(6,M)
0202      MATS(22)=S6(7,M)
0203      DO 3400 I=1,10
0204      VECRE(I)=0
0205      3400  CONTINUE
          C   R.E.
0206      VECRE(1)=S4(1,M)
0207      VECRE(2)=S4(2,M)
0208      VECRE(3)=S4(3,M)
```

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```
0209      VECRE(4)=S4(4,M)
0210      VECRE(5)=S4(5,M)
0211      VECRE(6)=VECRE(4)+VECRE(5)
0212      VECRE(7)=S4(6,M)
0213      VECRE(8)=S4(7,M)
0214      VECRE(9)=S4(8,M)
0215      VECRE(10)=S4(9,M)
0216      KREG=K-3
0217      CALL AFCAM
0218      IF(K.EQ.6)GO TO 3500
0219      K=K+1
0220      GO TO 1900
0221      3500  CONTINUE
0222      PRINT 99, NMCIE, YEAR, (KCDE(1,J),J=1,4), (KCDE(3,J),J=1,4)
0223      PRINT 98, (J, SR(1,J), SR(2,J),J=1,27)
0224      RETURN
0225      99  FORMAT(IH1,12X,E44.4,13X,"SIGNIFICANT RATIOS - ",4I2,
     1      ",10X,4A4,1-4,4A4)
0226      98  FORMAT('   SR#',I2,7X,F10.5," : ",4X,F10.5)
0227      97  FORMAT(//,(2X,17,2X,17,2X,17,2X,17,2X,17,2X,17))
0228      END
```

OPTIONS IN EFFECT NOTERM, ID, EBCDIC, SOURCE, NCLIST, NCDECK, LCAD, NOVAP, NCTEST

OPTIONS IN EFFECT NAME = ASSEM, LINECNT = 56

STATISTICS SOURCE STATEMENTS = 228, PROGRAM SIZE = 001570

STATISTICS NO DIAGNOSTICS GENERATED

0001 SLEROLTINE AFORM

C
C P R I S E E N F A C E (S C O R C E S A N D U S E S O F F U N D S)
C

```
0002      INTEGER MAT(8,6),MATA(12,2),MATL(24,2),MATI(25),MATS(22)
1,NAT(7,4),VCRE(10),NMCIE(5),YEAR(4),KCCE(3,4)
0003      COMMON/TRBS/MAT,MATA,MATL
0004      COMMON/TRIS/NAT,MATI
0005      COMMON/TRSU/MATS
0006      COMMON/TRRE/VCRE
0007      COMMON/TRNY/NMCIE,LAN,KREG,KCCE,YEAR
0008      LAN = 1971
0009      YEAR(1)=LAN/1000
0010      II=LAN-1000*YEAR(1)
0011      YEAR(2)=II/100
0012      I2=II-100*YEAR(2)
0013      YEAR(3)=I2/10
0014      YEAR(4)=I2-10*YEAR(3)
0015      PRINT 876,NMCIE
0016      876  FORMAT('1',4X,5A4)
0017      PRINT 870,(KODE(KREG,I),I=1,4)
0018      870  FORMAT(4X,4A4)
0019      PRINT 899,YEAR
0020      899  FORMAT(34X,'INCOME STATEMENT - ',4I2,T110,
110H(' $1000'S))
0021      PRINT 898
0022      898  FORMAT(' /' REVENUE :'/ *-----')
0023      PRINT 895,(MATI(I),I=1,7)
0024      895  FORMAT(' INTER-TOLL - PUBLIC MESSAGE',T92,I7/
1      ' - PRIVATE LINES ',T92,I7/
2      ' - PROGRAM TRANSMISSION',T92,I7/
3      ' INTRA-TOLL',T92,I7/
4      ' TOTAL TOLL',T92,I7/
5      ' LOCAL',T92,I7/
6      ' OTHER',T92,I7)
0025      PRINT 894,MATI(E)
0026      894  FORMAT(' LESS UNCOLLECTIBLES',T90,' (',I7,')/T92,'-----')
0027      PRINT 892,MATI(S)
0028      892  FORMAT(' TOTAL OPERATING REVENUE',T103,I7)
0029      PRINT 891
0030      891  FORMAT(' EXPENSES :',T55,'INTER-REGIONAL',T76,'REGIONAL'
1' -----',T51,'SWITCHING TRANSMISSION',/ )
0031      PRINT 889,((NAT(I,K),K=1,4),I=1,6)
0032      889  FORMAT(' MAINTENANCE',TS3,I7,5X,I7,5X,I7,8X,I7/
1      ' TRAFFIC',TS3,I7,5X,I7,5X,I7,8X,I7/
2      ' COMMERCIAL & MARKETING',TS3,I7,5X,I7,5X,I7,8X,I7/
3      ' OTHER EXPENSES',TS3,I7,5X,I7,5X,I7,8X,I7/
4      ' TAXES OTHER THAN INCOME TAXES',TS3,I7,5X,I7,5X,I7,8X,I7/
5      ' DEPRECIATION',TS3,I7,5X,I7,5X,I7,8X,I7/
6 TS3,7(IH-1),5X,7(IH-1),5X,7(IH-1),8X,7(IH-1))
0033      PRINT 887,(NAT(7,I),I=1,4),MATI(10)
0034      887  FORMAT(' OPERATING EXPENSES',TS3,I7,5X,I7,5X,I7,8X,I7,T102,
1 ' (',I7,')/T103,7(IH-1))
0035      PRINT 8865,MATI(11)
```

6
0036 8865 FORMAT(/ * NET OPERATING REVENUE*,T103,I7/)
0037 PRINT 885
0038 885 FORMAT(* OTHER INCOME(NET) :*1X,19(1F-))
0039 PRINT 8845,(MATI(I),I=12,14)
0040 8845 FORMAT(* DIVIDEND FROM SUBSIDIARIES*,T93,I7/
1 * INCOME FROM OTHER INVESTMENTS*,T93,I7/
2 * MISCELLANEOUS INCOME*,T93,I7)
0041 PRINT 8925,MATI(15)
0042 8925 FFORMAT(T103,I7/)
0043 PRINT 8923,MATI(16)
0044 8923 FFORMAT(* INCOME BEFORE INCOME TAXES*/
1 * AND DEBT-SERVICE CHARGES*,T103,I7/)
0045 PRINT 8921,MATI(25)
0046 8921 FFORMAT(* INCOME TAXES:*,T92,I7/1X,13(1F-))
0047 PRINT 8922,MATI(17)
0048 8922 FORMAT(/3X,*INCOME BEFORE DEBT SERVICE CHARGES*,T103,I7/
1 3X,*DEBT SERVICE CHARGES :*,/3X,22(1F-))
0049 PRINT 70,(MATI(I),I=18,19)
0050 70 FFORMAT(* LONG TERM DEBT*,T93,I7/
1 * OTHER*,T93,I7)
0051 PRINT 71,MATI(20),MATI(21)
0052 71 FFORMAT(* AMORTIZATION OF LONG TERM DEBT ASSET*,T93,I7,3X,I7/T93
1 ,7(1H-),3X,7(1F-))
0053 PRINT 72,MATI(22)
0054 72 FFORMAT(* INCOME BEFORE EXTRAORDINARY ITEM*,T103,I7/)
0055 PRINT 73,MATI(23)
0056 73 FFORMAT(* EXTRAORDINARY ITEM :*,T103,I7/3X,20(1H-),T103,7(1H-)/)
0057 PRINT 74,MATI(24)
0058 74 FFORMAT(* NET INCOME*,T103,I7)
0059 PRINT 9551,NMCIE
0060 PRINT 9521,(KODE(KREG,I),I=1,4)
0061 PRINT 9521,YEAR
0062 9531 FORMAT(46X,*B A L A N C E S H E E T - *,4I2,T110,10H(\$1000'S))
0063 9551 FFORMAT('1', 52X,20A4)
0064 9521 FORMAT(57X,4A4)
0065 990 FFORMAT(* *)
0066 PRINT 998
0067 998 FORMAT(/33X,*ASSETS*,37X,':*:1,21*,*LIABILITIES*)
0068 PRINT 997
0069 997 FFORMAT(* *,130(1H-))
0070 PRINT 995
0071 995 FORMAT(24X,* AT BEGINNING OF YEAR :*,2X,* AT END OF YEAR :*,10X,
1 * :* AT BEGINNING OF YEAR :*,15X,* AT END OF YEAR :*)
0072 PRINT 993
0073 993 FORMAT(24X,22(1H-),3X,16(1H-),13X,22(1H-),16X,16(1H-))
0074 PRINT 991
0075 991 FFORMAT(* TELE. PROPERTY*,64X,*SHRLDERS CAP*)
0076 PRINT 954
0077 954 FFORMAT(3X,14(1H-),64X,12(1H-))
0078 PRINT 989,(MATL(1,J),J=1,2)
0079 989 FFORMAT(* *,78X,*CAP STOCK PREF. *,T102,I7,8X,I7)
0080 PRINT 988,(MATL(2,J),J=1,2)
0081 988 FFORMAT(19X,2(19X,*COST LESS*),* :* *,*CAP STOCK COM-IN-PR*,2X*
1 17,8X ,I7)

```
0082      PRINT 987,(MATL(3,J),J=1,2)
0083      987  FORMAT(22X,2('AT CEST ACC.CEF ACC.CEF   '),T77,':',T80,
115PHEI'NC EARNINGS.7X,I7,8X,I7)
0084      PRINT 9872
0085      9872  FORMAT(22X,6(7IH-),2X),':')
0086      PRINT 986,(MAT(1,J),J=1,6),(MATL(4,J),J=1,2)
0087      986  FCHMAT('SWITCHING',T22,6(I7,2X),T77,':',
1160,'TOTAL EQUITY',T110,I7,7X,I7)
0088      PRINT 985,(MAT(2,J),J=1,6)
0089      985  FORMAT('TRANSMISSION',T22,6(I7,2X),T77,':',T82,'DEET')
0090      PRINT 984,(MAT(3,J),J=1,6)
0091      984  FORMAT('STAT.EQUIP.',T22,6(I7,2X),T77,':',T82,'----')
0092      PRINT 983,(MAT(4,J),J=1,6),(MATL(5,J),J=1,2)
0093      983  FORMAT('GEN.EGLIP.',T22,6(I7,2X),T77,': ACVAN.FROM GVT',T102,
117,8X,I7)
0094      PRINT 982,(MAT(5,J),J=1,6),(MATL(6,J),J=1,2)
0095      982  FORMAT('BUILDINGS',T22,6(I7,2X),T77,': L.T.D. : ECNDS',T102,
117,8X,I7)
0096      PRINT 981
0097      981  FORMAT(T31,7(1H-),T59.7(1H-),T77,':')
0098      PRINT 980,(MAT(6,I),MAT(6,3),MAT(6,4),MAT(6,6)),(MATL(7,J),J=1,2)
0099      980  FCRMAT('LAND',T22,17,T40,I7,2X,I7,T67,I7,T77,':',T102,17,8X,I7)
0100      PRINT 979,(MAT(7,1),MAT(7,3),MAT(7,4),MAT(7,6)),(MATL(8,J),J=1,2)
0101      979  FORMAT('PLANT UNDER CONSTR.',T22,I7,T40,I7,2X,I7,T67,I7,T77,
117,8X,I7)
0102      PRINT 978,(MAT(8,J),J=1,6),(MATL(9,J),J=1,2)
0103      978  FORMAT('TOTAL',T22,6(I7,2X),T77,':',T80,'TOTAL DEBT',T110,I7,
117X,I7)
0104      PRINT 977
0105      977  FORMAT('----',T22,6(7(1H-),2X),T77,':',T110,7(1H-),7X,7(1H-))
0106      PRINT 976
0107      976  FORMAT('75(1H-),':')
0108      PRINT 975,(MATL(10,J),J=1,2)
0109      975  FORMAT(T80,15HTOTAL CAPITAL',T110,I7,7X,I7)
0110      PRINT 974
0111      974  FORMAT('INVESTMENTS',T80,15(1H-))
0112      PRINT 973
0113      973  FCRMAT(3X,11(1H-))
0114      PRINT 972,(MATA(1,J),J=1,2)
0115      972  FCRMAT('SUBSIDIARY CC.',T31,I7,11X,I7,T82,'CURRENT LIAB.')
0116      PRINT 971,(MATA(2,J),J=1,2)
0117      971  FORMAT('OTHER',T31,I7,11X,I7,T82,13(1H-))
0118      PRINT 970,(MATA(11,J),J=1,2)
0119      970  FORMAT(T80,'ACCT.PAYABLE',T102,I7,8X,I7)
0120      PRINT 969,(MATA(3,J),J=1,2),(MATL(12,J),J=1,2)
0121      969  FORMAT(T40,I7,T67,I7,T80,'DIV.PREFERRED',T102,I7,8X,I7)
0122      PRINT 968,(MATL(13,J),J=1,2)
0123      968  FORMAT(T80,'DIV.CMNCLN',T102,I7,8X,I7)
0124      PRINT 967,(MATL(14,J),J=1,2)
0125      967  FORMAT('CURRENT ASSETS',T80,'ACCRUED TAXES',T102,I7,8X,I7)
0126      PRINT 966,(MATL(15,J),J=1,2)
0127      966  FORMAT(3X,14(1H-),T80,'ACCRUED INTRSTS',T102,I7,8X,I7)
0128      PRINT 965,(MATA(4,J),J=1,2),(MATL(16,J),J=1,2)
0129      965  FORMAT('CASH & TEMP.INVES',T21,I7,11X,I7,T80,'ADV.BIL.FOR SERV')
```

```
1 T1C2,I7,8X,[7]
0130      PRINT 964,(MATA(5,J),J=1,2),(MATL(17,J),J=1,2)
0131      964 FORMAT(' ACCT.RECEIVABLE',T31,I7,1IX,I7,T80,'TRFR TC GVT OWNERS',
IT1C2, I7,8X,I7)
0132      PRINT 963,(MATA(6,J),J=1,2)
0133      963 FORMAT(' MAT SUPPLIES',T31,I7,1IX,I7,T102,7(1H-),8X,7(1H-))
0134      PRINT 962,(MATA(7,J),J=1,2),(MATL(18,J),J=1,2)
0135      962 FORMAT(' PREPAYMENTS',T31,I7,1IX,I7,T110,I7,7X,I7)
0136      PRINT 961,(MATA(8,J),J=1,2)
0137      961 FORMAT(T40,I7,T67,I7,T82,'DEFERRED TAXES'/T82,14(1H-))
0138      PRINT 960,(MATL(19,J),J=1,2)
0139      960 FORMAT(3X,'DEFERRED CHARGES',T80,'INCOME TAX',T102,I7,8X,I7)
0140      PRINT 959,(MATL(20,J),J=1,2)
0141      959 FORMAT(3X,16(1H-),T80,'UNANCR.INV.T.CRED',T102,I7,8X,I7)
0142      PRINT 958,(MATA(9,J),J=1,2)
0143      958 FORMAT(' UNANOR.L.T.C.EXPEN.',T31,I7,1IX,I7,T102,7(1H-),8X
I ,7(1H-))
0144      PRINT 957,(MATA(10,J),J=1,2),(MATL(21,J),J=1,2)
0145      957 FORMAT(' OTHER',T31,I7,1IX,I7,T110,I7,7X,I7)
0146      PRINT 956,(MATA(11,J),J=1,2)
0147      956 FORMAT(T40,I7,T67,I7,T82,15HCTH.DEF'D CRED.)
0148      PRINT 955
0149      955 FORMAT(T40,7(1H-),T67,7(1H-),T82,15(1H-))
0150      PRINT 9545,(MATL(22,J),J=1,2)
0151      9545 FORMAT(T80,'OTHER',T102,I7,8X,I7)
0152      PRINT 953
0153      953 FORMAT(T102,7(1H-),8X,7(1H-))
0154      PRINT 952,(MATL(23,J),J=1,2)
0155      952 FORMAT(T110,I7,7X,I7)
0156      PRINT 950
0157      950 FORMAT(T40,7(1H-),T67,7(1H-),T110,7(1H-),7X,7(1H-))
0158      PRINT 949,(MATA(12,J),J=1,2),(MATL(24,J),J=1,2)
0159      949 FORMAT(' TOTAL ASSETS',T40,I7,T67,I7,T80,'TOTAL LIABILITIES',T110,
1 I7,7X,I7)
0160      PRINT 948
0161      948 FORMAT(' -----',T40,7(1H-),T67,7(1H-),T80,I7(1H-),T110,
1 7(1H-),7X,7(1H-))
C
C     END OF BALANCE SHEET
C
0162      PRINT 699,NMCIE
0163      699 FORMAT('1',10X,5A4)
0164      PRINT 624,(KODE(KREG,I),I=1,4)
0165      624 FORMAT(15X,4A4)
0166      PRINT 698,YEAR
0167      698 FORMAT(9X,'RETAINED EARNINGS STATEMENT -',412,5X,10H(' $1000'S))
0168      PRINT 697,VCRE(1)
0169      697 FORMAT(//,'NET INCOME',T45,I7)
0170      PRINT 696,VCRE(2)
0171      696 FORMAT('PREFERRED SHARE DIVIDENDS',T44,*(0,I7,0)*,T45,7(1H-))
0172      PRINT 694,VCRE(3)
0173      694 FORMAT(' NET INCOME AFTER PREFERRED DIVIDENDS',T55,I7)
0174      PRINT 693,VCRE(4)
0175      693 FORMAT('COMMON SHARE DIVIDENDS',T45,I7)
```

```
0176      PRINT 692, VCRE(5)
0177      692  FCRMAT('TRANSFERS TO GOVERNMENT OWNERS',T45,I7/T45,7(1H-))
0178      PRINT 691, VCRE(6)
0179      691  FCRMAT(TE4,'(*,17,*)/T55,7(1H-))
0180      PRINT 689, VCRE(7)
0181      689  FCRMAT(' INCOME RETAINED',T55,I7)
0182      PRINT 688, VCRE(8)
0183      688  FCRMAT('CSHARE ISSUE EXPENSE',T54,'(*,17,*)')
0184      PRINT 687, VCRE(9)
0185      687  FORMAT('OTHER ADJUSTMENTS (NET)',T55,I7/T55,7(1H-))
0186      PRINT 686, VCRE(10)
0187      686  FORMAT('BALANCE END OF YEAR',T55,17)
0188      PRINT 799,NMCIE
0189      PRINT 797,(KODE(KREG,I),I=1,4)
0190      799  FCRMAT('1',1,51X,5A4)
0191      PRINT 798,YEAR
0192      798  FCRMAT(T22,'SOURCES AND USES OF FUNDS',
1 ' STATEMENT -*.2X,4I2,T11G,10F($1000'S)')
0193      797  FCRMAT(T56,4A4)
0194      PRINT 796
0195      796  FORMAT(/)
0196      PRINT 7971
0197      7971 FORMAT(' SOURCES:/* -----')
0198      PRINT 7965,MATS(1),MATS(2),MATS(3)
0199      7965 FCRMAT(T8,'NET INCOME',T101,I7/T8,'DIVIDEND AND TRANSFERS TO',
1 ' GOVERNMENT OWNERS',T99,'(*,T101,I7,*)/T101,7(1H-)/T8,
2 'INCOME RETAINED',T112,I7)
0200      PRINT 795,MATS(4),MATS(5),MATS(6)
0201      795  FCRMAT(T8,'DEFERRED INCOME TAX - CURRENT',T101,I7/T28,'- PRIOR',
1 T101,I7,T112,I7/T101,7(1H-))
0202      PRINT 794,MATS(7),MATS(8)
0203      794  FORMAT(T8,'DEPRECIATION AND OTHER NON CASH CHARGES (NET)',T112,I7,
1/T112,7(1H-)/T13,'TOTAL SOURCES FROM OPERATIONS (NET)',T112,I7/
2 T13,35(1H-))
0204      PRINT 793,MATS(9),MATS(10)
0205      793  FORMAT(T8,'ADDITIONS TO LONG TERM DEBT',T101,I7/T8,'LESS',
1 ' REPAYMENT OF LONG TERM DEBT AND INCREASE IN SINKING FUND ASSETS',
2 '*,T99,'(*,T101,I7,*)')
0206      PRINT 792,MATS(11),MATS(12),MATS(13),MATS(14)
0207      792  FORMAT(T8,'NET INCREASE IN LONG TERM DEBT EXCHANGINGS',T112,I7/
1 T8,'PREFERRED AND COMMON STOCK ISSUED',T112,I7/T8,'MISCELLANEOUS',
2 '*,T112,I7/T8,'REDUCTIONS OF WORKING CAPITAL',T112,I7/T112,7(1H-))
0208      PRINT 791,MATS(15)
0209      791  FORMAT(T8,'TOTAL SOURCES OF FUNDS',T123,I7/T13,22(1H-))
0210      PRINT 790,MATS(16),MATS(17),MATS(18)
0211      790  FORMAT(///' USES:/* ----- /T8,'GROSS CONSTRUCTION EXPENDITURES',
1 T112,I7/T8,'LEASE CHARGES NOT REQUIRING FUNDS',T111,'(*,17,*)'
2 T112,7(1H-)/T13,'NET CONSTRUCTION EXPENDITURE',T112,I7/T13,
3 28(1H-))
0212      PRINT 789,MATS(19),MATS(20),MATS(21),MATS(22)
0213      789  FORMAT(T8,'INVESTMENTS',T112,I7/T8,'MISCELLANEOUS',T112,I7/T8
1 'INCREASE OF WORKING CAPITAL',T112,I7/T112,7(1H-)/T13,
2 'TOTAL USES OF FUNDS',T123,I7/T13,19(1H-))
0214      RETURN
```

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0215

END

OPTIONS IN EFFECT NOTERM,IC,EBCDIC,SOURCE,NGLIST,NCDECK,LEAD,ROMAP,NCTEST

OPTIONS IN EFFECT NAME = AFORM LINECNT = 56

STATISTICS SOURCE STATEMENTS = 215,PROGRAM SIZE = 602EE0

STATISTICS NO DIAGNOSTICS GENERATED

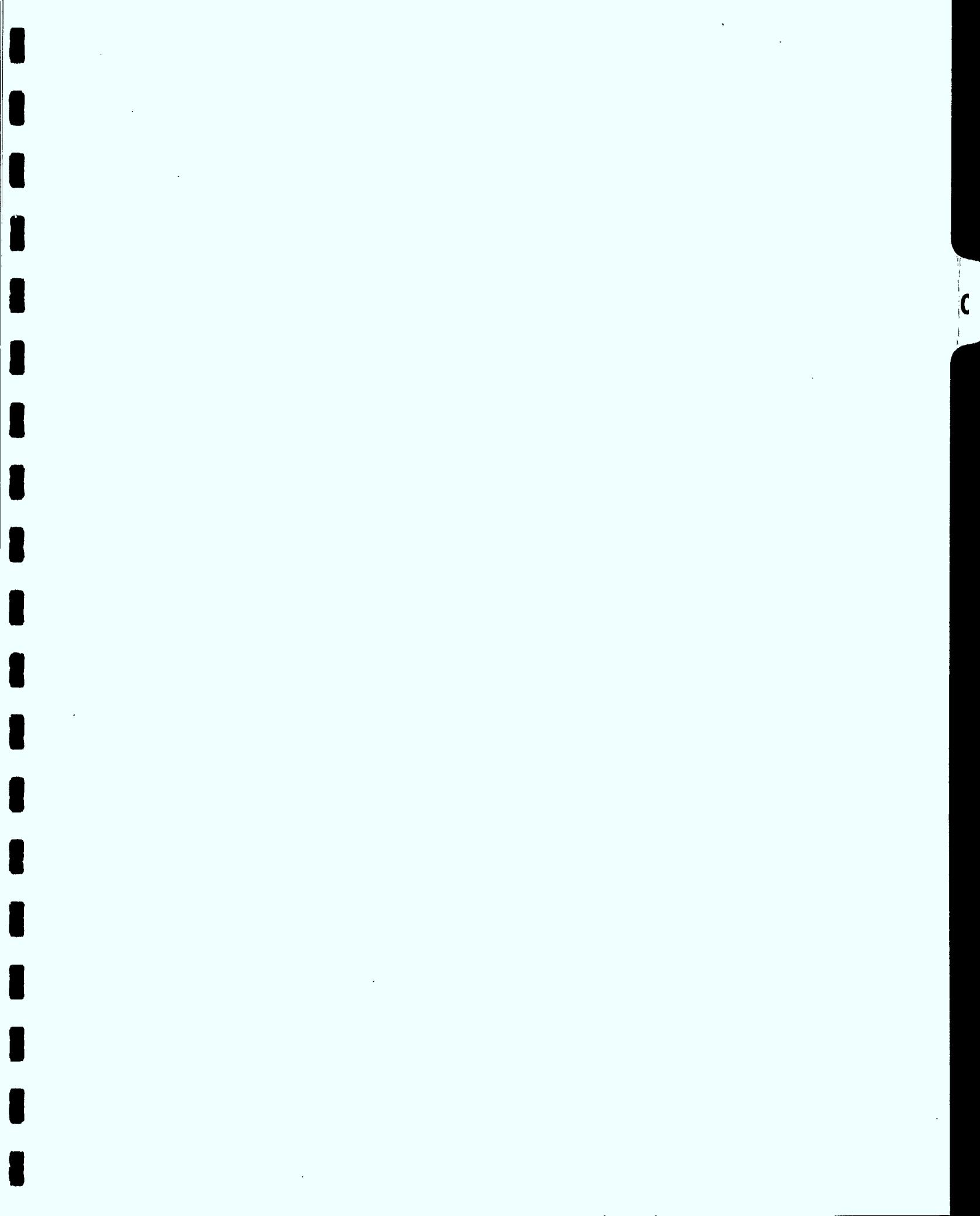
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/DATA

000000 BYTES USED

EXECUTION BEGINS 32.95

32.05



APPENDIX C

DESCRIPTION DU PROGRAMME "SIMEQ"

**(This appendix is not presently
available and will follow)**

sorēs inc.

SYSTEMS, OPERATIONS RESEARCH AND ECONOMIC STUDIES

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June 5th, 1974

Our Ref.: 1721

The attached is to be read in conjunction with the
"Final Report on the First Phase of the Project",
IRA Project, March 31st, 1974.

Annexe C - Description du Programme "SIMEQ", the
Listing (program listing) and Passe d'ordinateur
avec des résultats typiques (sample run) incorporate
Appendix C of the Final Report. Appendix D attached
replaces Appendix D of the Final Report, March 31st,
1974.

ANNEXE C

DESCRIPTION DU PROGRAMME "SIMEQ"

1. Description générale

Ce programme d'ordinateurs, écrit en APL, exécute des simulations du type de celles décrites dans la Sous-Section 5.3. du présent Rapport. Ces simulations sont effectuées par la résolution de systèmes d'équations simultanées. Il est important de noter que le programme ne pourra effectuer aucune simulation sur un système d'équations différent.

2. Mode d'emploi

Le programme, comme on pourra s'en convaincre à la vue de l'exemple annexé, pose une série de questions à l'utilisateur, auxquelles il suffit de répondre pour obtenir les résultats désirés.

- a) La première question sera

DONNER LE TAUX D'IMPOSITION

Il suffira de taper ce taux sous forme décimale (par exemple 0.46 pour 46%), et d'effectuer un retour de chariot pour répondre à cette question.

Ce taux d'imposition est nécessaire pour connaître les coefficients des variables New Debt et Operating Revenue dans la seconde équation.

- b) La seconde question sera:

DONNER LE COEFFICIENT DE LA VARIABLE NEW DEBT

De la même façon, on doit rentrer cette constante sous sa forme décimale. Cette constante (Constante 2A dans le texte) est: la moitié du taux d'intérêt sur les nouvelles obligations. On a besoin de cette constante pour connaître le coefficient de la variable New Debt dans la seconde équation du système.

- c) La question à laquelle on doit répondre ensuite est:

DONNER LA CONSTANTE 2 ENTRANT DANS LE
CALCUL DU RAPPORT RORC

Il s'agit de Constante ₂: elle est définie comme les frais du service de la dette, causés par la dette demeurant au début de l'année en cours diminuée de la moitié des remboursements.

Cette constante, qu'on voit également apparaître dans le membre droit de la seconde équation, est importante dans le calcul du rapport RORC.

- d) Il est ensuite demandé:

DONNER LE MEMBRE DROIT DES 4 PREMIERS EQUATIONS

Il faut alors donner, dans l'ordre, et séparés par des virgules, les résultats des 4 expressions suivantes:

i) Dividends-Depreciation+Gross Construction Exp.+Const₁

où la signification de Const₁ peut être trouvée dans le présent Rapport au paragraphe: Equation 1.

ii) -(1-tax rate)x(Depreciation+Operating Expenses
+Const₂)

où Const₂ est la constante mentionnée au paragraphe c) ci-dessus.

iii) $\text{Equity}_0 - \text{Dividends-Const}_3$

où Const_3 représente: "The Share Issue Expenses minus Other Adjustments (Net)".

iv) $\text{Debt}_0 - \text{Const}_4$

où Const_4 "consists of Repayment of long term debt and increase in sinking fund assets", selon les termes du présent Rapport.

Remarque: Un exemple de réponse à la question de ce paragraphe serait:

97193, 83749, 242047, 271160

Mais on peut aussi faire effectuer les opérations nécessaires, par exemple:

$(11062-228033+491731+264024), ((-1+0.5)\times(228033+712534+92196)),$
 $(1779671-110621+37443), (1652238-99134).$

On peut procéder ainsi à condition d'introduire chaque expression entre parenthèses, de séparer 2 expressions par une virgule et de s'assurer qu'à l'intérieur de chaque paire de parenthèses apparaît une expression APL valide. Il est par conséquent déconseillé d'utiliser ce mode d'enregistrement des données à tous ceux qui ne connaissent que très superficiellement le langage APL. On conseille plutôt à ces gens d'effectuer les différentes opérations séparément et d'utiliser ensuite le premier mode.

e) La question suivante sera:

DONNER LES NUMEROS DES VARIABLES PREDERMINEES,
EN ORDRE CROISSANT.

Voici les numéros des variables:

Net Income : 1
New Equity : 2

New Debt	:	3
Operating Revenue	:	5
Equity	:	6
Debt	:	7

Ces numéros ont été choisis de façon à respecter la notation maintenant traditionnelle. L'expression

2,3

constitue une réponse à la question et signifie que les variables New Equity et New Debt ont été choisies comme variables prédéterminées. L'expression

2,3,5

entraîne un message d'erreur, et un retour à la question parce qu'il ne peut y avoir ni plus ni moins de 2 variables prédéterminées. L'expression

3,2

n'entraîne aucun message d'erreur. Cependant dans la suite du programme il peut se poser des problèmes et une sortie anormale de la fonction, si les numéros sont entrés en ordre décroissant.

f) La dernière question concernant les données est:

DONNER LES VALEURS DES VARIABLES PREDETERMINEES,
DANS LE MEME ORDRE.

Il faut alors donner les valeurs des variables prédéterminées nommées à la question précédente.

Si on ne donne pas exactement 2 valeurs (séparées par une virgule), un message d'erreur apparaît et la question est reprise.

Ici se termine la partie questionnaire du programme.

3. Résultats

Les résultats de ce programme sont, dans l'ordre:

- a) La matrice décrivant le système, avec le numéro de la contrainte devant chaque ligne de la matrice, le nom de la variable correspondante au-dessus de chaque colonne, et le membre droit correspondant. Ainsi, en supposant que le système soit $Ax=b$, la matrice A et les vecteurs x et b seront clairement identifiés.
- b) La matrice inverse de la matrice A. Il peut être important de connaître A^{-1} pour effectuer des paramétrisations sur les coefficients de la matrice A.
- c) Les niveaux de toutes les variables, ces variables étant identifiées par leur nom, y compris les rapports DCR, RORE et RORC.

4. Sortie de la fonction

Le programme demande ensuite si on désire effectuer d'autres simulations:

DESIREZ-VOUS D'AUTRES SIMULATIONS AVEC LES
MEMES DONNEES?

A la réponse

NON

ou

NO

le programme s'arrête. A la réponse

OUI

ou

YES

Le programme recommence à la question du paragraphe 2e). Il faut remarquer qu'on ne peut en une seule fois passer plusieurs simulations avec des systèmes différents. Si tel est notre désir, il faut répondre NON à la question du paragraphe 4 chaque fois que l'on désire changer au moins un élément du système lui-même.

5. Autres fonctions requises

Pour exécuter ce programme, il faut dans le même espace de travail les fonctions

i) INV: qui se trouve dans la librairie 2
espace de travail STP4

ii) ΔFMT: qui se trouve dans la librairie 1
espace de travail ΔFMTHOW.

LISTING

```

VSIMEQ[[]]V
VSIMEQ[A;B;CEC;CND;C2;I;IN;L;MAT;MAT1;HOM;PRDT;RHS;RHS1;TR;VAL
[1] TR+[],OpM+'DONNER LE TAUX D''IMPOSITION'
[2] CND+[],OpM+'DONNER LA CONSTANTE DE LA VARIABLE NEW DEBT'
[3] C2+[],OpM+'DONNER LA CONSTANTE 2 ENTRANT DANS LE CALCUL DU RAPPORT EORG'
[4] MAT1+4 6 p(1 1 1 0 0 0 1 0),(CNDx1-TR),(TR-1),0 0 -1 1 0 0 1 0 0 0 -1 0 0 1
[5] RHS:=(pRHS1+[],OpM+'DONNER LE MEMBRE DROIT DES 4 PREMIERES EQUATIONS')*4)/ERR0
[6] DEP:=(pPRDT+PRDT-(PRDT+[])+3,OpM+'DONNER LES NUMEROIS DES VARIABLES PREDETERMINNEES')*2)/ERR1
[7] VA:=(pVAL+[],OpM+'DONNER LES VALEURS DES VARIABLES PREDETERMINNEES, DAHS LE MEME ORDRE')*2)/ERR2
[8] VA+VAL[PRDT]
[9] PRDT+PRDT[PRDT]
[10] L+14
[11] RHS+RHS1
[12] MAT+MAT1
[13] I+2
[14] L1:=(PRDT[I]>7)/RAP
[15] RHS+RHS-MAT[;PRDT[I]]*VAL[I]
[16] +(I+I-1)>1)/L1
[17] +SORT
[18] RAP:RHS+RHS,(PRDT[I]=9)*C2
[19] MAT+((pMAT+1 0)p(.MAT),((A=7)/(4p0),B,B-1),((A=8)/(-1,3p0),B,0),(9=A+PRDT[I])/(-1 0),(-CND),0,2pB+VAL[I])
[20] L+L,PRDT[I]-2
[21] +(I+I-1)>1)/L1
[22] SORT:MAT+MAT[;(CEC+~(PRDT[1]=16)vPRDT[2]=16)/16]
[23] HOM+ 9 8 p'NET INC.NEW EQY.NEW DEBTOPRV. EQUITY DEBT D.C.R. R.O.R.E.R.O.R.C.
[24]

```

LA MATRICE DE CE SYSTEME D'EQUATIONS EST:

```

[25] 'X8,8A1' AFMT((1,8*x+/CEC)^,HOM[CEC/16:1]
[26] 2 1 o'
[27] 'T2.8F16.6' AFMT((L[AL]):(MAT+MAT[AL]):(RHS+RHS[AL]))
[28]

```

ET LA MATRICE INVERSE EST:

```

[29] 2 1 o'
[30] 'X2.8F16.6' AFMT(IN+INV MAT)
[31] REP+(CEC\INV*xRHS)+(~CEC)(PRDT<7)/VAL
[32] REP+REP,(REP[6]++/REP[5 6]).(REP[1]+REP[5]).(REP[1]+C2+CND*REP[3])++/REP[5 6]
[33]

```

SOLUTION DE CETTE SIMULATION.
VARIABLES PREDETERMINNEES:

```

[34] ':HOM[PRDT[1]:]
[35] ',HOM[PRDT[?]:]
[36] 2 1 o'
[37] 'X3,8A1,M:M,X4,F15.6' AFMT(HOM:REP)
[38]

```

DESIREZ-VOUS D'AUTRES SIMULATIONS AVEC LES MEMES DONNES?

```

[39] +(C+M)[1]=*H'/0
[40] +DEP
[41] ERR0:'ERREUR DANS L''INTRODUCTION DU MEMBRE DROIT, Veuillez RECOMMENCER A'
[42] +RN
[43] ERR1:'ERREUR DANS L''INTRODUCTION DES NUMEROIS, Veuillez RECOMMENCER A'
[44] +DEP
[45] ERR2:'ERREUR DANS L''INTRODUCTION DES VALEURS, Veuillez RECOMMENCER A'
[46] +VA

```

PASSE D'ORDINATEUR AVEC DES RESULTATS TYPIQUES

SIMEQ

DONNER LE TAUX D'IMPOSITION

□:

.473

DONNER LA CONSTANTE DE LA VARIABLE NEW DEBT

□:

.0385

DONNER LA CONSTANTE 2 ENTRANT DANS LE CALCUL DU RAPPORT RORC

□:

19672.196

DONNER LE MEMBRE DROIT DES 4 PREMIERES EQUATIONS

□:

111078 -83749.78929 228162 271 160

ERREUR DANS L'INTRODUCTION DU MEMBRE DROIT, Veuillez RECOMMENCER A
DONNER LE MEMBRE DROIT DES 4 PREMIERES EQUATIONS

□:

111078,-83749.78929,228162 271160

DONNER LES NUMEROS DES VARIABLES PREDETERMINNEES

□:

3 5 6

ERREUR DANS L'INTRODUCTION DES NUMEROS, Veuillez RECOMMENCER A
DONNER LES NUMEROS DES VARIABLES PREDETERMINNEES

□:

3 5

PASSE D'ORDINATEUR AVEC DES RESULTATS TYPIQUES (suite)

DONNER LES VALEURS DES VARIABLES PREDETERMINES, DANS LE MEME ORDRE

Q:

0

ERREUR DANS L'INTRODUCTION DES VALEURS, Veuillez RECOMMENCER A
DONNER LES VALEURS DES VARIABLES PREDETERMINES, DANS LE MEME ORDRE

Q:

0.199892

LA MATRICE DE CE SYSTEME D'EQUATIONS EST:

	NET INC.	NEW EQY.	EQUITY	DEBT	
1	1.000000	1.000000	0.000000	0.000000	111078.000000
2	1.000000	0.000000	0.000000	0.000000	21593.294710
3	-1.000000	-1.000000	1.000000	0.000000	228162.000000
4	0.000000	0.000000	0.000000	1.000000	271150.000000

ET LA MATRICE INVERSE EST:

0.000000	1.000000	0.000000	0.000000
1.000000	-1.000000	0.000000	0.000000
1.000000	0.000000	1.000000	0.000000
0.000000	0.000000	0.000000	1.000000

SOLUTION DE CETTE SIMULATION.

VARIABLES PREDETERMINES:

NEW DEBT

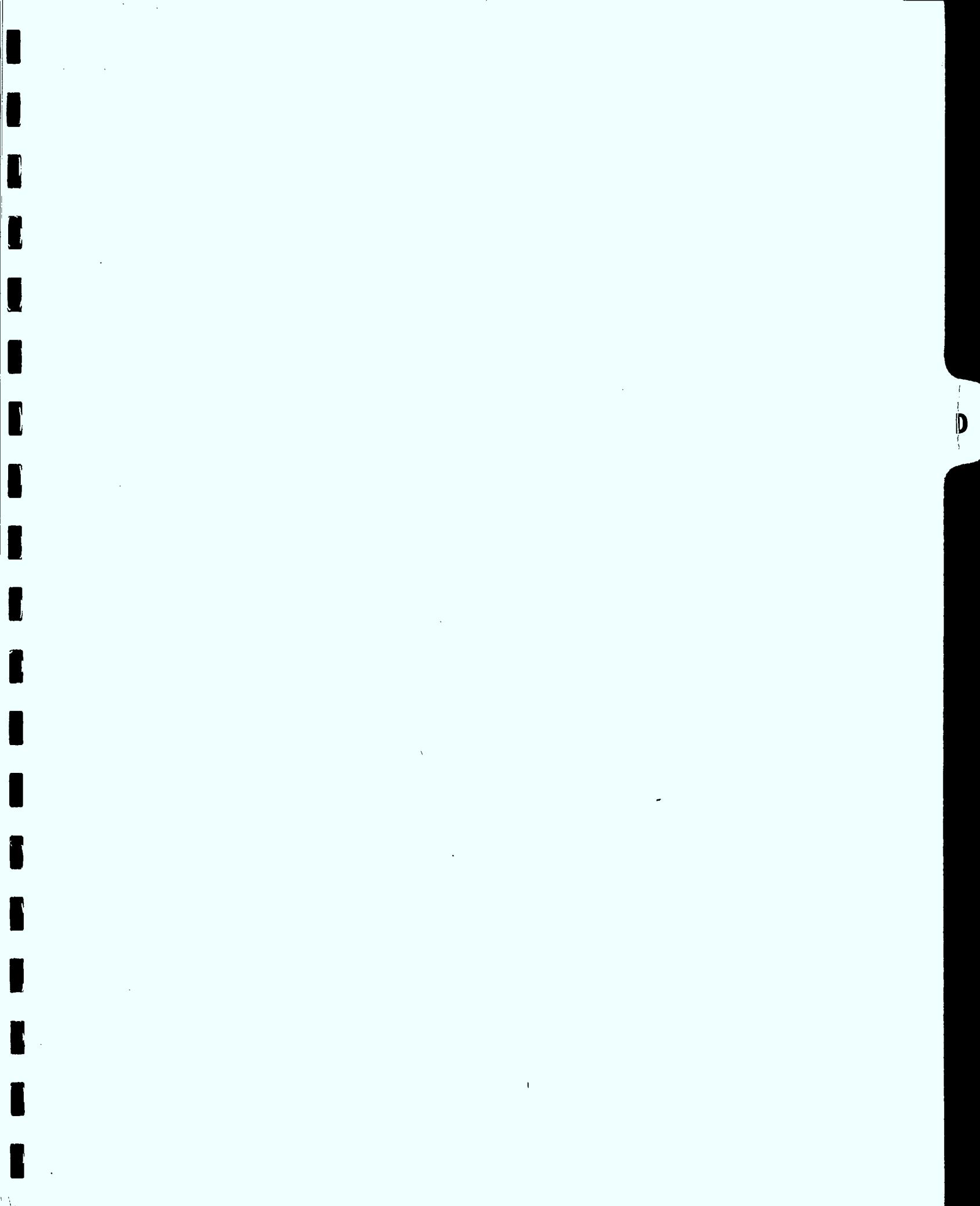
OPRV.

PASSE D'ORDINATEUR AVEC DES RESULTATS TYPIQUES (suite)

NET INC.:	21593.294710
NEW EQY.:	89484.705290
NEW DEBT:	0.000000
OPRV. :	199892.000000
EQUITY :	339240.000000
DEBT :	271160.000000
D.C.R. :	0.444233
R.O.R.E.:	0.063652
R.O.R.C.:	0.067604

DESIREZ-VOUS D'AUTRES SIMULATIONS AVEC LES MEMES DONNES?

NON MERCI



APPENDIX D

Definition of the variables

In the present Appendix, all variables will be represented by their corresponding symbol.

Net Income	x_1
New Equity	x_2
New Debt	x_3
Dividends	x_4
Operating Revenues	x_5
Equity	x_6
Debt	x_7
Debt-capital Ratio	x_8
Rate of return on equity	x_9
Rate of return of capital	x_{10}

Simulations by the linear equations system for B.C. Telephone (1971)

The system of linear equations with which we worked is the following, where the appropriate values for the exogeneous variables are given by B.C. Telephone's financial statements for the 1971 fiscal year.

- (1) $x_1 + x_2 + x_3 = 111,078$
- (2) $x_1 + 0.0203x_3 - 0.527x_5 = -83,749.79$
- (3) $-x_1 - x_2 + x_6 = 228,162$
- (4) $-x_3 + x_7 = 271,160$
- (5) $-x_8x_6 + (1-x_8)x_7 = 0$
- (6) $x_1 - x_9x_6 = 0$
- (7) $x_1 + 0.0385x_3 - x_{10}x_6 - x_{10}x_7 = -19,672.196$

The results of the simulations performed with the preceding system appear in the following table.

Results of simulations by the linear equations system for B.C. Telephone (1971)

Variables	Historical Value	NU. OF THE SIMULATIONS												
		1	2	3	4	5	6	7	8	9	10			
1. NET INC	20,209	21,593	26,920	19,740	25,177	21,592	19,840	23,435	26,108	21,623	24,797			
2. NEW EQY	20,145	89,488	84,158	*	0	*	*	0	18,219	84,970	55,414	52,241		
3. NEW DEBT	69,424	*	0	*	91,338	85,901	69,341	91,238	69,424	*	0	34,040	34,040	
4. DIV	13,885	13,885	13,885	13,885	13,885	13,885	13,885	13,885	13,885	13,885	13,885	*	13,885	
5. OPRV	199,892	199,892	210,000	199,892	210,000	202,559	200,078	206,059	208,458	201,259	207,282			
6. EQUITY	268,516	339,240	339,240	247,902	253,339	269,899	248,002	269,816	339,240	305,200	305,200			
7. DEBT	340,584	271,160	271,160	362,498	357,061	340,501	362,398	340,584	271,160	305,200	305,200			
8. DCR	0.5592	0.4442	0.4444	0.594	0.585	0.5578	0.5937	0.558	0.4442	0.5	0.5	*	*	
9. RORE	0.0753	0.0636	0.0793	0.08	0.1	*	*	0.08	0.0869	0.0769	0.0709	0.0813		
10.RORC	0.0698	0.0676	0.0763	0.07	0.08	0.072	0.0705	*	0.075	*	0.075	0.0698	*	0.075

* Predetermined values for the corresponding variable in the simulation.

As we have said in the text, one of the advantages of the approach by the system of linear equations is that we can evaluate the impact on the endogeneous variables of a modification in some (or all) parameters in the matrix of the coefficients or the right-hand side member. Suppose that the system can be represented in the general form by

$$Ax=c$$

where A is $(n \times n)$, x is $(n \times 1)$ et c is $(n \times 1)$. We restrict ourselves to the case where the number of unknowns is equal to the number of equations: of course, the general case can be easily deduced from this particular case.

Assuming that the inverse of A exists, one has

$$x = A^{-1}c$$

We are interested in a modification in the element CONST2A, where by definition this constant is equal to one half of the interest rate on new bonds. If we keep NEW DEBT and RORC constants, like in Simulation 7, the variation of CONST2A has consequences on the right hand side member of equations 2 and 7. The impact on the endogeneous variables will be given by the following formula

$$\frac{dx}{d \text{CONST2A}} = \frac{\partial A^{-1}}{\partial \text{CONST2A}} c + A^{-1} \frac{\partial c}{\partial \text{CONST2A}}$$

Since the matrix A will not be modified by a variation of CONST2A, so is A^{-1} and consequently the first term in the right-hand side is equal to zero. Also, as explained above,

$(\partial c_i / \partial \text{CONST2A}) = 0$, except for $i=2$ and 7. Then

$$\frac{dx}{d \text{CONST2A}} = A^{-1} \begin{bmatrix} 0 \\ c_2 / \partial \text{CONST2A} \\ 0 \\ 0 \\ \vdots \\ 0 \\ c_7 / \partial \text{CONST2A} \end{bmatrix}$$

Executing the appropriate calculations, one finds, for a variation of 0.0385 to 0.0485 of CONST2A, the following numbers

NET INC	:	22,740.74
NEW EQY	:	18,913.26
OPRV	:	205,436.81
EQUITY	:	269,816
DEBT	:	340,584
D.C.R.	:	0.558
R.O.R.E.	:	0.084

Comparing these results with those appearing in the preceding table, we found that the variables EQUITY, DEBT and DCR remain unchanged, while there is a small decrease in NET INC and RORE and a small increase in the other ones.

ANNEXE D

RESULTATS DES SIMULATIONS PAR LA PROGRAMMATION LINEAIRE POUR B.C. Téléphone (1971)

Pour toutes les simulations les quatres contraintes suivantes sont utilisées:

- $$(1) \quad x_1 + x_2 + x_3 - x_4 = 97,193$$
- $$(2) \quad -x_1 - 0.02029x_3 + 0.527x_5 = 83,749.8$$
- $$(3) \quad -x_1 - x_2 + x_4 + x_6 = 242,047$$
- $$(4) \quad -x_3 + x_7 = 271,160$$

Remarque: Pour toutes les simulations considérées, nous n'avons pas tenu compte de la variable RORC (rate of return on capital) puisque nous avons constaté qu'en ce faisant l'ensemble des solutions réalisables était toujours vide.

Les symboles ont la même définition que celle utilisée dans l'approche par le système d'équations linéaires.

SIMULATION II

Borne inf.	Variable	Borne sup.	Poids dans la fonction économique		
0.5	\leq	x_8	\leq	0.5592	2
0.0753	\leq	x_9	\leq	0.08	1
13,885	\leq	x_4	\leq	14,500	1
199,892	\leq	x_5	\leq	210,000	2

Solution optimale

$x_1 = 21,525$	$x_6 = 269,064$
$x_2 = 19,992$	$x_7 = 341,336$
$x_3 = 70,176$	$x_8 = 0.5592$
$x_4 = 14,500$ (b.s.)	$x_9 = 0.08$ (b.s.)
$x_5 = 202,464$	

Les résultats suivants donnent les champs de variations possibles pour le membre droit des quatre premières contraintes et les champs de variations possibles pour les bornes inférieures et supérieures pour les variables x_5 et x_4 qui laissent inchangés les solutions de base optimales. De plus, la dernière colonne contient les prix d'ordre ou variables duales associées aux différentes contraintes.

Contrainte	Activité	Borne inf.	Borne sup.	Prix d'ordre
1	97,193	68,107	182,395	0.4725
2	83,749.8	82,394	87,721	7.5902
3	242,047	212,961	275,678	0.4743
4	271,160	221,862	422,041	0.3203
x_5 (b.i.)	199,892	$-\infty$	202,464	-2
x_5 (b.s.)	210,000	202,464	∞	-2
x_4 (b.i.)	13,885	$-\infty$	14,500	-1
x_4 (b.s.)	14,500	13,885	∞	1

SIMULATION 12

Borne inf.	Variable	Borne sup.	Poids dans la fonction économique
0.5	$\leq x_8$	≤ 0.5592	1
0.0753	$\leq x_9$	≤ 0.08	1
199,892	$\leq x_5$	$\leq 210,000$	1
13,885	$\leq x_4$	$\leq 14,500$	1

Solution optimale

$$\begin{array}{ll}
 x_1 = 21,525 & x_6 = 269,064 \\
 x_2 = 19,992 & x_7 = 341,336 \\
 x_3 = 70,176 & x_8 = 0.5592 \\
 x_4 = 14,500 \text{ (b.s.)} & x_9 = 0.08 \text{ (b.s.)} \\
 x_5 = 202,464 &
 \end{array}$$

Contrainte	Activité	Borne inf.	Borne sup.	Prix d'ordre
1	97,193	68,107	182,395	0.2382
2	83,749.75	82,394	87,721	3.7951
3	242,047	212,961	327,249	0.2382
4	271,160	219,653	422,041	0.1612
x_5 (b.i.)	199,892	$-\infty$	202,464	-1
x_5 (b.s.)	210,000	202,464	∞	-1
x_4 (b.i.)	13,885	$-\infty$	14,500	-1
x_4 (b.s.)	14,500	13,885	∞	1

SIMULATION 13

Borne inf.	Variable	Borne sup.	Poids dans la fonction économique
0.0753	$\leq x_9$	≤ 0.08	2
20,209	$\leq x_2$	$\leq 50,000$	2
199,892	$\leq x_5$	$\leq 210,000$	1
13,885	$\leq x_4$	$\leq 14,500$	1

Solution optimale

$x_1 = 24,135$	$x_6 = 301,682$
$x_2 = 50,000$ (b.s.)	$x_7 = 308,718$
$x_3 = 37,558$	$x_8 = 0.5058$
$x_4 = 14,500$ (b.s.)	$x_9 = 0.08$ (b.s.)
$x_5 = 206,160$	

Contrainte	Activité	Borne inf.	Borne sup.	Prix d'ordre
1	97,193	- 65,614	196,932	0.154
2	83,749.75	80,446	85,773	7.59
3	242,047	203,273	265,801	0.6517
4	271,160	- 37,558	∞	0
x_2 (b.i.)	20,209	$-\infty$	50,000	-1
x_2 (b.s.)	50,000	20,209	81,180	1.4977
x_4 (b.i.)	13,885	$-\infty$	14,500	-1
x_4 (b.s.)	14,500	13,885	65,396	0.5023
x_5 (b.i.)	199,892	$-\infty$	206,160	-2
x_5 (b.s.)	210,000	206,160	∞	-2

SIMULATION 14

Borne inf.	Variable	Borne sup.	Poids dans la fonction économique
0.0753	x_9	≤ 0.08	1
20,209	x_2	$\leq 50,000$	1
199,892	x_5	$\leq 210,000$	1
13,885	x_4	$\leq 14,500$	1

Solution optimale

$x_1 = 24,135$	$x_6 = 301,682$
$x_2 = 50,000$ (b.s.)	$x_7 = 308,718$
$x_3 = 37,558$	$x_8 = 0.05058$
$x_4 = 14,500$ (b.s.)	$x_9 = 0.08$ (b.s.)
$x_5 = 206,160$	

Contrainte	Activité	Borne inf.	Borne sup.	Prix d'ordre
1	97,193	- 65,614	196,932	0.077
2	837,749.75	80,446	85,773	3.795
3	242,047	203,273	265,801	0.3284
4	271,160	- 37,558	∞	0
x_2 (b.i.)	20,209	$-\infty$	50,000	-1
x_2 (b.s.)	50,000	20,209	81,180	1.2514
x_4 (b.i.)	13,885	$-\infty$	14,500	-1
x_4 (b.s.)	14,500	13,885	65,396	0.7486
x_5 (b.i.)	199,892	$-\infty$	206,160	-1
x_5 (b.s.)	210,000	206,160	∞	-1

SIMULATION 15

Borne inf.		Variable	Borne sup.	Poids dans la fonction d'économique
0.0753	\leq	x_9	\leq 0.08	2
20,209	\leq	x_2	\leq 50,000	1
0	\leq	x_3	\leq 50,000	2
13,885	\leq	x_4	\leq 14,500	1

Solution optimale

$x_1 = 23,139$	$x_6 = 289,240$
$x_2 = 38,554$	$x_7 = 321,160$
$x_3 = 50,000$ (b.s.)	$x_8 = 0.5261$
$x_4 = 14,500$ (b.s.)	$x_9 = 0.08$ (b.s.)
$x_5 = 204,750$	

Contrainte	Activité	Borne inf.	Borne sup.	Prix d'ordre
1	97,193	77,253	109,634	1.8
2	83,749.75	-24,154	∞	0
3	242,047	98,970	471,357	-0.1
4	271,160	-50,000	∞	0
x_2 (b.i.)	20,209	$-\infty$	38,554	-1
x_2 (b.s.)	50,000	38,554	∞	-1
x_3 (b.i.)	0	$-\infty$	50,000	-2
x_3 (b.s.)	50,000	37,558	69,940	0.1
x_4 (b.i.)	13,885	$-\infty$	14,500	-1
x_4 (b.s.)	14,500	13,885	25,946	3

SIMULATION 16

Borne inf.	Variable	Borne sup.	Poids dans la fonction économique
0.0753	$\leq x_9$	≤ 0.08	1
20,209	$\leq x_2$	$\leq 50,000$	1
0	$\leq x_3$	$\leq 50,000$	1
13,885	$\leq x_4$	$\leq 14,500$	1

Solution optimale

$$\begin{aligned}
 x_1 &= 23,139 & x_6 &= 289,240 \\
 x_2 &= 38,554 & x_7 &= 321,160 \\
 x_3 &= 50,000 \text{ (b.s.)} & x_8 &= 0.5261 \\
 x_4 &= 14,500 \text{ (b.s.)} & x_9 &= 0.08 \text{ (b.s.)} \\
 x_5 &= 204,750
 \end{aligned}$$

Contrainte	Activité	Borne inf.	Borne sup.	Prix d'ordre
1	97,193	77,253	109,635	1.8447
2	83,749.75	- 24,154	∞	0
3	242,047	98,970	471,357	-0.1553
4	271,160	- 50,000	∞	0
x_2 (b.i.)	20,209	$-\infty$	38,554	-1
x_2 (b.s.)	50,000	38,554	∞	-1
x_3 (b.i.)	0	$-\infty$	50,000	-1
x_3 (b.s.)	50,000	37,558	69,940	-0.8447
x_4 (b.i.)	13,885	$-\infty$	14,500	-1
x_4 (b.s.)	14,500	13,885	25,946	3

SIMULATION 17

Borne inf.	Variable	Borne sup.	Poids dans la fonction économique
0.5	$\leq x_8$	≤ 0.5592	2
0.0753	$\leq x_9$	≤ 0.08	1
0	$\leq x_2$	$\leq 20,145$	1
0	$\leq x_3$	$\leq 50,000$	1
13,885	$\leq x_4$	$\leq 14,500$	1
199,892	$\leq x_5$	$\leq 210,000$	2

Solution non réalisable

SIMULATION 18

Identique en tout point à la Simulation 17, sauf pour les poids dans la fonction économique, qui sont tous égaux à 1.

E

NOM DE LA VARIABLE	QUANTITE	QUALITE	EXOGENE	INSTRUMENT	FIXE	VARIABLE(S) A CHANGER SIMULTANEMENT PARMI LES VARIABLES " INTRANTS ".	REMARQUES
<u>TRAFIG</u>							
1 ^e Messages publics	x	x					
Types de services	x	x				Tarif	
Types de clients	x	x				Tarif	
affaires							
ménages							
gouvernements							
Types de liaisons	x	x				Tarif	
intérieures							
Canada-U.S.A.							
Canada-autres pays							
Nombre d'origine-destination	x	x				Réseaux de commutation et physique, routage, capacité	
origine-destination	x	x	x				
Zone pour la distance	x		x				Selon l'origine et la destination.
Volume	x	x					
Taux de croissance	x	x				Capacité du réseau physique	A moins de changements marginaux.
Durée des messages	x		x			Tarif	
Zone horaire	x		x				Pour fin de tarification Ex.: ≤ 1 minute
Nombre de périodes dans la journée	x		x			Tarif	Pour fins de tarification pour la paire C-D.

INTRANTS DU MODELE IRA

(2)

NOM DE LA VARIABLE			VARIABLE(S) À CHANGER SIMULTANEMENT PARMI LES VARIABLES "INTRANTS"	REMARQUES
Nombre de périodes de trafic	x	x		Pour fin de distribution du trafic, pour la paire origine-destination.
Période de pointe	x	x	Capacité	
2 ^e Lignes privées commutées nombre d'origine-destination origine-destination zone pour la distance	x	x	Réseaux, capacité	Parfois et par endroits
non commutées nombre d'origine-destination origine-destination zone pour la distance	x	x	Réseaux, capacité	Parfois et par endroits
3 ^e Transmission des programmes nombre d'origine-destination origine-destination	x	x	Réseaux, capacité	

NOM DE LA VARIABLE	VARIABLE(S) A ECHANGER SIMULTANEMENT PARMI LES VARIABLES "INTRANTS"			REMARQUES
<u>CONFIGURATIONS DU RESEAU</u>				
<u>PHYSIQUE</u>				
Nombre de noeuds de commutation	x	x	Routage, capacité des noeuds, nombre d'arêtes	
Nombre d'arêtes	x	x	Routage, capacité des arêtes	
<u>CONFIGURATIONS DU ROUTAGE</u>				
Hiérarchie des noeuds	x	x	Capacité	
"High Usage"	x	x	Capacité de commutation	
"Finals"	x	x	Capacité de commutation	
"Full Groups"	x	x	Capacité de commutation	
Probabilités de perte et de débordement	x	x	Capacité	Quand on les diminue.
Règles de débordement	x	x	Capacité	Simple, multiplie.
Règles d'interconnexion	x	x		Libère de la capacité en général quand on favorise l'interconnexion.

INTRANTS DU MODELE IRA

(4)

NOM DE LA VARIABLE

VARIABLE(S) A CHANGER SIMULTANEMENT PARMI LES
VARIABLES "INTRANTS"

REMARQUES

PROPRIETE DES ELEMENTS DU
RESEAU :

Nombre d'exploitants

x

Trafic, routage, réseau

Toute consolidation possi-
ble

Régie centrale

x

x

Routage, schéma de partage

Surtout par l'intercon-
exion possible, un modèl-
de paiement est nécessair

Système T.C.T.S.

x

x

Trafic, routage, réseau, schéma de partage

Bell-Québec, Bell-Ontario

x

x

Que l'on peut combiner
avec les variables préce-
dentes.STRUCTURE DES COMPAGNIES

Intégration horizontale

x

x

Voir "Propriété..."
ci-dessus.

Intégration verticale

Intrants comptables exogènes

NOM DE LA VARIABLE				<u>INTRANTS DU MODELE IRA</u>	REMARQUES
VARIABLE(S) A CHANGER SIMULTANEMENT PARMI LES VARIABLES "INTRANTS"					
<u>FONCTIONS DE COUT</u>					
Obtention des prix des actifs aux noeuds sur les arêtes	x	x			Actifs physiques
Cout des équipements ("Capital cost")	x	x			
Coûts d'exploitation	x	x		Coûts des équipements	Si ces coûts sont affectés aux équipements.
<u>METHODES D'ETABLISSEMENT DES COUTS</u>					
Dépréciation	x	x			
Capitalisation ou dépenses	x	x		Coûts d'exploitation et coûts des équipements	
Coût du capital	x	x			
Impôts	x	x		Coûts du capital	

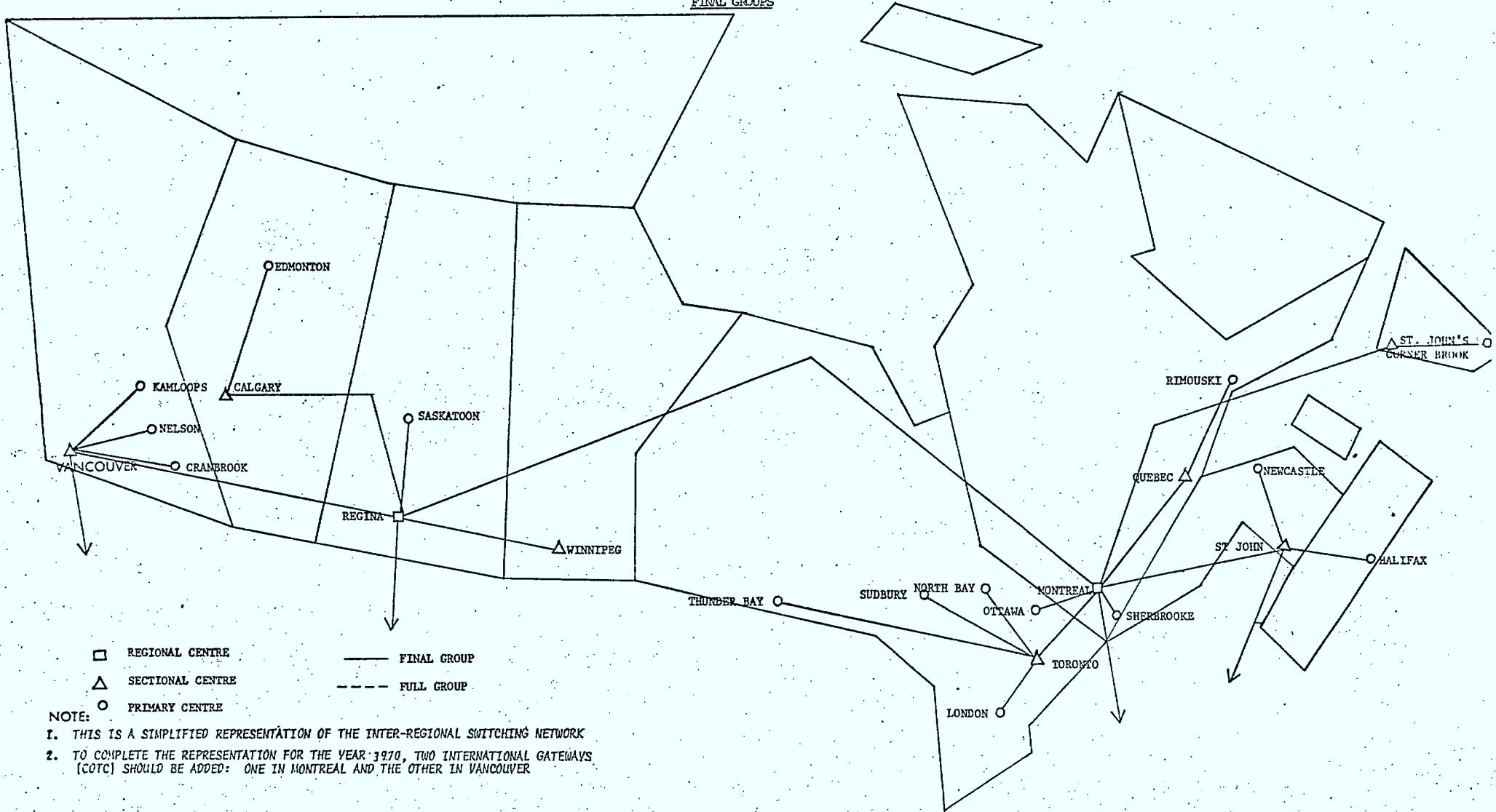
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APPENDIX F

**REDUCED INTER-REGIONAL SWITCHING NETWORK (LATE 1970):
FINAL GROUPS**

APPENDIX F REDUCED INTER-REGIONAL SWITCHING NETWORK (LATE 1970):

FINAL GROUPS



G

APPENDIX G

EXOGENOUS FINANCIAL INPUT

British Columbia Telephone Company

1. INCOME STATEMENT - 1971 (End of Year)

(Absolute Values in Thousands of Dollars)

Items	Inter-Regional			Interregional Total (4)	Regional Total (5)	Company Total (6)
	Switching (1)	Transmission (2)	Others (3)			
1.1. Toll - public message					59,527	
1.2. Toll - private lines					9,805	
1.3. Toll - program transmission & others					700	
1.4. Total toll service revenue (1+2+3)					70,032	
1.5. Local service revenue					93,444	
1.6. Miscellaneous revenues					6,722	
1.7. Uncollectibles					1,472	
1.8. Total operating revenue (4+5+6-7)					168,726	
1.9. Maintenance					37,416	
1.10. Depreciation					33,840	
1.11. Traffic					15,272	
1.12. Commercial & marketing					11,334	
1.13. Other expenses					20,289	
1.14. Taxes other than income taxes					6,762	
1.15. Operating expenses (9+10+11+12+13+14).....					124,913	
1.16. Net operating revenue (8 - 15)					43,813	
1.17. Other income (net)				0	1,423	
1.18. Income before income taxes and debt-service charges (16 + 17)					45,236	
1.19. Income taxes					11,451	

1. INCOME STATEMENT - 1971 (End of Year)

(Absolute Values in Thousands of Dollars)

Items	Inter-Regional			Interregional Total	Regional Total	Company Total
	Switching (1)	Transmission (2)	Others (3)			
1.20. Income before debt service charges (18 - 19)					33,785	
1.21. Debt service charges					19,613	
1.22. Net Income (20 - 21)					14,172	

Note 1

Exposition on Numeration of Item Numbers in Financial Statements and other Tabulations - Last digits refer to column numbers and digits next the last refer to row numbers; third digits from the last refer to Statements and Other Tabulations of a certain TCTS member, and the first digits to be prefixed refer to company numbers, which will be:

BC Tel 1; AGT, 2; SASK TEL, 3; MTS 4; Bell Canada, 5 ; NB TEL 6
MT & T 7; NEWFOUNDLAND TEL 8; TCTS 9

Note 2 numbers in brackets in items block in financial statements refer to row numbers

2. Balance Sheet (Assets) - 1971
 (Absolute Values in Thousands of Dollars)

Items	Beginning of Year			End of Year		
	Interregional (1)	Regional (2)	Company Total (3)	Interregional (4)	Regional (5)	Company Total (6)
2. 1. Switching - at Cost		259,458			293,335	
2. 2. Switching - Accum Depre		54,591			62,525	
2. 3. Switching - Property less Accum Depre (1 - 2)						
2. 4. Transmission - at Cost		151,303			171,047	
2. 5. Transmission - Accum Depre		27,745			32,032	
2. 6. Transmission - Property less Accum Depre(4 - 5)						
2. 7. Station Equipment - at cost		171,794			194,232	
2. 8. Station Equipment - Accum Depre.....		64,591			70,948	
2. 9. Station Equipment - (7-8)						
2.10. General Equipment - at Cost		14,212			16,068	
2.11. General Equipment - Accum Depre		6,210			6,789	
2.12. General Equipment - Property less Accum Depre						
2.13. Building - at Cost		49,056			55,461	
2.14. Building - Accum Depre		4,650			5,937	
2.15. Building - Property less Accum Depre.....						
2.16. Land		2,387			2,702	
2.17. Plant under Construction	2,266	16,621		2,527	18,532	
2.18. Telephone Plant at Cost (1 + 4 + 7 + 10 + 13 + 16 + 17).....		664,831			751,377	
2.19. Accumulated Depreciation (2 + 5 + 8 + 11 + 14)		157,787			172,721	
2.20. Telephone Property less Accum Depre (18 - 19)		507,044			573,146	

2. Balance Sheet (Assets) - 1971

(Absolute Values in Thousands of Dollars)

Items	Beginning of Year			End of Year		
	Interregional (1)	Regional (2)	Company Total (3)	Interregional (4)	Regional (5)	Company Total (6)
2. 21. Investment	210	1,567		405	3,018	
2. 22. Current Assets - Cash		292			551	
2. 23. Current Assets - Accounts Receivable		18,760			22,363	
2. 24. Other Current Assets		10,213			11,627	
2. 25. Total Current Assets (22 + 23 + 24)	3,928	29,265		4,636	34,541	
2. 26. Deferred Charges	1,807	7,453		693	5,165	
2. 27. Total Assets (20 + 21 + 25 + 26)		545,329			615,870	

Sources:

All items from D.O.C. Financial Handbook

3. Balance Sheet (Liabilities) - 1971

(Absolute Values in Thousands of Dollars)

Items	Beginning of Year			End of Year		
	Interregional (1)	Regional (2)	Company Total (3)	Interregional (4)	Regional (5)	Company Total (6)
3.1. Capital Stock - Preferred		66,425			73,247	
3.2. Capital Stock - Common including Premium		106,511			117,450	
3.3. Retained Earnings		39,996			43,568	
3.4. Total Shareholders Capital (1+2+3)		212,932			234,265	
3.5. Advances from Government		0			0	
3.6. Long Term Debt		250,230			277,397	
3.7. Notes Payable		17,682			19,743	
3.8. Total Debt (5+6+7)		267,912			297,140	
3.9. Total Capitalization (4+8)		480,844			531,405	
3.10. Current Liabilities		20,126			28,408	
3.11. Deferred Taxes		44,359			56,057	
3.12. Other Deferred Credits		0			0	
3.13. Total Liabilities (9+10+11+12)		545,329			615,870	

Sources (Numbers refer to Item numbers in the Statement above)

3.3 from Retained Earnings Statement

Rest of items from D.O.C. Financial Handbook

4. Retained Earnings Statement - 1971

(Absolute Values in Thousands of Dollars)

Items	Beginning of Year			End of Year		
	Interregional (1)	Regional (2)	Company Total (3)	Interregional (4)	Regional (5)	Company Total (6)
4.1. Net Income					14,172	
4.2. Preferred Share Dividends				1,317	3,074	
4.3. Net Income After Preferred Dividends (1-2)					11,098	
4.4. Common Share Dividends				3,029	6,465	
4.5. Transfer to Government Owners				0	0	
4.6. Income Retained (3-4-5)					4,633	
4.7. Share Issue Expense				35	81	
4.8. Other Adjustments (Net)				-420	-980	
4.9. Net Change (6-7+8)					3,572	
4.10 Balance, Beg of year					39,996	
4.11. Balance, End of year (4.9 + 4.10).....					43,568	

Sources (Numbers refer to item numbers in the Statement above)

4.1. from Income Statement

4.2, 4.4, 4.5, 4.7, 4.8. from D.O.C. Financial Handbooks

5. Sources of Funds Statement - 1971

(Absolute Values in Thousands of Dollars)

Items	Beginning of Year			End of Year		
	Interregional (1)	Regional (2)	Company Total (3)	Interregional (4)	Regional (5)	Company Total (6)
5.1. Net Income					14,172	
5.2. Dividends and transfers to government owners					9,539	
5.3. Income retained (1 - 2)					4,633	
5.4. Deferred income taxes - current					9,323	
5.5. Deferred income taxes - prior					2,375	
5.6. Depreciation and other non cash charges (net)					33,840	
5.7. Total sources from operations (net) (3+4+5+6)					50,171	
5.8. Additions to long term debt					61,203	
5.9. Repayments of long term debt and increase in sinking fund assets (Plus Bonds Issue Expense in 5.9)					31,975	
5.10. Net increase in long term debt borrowings (8-9)					29,228	
5.11. Preferred and common stock issued					17,761	
5.12. Miscellaneous					2,805	
5.13. Reductions of working capital					3,006	
5.14. Total external sources of funds (10+11+12+13)					52,800	
5.15. Total sources of funds (7+14)					102,971	

Sources (Numbers refer to item numbers in the Statement above)

1. from Income Statement
2. from Retained Earnings Statement
4. from D.O.C. Handbook or Table 4
- 5, 6, 8, 9, 11, 12, 13. from DOC Handbook

6. Uses of Funds Statement - 1971

(Absolute Values in Thousands of Dollars)

Items	Beginning of Year			End of Year		
	Interregional (1)	Regional (2)	Company Total (3)	Interregional (4)	Regional (5)	Company Total (6)
6.1. Gross Construction Expenditures					101,520	
6.2. Charges not Requiring Funds					-0-	
6.3. Net Construction Expenditures (1-2)					101,520	
6.4. Investments					1,451	
6.5. Miscellaneous					-0-	
6.6. Increase of Working Capital					-0-	
6.7. Total Uses of Funds (3+4+5+6)					102,971	

Sources

6.1, 6.2, 6.4, 6.5, from D.O.C. Financial Handbook

7. TELEPHONE PROPERTY AND DEPRECIATION

	<u>Cost at beginning of year (gross)</u>	<u>Additions</u>	<u>Retirements</u>	<u>Other Change</u>	<u>Net Addition to plant</u>	<u>Cost at end of year</u>	<u>Avg. Cost</u>	<u>Depreciation rate</u>	<u>Annual Depreciation</u>
	1	2	3	4	5=(2-3+4)	6=1+5	7=(1+6)÷2	8	9=7x8
7.1 Switching	259,458	39,864	5,987			293,335		.038778	11,375
7.2 Transmission	151,303	23,463	3,719			171,047		.035546	6,080
7.3 Station Equipment.....	171,794	26,243	3,805			194,232		.073253	14,228
7.4 General Equipment	14,212	2,184	328			16,068		.085449	1,373
7.5 Building	49,056	7,540	1,135			55,461		.014136	784
7.6 Land,.....	2,387	315	0			2,702			
7.7 Plant Under Construction	16,621	1,911	0			18,532			
7.8 Total Plant	664,831	101,520	14,974			751,377			33,840

8. NET CHANGE TO ACCUMULATED DEPRECIATION

	Annual Depreciation			Retirement			Cost of Removal			Salvage Value			Net Change Accum. Depreciation		
	Inter-regional	Regional	Company Total	Inter-regional	Regional	Company Total	Inter-regional	Regional	Company Total	Inter-regional	Regional	Company Total	Inter-regional	Regional	Company Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
8.1 Switching		11,375			5,987						2,546				7,934
8.2 Transmission		6,080			3,719						1,926				4,287
8.3 Station Equipment		14,228			3,805						-4,066				6,357
8.4 General Equipment		1,373			328						-466				579
8.5 Building		784			1,135						1,638				1,287
8.6 Total		33,840			14,974						1,578				20,444

(Absolute Values in Thousands of Dollars)

9. Telephone Service & Other Corporate Items

(Dollars = \$'000)

	Beginning of Year			End of Year		
	Interregnl	Regional	Total	Interregnl	Regional	Total
9.1 Wages & Salaries		74,217			Same as regional	88,724
9.2 Employees		9,636				10,274
9.3 Total Telepn in serv		1,037,684				1,099,791
9.4 Interest on L.T.D.			.06841		.06841	
9.5 Interest on New Bonds			.0777		.0777	
9.6 Other Non Charges			.0		.0	
9.7 DCR			.5582		.5582	
9.8 Ratio of Δ Exp net			.1		.1	
9.9 % of Misc Rev / Co's Gross Op Revenue						.03984
9.10 % of Uncolltbles / Co's Gross Op Revenue						.00872
9.11 Effective Inc Tx Rate						.47312
9.12 Dfd Inc Tx - Prior			321		.2375	
9.13 Ratio of UCCb / Tel Plant at Cost b of yr						.5891
9.14 Ratio of Net Addition			.9		.9	
9.15 Composite CCA Rate						.092

Table 17 - Ratios for Costing Block of Interregional Sector

17.1	Effective Tax Rate	.47312
17.2	Rate of Return on Equity	.0789
17.3	Debt Capital Ratio	.5582
17.4	Avr. Int. Rate on LTD	.06841
17.6	% of Working Capital/Co's Tot Net Asset (b. of y)	.0011

Table 17 - Ratios for Costing Block of Interregional Sector

17.7 Ratio of Tot Maint/Tot Gross Asset .....	.0532
17.9 Ratio of Tot Traf/Tot Gross Asset .....	.0217
17.11 Ratio of Tot C & M/Tot Gross Asset .....	.0161
17.13 Ratio of Tot Other Op Exp/Tot Gross Asset .....	.0288
17.15 Ratio of Tot Taxes Other than Income Taxes/Tot Gross Asset .....	.0096
17.27 Ratio of Tot Additions (SW) to Total Plant at Cost (b) .....	.0587
17.28 Ratio of Tot Additions (T) to Total Plant at Cost (b) .....	.0404
17.29 Ratio of Tot Additions (S) to Total Plant at Cost (b)	N/A
17.30 Ratio of Tot Additions (G) to Total Plant at Cost (b) .....	.0032
17.31 Ratio of Tot Additions (B) to Total Plant at Cost (b) .....	.0112
17.32 Ratio of Tot Additions (L) to Total Plant at Cost (b) .....	.0006
17.33 Ratio of Tot Retirements (SW) to Total Plant at Cost (b) .....	.0081
17.34 Ratio of Tot Retirements (T) to Total Plant at Cost (b) .....	.0056
17.35 Ratio of Tot Retirements (S) to Total Plant at Cost (b)	N/A
17.36 Ratio of Tot Retirements (G) to Total Plant at Cost (b) .....	.0004
17.37 Ratio of Tot Retirements (B) to Total Plant at Cost (b) .....	.0015
17.38 Ratio of Tot Retirements (L) to Total Plant at Cost (b)	0

Table 17 - Ratios for Costing Block of Interregional Sector

17.17	Ratio of Stat Eqp (S) / Inter Plant at Cost Tot	8%
17.18	Ratio of Stat Eqp (T) / Inter Plant at Cost Tot	8%
17.19	Ratio of Gnl Eqp (S) / Inter Plant at Cost Tot	2%
17.20	Ratio of Gnl Eqp (T) / Inter Plant at Cost Tot	2%
17.21	Ratio of Bldg (S) / Inter Plant at Cost Tot	7%
17.22	Ratio of Bldg (T) / Inter Plant at Cost Tot	7%
17.23	Ratio of Land (S) / Inter Plant at Cost Tot	1%
17.24	Ratio of Land (T) / Inter Plant at Cost Tot	1%
17.25	Ratio of Plant Under Const (S) / Inter Plant at Cost Tot	4%
17.26	Ratio of Plant Under Const (T) / Inter Plant at Cost Tot	4%

Table "A"
Regional Dfd. Inc. Tx. (Current)
(B.C. Tel)

- A) Dfd Inc Tx (Current) = 9,323
- B) Efftv Inc Tx Rate (Regional) = .473182
- C) Taxbl Inc for Dfd Inc Tx = $\textcircled{A} \div \textcircled{B}$ = 19,703
- C) $\textcircled{C} = \text{CCA} - \text{Depr. (Annual)} + \Delta \text{Exp}$
- 1) Annual Dep = 33,840
 - 2) $\Delta \text{Exp} = .1 * [\text{OP Exp} - \text{Depr}] = .1 * [91,073] = 9,107$
 - 3) CCA = $\textcircled{C} + \textcircled{1} - \textcircled{2} = 19,703 + 33,840 - 9,107 = 44,436$
- D) Composite CCA Rate = 9.2%
- E) UCC (end of yr) = CCA \div composite CCA rate = $44,436 \div .092 = 483,000$
- F) Net Addn = $.9 * \text{Gross Constrn Exp} = .9 \times 101,520 = 91,368$
- G) UCC (beg of yr) = $\textcircled{E} - \textcircled{F} = 483,000 - 91,368 = 391,632$
- H) Ratio of $\text{UCC}_b / \text{Tel Plant}_b = \frac{391,632}{664,831} = .58907$
(item 9.13)

Table "B"

Flow Through Income Tax (In Company Books)

(For Newfoundland Telephone)

- a) Net operating Revenue (1.16)
- b) Less: Debt Service Charges (1.21)
- c) Less: CCA (see col. 2) - Depreciation (1.10)
- d) Less: Δ Exp (See Col. 1)
- e) Taxable Income
- f) Times: Effective Tax Rate (See Col. 2)
- g) Income Tax Payable
- h) Add: Deferred Tax Prior (9.12)
- i) Income Tax as per Company Books

Calculation 1

$$\Delta \text{Exp} = \text{Ratio of } \Delta \text{Exp Net (9.8)} * [Opr. Exp (1.15) - Depr (1.10)]$$

Calculation 2 (Equation 1):

$$\text{Normalized Deferred Taxes} = [(CCA - Depr.) + \Delta \text{Exp}] * \text{Eff. Tax Rate}$$

Equation 2:

$$\text{Eff. Tax Rate} = \frac{g}{e}$$

Equation 3:

$$a - b - [CCA - Depr] - \Delta \text{Exp} = e$$

Table "C"

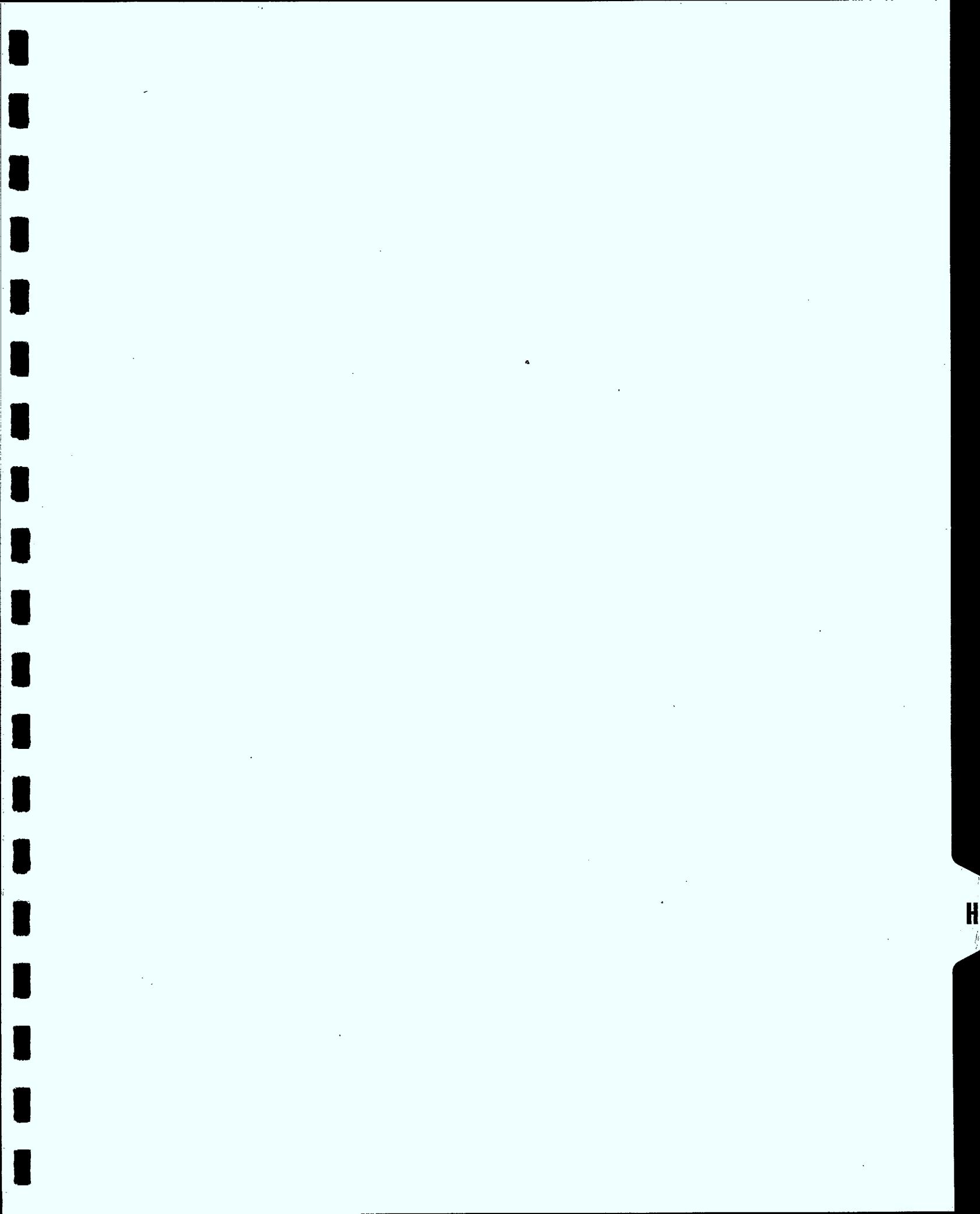
DSC and AIR Calculation

(B.C. Tel Regional)

- 1) NIR = 7.77%
- 2) ND = new debt = Δ TD = (Code # 5.8) = 61,203
- 3) Δ DSC = NIR \times $\frac{ND}{2}$ = .0777 \times 30,605 = 2,378
- 4) TD_b = 267,912
- 5) Repay = 31,975
- 6) DSC = 19,613
- 7) $DSC_b = DSC - \Delta DSC = 19,613 - 2,378 = 17,235$
- 8) $AIR = DSC_b \div (TD_b - \frac{Rep}{2}) = 17,235 \div (267,912 - 15,988)$
= 17,235 \div 251,924
 $\approx .068413$

Check

$$\begin{aligned} b) DSC &= AIR * \left[TD_b - \frac{Rep}{2} \right] + NIR * \frac{ND}{2} \\ &= .068413 * [267,912 - 15,988] + .077 * \frac{61,203}{2} \\ &= .068413 * 251,924 + .0777 * 30,602 \\ &= 17,235 + 2,378 \\ &= 19,613 \end{aligned}$$



APPENDIX H: DIMENSIONING CONVERSION FORMULAE

ERLANG-B FORMULA

The Erlang B formula used for traffic-to-trunk conversion in the IRA Model is the following:

$$E_n(x) = \frac{x E_{n-1}(x)}{n + x E_{n-1}(x)}$$

where n = no of circuits

x = traffic intensity (erlangs)

$E_n(x)$ = probability of overflow with n circuits and x erlangs offered traffic.

and initial condition $E_0(x) = 1$

This formula can be used recursively to obtain n for given x and $E_n(x)$

POISSON FORMULA

The poisson formula is derived from a model in queueing theory giving the probability of all circuits being busy, as a function of the number of circuits S and the traffic (in erlangs).

The formula for the probability of blocking (or congestion)

is $P_B(S, \rho) = 1 - \sum_{i=0}^S P(i)$

where $P(0) = 1 / (\sum_{i=0}^S \frac{\rho^i}{i!} + \frac{\rho^S}{S!(1-\rho)})$

and $P(i) = \frac{\rho^n}{n!} P(0)$

with $P_B(S, \rho)$ we use the formula interatively for given P by varying S in steps of 1 until the desired probability of blocking is obtained.

Beyond offered traffic of 30 erlangs the Poisson formula is nearly linear and the software uses a fitted linear regression to obtain traffic to circuits conversion in this case.

SWITCHING NODES

A uniform conversion formula is used for the dimensioning of all switching nodes as follows:

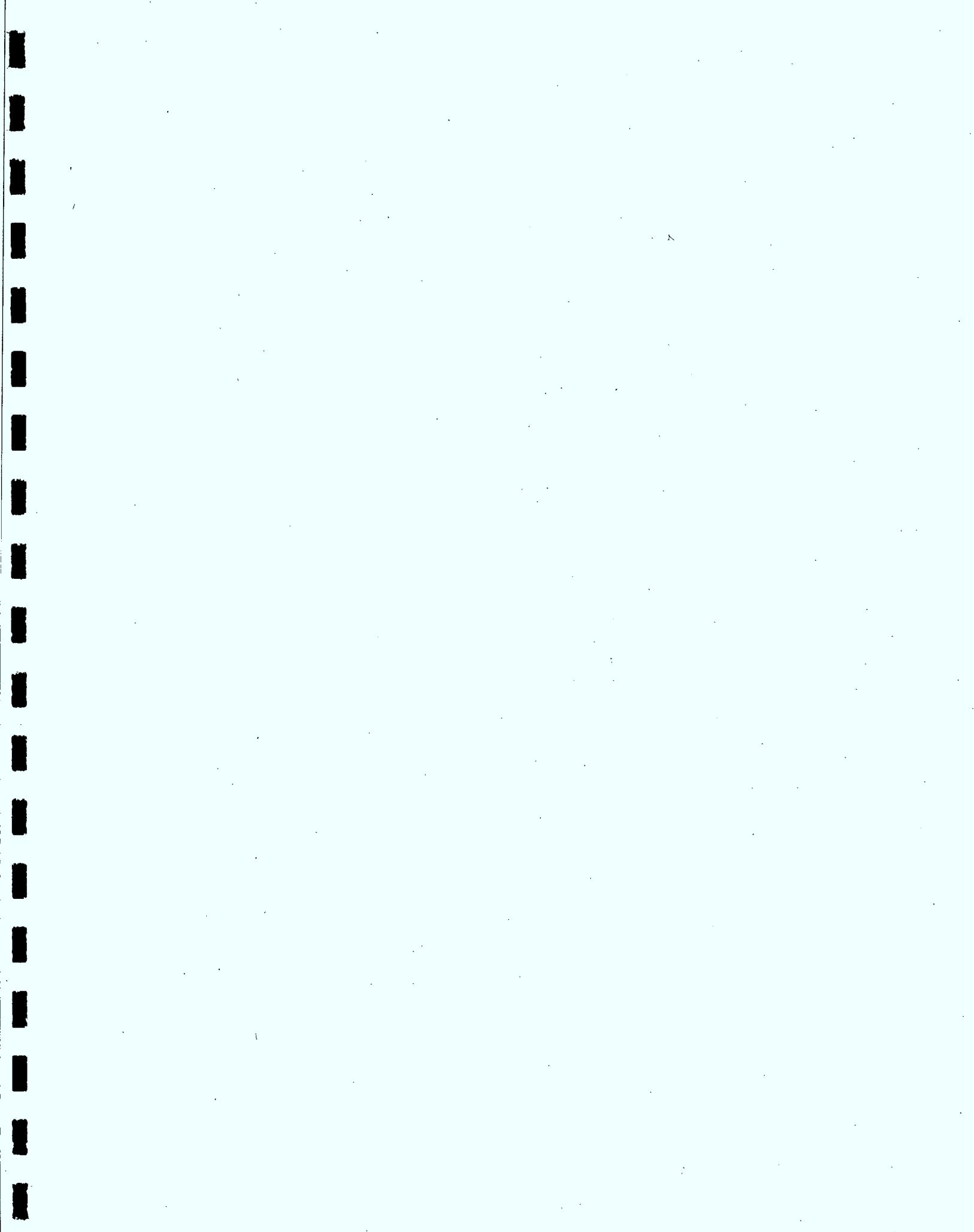
$$\text{no of circuits} = (\text{switched traffic in CCS})/(21)$$

Sample results of this formula are also shown in the table below.

Sample results from these three formulae are given below, for probability of congestion $P = .1$ in Erlang calculations and $P = .01$ in Poisson calculations.

TABLE

<u>Offered Traffic</u>	<u>Circuits</u>		<u>Trunks</u>
Erlangs	(Erlang-B)	(Poisson)	
1	3	4	1.71
2	4	6	3.42
3	6	8	5.14
4	7	10	6.85
5	8	11	8.57
6	9	13	10.29
7	10	14	11.99
8	11	16	13.71
9	12	17	15.42
10	13	18	17.14



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