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Communications Network Design and Costing Model

User's Manual

prepared by

SONALYSTS, INC.
215 Parkway North
Post Office Box 280
Waterford, Connecticut 06385

prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NASA Lewis Research Center
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16. Abstract

A Communications Network Design and Costing (CNDC) computer model provides the capability for analyzing long-haul communications networks. The model is well-suited for market assessment studies involving the integration of developing satellite communication systems into the environment of existing service offerings of licensed domestic and specialized interstate communications common carriers. A capability is provided for analyzing long-haul trunking networks comprising a set of user-defined cities, traffic conditions, and tariff rates. Networks may consist of all terrestrial connectivity, all satellite connectivity, or a combination of terrestrial and satellite connectivity. Network solutions provide the least-cost routes between all cities, the least-cost network routing configuration, and terrestrial and satellite service cost totals. The CNDC model allows analyses involving three specific FCC-approved tariffs, which are uniquely structured and representative of most existing service connectivity and pricing philosophies. User-defined tariffs that can be variations of these three tariffs are accepted as input to the model and allow considerable flexibility in network problem specification.

The resulting model extends the domain of network analysis from traditional fixed link cost (distance-sensitive) problems to more complex problems involving combinations of distance- and traffic-sensitive tariffs. A heuristic algorithm is developed to determine minimum cost network routing solutions specifying the location of satellite access cities and their hubbing terrestrial extensions for typical customer premise services.

This manual presents a detailed description of the CNDC computer model from the user's point of view.

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COMMUNICATIONS NETWORK DESIGN AND COSTING MODEL

USER'S MANUAL

JULY 1983

REVISIONS

This User's Manual describes the concepts and operating procedures of the Communications Network Design and Costing (CNDC) Model developed for NASA Lewis Research Center. All revisions to the original User's Manual produced in July 1983 are shown below by page and date of revision.

Page	Revision	Page	Revision	Page	Revision

PREFACE

MANUAL OBJECTIVES

The primary objective of this manual is to present the information and procedures needed to exercise the Communications Network Design and Costing (CNDC) Model for performing network analyses. Specific procedures are provided for executing the model on the NASA Lewis Research Center (LeRC) IBM 3033 computer. While some familiarity of the operating procedures will be helpful in understanding the model's operating environment, minimal knowledge of the LeRC computer is necessary. Descriptions are given of the concepts, functions, and data bases relating to the model. In addition, this manual also provides detailed descriptions of model parameters and their format specifications for running the model.

INTENDED AUDIENCE

This manual is intended as a tutorial for novice users of the CNDC Model, as well as a reference document for experienced network analysts. This manual, as well as the model itself, was designed for ease of use. The chapters are organized to correspond to the various user sessions of the model, providing a step by step guide through model execution.

STRUCTURE OF THE DOCUMENT

The manual is organized into four major parts:

Part I - Introduction to the CNDC Model,

Part II - Running the CNDC Model in INTERACTIVE Mode,

Part III - Running the CNDC Model in BATCH Mode, and

Part IV - Interpretation of CNDC Mode Outputs.

Part I presents an introduction to the CNDC Model. Chapter 1 provides an overview of the model concepts and summarizes the capabilities and uses of the model.

Chapter 2 discusses the relational nature of the various data structures within the data base. The information is presented in enough detail to allow the user to understand the interaction between the data base and the CNDC Model. Chapter 2 discusses the Traffic and Tariff data bases and also describes the construction and use of Execution Control Files. These user constructed files define the network problems to be analyzed by the model.

Part II presents detailed instructions for running the CNDC Model in INTERACTIVE mode. Chapter 3 provides a brief overview of the general program options and model operating procedures. Chapters 4, 5, and 6 give specific instructions to the user for creating network, tariff, and execution control files, respectively. Chapter 7 summarizes the procedures for running the model and obtaining output reports.

Part III presents detailed instructions for executing the CNDC Model in BATCH mode. Chapter 8 presents the general BATCH operating procedures within the LeRC IBM 3033 operating environment. It also discusses the various BATCH mode job control parameters and how they are used. This chapter provides a tutorial for creating and organizing BATCH input files and card decks and also summarizes the procedures for submitting BATCH runs.

Part IV discusses each of the model's output reports. A detailed discussion of each of the various reports is provided to allow the user to clearly interpret their meaning. Examples of output reports are presented along with annotated descriptions of the information they provide.

Any changes to the tariffs will be set forth in the Addendum.

ASSOCIATED DOCUMENTS

This manual is one volume of a three volume set of documentation on the CNDC Model. Supporting documents include the following:

Final Technical Report - Communications Network Design and Costing Model, and

Programmer's Manual - Communications Network Design and Costing Model.

The Final Technical Report contains a detailed description of the network optimization algorithms, as well as a summary of the work efforts throughout the project. The Programmer's Manual contains a programmer level description of the CNDC Model and its supporting data bases.

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CHAPTER 1 - OVERVIEW OF THE CNDC MODEL

This chapter provides a brief summary of the model's capabilities, the kinds of problems analyzed, and the types of input required and output reports produced. This chapter should be read first in order to achieve an overall understanding of the model.

1.1 INTRODUCTION

The CNDC Model is a tool for analyzing the market capture potential of postulated tariffs for a given network of cities. The model provides the capability to perform detailed investigations of voice traffic distribution changes on a service by service basis (terrestrial and satellite) given postulated tariffs. Network routing alternatives and costs are assessed by the model to determine optimal routing solutions.

The model allows the user to define the network analysis problem by specifying a network of cities and a set of applicable tariffs. In general, there are three problem types which can be analyzed using the model. These are:

- All terrestrial networks,
- All satellite networks, and
- Mixed terrestrial/satellite networks.

The problem type is defined by the types of tariffs specified as input for each analysis. For all terrestrial problems, some combination of a prestored AT&T and/or user-defined (AT&T type) tariffs are specified. All satellite problems are either WU type or SBS type. In either case, some combination of the prestored tariff and/or user-defined tariffs of a corresponding type are specified. Mixed terrestrial/satellite problems involve a single terrestrial tariff of any type and a single satellite tariff of any type.

The model uses the network and tariff files specified by the user to calculate: 1) the set of least-cost routes between all network cities (exclusive of other network traffic) and 2) a least-cost network solution (inclusive of the total network traffic). Each solution results in the identification of a set of optimal links between network cities.

1.2 OVERVIEW OF MODEL PROGRAM STRUCTURE

The CNDC Model consists of the following five primary program modules:

INPUT module,
INIT module,
COSTING module,
OPTIMIZATION module, and
OUTPUT module.

The logical relationship between the primary program modules is illustrated in figure 1-1.

The following paragraphs provide a brief description of each of the major program modules.

INPUT Module - All user input necessary for the execution of the CNDC Model is controlled through this module. Specifically, the user is provided the capability to construct one or more network files for analysis, select the desired common carrier tariffs to be used or create his own, and set input parameters controlling program execution. The user is provided with a convenient data base management capability with which to manipulate problem data sets.

INIT Module - All the necessary initialization functions required for program execution are performed by this module. Program variables, data arrays, and key data elements are set to their initial values. Input

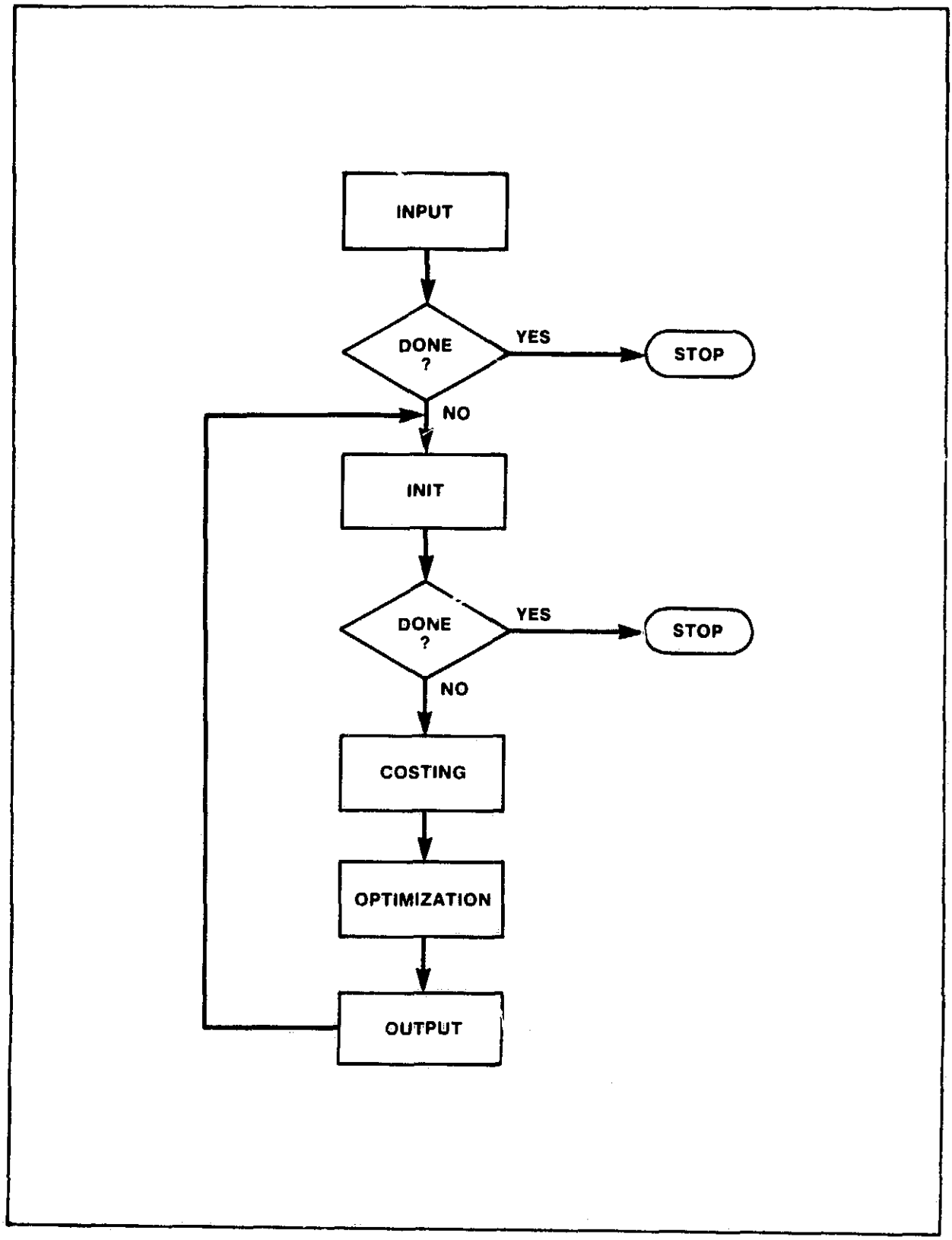

Figure 1-1. Overall Program Flow of CNDC Model

data are sorted and placed in the appropriate order for use by other program modules. Data files and internal storage arrays are also created.

COSTING Module - This module uses the network and tariff data specified as input to calculate link costs between all nodes of a specified network. Link costs are calculated for both terrestrial and satellite services and are dependent on the tariffs being used. The resulting link costs calculated by this module are used by other program modules.

OPTIMIZATION Module - The computer algorithms which solve the least-cost routing and least-cost network problems are contained in this module. The optimal selection of routing alternatives is based on the network file, traffic conditions, and the combination of tariffs specified during the INPUT session. The resulting network solutions are stored internally in the computer for use by other program modules which produce the output summary reports.

OUTPUT Module - The generation of all output reports resulting from an execution of the model are controlled by this module. Reports and tabular data files are the principle outputs. The user is provided with the capability of selecting the desired output reports during the INPUT session.

The user's only interface with the model is through the INPUT session controlled by the INPUT module. All other CNDC Model functions are transparent to the user. The majority of this manual provides information relating to the user's interface with the INPUT module.

1.3 OVERVIEW OF OPERATING PROCEDURES

The CNDC Model was designed for ease of use and maximum user flexibility. The user controls the execution of the model via one of two possible modes: INTERACTIVE or BATCH. In the INTERACTIVE mode, the user supplies

model inputs and performs data base operations interactively on a CRT terminal. In the BATCH mode, model input and control parameters are supplied from a card deck or disk file created off-line from the program. In either the INTERACTIVE or BATCH mode, the user has complete control of problem specification and setup. Network and tariff files can be created in either of the two modes.

The CNDC Model provides the user with the capability of specifying the types of networks to be analyzed. The user is able to build and maintain a library of network files, specifying the cities included in each network, as well as the voice traffic between them. The user has the option of entering a specific list of cities for each network definition or selecting cities from a prestored list of 350 Statistical Metropolitan Sampling Area (SMSA) cities. The user can maintain a library of up to 20 different network files.

The model provides the user with the same flexibility in specifying the types of tariffs to be used in network analysis problems. An option is provided to allow the user to select prestored and/or user-defined tariffs to be included in network problems. The prestored tariffs included in the model are:

- AT&T Tariff F.C.C. No. 260 - Private Line Service,
- AT&T Tariff F.C.C. No. 264 - List of Rate Centers,
- Western Union Tariff F.C.C. No. 261 - Satellite Transmission Service, and
- Satellite Business Systems Tariff F.C.C. No. 2 - Communications Network Service.

The user may define his own tariffs and use them to analyze market capture given postulated rates. User-defined tariffs must follow the same connectivity philosophy as one of the prestored tariffs. The model provides the user with the capability to build and maintain a library of the tariff files which contain the specifications for each user-defined tariff. Up to twelve different user-defined tariff files can be maintained in the tariff

library. The user may specify one or more of these files for inclusion in network problems, in addition to any of the three prestored tariffs.

The model allows the user to run several network analysis problems within a single execution. The user simply selects the network and tariff files for each problem from the libraries stored on disk. By specifying the names of the files in response to program prompts, the user defines each network analysis problem. During the INPUT session, the program also prompts for other types of user inputs. A detailed discussion of the INPUT session begins in chapter 3.

1.4 SUMMARY OF CNDC MODEL OUTPUTS

The CNDC Model generates six different output reports for each network analysis problem. Table 1-1 provides a summary of these reports and the information contained in each. The user is provided with the option of selecting the reports to be generated by the program during each problem run. Chapter 9 discusses in detail the information contained in the output reports.

TABLE 1-1 - SUMMARY OF CNDC MODEL OUTPUTS

OUTPUT REPORT 1 - INPUT AS OUTPUT

- LIST OF NETWORK CITIES
- TOTAL TRAFFIC LEVEL FOR NETWORK (VOICE CIRCUITS)
- LISTING OF EACH TARIFF USED

OUTPUT REPORT 2 - LEAST-COST ROUTE SOLUTION

- LISTING OF LEAST-COST ROUTE LINKS
- LINK SUMMARIES
  - TOTAL AIRLINE MILEAGE
  - TRAFFIC VOLUME ON LINK (VOICE CIRCUITS)
  - VOICE CIRCUIT FACILITY GROUPINGS (JUMBO, MASTER, SUPER, BASE)
  - COST PER CIRCUIT OVER LINK
  - TOTAL COST OF CIRCUITS OVER LINK
  - TARIFF USED
  - TYPE OF SERVICE USED (TERRESTRIAL OR SATELLITE)

OUTPUT REPORT 3 - LEAST-COST NETWORK SOLUTION

- LISTING OF LEAST-COST ROUTES
- LINK SUMMARIES (SAME AS REPORT 2)

OUTPUT REPORT 4 - NETWORK SUMMARY

- TOTAL TERRESTRIAL CIRCUIT MILEAGE
- TOTAL SATELLITE CIRCUIT MILEAGE
- TOTAL TERRESTRIAL TRAFFIC
- TOTAL SATELLITE TRAFFIC
- TOTAL NETWORK TRAFFIC
- TOTAL TERRESTRIAL COSTS
- TOTAL SATELLITE COSTS
- TOTAL NETWORK COSTS

OUTPUT REPORT 5 - TARIFF SUMMARY

- SUMMARY LIST FOR EACH TARIFF INCLUDED IN NETWORK SOLUTION
  - TOTAL CIRCUIT MILEAGE
  - TOTAL TRAFFIC
  - PERCENT OF NETWORK TRAFFIC USING TARIFF SERVICE
  - TOTAL NETWORK COST ASSOCIATED WITH TARIFF
  - PERCENT OF NETWORK COST ASSOCIATED WITH TARIFF SERVICE (TERRESTRIAL/SATELLITE)

OUTPUT REPORT 6 - TRAFFIC TABLE

- TRAFFIC VOLUME (VOICE CIRCUITS) BETWEEN ALL NETWORK CITY PAIRS

CHAPTER 2 - OVERVIEW OF THE CNDC MODEL DATA BASE

This chapter provides a summary of the data base which supports the CNDC Model. The objective of this chapter is to present the user with the types of information used by the model and to identify those specific data elements which the user must supply as input.

2.1 ORGANIZATIONAL STRUCTURE OF CNDC MODEL

The CNDC Model is comprised of programs and a supporting data base. The types of programs included in the model are categorized as either data base management programs or network analysis programs. The data base management programs provide the capability to create and maintain the data base which supports the CNDC model. The network analysis programs perform the costing and optimization functions of the model. Figure 2-1 depicts the relationship between the different types of programs and the CNDC data base.

The CNDC data base is comprised of two types of information: 1) prestored data and 2) user-defined data. The prestored data consists of the following:

- Master list of SMSA cities,
- Traffic between all SMSA city pairs,
- Tariff information on the actual communication carriers (ATT, WU, and SBS), and
- Library directories of user-defined networks and tariffs.

The information in the prestored portion of the CNDC data base cannot be directly modified by the user. The user-defined portion of the data base contains the information that the user will be changing to create different network problems. The user-defined data consists of the following:

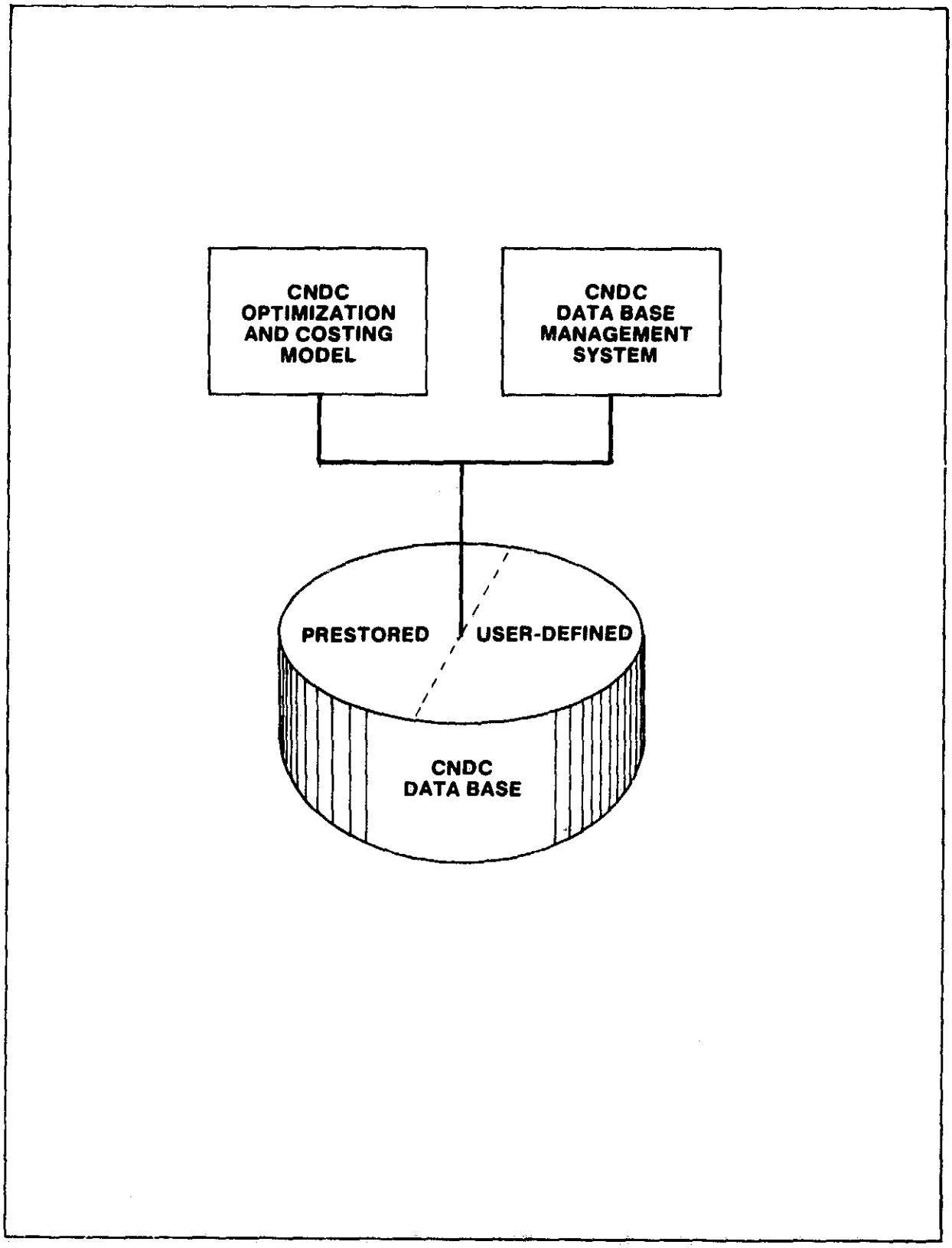

Figure 2-1. Major Components of the Communications Network Design and Costing Model

- User-defined networks,
- User-defined tariffs, and
- User-defined execution control file.

The information contained in both the prestored and user-defined portions of the CNDC data base are described in more detail in the following sections.

2.2 CNDC PRESTORED DATA BASE

The prestored data base contains a master list of SMSA cities and the traffic between them, rate and other information related to the actual ATT, WU, and SBS tariffs, and the directories for the user-defined tariff and network files. The computer files which contain the prestored data cannot be altered by the user.

The prestored master list of SMSA cities contains 350 city names and their associated alphabetic code names. When creating user-defined networks, the user may include any or all of these 350 cities in his network by specifying their code names as part of the input. The directional traffic between all pairs of cities in the master list is included in the prestored data base as a traffic table. The traffic table defines the traffic between any two node pairs as a percentage of the total traffic volume between all 350 SMSA cities. The user inputs the total traffic volume when defining a network and the percentages are converted to numbers of voice circuits by the program.

The type of prestored tariff data varies for each tariff. The prestored ATT tariff contains a list of the Private Line Service Category A rate centers and the rates for Series 2000/3000 channels between any two cities. Three different rate schedules are included in the prestored ATT tariff. The different schedules apply under the following conditions:

Schedule 1 - Both cities of a specified pair are category A rate centers,

Schedule 2 - Only one city of a specified pair is a category A rate center, and

Schedule 3 - Neither city of a specified pair is a category A rate center.

Each of the three ATT tariff schedules is defined by a table of rates which are a function of mileage between cities.

The prestored Western Union tariff contains a list of satellite access city pairs along with an indication of the channel category (long haul, medium haul, or short haul). The prestored tariff also contains the rate charges associated with each channel category.

The prestored Satellite Business Systems tariff contains the monthly rates for equipment applicable to the Series A Communications Network Service. Specifically, the prestored tariff contains monthly rates for Network Access Centers (NACs), Supplemental Capacity Units (SCUs), Full-Time Transmission Units (FTUs), and analog Channel Access Units (CAUs).

The CNDC Model maintains directories of user-defined tariff and network files. The model allows 12 tariff files and 20 network files to be defined by the user. The files are given standard names which cannot be changed by the user. The tariff and network directories contain status information on each file which indicates if the file is available for storage of a user-defined entry. Both the tariff and network directories are part of the prestored data base and cannot be directly altered by the user.

2.3 CNDC USER-DEFINED DATA BASE

The user-defined portion of the CNDC data base consists of the following:

- User-defined network files,
- User-defined tariff files, and
- User-defined execution control files.

The CNDC Model allows the user to define a network configuration for each problem run and to store this information in a network file. In defining a network, the user may specify which of the prestored SMSA cities are to be included in the network configuration. The user may also include cities not contained in the prestored SMSA list in his network. The traffic volume between all cities included in the network is specified as input by the user. During an INPUT session, the user enters all information which defines a network and saves it in an available network file. The file can then be specified as an input to a problem data set when the user creates execution control records. The user can store up to twenty separate network files at any one time.

The model provides the user with the capability to define postulated tariffs having the same connectivity philosophy as any of the three prestored tariffs. The user can store up to twelve separate tariff files at any one time.

In creating an ATT-type tariff, the user may redefine which cities are to be considered category A cities. The user can add new cities to the category A list of the actual ATT tariff or delete any cities from this same list. The user can also specify his own set rates for each of the three ATT tariff rate schedules.

In creating a WU-type tariff, the user may modify the actual WU tariff by adding satellite access city pairs or by deleting city pairs from the standard list in the WU tariff. The user can also define his own channel charges for short, medium, and long haul satellite channels.

In creating an SBS-type tariff, the user may specify his own monthly rates for any of the CNS-A equipment, including NACs, SCUs, FTUs, and CAUs.

In order to execute the CNDC Model, an execution control record must be specified for each network problem. The execution control record contains information the computer needs to read the appropriate data inputs, model the specified network, and produce the desired output reports. In creating an execution control record, the user must specify the following information:

- Problem identification number,
- Problem type (terrestrial, satellite, or mixed terrestrial/satellite),
- File name containing the user-defined network,
- File names containing the prestored or user-defined tariffs to be used, and
- Output reports desired.

The user can create several execution control records during on INPUT session to cause multiple network problems to be consecutively executed.

A detailed discussion of all user inputs is given in Part II - Running the CNDC Model (INTERACTIVE mode). The reader should pay close attention to the information and examples presented in this part of the manual.

CHAPTER 3 - GENERAL OPERATING MODES AND PROCEDURES

The CNDC Model can be executed in either of two modes: INTERACTIVE or BATCH. In the INTERACTIVE mode, the user supplies model inputs and performs data base operations interactively on a CRT terminal. In running the model in BATCH mode, input and control parameters are supplied from a card deck or disk file created off-line from the program. In either the INTERACTIVE or BATCH mode, the user has complete control of input file creation, problem specification, and output report generation. Chapters 4 through 7 provide the detailed procedures for the INTERACTIVE sessions. Chapter 8 provides the details for BATCH mode operation.

3.1 LOGON PROCEDURE FOR INTERACTIVE OPERATION

During the LOGON procedure, the user causes the computer to acknowledge his presence at a CRT terminal, to load in the CNDC programs and data files, and to begin executing the model. All user inputs on the CRT should be followed by pressing the carriage return key. The system cursor symbol should appear in the left most column of the screen, indicative that the system is ready to accept user commands. The cursor symbol is a single underline character. The user should type the following command to LOGON the system:

```
LOGON      USERID, PASSWORD, PACK = A
```

The USERID and PASSWORD are access codes given to the user by the computer system manager. Shortly after the user enters the LOGON command followed by a carriage return, the system should respond by again displaying the cursor symbol. The user should now enter the command

```
UNLOADA
```

The system will again respond by displaying the cursor symbol. At this point, the user should enter the following command to execute the CNDC Model:

```
CNDC
```

The system will then begin loading and executing the model. This process will take a few minutes and several system messages will appear on the screen. When the following message appears, the model has been successfully loaded and is waiting for further user actions:

```
NASA COMMUNICATIONS NETWORK DESIGN AND COSTING MODEL

PREPARED BY
          SONALYSTS, INC.
          215 PARKWAY NORTH
          WATERFORD, CT  06385


          INPUT MENU
          ----- ----

     1 - NETWORK CONSTRUCTION
     2 - TARIFF CONSTRUCTION
     3 - EXECUTION CONTROL
     4 - EXIT

SELECT OPTION (1-4)
```

At this point, the procedures discussed in chapters 4 through 7 should be followed.

3.2 LOGON PROCEDURE FOR BATCH OPERATION

BATCH execution of the CNDC Model is controlled by an input data set that can be a disk data set or a deck of punched cards. In either form, the input data set contains all the commands necessary to run a task. The BATCH command format is very similar to that of the INTERACTIVE mode. The first card or record of the data set must contain a LOGON command of the following format:

```
LOGON USERID,TIME=60,PACK=A
```

The second card of the data set should be

```
UNLOADA
```

The third card of the data set must contain the command to load and execute the BATCH version of the CNDC Model. This command is as follows:

```
BATRUN
```

Chapter 8 discusses the other types of input cards which follow the initial two cards. The final card of the data set should be

```
LOGOFF
```

The TIME= parameter of the LOGON card requires more explanation. The number entered, expressed in seconds, specifies the number of seconds of execution time to be allowed before the timer terminates the task. If the job requires more than 3600 seconds, an additional command, the TIME command, must be included in the batch run stream along with the TIME= parameter of the LOGON command. The TIME command specifies the number of minutes of execution time before the timer interrupts the task. The maximum time allowed is 450 minutes (7 1/2 hours). The following pair of commands

```
LOGON USERID,PACK=A,TIME=27000
TIME 450
```

is requesting the maximum time of 7 1/2 hours. Again, if the time value requested is less than 3600 seconds, the TIME command (second command) can be omitted.

CHAPTER 4 - CREATING AND MANAGING NETWORK FILES

4.1 OVERVIEW

The network construction session allows the user to maintain a set of network files for input to the CNDC Model. Entry into a network construction session is accomplished by selecting option 1 - NETWORK CONSTRUCTION from the INPUT menu. Exiting from the session returns the user to the INPUT menu. The relationship between the input and network construction sessions is shown in figure 4-1.

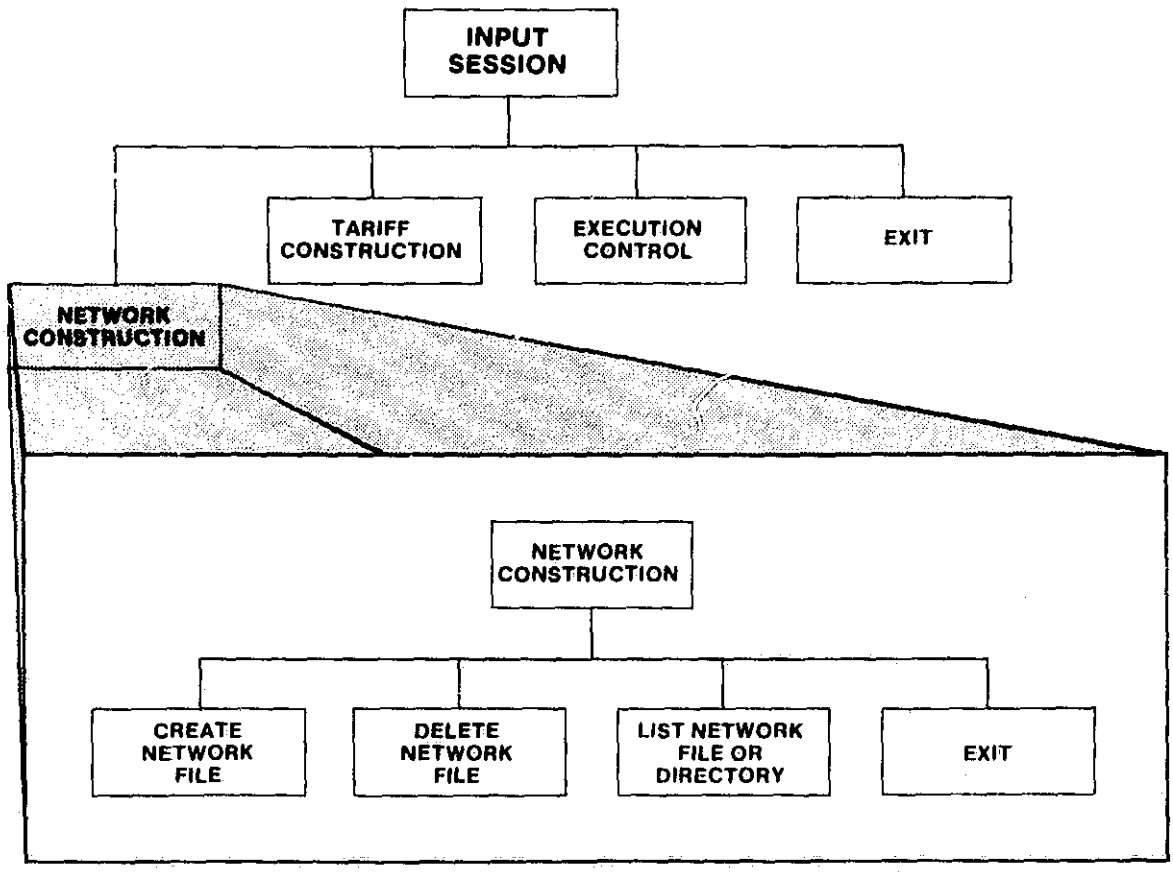

Figure 4-1. Logical Relationship Between the INPUT and Network Construction Sessions

During a network construction session, the user can perform the following functions:

- Create one or more network files,
- Delete previously stored network files,
- Examine the contents of any network file, and
- Examine the network file directory to determine the availability status of any network file.

The overall control of a network construction session is provided by a menu that enables the user to select the function to be performed next. The NETWORK menu is as follows:

```
                    NETWORK MENU
                    ------------

          1 - CREATE NETWORK FILE
          2 - DELETE NETWORK FILE
          3 - LIST A NETWORK FILE OR NETWORK DIRECTORY
          4 - EXIT

SELECT OPTION (1-4)
```

Upon completion of creating, deleting, or listing a network file (or the network directory), program control returns to the NETWORK menu. Only the EXIT option causes the program to return to the INPUT menu. Creation of a network file consists of a series of input actions by the user. The user has the capability to return to the NETWORK menu without completing a network file creation. If the user chooses to return to the NETWORK menu, the partially created network file is lost.

4.2 CREATING A NETWORK FILE

To create a network file, the user selects option 1 - CREATE NETWORK FILE from the NETWORK menu.

The model prompts the user to provide the information necessary to construct a network file. The information the user must provide includes:

- Network file name,
- Selection of prestored nodes,
- Traffic volume for prestored nodes,
- Identification of additional cities, and
- Additional traffic entries.

The sequence of user inputs is diagrammed in figure 4-2. The following sections describe all user inputs and the associated program responses in the order in which they occur.

4.2.1 Network File Name

The program prompts the user to enter a name for the file being created by printing the following message:

ENTER THE NAME OF THE NETWORK FILE TO CREATE (6 CHARACTERS)

The user must provide the name of a file that is listed in the network file directory and is available for file storage. The twenty file names that are currently defined in the directory are NET001 through NET020.

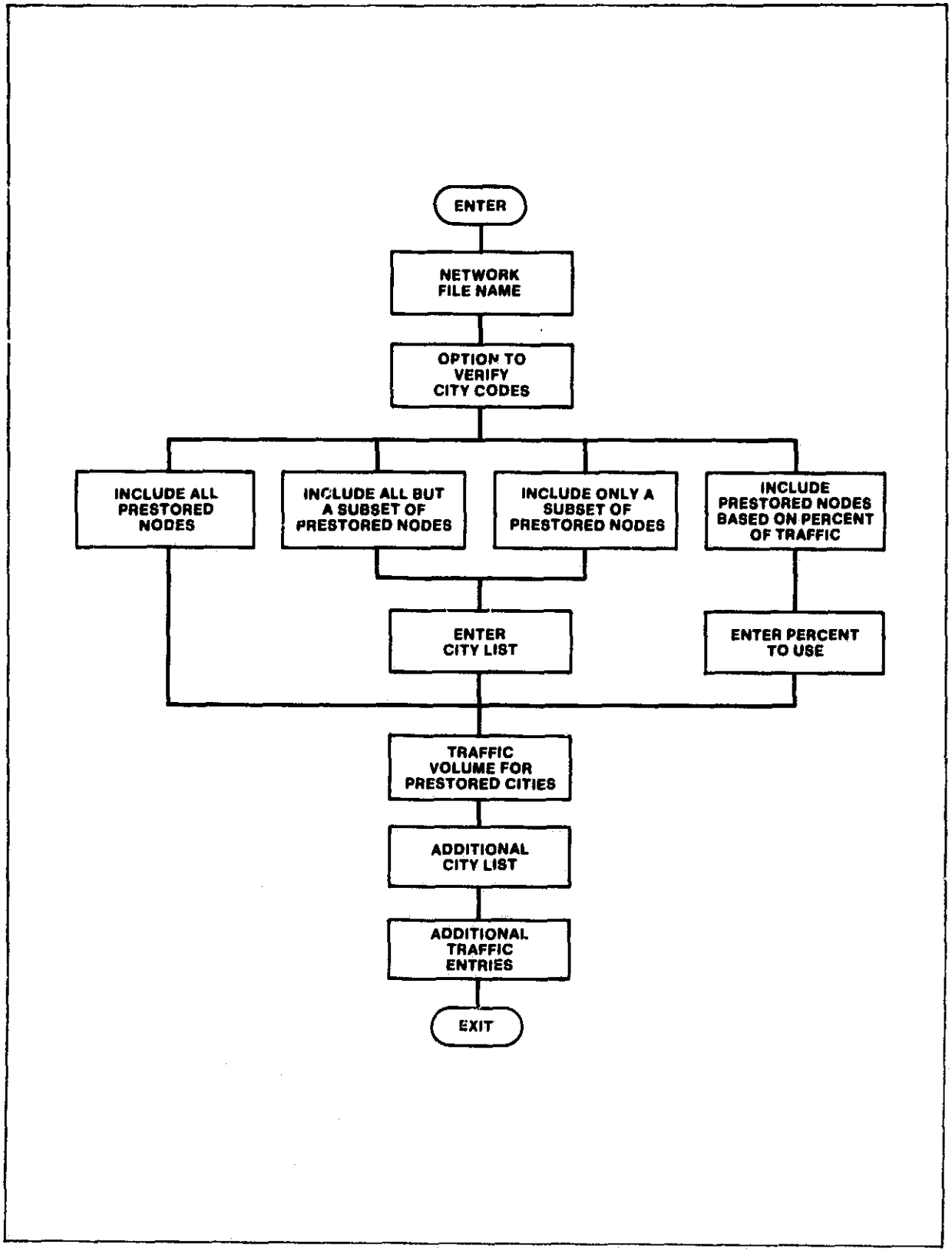

Figure 4-2. Sequence of Inputs for Network File Creation

4.2.2 Verification of Individual Entries

After a valid network file name has been entered, the program issues the following prompt:

DO YOU WANT TO VERIFY INDIVIDUAL ENTRIES IN CITY LISTS? (Y/N)

If the user enters a "Y", all city codes entered during the network file creation session will be echoed to the user for verification. This verification provides the user with a double check to ensure that all code names are entered correctly.

4.2.3 Selection of Prestored SMSA Cities

The user is provided with four methods for selecting the prestored SMSA cities to be included in his network. The four options involve including all 350 prestored cities, all but a subset of the prestored cities, only a subset of the prestored cities, or the set of prestored cities that accounts for a given percentage of the total traffic volume of the prestored cities. The model prints the following prompt:

1 - ALL
2 - ALL EXCEPT
3 - ONLY
4 - PERCENT

ENTER OPTION TO USE FOR SELECTING PRESTORED CITIES (1-4)

The user selects one option by entering a single digit from 1 to 4. The following paragraphs provide a detailed explanation of each option.

4.2.3.1 Selecting ALL Prestored Cities

If the user selects option 1 - ALL, the program automatically includes all of the cities in the prestored traffic table in the new network file. Appendix A lists the prestored SMSA cities and their associated code names.

4.2.3.2 Selecting ALL EXCEPT a Subset of Prestored Cities

If the user selects option 2 - ALL EXCEPT, all prestored cities except those entered by the user will be included in the new network file. After selecting the option, the user inputs a list of four-character city codes he wishes to exclude from the network file. The program will issue the following prompt for each city code.

ENTER FOUR CHARACTER CITY CODES -- <CR> TO STOP

The four-character codes entered must be codes associated with cities listed in Appendix A. When the complete list of cities has been entered, the user enters a single carriage return and the network file creation session continues.

4.2.3.3 Selecting ONLY a Subset of Prestored Cities

If the user selects option 3 - ONLY, only those prestored city codes entered by the user are included in the new network file. After selecting this option, the user inputs four-character city codes to define the network. The program issues the following prompt for each city code:

ENTER FOUR CHARACTER CITY CODES -- <CR> TO STOP

The four-character codes entered must be codes associated with cities listed in Appendix A. When the complete list of cities has been entered, the user enters a single carriage return and the network file creation session continues.

4.2.3.4 Selecting Prestored Cities Representing a Given PERCENT of Network Traffic

The PERCENT option causes the program to select cities from the prestored SMSA list based on a user-input percentage. The program arranges cities by total originating traffic volume from highest to lowest. The percentage of the total traffic is then computed and added to a cumulative percentage as each city is processed. When the cumulative percentage equals or exceeds the percentage input by the user, the processing stops. At this point, the cities processed represent the desired percentage of the total traffic volume of the prestored SMSA cities.

If the user selects option 4 - PERCENT, the program will print the following prompt:

ENTER PERCENT TO USE IN SELECTING CITIES - 0.0 TO 100.0

The user must enter a number between 0.0 and 100.0 indicating the percentage of total network traffic. The number must include a decimal point. After a valid percentage is entered, the user is given the opportunity to examine the cities selected by the program. The program prints the following question:

DO YOU WANT TO VIEW NODES IN THIS NETWORK? (Y/N)

If the user responds with a "Y", the set of cities will be printed. For example, if the user specified 2Ø.Ø percent, the following list of cities would be printed:

THE TOP 20 PERCENT NODES ARE

NENY	CIIL	LOCA	PHPA
DEMI	NANY	WADC	BAMD
NWNJ	JENJ	CLOH	PIPA
HOTX	MIMN	NENJ	CIOH
MIWI	LONJ	ATGA	BOMA
ININ	DATX	SLMO	COOH
DECO	HACT	LOKY	BRCT
TOOH	PANJ	DAOH	NOPA
NWC	SFCA	MIFL	AKOH
HAPA	KAMO	WIDE	GRMI
NELA	NATN	METN	NOVA
BUNY	RIVA	ALPA	RUNC
PRRI	CHNC	RONY	LAMI
BIAL	OKOK	SNCA	FLMI
YOOH	FOIN	GRNC	GAIN
PHAZ	SPCT	RANC	ALNY
KNTN	SYNY	SJCA	CAOH
TMFL	JOTN	COSC	ANCA
OMNE	TUOK	WOMA	

4.2.4 Traffic Volume for Prestored SMSA Cities

Once the selection of prestored cities is complete, the program asks the user to enter the total traffic volume between the prestored cities by printing the following prompt:

```
ENTER TOTAL NUMBER OF VOICE CIRCUITS FOR PRESTORED CITIES -
INCLUDE DECIMAL POINT
```

The user must enter the traffic volume in voice circuits. The number entered must include a decimal point. The volume entered is used to compute traffic levels in voice circuits between the prestored cities included in the network.

4.2.5 Entering Additional Cities

The user is given the option of including additional cities in the network. Additional cities are cities other than those included in the prestored list of Appendix A which the user wishes to include in the network file. The program will print the following question:

```
DO YOU WANT TO INCLUDE ADDITIONAL CITIES (Y/N)?
```

If the user types "N", the program proceeds to the next question. If the user types "Y", he will be prompted to enter a list of additional city codes along with vertical and horizontal coordinates for each. The program issues the following prompt for each additional city entry:

```
ENTER ADDITIONAL CITY DATA IN THE FORMAT
4 CHARACTER CITY CODE, 4 DIGIT VERTICAL COORDINATE, 4 DIGIT HORIZONTAL
COORDINATE
ENTER <CR> TO STOP
```

The four-character codes entered must not match any codes associated with the prestored cities of Appendix A. If the code name of a prestored city is entered as an additional city, the user will be notified and prompted to reenter. Vertical and horizontal coordinates must be exactly four digits each and must follow the additional city code entry. The three fields (code name, vertical coordinate, horizontal coordinate) must be entered on one line in the correct sequence and the fields must be separated by commas. For example, if the user wants to define a city code of EIRU with vertical and horizontal coordinates of 4568 and 9857, he would type the following:

When the complete list of additional cities has been entered, the user enters a single carriage return and the network file creation session continues.

4.2.6 Review of Intercity Traffic Volumes

Upon completion of specifying the cities to be included in the network, the user may wish to review traffic volumes between specific cities. The program prints the following query:

```
DO YOU WANT TO REVIEW ANY INTERCITY TRAFFIC VOLUMES?  (Y/N)
```

If the user types "Y", he may review as many traffic volumes as he wishes by entering city pairs. The program will then issue the following prompt:

```
ENTER CITY PAIRS IN THE FORMAT

4 CHARACTER FROM CITY CODE, 4 CHARACTER TO CITY CODE
<CR> TO STOP
```

The user must enter the code names of two cities that are included in the network. If either of the code names cannot be found in the list of cities

defining the network, the user will be informed of the error and prompted to reenter. The two code names must be exactly four characters each and they must be separated by a comma. For example, if the user enters the valid code names, GHJF,ABCD, the program will print the appropriate volume in voice circuits as follows:

THE TRAFFIC VOLUME FROM GHJF TO ABCD IS 0 VOICE CIRCUITS

4.2.7 Entering Additional Traffic Volumes

After reviewing selected intercity traffic volumes, the user may wish to supplement individual volumes by entering additional traffic. The program prints the following query:

DO YOU WANT TO ENTER ADDITIONAL TRAFFIC? (Y/N)

If the user enters "Y", the program will prompt for additional traffic entries as follows:

ENTER TRAFFIC TABLE ADDITIONS IN THE FORMAT

4 CHARACTER FROM CITY CODE, 4 CHARACTER TO CITY CODE, VOICE CIRCUITS
INCLUDE DECIMAL POINT
ENTER <CR> TO STOP

The user may enter the code names of city pairs along with a number of additional voice circuits associated for each pair. The city code names must be exactly four characters each and the number of voice circuits must include a decimal point. The three fields (from city code, to city code, traffic volume) must be entered on one line in the correct sequence and the fields must be separated by commas. For example, to add 10 voice circuits to the volume of traffic from city AKOH to city BAMI, the user enters:

```
AKOH,BAMI,10.0
```

The city code names must be included in the network. Entry of a single carriage return by the user signals the program to end the additional traffic entry process.

4.2.8 Traffic Table Listing

The program gives the user the option to have the final traffic table for the network spooled to the high speed printer by prompting:

```
DO YOU WANT A LISTING OF THE TRAFFIC TABLE?  (Y/N)
```

If the user types "Y", a listing of the traffic table will be spooled to the printer. The user is notified that the creation of the network file is complete and control returns to the NETWORK menu.

4.3 DELETING A NETWORK FILE

To delete a previously created network file, the user selects option 2 - DELETE NETWORK FILE from the NETWORK menu. After selecting the DELETE option, the user is prompted for a file name corresponding to the file to be deleted as follows:

```
ENTER THE NAME OF THE NETWORK FILE TO DELETE (SIX CHARACTERS)
```

If the user enters a file name that is not in the network directory, the user is informed of the error and the program returns to the NETWORK menu. If a valid network file name is entered, the user is queried as follows to verify his intention to delete the named file (in this case NET020):

```
DELETE NET020?  (Y/N)
```

If the user enters "Y", the file is made available for storing a new network definition. The user is informed that the named file has been deleted and the program returns to the NETWORK menu.

4.4 LISTING A NETWORK FILE OR THE NETWORK DIRECTORY

To list a network file or the network directory, the user selects option 3 - LIST A NETWORK FILE OR NETWORK DIRECTORY from the NETWORK menu. The program will prompt the user for the name of the file to list by printing the following message:

ENTER THE NAME OF THE FILE TO LIST -- <CR> FOR DIRECTORY

If the user enters the name of a file that is not in the network directory, an appropriate error message is displayed and he is prompted to reenter the file name. After the requested file or directory has been listed, the program returns to the NETWORK menu.

4.4.1 Network File Listing

The following sections describe the contents of a network file listing. The network in the example is stored with file name NET020.

Total Number of Cities

The total number of cities in the network is indicated as follows:

THERE ARE 12 CITIES IN NETWORK FILE NET020

The total number of cities is the sum of the number of prestored cities included in the network plus the number of additional cities entered.

List of City Mnemonics and V-H Coordinates

The code names and vertical and horizontal coordinates of each of the cities in the network are listed in alphabetical order by codes as in the following example:

```
ABTX 8698 4513
ADIW 4858 2048
AKOH 5637 2472
AKSD 4848 3948
ANCA 9250 7810
ANSC 6961 1894
ATGE 7130 1948
BAMI 5713 3124
BETX 8777 3344
HFIW 9384 3736
HSYQ 4856 5853
JAJW 9393 2739
ENTER <CR> TO CONTINUE
```

If there are more than twenty nodes in the network, they are listed in groups of twenty. The user is prompted to enter a carriage return <CR> to continue after each group of twenty cities.

Traffic Level for Prestored Cities

The traffic level (voice circuits) used to determine the base traffic volumes for the prestored cities is listed as follows:

```
THE TRAFFIC LEVEL FOR THE PRESTORED CITIES IS 394865 VOICE CIRCUITS
```

Additional Traffic

The number of additional traffic entries, the from and to city code names, and the number of additional voice circuits are listed as follows:

```
THERE ARE 2 PAIRS OF ADDITIONAL TRAFFIC SPECIFIED
     ABTX AKOH         56
     AKOH BAMI        394
ENTER <CR> TO CONTINUE
```

If there are more than twenty additional traffic entries, they are listed in groups of twenty. The user is prompted to enter a carriage return <CR> to continue after each group of twenty entries.

4.4.2 Network Directory Listing

If the user enters a single carriage return instead of a network file name after selecting option 3 from the NETWORK menu, the program lists the network file directory. The following is an example of a network directory listing. In the example, files NET002 through NET006 are used to store network files. Files NET001 and NET007 through NET020 are available for network file storage.

```
                    NETWORK DIRECTORY
                    NET001   UNUSED
                    NET002   IN USE
                    NET003   IN USE
                    NET004   IN USE
                    NET005   IN USE
                    NET006   IN USE
                    NET007   UNUSED
                    NET008   UNUSED
                    NET009   UNUSED
                    NET010   UNUSED
                    NET011   UNUSED
                    NET012   UNUSED
                    NET013   UNUSED
                    NET014   UNUSED
                    NET015   UNUSED
                    NET016   UNUSED
                    NET017   UNUSED
                    NET018   UNUSED
                    NET019   UNUSED
                    NET020   UNUSED
ENTER <CR> TO CONTINUE
```

4.5 EXITING THE NETWORK CONSTRUCTION SESSION

To exit from the network construction session, the user selects option 4 - EXIT from the NETWORK menu. Program control then returns to the INPUT menu. Any network files that have been created and stored are available to be specified as input to the model in an execution control session. Network files remain available for use until they are intentionally deleted by the user.

CHAPTER 5 - CREATING AND MANAGING TARIFF FILES

5.1 OVERVIEW

Through the tariff construction session, the user is able to create and maintain a set of tariff files used for input to the CNDC Model. Entry into a tariff construction session is accomplished by selecting option 2 - TARIFF CONSTRUCTION from the INPUT menu. Exiting from the session returns the user to the INPUT menu. The logical relationship between the input and tariff construction sessions is shown in figure 5-1.

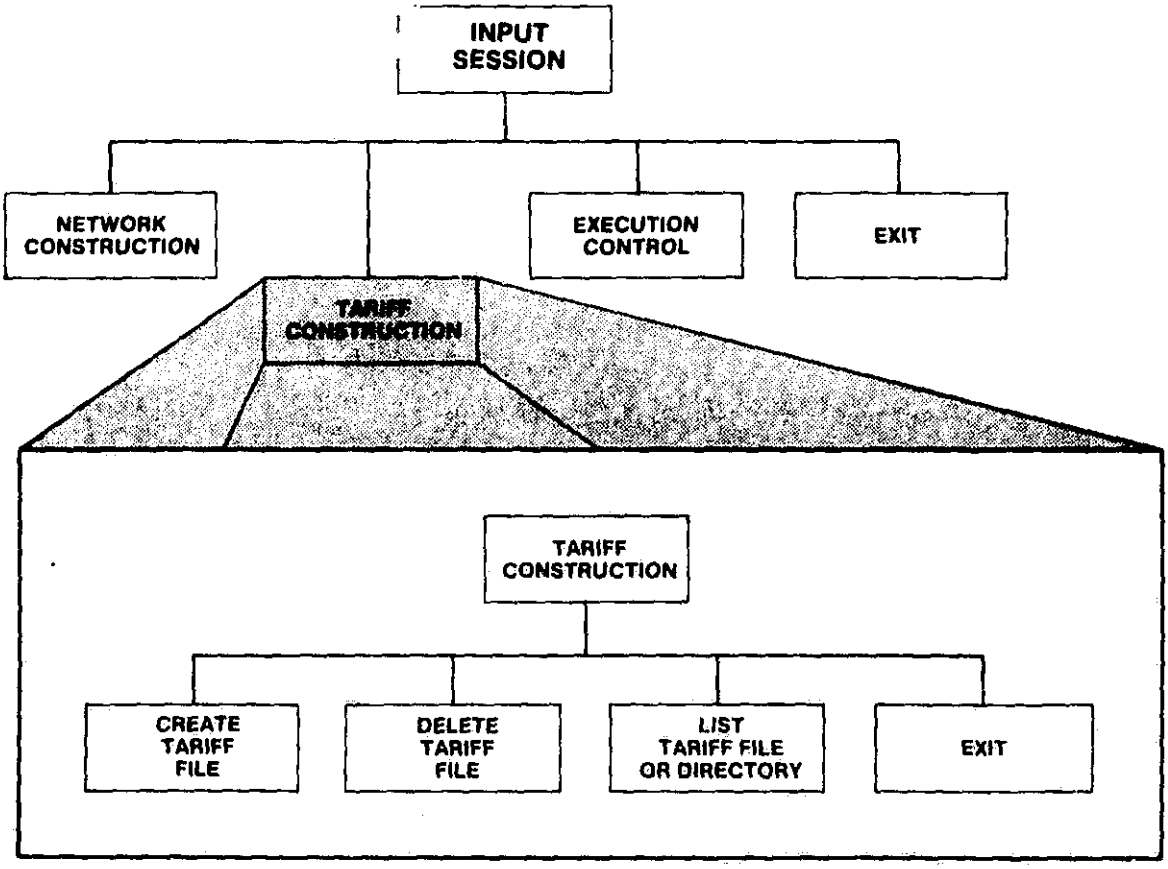

Figure 5-1. Logical Relationship Between Tariff Construction and INPUT Sessions

During a tariff construction session, the user can perform the following functions:

- Create one or more user-defined tariff files,
- Delete any previously stored tariff file,
- Examine the contents of any tariff file, and
- Examine the tariff file directory to determine the availability status of any tariff file.

The overall control of a tariff construction session is provided by a menu that enables the user to select the function to be performed. The TARIFF menu is displayed as follows:

```
                    TARIFF MENU
                    ------ ----
1 - CREATE TARIFF FILE
2 - DELETE TARIFF FILE
3 - LIST A TARIFF FILE OR TARIFF DIRECTORY
4 - EXIT

SELECT OPTION (1-4)
```

Upon completion of creating, deleting, or listing a tariff file (or the tariff directory), program control returns to the TARIFF menu. The creation of a tariff file consists of a series of user inputs which vary depending on the tariff type. The user has the capability to return to the TARIFF menu without completing a tariff file creation. If the user chooses to return to the TARIFF menu, the partially created tariff file is lost. Program control returns back to the TARIFF menu upon completion of each function, until the user selects the EXIT option. Control is then returned to the INPUT menu.

5.2 CREATING A TARIFF FILE

To create a new tariff file, the user selects option 1 - CREATE TARIFF FILE from the TARIFF menu. The program will prompt the user for information necessary to construct a tariff file. The information the user must provide depends on the type of tariff being created (ATT, WU, or SBS). The sequence of user inputs is diagrammed in figure 5-2. The following sections describe all the user inputs and the associated program responses for each of the three tariff types (ATT, WU, and SBS).

5.2.1 Tariff File Name

The program prompts the user to provide a name for the file being created by printing the following message:

ENTER THE NAME OF THE TARIFF FILE TO CREATE (6 CHARACTERS)

The user must provide the name of a file that is listed in the tariff file directory and available for file storage. The twelve file names that are currently listed in the directory are TAR001 through TAR012. By listing the tariff file directory, the user can determine which files are currently in use and which are unused (available).

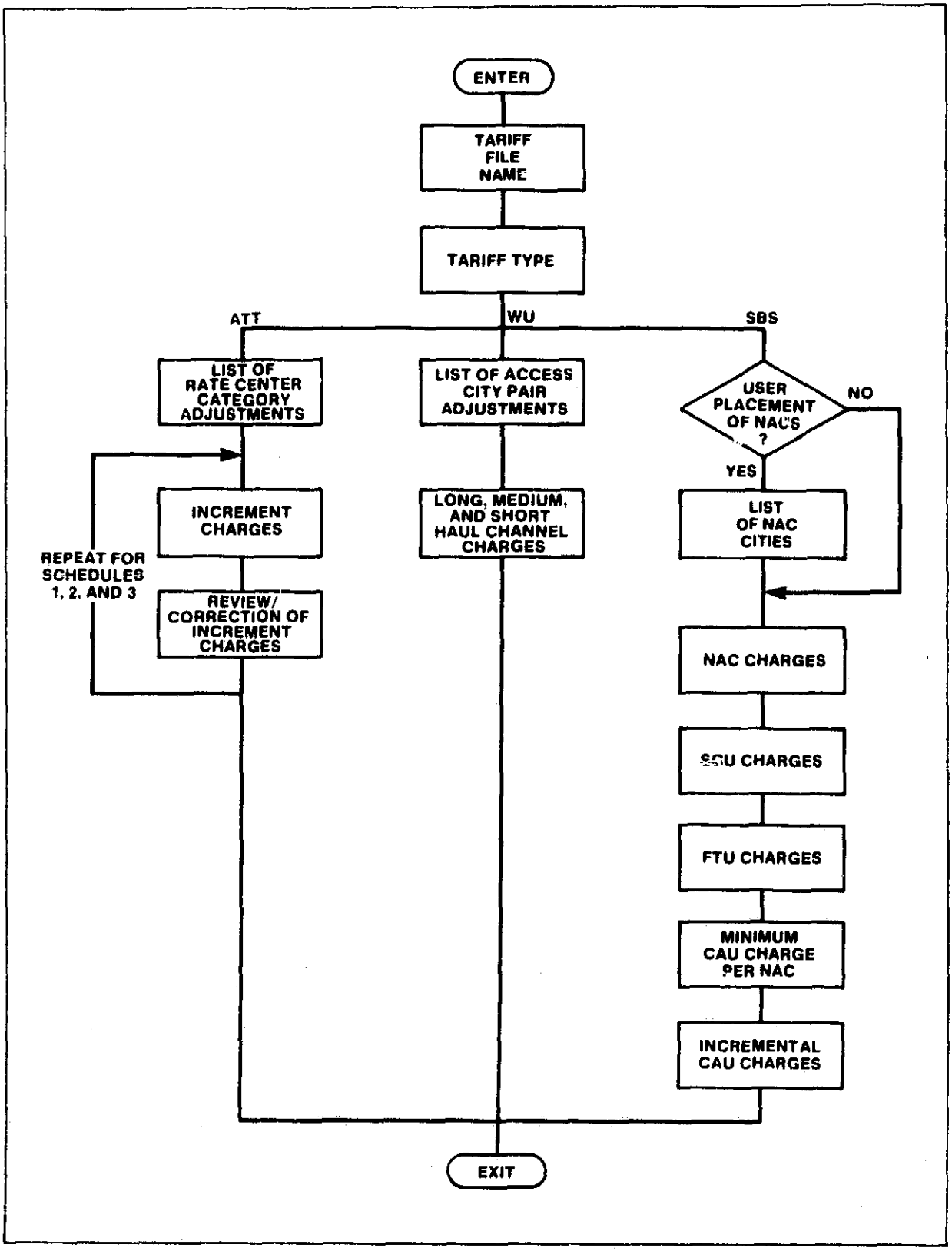

Figure 5-2. Sequence of Inputs for Tariff File Creation

5.2.2 Tariff Type

The program prompts the user to identify the type of tariff he wishes to create by printing the following:

```
1 - AT&T
2 - WU
3 - SBS

ENTER TARIFF TYPE
```

The user must enter a single digit (1, 2, or 3) to indicate the file type. Depending on the user's response, the program will prompt for the inputs to define an ATT, WU, or SBS type tariff, respectively.

5.2.3 Creating an ATT-Type Tariff File

If the user enters a file type of "1" (ATT), the program will acknowledge the user's wish to create an ATT-type tariff file by displaying the following message:

```
CREATE A NASA TARIFF BASED ON THE AT&T PHILOSOPHY
```

The program then proceeds to prompt the user for the required inputs.

The philosophy of an ATT-type tariff is based on AT&T - FCC Tariffs 260 and 264. Category A rate centers are defined by a list of cities within the AT&T tariff. These are shown in Appendix B. Any city not included in this list is declared as a Category B rate center by the tariff.

To create a tariff based on the AT&T philosophy, the user can make adjustments to:

1. The categories of individual rate centers, and

2. The increment charges for Schedules I, II, and III.

The associated program/user interactions are described in the following sections.

Entering Adjustments to Rate Center Categories

The two possible ways to adjust the category of a rate center are:

1. Change a Category B ("unlisted") rate center to Category A ("listed"), or

2. Change a Category A ("listed") rate center to Category B ("unlisted).

The program issues the following prompt:

```
ENTER ADDITIONS AND DELETIONS OF CATEGORY A RATE CENTERS
FOR ADDITIONS ENTER CODE NAME, +1 AND FOR DELETIONS ENTER CODE NAME, -1.
ENTER <CR> TO STOP
```

To change the status of a city from "unlisted" to "listed", the user enters the four-character code name of the city followed by +1. If the named city is already a Category A rate center, an error message is printed and the entry is ignored. To change the status of a city from "listed" to "unlisted", the user enters the four-character code name of the city followed by -1. The two fields (code name, ±1) must be entered on one line and separated by a comma. For example, if the user wishes to add Ridgewood, New Jersey (RINJ) to the list of Category A rate centers, he enters:

```
RINJ,+1
```

If he wishes to change Boise, Idaho (BOID) from Category A to Category B, he enters:

```
BOID,-1
```

When the list of rate center category adjustments is complete, the user enters a single carriage return and the tariff creation session continues.

Entering Incremental Mileage Charges for Rate Schedules I, II, and III

The structure of the ATT tariff provides for a rate calculation for private line service based on the distance between any two cities. The tariff contains base rates for a fixed set of distances or mileages, which include 1, 15, 25, 40, 60, 80, 100, and 1000 miles. The rate for any distance other than these eight is calculated based on an incremental charge on each mile over the closest fixed base mileage. Given a set of incremental mileage charges the base rates for the eight fixed distances can be calculated by the program. The user can create his own ATT-type tariffs by inputting a complete set of incremental mileage charges for each of the three rate schedules within an ATT-type tariff.

The user is prompted by the program to enter increment charges in exactly the same manner for each of the three schedules in turn. All charges entered must include a decimal point. The input of increment charges is introduced by the following message:

```
ENTER INCREMENT CHARGES FOR EACH MILEAGE BREAKPOINT IN SCHEDULES 1, 2,
AND 3 -- INCLUDE DECIMAL POINTS
```

The program then identifies each schedule in turn, followed by prompts for the necessary increment charges. A sample session with user inputs underlined is as follows:

```
SCHEDULE 1

ENTER INCREMENT CHARGE FOR EACH MILE UP TO     1 MILES
24.00
ENTER INCREMENT CHARGE FOR EACH MILE UP TO    15 MILES
20.00
ENTER INCREMENT CHARGE FOR EACH MILE UP TO    25 MILES
18.00
ENTER INCREMENT CHARGE FOR EACH MILE UP TO    40 MILES
16.00
ENTER INCREMENT CHARGE FOR EACH MILE UP TO    60 MILES
13.00
ENTER INCREMENT CHARGE FOR EACH MILE UP TO    80 MILES
10.00
ENTER INCREMENT CHARGE FOR EACH MILE UP TO   100 MILES
 8.00
ENTER INCREMENT CHARGE FOR EACH MILE UP TO  1000 MILES
 5.00
ENTER INCREMENT CHARGE FOR EACH MILE OVER   1000 MILES
 3.00
```

Increment charges for Schedules II and III are input in an identical manner.

Reviewing and Correcting Increment Charges

To ensure the increment charges are correct, each schedule is printed upon completion of user inputs and the user is given the opportunity to correct any errors. For the previous example, the program echoes the entire schedule as follows:

```
1.  THE CHARGE FOR EACH MILE UP TO     1 IS      24.00
2.  THE CHARGE FOR EACH MILE UP TO    15 IS      20.00
3.  THE CHARGE FOR EACH MILE UP TO    25 IS      18.00
4.  THE CHARGE FOR EACH MILE UP TO    40 IS      16.00
5.  THE CHARGE FOR EACH MILE UP TO    60 IS      13.00
6.  THE CHARGE FOR EACH MILE UP TO    80 IS      10.00
7.  THE CHARGE FOR EACH MILE UP TO   100 IS       8.00
8.  THE CHARGE FOR EACH MILE UP TO  1000 IS       5.00
9.  THE CHARGE FOR EACH MILE OVER   1000 IS       3.00

ENTER NUMBER OF CHANGE -- <CR> IF NO CHANGES
```

If the user enters a number corresponding to one of the increments, he is prompted to reenter the associated charge. The new value entered replaces the old value and the entire schedule is printed again, giving the user the opportunity to make further corrections. When all values have been entered correctly, the user enters a single carriage return and the tariff file creation session continues.

When all increment charges for the three schedules are entered correctly, the user is notified that the creation of the tariff file is complete, and program control returns to the TARIFF menu.

5.2.4 Creating a WU-Type Tariff File

If the user enters a file type of "2" (WU), the program will acknowledge the users wish to create a WU-type tariff file by displaying the following message:

CREATE A NASA TARIFF FILE BASED ON THE WU PHILOSOPHY

The program will then proceed to prompt the user for the required inputs.

The philosophy of a WU-type tariff is based on Western Union FCC Tariff No. 261. The relevant contents of the prestored Western Union tariff are provided in Appendix B. To create a tariff based on the Western Union philosophy, the user can make adjustments to

1. The rate categories (long, medium, or short haul) of individual access city pairs, and

2. Long, medium, and short haul channel charges.

The associated program/user interactions are described in the following sections.

Entering Access City Pair Adjustments

The three possible ways to adjust the list of WU satellite access city pairs are:

1. Add a new access city pair to one of the three categories,

2. Change the category of an existing access city pair, or

3. Delete an access city pair.

The program issues the following prompt:

```
ENTER ADJUSTMENTS TO SATELLITE ACCESS CITY PAIRS
TO ADD AN ACCESS CITY PAIR OR TO CHANGE THE RATE CATEGORY OF A PAIR
ENTER CODE NAME, CODE NAME, CATEGORY (1, 2, or 3)
CATEGORIES ARE
     1 - LONG HAUL
     2 - MEDIUM HAUL
     3 - SHORT HAUL
FOR DELETIONS ENTER CODE NAME, CODE NAME, 0
ENTER <CR> TO STOP
```

To add a new access city pair to one of the three categories, the user enters the two four-character code names followed by a 1, 2, or 3 to indicate the rate category (long haul, medium haul, or short haul).

To change the category of an existing access city pair, the user enters the two four-character code names followed by a 1, 2, or 3 to indicate the new category as above.

To delete an access city pair, the user enters the two four-character code names followed by a Ø. If the named access pair is not listed in the prestored WU tariff, an error message is printed and the entry is ignored.

The three fields (code name,code name,category) must be entered on one line and separated by commas. For example, if the user wishes to change the category of the access city pair Los Angeles (LOCA) - Atlanta (ATGA) from long haul to medium haul, he enters:

```
LOCA,ATGA,2
```

When the entry of all satellite access city pair adjustments has been completed, the user enters a single carriage return and the tariff creation session continues.

Entering Long, Medium, and Short Haul WU Satellite Channel Charges

The user is prompted to enter long, medium, and short haul channel charges. These charges represent the monthly charge per satellite channel for each rate category. All charges entered must include a decimal point. The following is an example of a typical session with user responses underlined:

```
ENTER CHANNEL CHARGES FOR EACH CATEGORY -- INCLUDE DECIMAL POINT
CATEGORY 1 -- LONG HAUL
1275.00
CATEGORY 2 -- MEDIUM HAUL
955.00
CATEGORY 3 -- SHORT HAUL
673.00
```

When all channel charges have been entered, the user is notified that the creation of the tariff file is complete and control returns to the TARIFF menu.

5.2.5 Creating an SBS-Type Tariff File

If the user enters a file type of "3" (SBS), the program will acknowledge the user's wish to create an SBS-type tariff file by displaying the following message:

CREATE A NASA TARIFF BASED ON THE SBS PHILOSOPHY

The program then proceeds to prompt the user for the required inputs.

The philosophy of an SBS-type tariff is based on Satellite Business Systems, Inc. FCC Tariff No. 2. The relevant contents of the prestored SBS tariff are provided in Appendix B. To create a tariff based on the SBS philosophy, the user can make adjustments to:

1. The placement of satellite access cities,
2. The monthly charge per Network Access Center (NAC),
3. The monthly charge per Supplemental Capacity Unit (SCU),
4. The monthly charge per Full-Time Transmission Unit (FTU),
5. The minimum monthly charge per Connection Arrangement Unit (CAU) per NAC, and
6. The monthly charge for incremental CAUs.

The associated program/user interactions are described in the following sections.

Selection of Satellite Access Cities

Unlike the Western Union tariff which contains specific satellite access city pairs, the prestored SBS tariff allows for satellite access equipment to be installed at customer premises anywhere in the United States. These premises are referred to as Network Access Centers or simply NAC cities. For mixed satellite/terrestrial problems using the SBS-type satellite tariff, the placement of NAC cities must be determined. The user has two alternatives in the selection of NAC cities:

1. The user may choose to have the program select the NAC cities automatically, or

2. The user may choose to define the NAC cities as user input.

The program determines which of these two options to follow by issuing the following user prompt:

DO YOU WISH TO DEFINE THE NAC PLACEMENT (Y/N)?

The user should respond with a "Y" only if he desires to input a specific set of NAC cities. Otherwise, the program will use its internal algorithms to determine NAC cities based on network costs.

Automatic Selection of NAC Cities

If the user enters "N" to the previous prompt, the program will execute an iterative routine to determine the NAC city selection that results in minimization of overall network cost. No further user interaction is necessary for NAC selection. The tariff file creation session then continues.

User Selection of NAC Cities

If the user enters "Y" to the previous prompt to indicate that he wishes to define the NAC city placement, the program will prompt for the codes of the user-selected NAC cities as follows:

```
ENTER CODE OF NEXT NAC LOCATION - <CR> TO STOP
```

The user must enter four-character codes, one entry per line, to identify the cities to be used for satellite access in the tariff. As specified in the SBS tariff, a minimum of three city codes must be entered. When the identification of NAC locations is complete, the user enters a single carriage return and the tariff file creation session continues.

Entering SBS Monthly Rates

All month-to-month charges listed in an SBS-type tariff must be entered with a decimal point. The program issues the following instruction prior to prompting for the tariff charges.

```
USE A DECIMAL POINT IN ALL NUMERIC INPUTS
```

The program then prompts the user to enter the monthly charge per NAC as follows:

ENTER CHARGE PER NETWORK ACCESS CENTER

The user must enter the monthly cost per NAC in dollars, including a decimal point.

The program then prompts the user to enter the monthly charge per SCU as follows:

ENTER CHARGE PER SUPPLEMENTAL CAPACITY UNIT

The user must enter the monthly cost per SCU in dollars, including a decimal point.

The program then prompts the user to enter the monthly charge per FTU as follows:

ENTER CHARGE PER FULL TIME TRANSMISSION UNIT

The user must enter the monthly cost per FTU in dollars, including a decimal point.

The user must now define both the minimum CAU charge per NAC and a set of incremental volume-sensitive CAU charges. A minimum CAU charge applies to each NAC whenever the monthly charge for CAUs at that NAC is less than the specified amount. The program prompts the user to specify this minimum charge as follows:

```
ENTER MINIMUM CAU CHARGE PER NAC
```

The user must enter the minimum CAU charge per NAC in dollars, including a decimal point.

SBS Tariff No. 2 specifies incremental CAU charges that depend on traffic volume. The program prompts for each of the necessary increment charges. All charges entered must include a decimal point. A sample session with user inputs underlined is as follows:

```
ENTER INCREMENTAL CAU CHARGES
ENTER MONTHLY CHARGE PER CAU UP TO          150
95.00
ENTER MONTHLY CHARGE PER CAU UP TO          300
90.00
ENTER MONTHLY CHARGE PER CAU IN EXCESS OF   300
65.00
```

When all incremental CAU charges have been entered, the user is notified that the creation of the tariff file is complete and control returns to the TARIFF menu.

5.3 DELETING A TARIFF FILE

To delete a previously created tariff file, the user selects option 2 - DELETE TARIFF FILE from the TARIFF menu. After selecting the DELETE option, the user is prompted for the file name to be deleted as follows:

ENTER THE NAME OF THE TARIFF FILE TO DELETE

If the user enters a file name that is not in the tariff directory, the user is informed of the error and the program returns to the TARIFF menu. If a valid tariff file name is entered, the user is queried as follows to verify his intention to delete the named file (in this case TAR012):

DELETE TAR012? (Y/N)

If the user enters "Y", the file is made available for storing a new tariff definition. The user is informed that the named file has been deleted and the program returns to the TARIFF menu.

5.4 LISTING A TARIFF FILE OR THE TARIFF DIRECTORY

To list a tariff file or the tariff directory, the user selects option 3 - LIST A TARIFF FILE OR TARIFF DIRECTORY. The program will prompt the user for the name of the file he wishes to list by printing the following message:

```
ENTER THE NAME OF THE FILE TO LIST -- <CR> FOR DIRECTORY
```

If the user enters the name of a file that is not in the tariff directory, an appropriate error message is displayed and he is prompted to reenter the file name. After the requested file or directory has been listed, the program returns to the TARIFF menu.

5.4.1 ATT-Type Tariff File Listing

The following sections describe the contents of an ATT-type tariff file listing. The tariff in the example is stored with file name TAR002.

Rate Center Category Adjustments

The total number of rate center category adjustments and the specific charges are indicated as follows:

```
THERE ARE 4 CATEGORY A ADJUSTMENTS IN TARIFF TAR002
THESE ADJUSTMENTS ARE
     SACA UNLISTED
     SNTX UNLISTED
     SUCA LISTED
     WWWW LISTED
ENTER <CR> TO CONTINUE
```

If there are more than twenty rate center category adjustments in the tariff, they are listed in groups of twenty. The user is prompted to enter a carriage return <CR> to continue after each group of twenty adjustments. In the above example, two rate centers that are Category A ("listed") cities in the prestored AT&T tariff, namely Sacramento, California (SACA) and San Antonio, Texas (SNTX), are changed to Category B ("unlisted") cities, and two cities with code names SUCA and WWWW are added to the set of Category A ("listed") cities.

ATT Rate Schedules I, II, and III

The three rate schedules are displayed in one table with base and increment charges for each mileage breakpoint as follows:

THERE ARE 9 LEVELS SPECIFIED IN ATT TARIFF

		SCHEDULE 1		SCHEDULE 2		SCHEDULE 3	
	MILEAGE	BASE	INC	BASE	INC	BASE	INC
UP TO	1	0.00	75.00	0.00	76.00	0.00	77.00
UP TO	15	75.00	5.00	76.00	6.00	77.00	7.00
UP TO	25	145.00	4.00	160.00	5.00	175.00	6.00
UP TO	40	185.00	3.00	210.00	4.00	235.00	5.00
UP TO	60	230.00	2.00	270.00	3.00	310.00	4.00
UP TO	80	270.00	1.00	330.00	2.00	390.00	3.00
UP TO	100	290.00	0.90	370.00	1.00	450.00	2.00
UP TO	1000	308.00	0.80	390.00	0.90	490.00	1.00
OVER	1000	1028.00	0.50	1200.00	0.80	1390.00	0.50

ENTER <CR> TO CONTINUE

The user enters a carriage return <CR> when he is ready to continue and program control returns to the TARIFF menu.

5.4.2 WU-Type Tariff File Listing

The following sections describe the contents of a WU-type tariff file listing. The tariff in the example is stored with file name TAR010.

Access City Pair Adjustments

The total number of access city pair category adjustments are indicated as follows:

```
THERE ARE 8 ADJUSTMENTS TO PRESTORED SATELLITE
ACCESS CITY PAIRS IN WU TARIFF TAR010
     CIIL BAMD MEDIUM
     CIIL DATX LONG
     CIIL HOTX LONG
     CIIL NENY EXCLUDE
     CIIL PHPA EXCLUDE
     CIIL WADC MEDIUM
     CIIL WIDE MEDIUM
     NLCT WFCT SHORT
ENTER <CR> TO CONTINUE
```

If there are more than twenty access city pair category adjustments in the tariff, they are listed in groups of twenty. The user is prompted to enter a carriage return <CR> to continue after each group of twenty adjustments. In the above example, satellite access between Chicago, Illinois (CIIL) and each of the three cities Baltimore, Maryland (BAMD), Washington, DC (WADC), and Wilmington, Delaware (WIDE) is to be considered as Category II (medium haul) access rather than Category III (short haul). Similarly, satellite access between Chicago and both Dallas and Houston, Texas (DATX and HOTX) is changed from Category III (short haul) to Category I (long haul). Satellite access

between Chicago and both New York, New York (NENY) and Philadelphia, Pennsylvania (PHPA) is eliminated. The city pair New London, Connecticut (NLCT) and Waterford, Connecticut (WFCT) is added to the set of Category III (short haul) satellite access city pairs.

Long, Medium, and Short Haul Channel Charges

The monthly charges per channel (in dollars) for long, medium, and short haul point-to-point service are listed as follows:

```
LONG HAUL RATE     925.00
MEDIUM HAUL RATE   695.00
SHORT HAUL RATE    580.00
ENTER <CR> TO CONTINUE
```

The user enters a carriage return <CR> when he is ready to continue and program control returns to the TARIFF menu.

5.4.3 SBS-Type Tariff File Listing

The following sections describe the contents of an SBS-type tariff file listing. The tariff in the example is stored with file name TAR012.

NAC Locations

The program indicates user specified satellite access cities by printing the total number of locations specified and listing the corresponding city codes as follows:

```
THERE ARE 8 NAC LOCATIONS SPECIFIED IN SBS TARIFF TAR012
     BAMD CIIL DEMI LOCA NANY NENY PHPA WADC
ENTER <CR> TO CONTINUE
```

If the user chose automatic program selection of NAC cities, there will be Ø NAC locations listed in the tariff. In this case, the identification of NAC cities occurs when the CNDC Model is executed in a mixed satellite/ terrestrial mode using this tariff file.

Equipment Charges

The monthly charge for all SBS equipment are listed (in dollars) as follows:

```
NAC CHARGE IS  35700.

SCU CHARGE IS  2850.

FTU CHARGE IS  1275.

MINIMUM CAU CHARGE IS  9000.

THERE ARE 3 BREAKPOINTS IN CAU RATE TABLE
          NO. CAU       BASE       INC
 ----------------------------------------
 UP TO      150            0.       49.
 UP TO      300         7350.       45.
 OVER       300        14100.       33.
 ENTER <CR> TO CONTINUE
```

For each breakpoint, the table lists the number of CAUs, the base rate in dollars for the minimum number of CAUs in each interval, and the incremental CAU charge for the interval in dollars.

5.4.4 Tariff Directory Listing

If the user enters a single carriage return instead of a TARIFF file name after selecting option 3 from the TARIFF menu, the program lists the tariff file directory. The following is an example of a tariff directory listing. In the example, files TAR001, TAR002, TAR007, and TAR008 are used to store AT&T-type tariffs. Files TAR009 and TAR010 are used to store Western Union type tariffs. Files TAR003, TAR006, TAR011, and TAR012 are used to store SBS-type tariffs, and files TAR004 and TAR005 are available to store other tariffs.

```
                    TARIFF DIRECTORY
                    TAR001   ATT
                    TAR002   ATT
                    TAR003   SBS
                    TAR004   UNUSED
                    TAR005   UNUSED
                    TAR006   SBS
                    TAR007   ATT
                    TAR008   ATT
                    TAR009   WU
                    TAR010   WU
                    TAR011   SBS
                    TAR012   SBS
ENTER <CR> TO CONTINUE
```

5.5 EXITING THE TARIFF CONSTRUCTION SESSION

To EXIT from the tariff construction session, the user selects option 4 - EXIT from the TARIFF menu. Program control then returns to the INPUT menu. Any tariff files that have been created and stored are available to be specified as input to the model in an execution control session. Tariff files remain available for use until they are intentionally deleted by the user.

CHAPTER 6 - CREATING EXECUTION CONTROL FILES

6.1 OVERVIEW

During an execution control session, the user creates the execution file that defines the network problem to be modeled. Entry into an execution control session is accomplished by selecting option 3 - EXECUTION CONTROL from the INPUT menu. Exiting from the session returns the user to the INPUT menu. The logical relationship between the input and execution control sessions is shown in figure 6-1.

During an execution control session, the user can perform the following functions:

1. Create an execution control file, and

2. Examine the contents of the current execution control file.

The execution control session is menu driven and enables the user to select the function to be performed next. An example of the EXECUTE menu is shown below.

```
                    EXECUTE MENU
                    ------------

                1 - CREATE EXECUTION FILE
                2 - LIST EXECUTION FILE
                3 - EXIT

  SELECT OPTION (1 - 3)
```

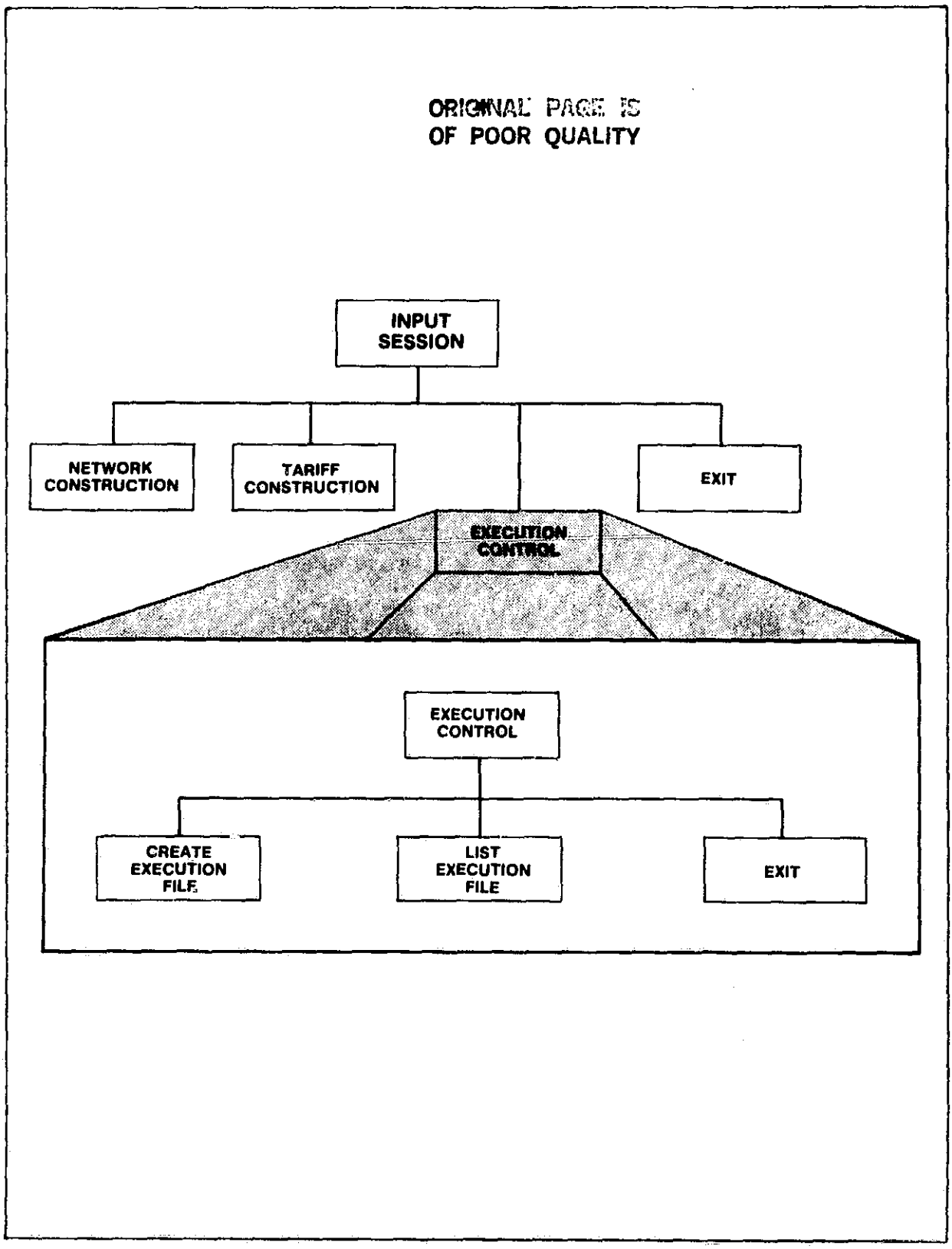

Figure 6-1. Logical Relationship Between the Execution Control and INPUT Sessions

Upon completion of creating or listing the execution file, program control returns to the EXECUTE menu. Creation of an execution control file consists of a series of input actions by the user. The user has the capability to return to the EXECUTE menu at any point without creating an execution control file, should he encounter an error condition.

6.2 CREATING AN EXECUTION CONTROL FILE

To create an execution control file, the user selects option 1 - CREATE EXECUTION FILE from the EXECUTE menu. The program prompts the user for the required information. The information the user must provide includes:

- Run identification,
- Number of problems to run,
- Network mode for each problem,
- Network file for each problem,
- Tariff files for each problem, and
- Output table selection.

The sequence of user inputs is diagrammed in figure 6-2. The following sections describe all user inputs and the associated program responses in the order in which they occur.

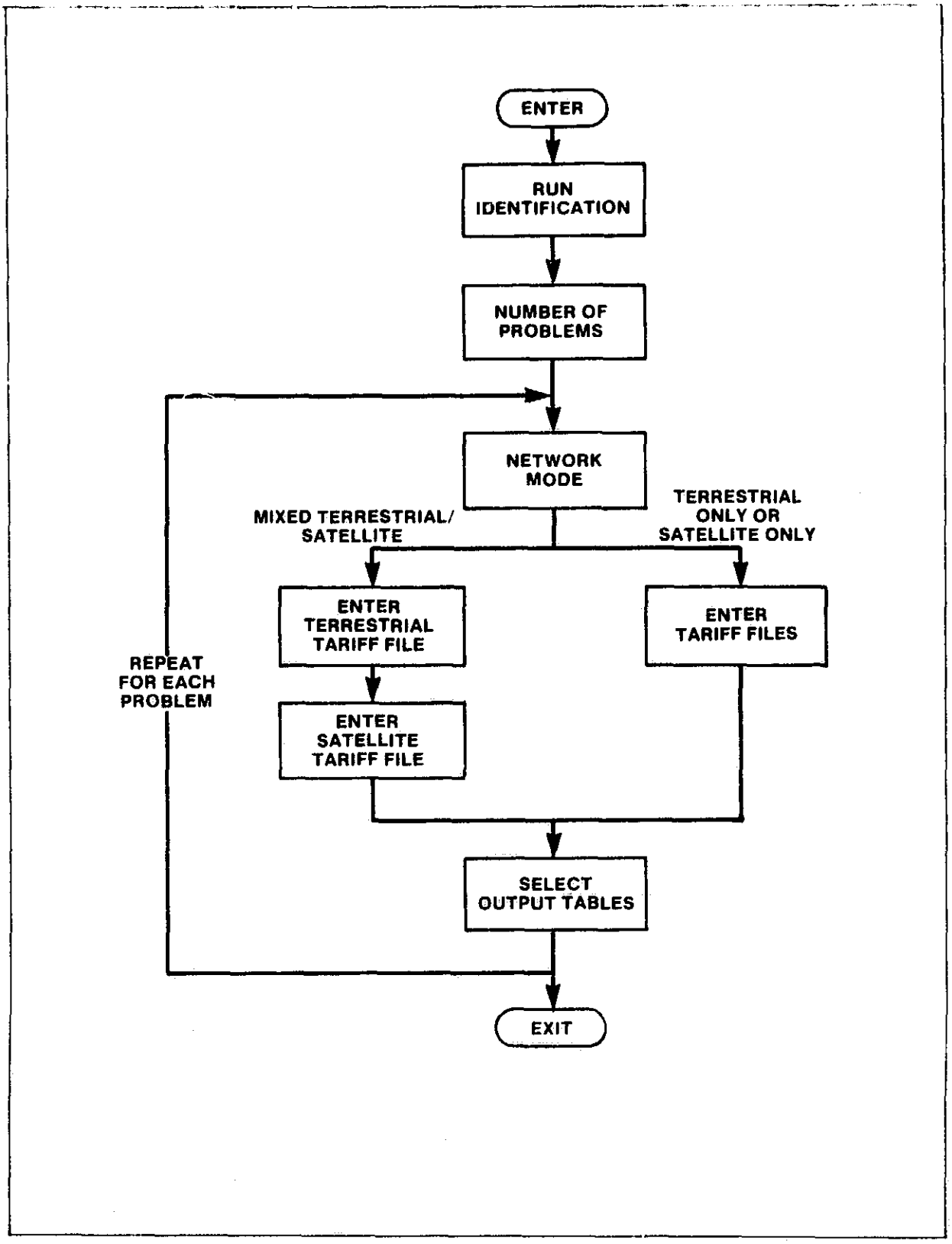

Figure 6-2. Sequence of Inputs for Execution Control File Creation

6.2.1 Run Identification

The program prompts the user to provide a name for the run by printing the following message:

ENTER EIGHT CHARACTER RUN IDENTIFICATION

The user enters up to eight characters to define an identifier which will be printed on all output associated with the run.

6.2.2 Number of Problems to Run

The user can specify multiple problems to be analyzed sequentially within one run of the CNDC model. The program prompts the user to specify the number of problems he wishes to run by printing the following message:

HOW MANY PROBLEMS DO YOU WISH TO RUN? (UP TO 10) INCLUDE DECIMAL POINT

The user must enter a number from one to ten and the number must include a decimal point. Problems within a run can vary based on the problem mode (terrestrial only, satellite only, or mixed terrestrial/satellite), the network file used, the tariff file(s) used, and the output tables generated. The program will prompt the user for the necessary information for each separate problem. The inputs described in sections 6.1.3 through 6.1.6 must be provided for each problem in the run.

6.2.3 Network Mode

The CNDC model analyzes communications networks based on a variety of satellite and/or terrestrial systems. The program prompts the user to specify the network mode for each problem by printing the following:

```
                    NETWORK MODES
                    -------------

          1 - TERRESTRIAL ONLY
          2 - SATELLITE ONLY (WU PHILOSOPHY)
          3 - SATELLITE ONLY (SBS PHILOSOPHY)
          4 - MIXED TERRESTRIAL/SATELLITE (WU PHILOSOPHY)
          5 - MIXED TERRESTRIAL/SATELLITE (SBS PHILOSOPHY)

 ENTER NETWORK MODE FOR PROBLEM (1-5)
```

The user enters a single number to indicate the type of connectivity the model will consider. The types of the tariff files specified for each problem must be consistent with the network mode selected.

Terrestrial-Only Mode

The TERRESTRIAL ONLY network mode specifies a problem in which all connectivity is via terrestrial systems. Up to thirteen terrestrial tariffs based on the philosophy of the prestored AT&T tariff can be included in a TERRESTRIAL ONLY analysis.

Satellite-Only Mode

The SATELLITE ONLY (WU PHILOSOPHY or SBS PHILOSOPHY) network modes specify problems in which all connectivity is via satellite systems. Up to thirteen satellite tariffs can be included in a SATELLITE ONLY analysis. WU and SBS type user-defined tariffs cannot be mixed within the same problem. There is no restriction on the types of problems that can be included as multiple problem executions within the same run.

Mixed Terrestrial/Satellite Mode

The MIXED TERRESTRIAL/SATELLITE network modes specify problems in which connectivity is via any combination of terrestrial and/or satellite systems. Exactly one ATT-type terrestrial tariff and one satellite tariff (either WU-type or SBS-type) can be included in a MIXED TERRESTRIAL/SATELLITE analysis.

6.2.4 Identifying the Network File to Use

The program prompts the user to specify the name of the network file to be used for each problem by printing the following:

```
ENTER THE NAME OF THE NETWORK FILE TO BE USED FOR PROBLEM 1
<CR> TO LIST NETWORK DIRECTORY
```

If the user enters a single carriage return <CR>, the network directory is printed as follows:

```
                    NETWORK DIRECTORY
                    NET001   UNUSED
                    NET002   IN USE
                    NET003   IN USE
                    NET004   IN USE
                    NET005   IN USE
                    NET006   IN USE
                    NET007   UNUSED
                    NET008   UNUSED
                    NET009   UNUSED
                    NET010   UNUSED
                    NET011   UNUSED
                    NET012   UNUSED
                    NET013   UNUSED
                    NET014   UNUSED
                    NET015   UNUSED
                    NET016   UNUSED
                    NET017   UNUSED
                    NET018   UNUSED
                    NET019   UNUSED
                    NET020   IN USE
ENTER <CR> TO CONTINUE
```

When the user enters another carriage return <CR> to continue, the program again prompts for the name of the network file to use. The user must enter the name of a file that is listed in the network directory with the IN USE status.

6.2.5 Identifying the Tariff Files to Use

For each problem within the run, the user must specify the names of the tariff files to be used as input. If the network mode specified for the problem is TERRESTRIAL ONLY or SATELLITE ONLY, the program prompts the user to enter the number of different tariffs to be used as follows:

HOW MANY TARIFFS ARE TO BE CONSIDERED FOR PROBLEM 1? - INCLUDE DECIMAL POINT

The user must enter a decimal number from one to thirteen. The program prompts the user for the file names, one at a time, as follows:

```
ENTER THE NAME OF THE FILE CONTAINING TARIFF 1 (RUN 1)
<CR> TO LIST TARIFF DIRECTORY
```

If the user enters a single carriage return <CR>, the tariff directory is printed as follows:

```
                    TARIFF DIRECTORY
                    TAR001    ATT
                    TAR002    ATT
                    TAR003    SBS
                    TAR004    UNUSED
                    TAR005    UNUSED
                    TAR006    SBS
                    TAR007    ATT
                    TAR008    ATT
                    TAR009    WU
                    TAR010    WU
                    TAR011    SBS
                    TAR012    SBS
ENTER <CR> TO CONTINUE
```

When the user enters another carriage return <CR> to continue, the program again prompts for the name of a tariff file. The user must enter either the name of a prestored tariff (TRFATT, TRFWU, or TRFSBS) or the name of a file that is listed in the tariff directory. The user-defined tariff must not have an UNUSED status. The type of the file entered must be consistent with the network mode specified for the problem. The appropriate tariff types for network modes 1, 2, and 3 are as follows:

Network Mode	Acceptable Tariff Type
1 - TERRESTRIAL ONLY	ATT
2 - SATELLITE ONLY (WU PHILOSOPHY)	WU
3 - SATELLITE ONLY (SBS PHILOSOPHY)	SBS

When a tariff file name has been entered successfully, the program repeats the procedure, prompting for the next file name as follows:

```
ENTER THE NAME OF THE FILE CONTAINING TARIFF 2 (RUN 1)
<CR> TO LIST TARIFF DIRECTORY
```

The program will continue to prompt for tariff file names until the specified number of tariffs are input.

If the network mode specified for the problem is MIXED TERRESTRIAL/SATELLITE, the program first prompts the user to enter the name of the terrestrial tariff file as follows:

```
ENTER THE NAME OF THE FILE CONTAINING THE TERRESTRIAL TARIFF FOR RUN 1 --
<CR> TO LIST TARIFF DIRECTORY
```

The user may enter a single carriage return <CR> to view the tariff directory as previously described. The user must enter either TRFATT to select the prestored terrestrial tariff or the name of an ATT-type file that is listed in the tariff directory. The program then prompts the user to enter the name of a satellite tariff file as follows:

```
ENTER THE NAME OF THE FILE CONTAINING THE SATELLITE TARIFF FOR RUN 1 --
<CR> TO LIST TARIFF DIRECTORY
```

The user may again enter a single carriage return <CR> to view the tariff directory. The user must enter either TRFWU or TRFSBS to select a prestored satellite tariff, or the name of a file that is listed in the tariff directory. The type of the file entered must be consistent with the network mode specified for the problem. The appropriate satellite tariff types for network modes 4 and 5 are as follows:

Network Mode	Acceptable Satellite Tariff Type
4 - MIXED TERRESTRIAL/SATELLITE (WU PHILOSOPHY)	WU
5 - MIXED TERRESTRIAL/SATELLITE (SBS PHILOSOPHY	SBS

6.2.6 Selecting Output Tables to be Printed

By default, the program will print out all reports for each problem run. The user may choose to suppress the printing of selected output tables by entering the numbers of the tables to be suppressed in response to the following prompt:

```
                    OUTPUT TABLES
                    -------------

                1 - INPUT AS OUTPUT
                2 - LEAST-COST ROUTES
                3 - LEAST-COST NETWORK
                4 - OUTPUT NETWORK TOTALS
                5 - TARIFF SUMMARY
                6 - TRAFFIC TABLE

  ENTER THE NUMBERS CORRESPONDING TO OUTPUT TABLES TO BE SUPPRESSED
  ONE ENTRY PER LINE -- <CR> TO STOP
```

The user enters numbers from one to six to indicate the output tables he does not want printed. When the list of tables to be suppressed has been entered, the user enters a single carriage return. The program notifies the user that the creation of the execution control file is complete, and program control returns to the EXECUTE menu.

6.3 LISTING THE EXECUTION FILE

To list the execution file, the user selects option 2 - LIST EXECUTION FILE from the EXECUTE menu. After the execution file has been listed, the program again returns to the EXECUTE menu.

6.4 EXITING THE EXECUTION CONTROL SESSION

To EXIT from the execution control session, the user selects option 3 - EXIT from the EXECUTE menu. Program control then returns to the INPUT menu. Only one execution control file can be stored by the program. The file remains in computer storage until it is replaced by the creation of a new execution control file.

CHAPTER 7 - RUNNING THE MODEL AND PRINTING OUTPUT FILES

Once the user has completed network, tariff, and execution control file construction, the program should return control to the INPUT menu and display the following:

INPUT MENU
----- ----

1 - NETWORK CONSTRUCTION
2 - TARIFF CONSTRUCTION
3 - EXECUTION CONTROL
4 - EXIT

SELECT OPTION (1-4)

In order to run the model, the user must first select option 4 - EXIT. The program will respond by displaying the following prompt:

AN EXECUTION CONTROL FILE WAS CREATED THIS SESSION. DO YOU WANT TO EXECUTE THE MODEL WITH THE MOST RECENTLY CREATED FILE (Y/N)?

At this point, the user can cause the model to begin executing by entering "Y" in response to the prompt. The program will then use the current execution control file to determine the problem parameters. The user can terminate the program without executing by simply entering "N" in response to the prompt.

Once the user has caused the model to being execution, the program will print out the following messages, indicating the completion of each problem:

```
OUTPUT COMPLETED FOR CASE 1 OF RUNID
. . . .
. . . . . .
. . . .
OUTPUT COMPLETED FOR CASE n OF RUNID
OUTPUT GENERATED IN FILE CNDCOUT
(system messages closing up data base)
```

When all problems have been completed, model execution will be terminated automatically and the system cursor symbol will appear on the screen. The user can now instruct the computer to print the output files generated during the run by entering the following command:

```
PRINT     CNDCOUT, ERASE = Y
```

The output file will then be spooled to the system printer. The system should then respond by again displaying the cursor symbol. The user should now LOGOFF the system by entering the following command:

```
LOGOFF
```

The user may, however, run CNDC several times during the same session simply by reentering the command CNDC each time the model is to be run. Each time the model executes, it puts the output in the file called CNDCOUT. If the output from a previous run hasn't yet been printed, it will be lost (written over) once CNDC is run again. To avoid this problem, the user may print the output using the command

```
LISTOUT fname
```

where fname is any name other than CNDCOUT not currently in use by the user. LISTOUT copies CNDCOUT into fname, erases CNDCOUT, and prints fname, erasing fname when it has been printed. In this way, CNDCOUT has been freed for use by a subsequent run of the model.

CHAPTER 8 - RUNNING THE CNDC MODEL IN BATCH MODE

8.1 OVERVIEW

In the BATCH mode of operation, all commands that direct model execution are provided in a nonconversational data set. There is no direct communication between the system and the user. The commands and data in the input data file are acted upon by the system in the order in which they are stored.

The BATCH mode of the CNDC Model enables the user to perform all the same functions as provided in the INTERACTIVE mode. It may be convenient to use the BATCH mode to define large network files or to define a number of network and tariff files simultaneously. Long lists of city mnemonics that may be tedious to input interactively can be easily stored on punched cards or in a disk file. Changes to large network or tariff files may be easier to perform in BATCH mode. By using combinations of the five options defined for the BATCH mode, the user can (1) create network files, (2) create tariff files, (3) create an execution control file, (4) execute the model, or (5) terminate without executing the model. Since no provision is made in BATCH mode for deleting files, the BATCH mode must be used in conjunction with the INTERACTIVE mode of the CNDC Model. Network, tariff, and execution control files are stored in exactly the same way in either the BATCH or INTERACTIVE modes. The user can maintain his library of tariff and network files and delete unnecessary files by using the INTERACTIVE mode. The BATCH mode provides a supplemental capability to the INTERACTIVE mode and is more convenient for manipulating large data sets.

This chapter describes the details of BATCH mode operation of the CNDC model. The procedures described must be precisely followed to prevent errors in program execution. If errors are encountered in the input data set, one of two possible outcomes results. If the error can be ignored by the program without affecting execution, a warning message or non-fatal error will be printed to the output files and the run will continue. If the error cannot be ignored, a fatal error message is printed to the output files, and the run is terminated.

8.2 BATCH MODE JOB CONTROL PARAMETERS

BATCH execution of the CNDC Model is controlled by an input data set that can be a disk data set or a deck of punched cards. In either form, the input data set contains all the commands necessary to run a task. The BATCH command format is exactly the same format used in the INTERACTIVE mode. Figure 8-1 shows the overall organization of the input data set.

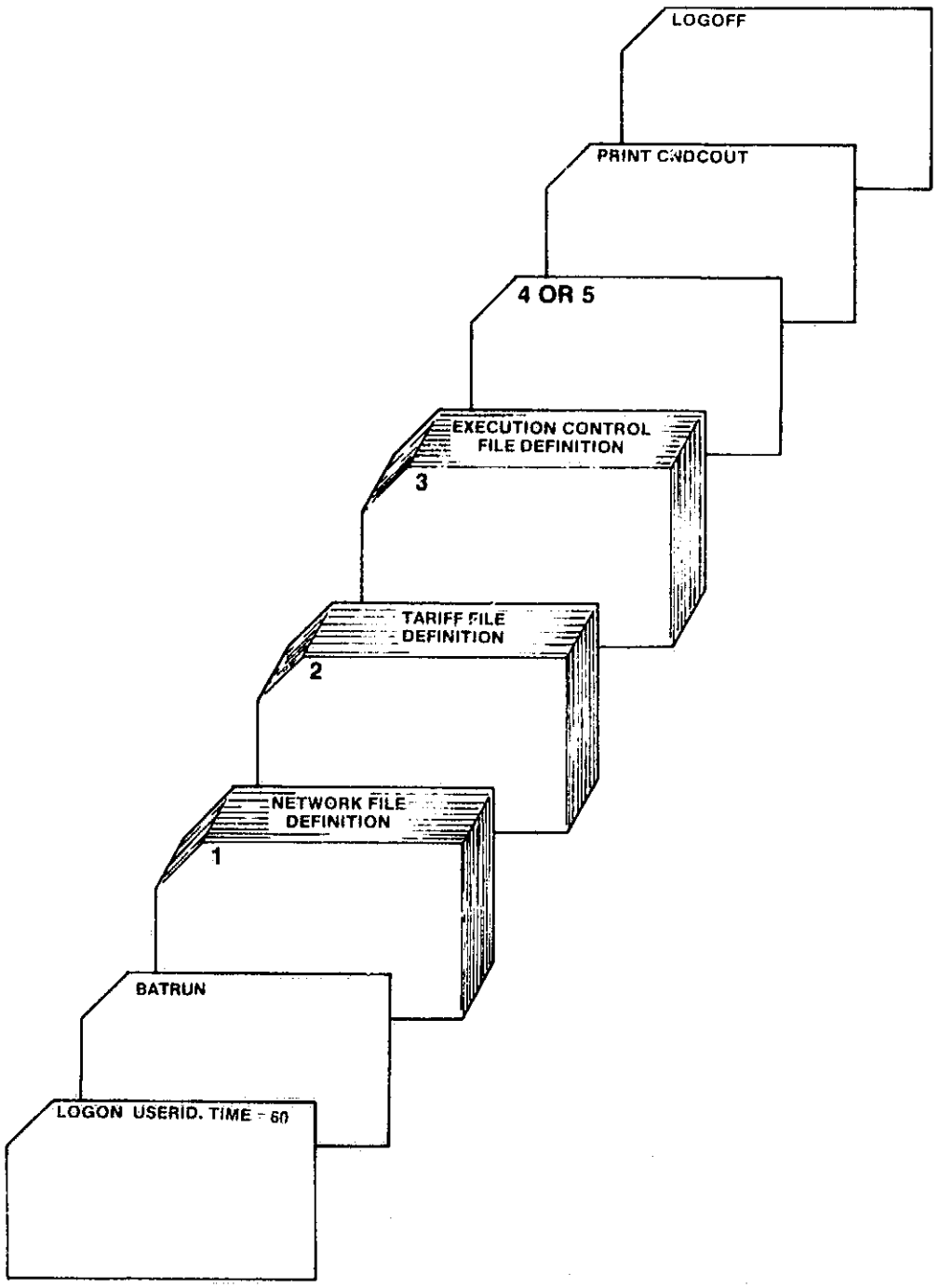

Figure 8-1. Organization of BATCH Input Data Set

The first card in the data set must be a LOGON command and the last card must be a LOGOFF command. The TIME parameter must be included in the LOGON command. It is used to determine the batch job partition that the job will run in. It should be a reasonable estimate of the number of seconds the job will take to execute. For more details, see section 3.2.

The second card shown in figure 8-1 contains the command BATRUN. This invokes a command that will execute the CNDC Model.

The BATRUN command is followed by groups of cards that instruct the program to perform one or more of the five options. The first card of each group must contain a single digit from 1 to 5 in column 1 to indicate the desired option. The five options are as follows:

Option	Function
1	Create a network file,
2	Create a tariff file,
3	Create the execution control file,
4	Execute the model, and
5	Terminate.

Detailed descriptions of the card images associated with each of these options are contained in section 8.2. The final option card must contain either 4 or 5 to execute or terminate the model.

The next to the last card shown in figure 8-1 contains the command PRINT CNDCOUT. This command causes the output of the model to be printed and should only be included if an option 4 was specified to execute the model. It is possible to submit a batch run for the purpose of creating network, tariff, and/or execution control files without executing the model. In this case, the final option card would contain a 5 to terminate the program and the PRINT CNDCOUT command would be omitted. Whenever a network or tariff file is successfully created, the updated directory and the newly created file are printed to an output data set that is automatically spooled to the printer.

8.3 CREATING AND ORGANIZING BATCH INPUT FILES

The overall organization of the CNDC batch input data set is shown in figure 8-1. The data set is pictured as a deck of punched cards, but it can also be a cataloged data set residing on disk with each card image corresponding to one line of the data set. The input data set can be constructed from a terminal by using one of the text editors or it can be punched on cards and submitted to the system operator for entry into the system via the card reader. A data set residing on disk can be converted to a card deck and a card deck can be converted to a disk data set by following the appropriate procedures. The user is referred to the IBM Time Sharing System Command System User's Guide and the Lewis CSUG Supplement for further information about data set manipulation.

The job control parameters that are included in the input data set have been described in section 8.1. The BATRUN command is followed by option codes that define the functions to be performed by the model along with the data associated with each option specified. Option codes 4 and 5 indicate execution and termination of the model, respectively, and are not accompanied by any other data inputs. Option codes 1, 2, and 3 indicate that a network, tariff, or execution control file is to be created. Each of these options is followed by the appropriate data defining the file.

The content of the input data file varies according to the options exercised in the run. Figures 8-2, 8-3, and 8-4 show the three possible BATCH data set organizations for a network file definition. The organization used depends on the network option specified for selecting prestored cities. Figures 8-5, 8-6, and 8-7 show the organization of the data sets required for three types of tariff file definition. Figures 8-8 and 8-9 show two possible data set organizations for an execution control file definition. The organization of the data for each network problem depends on the network mode specified.

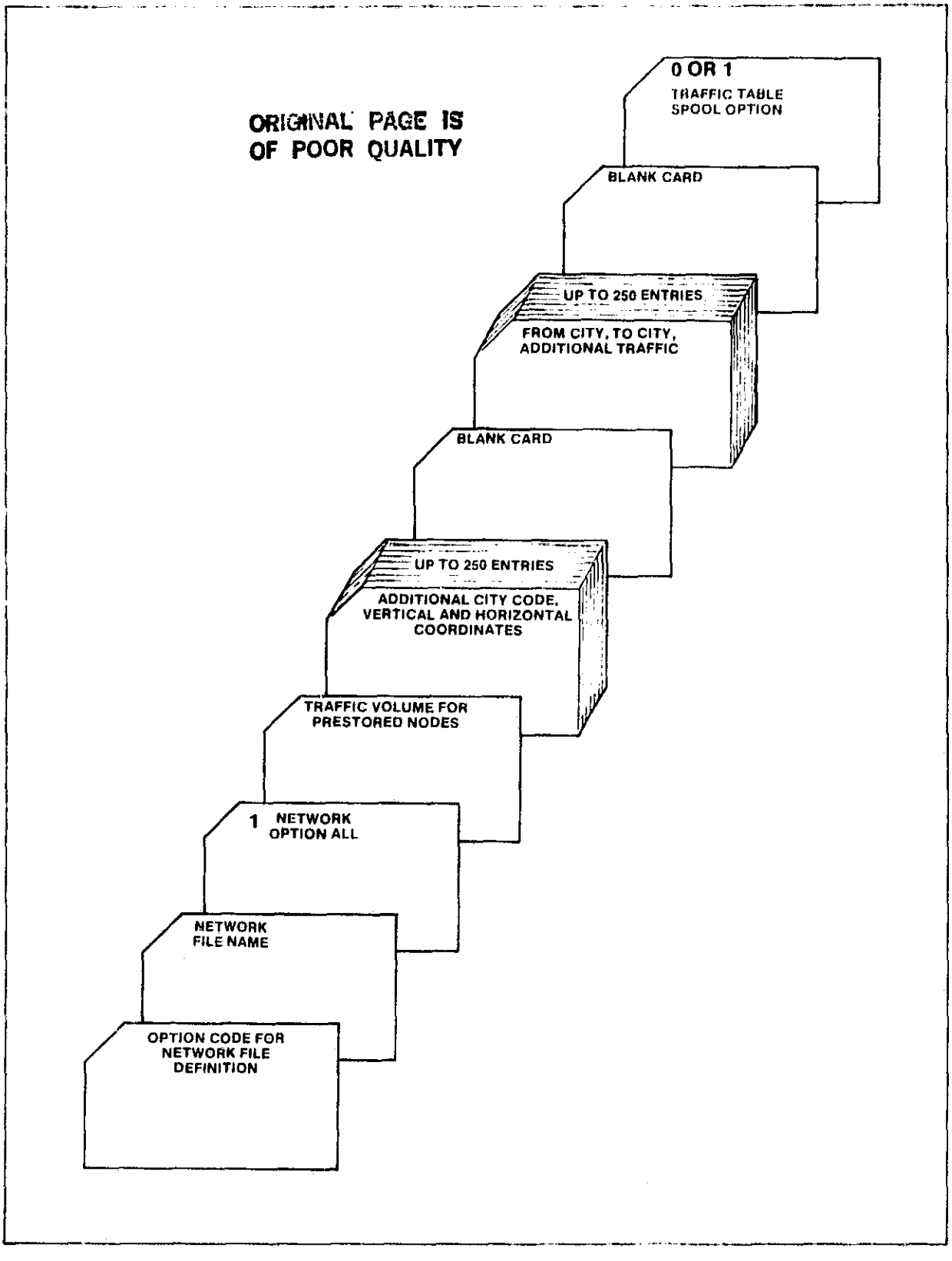

Figure 8-2. BATCH Mode Network File Definition with Option 1-ALL

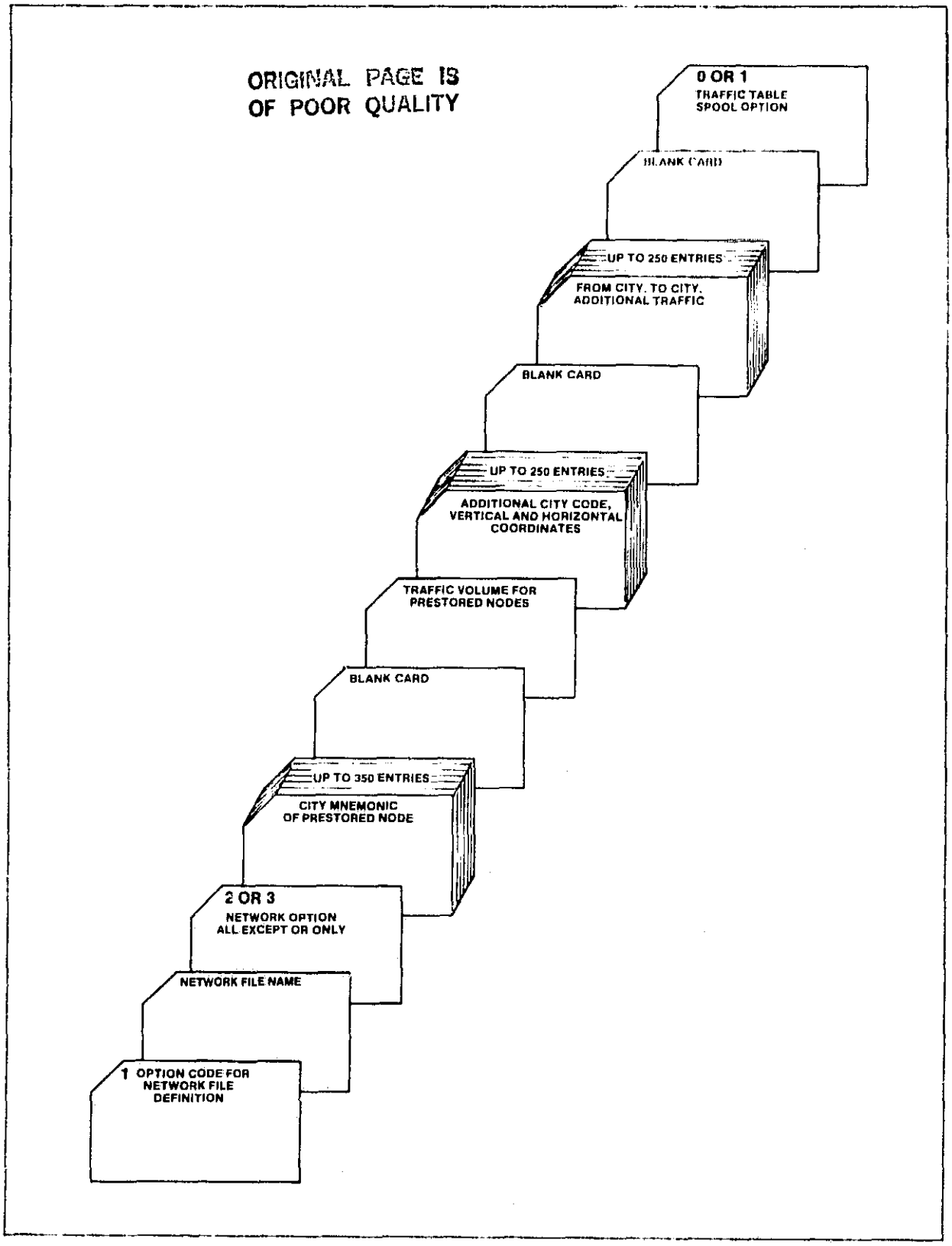

Figure 8-3. BATCH Mode Network File Definition with Option 2 - ALL EXCEPT or Option 3 - ONLY

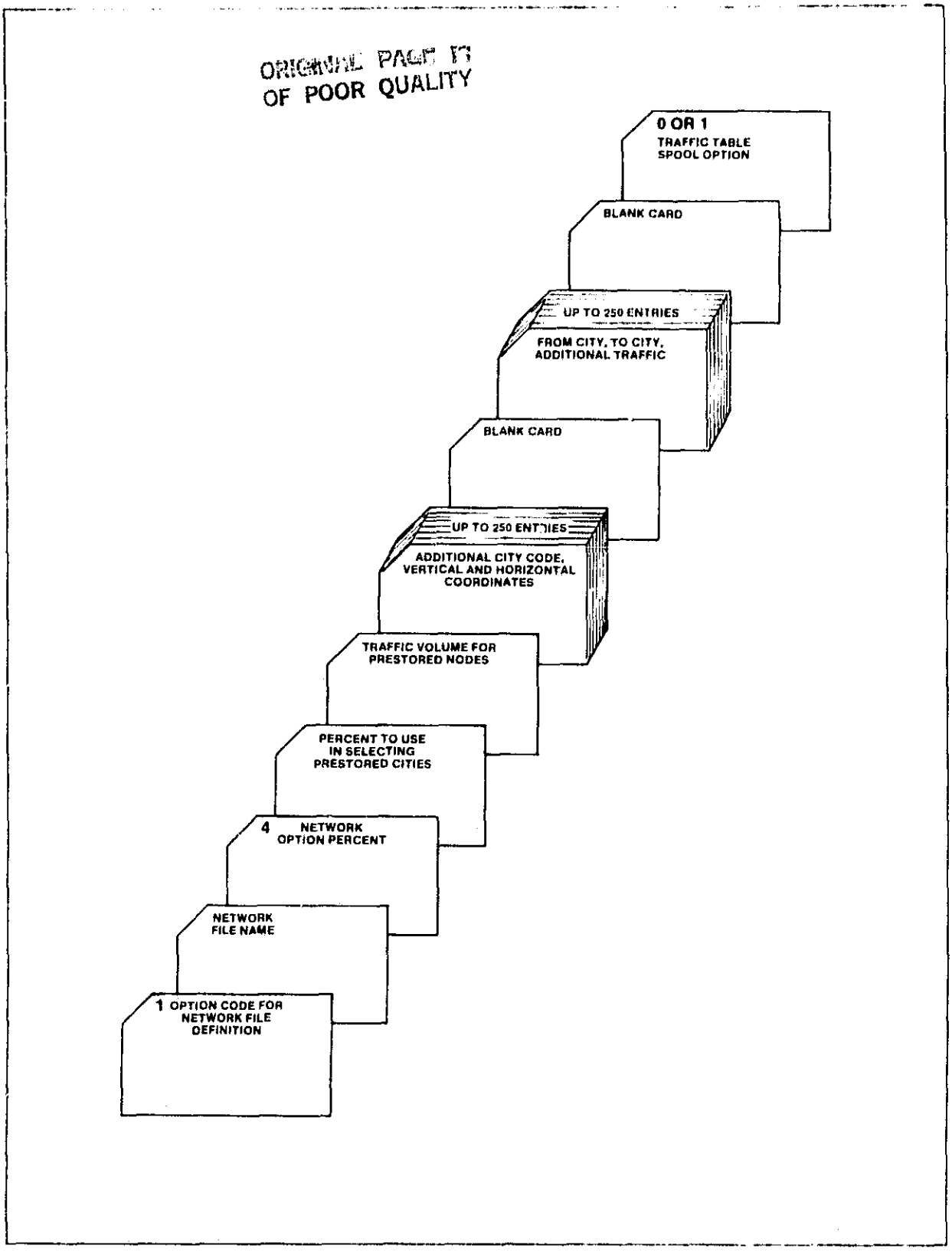

Figure 8-4. BATCH Mode Network File Definition with Option 4 - PERCENT

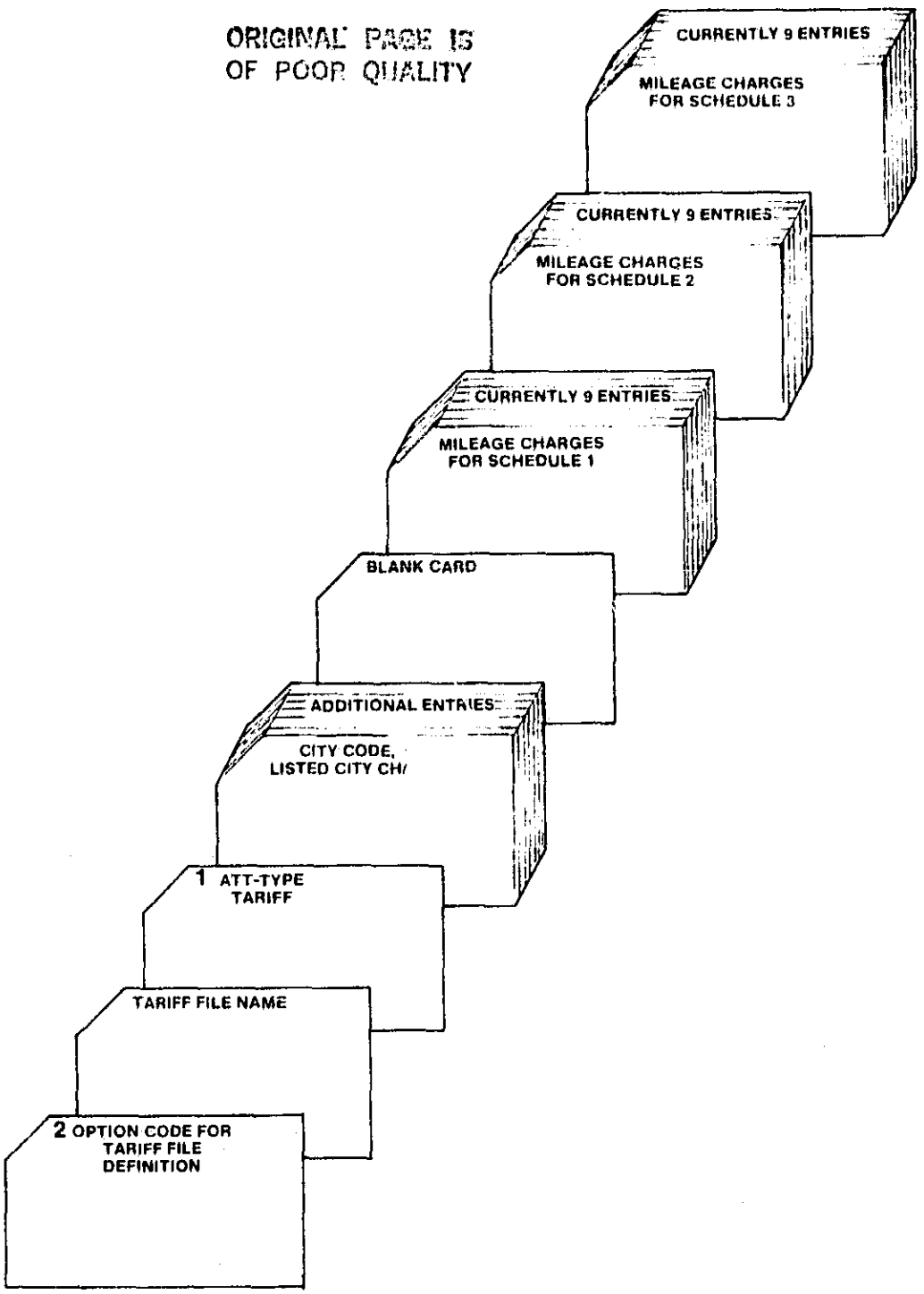

Figure 8-5. BATCH Mode ATT-Type Tariff File Definition

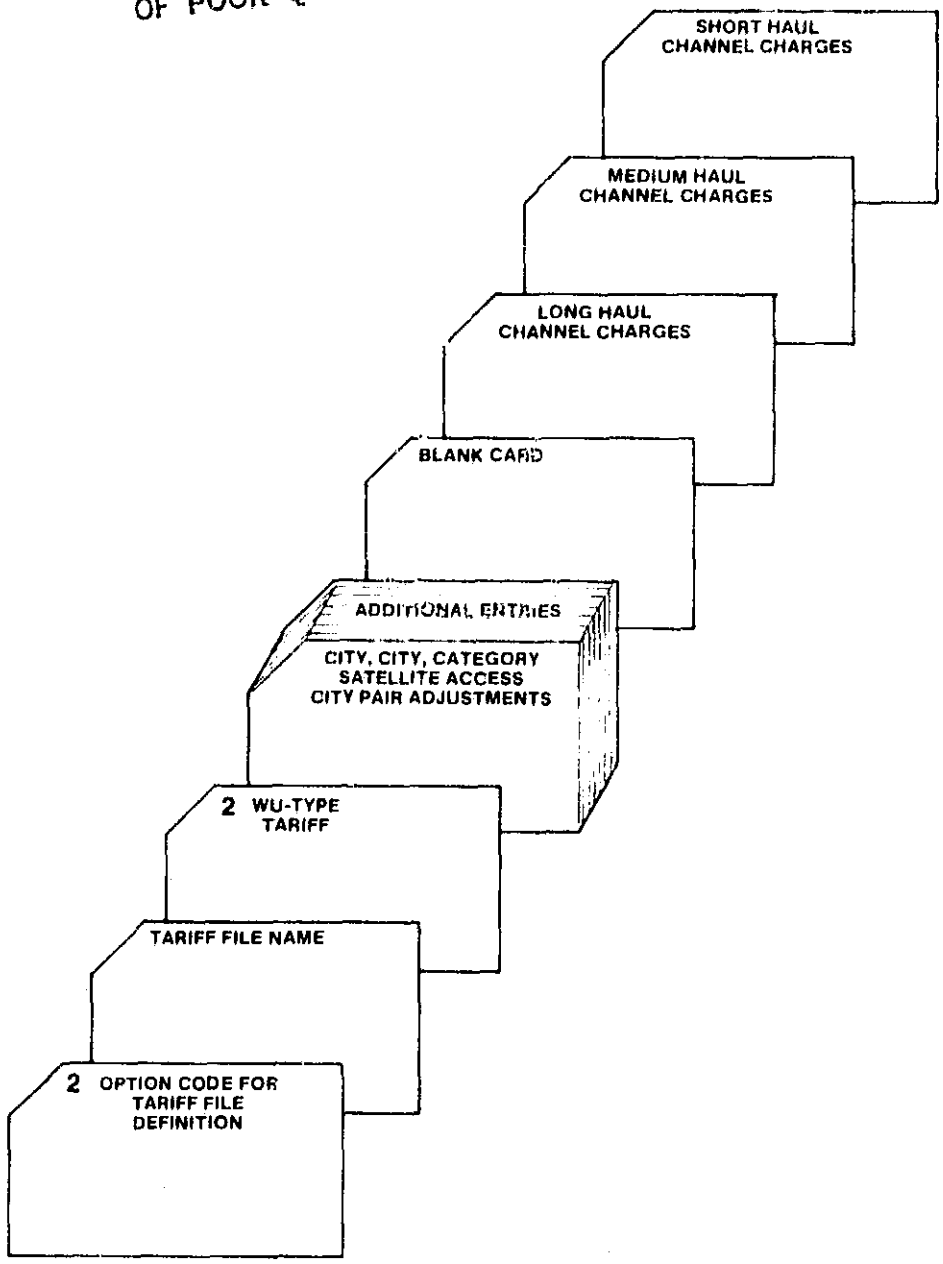

Figure 8-6. BATCH Mode WU-Type Tariff File Definition

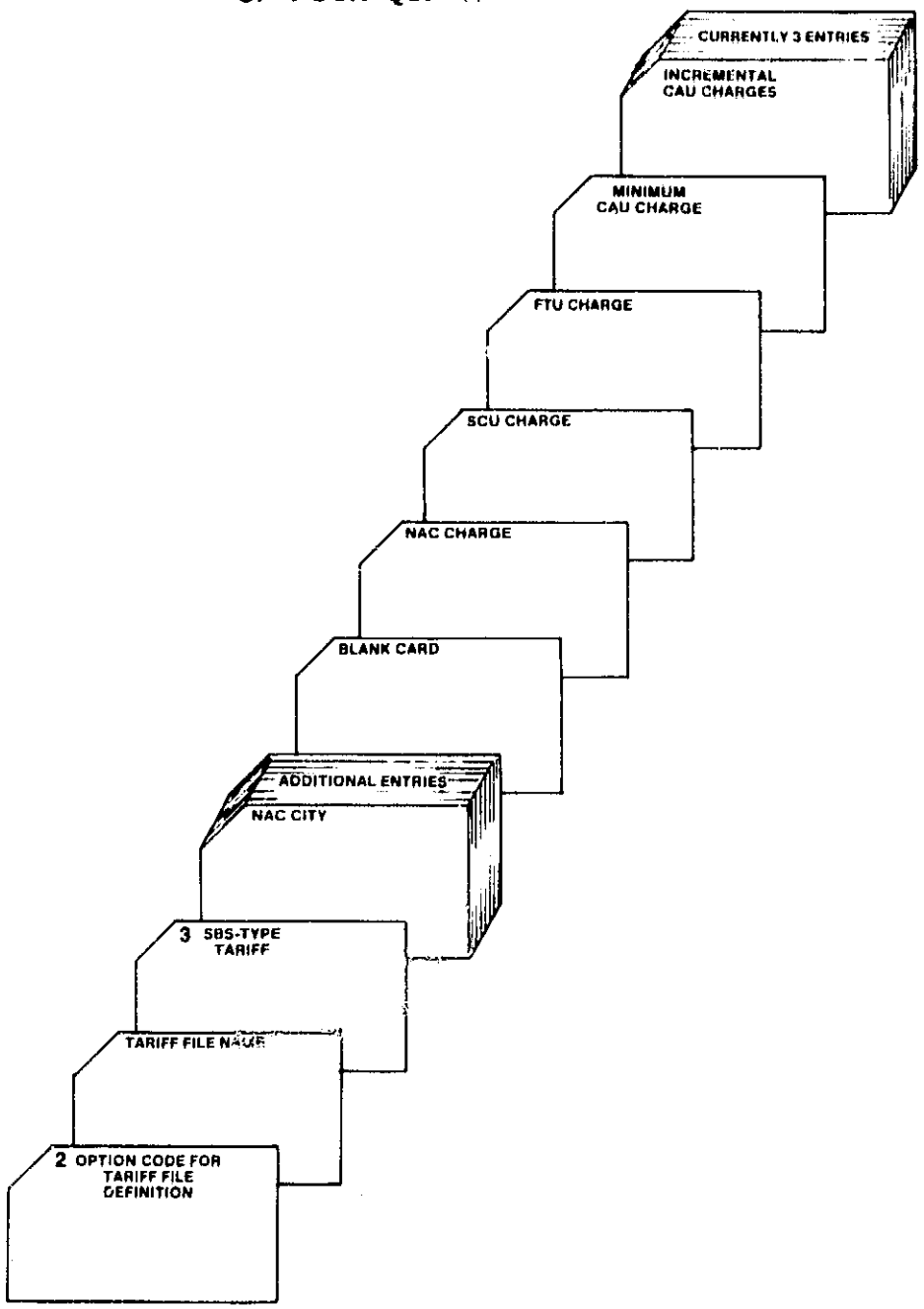

Figure 8-7. BATCH Mode SBS-Type Tariff File Definition

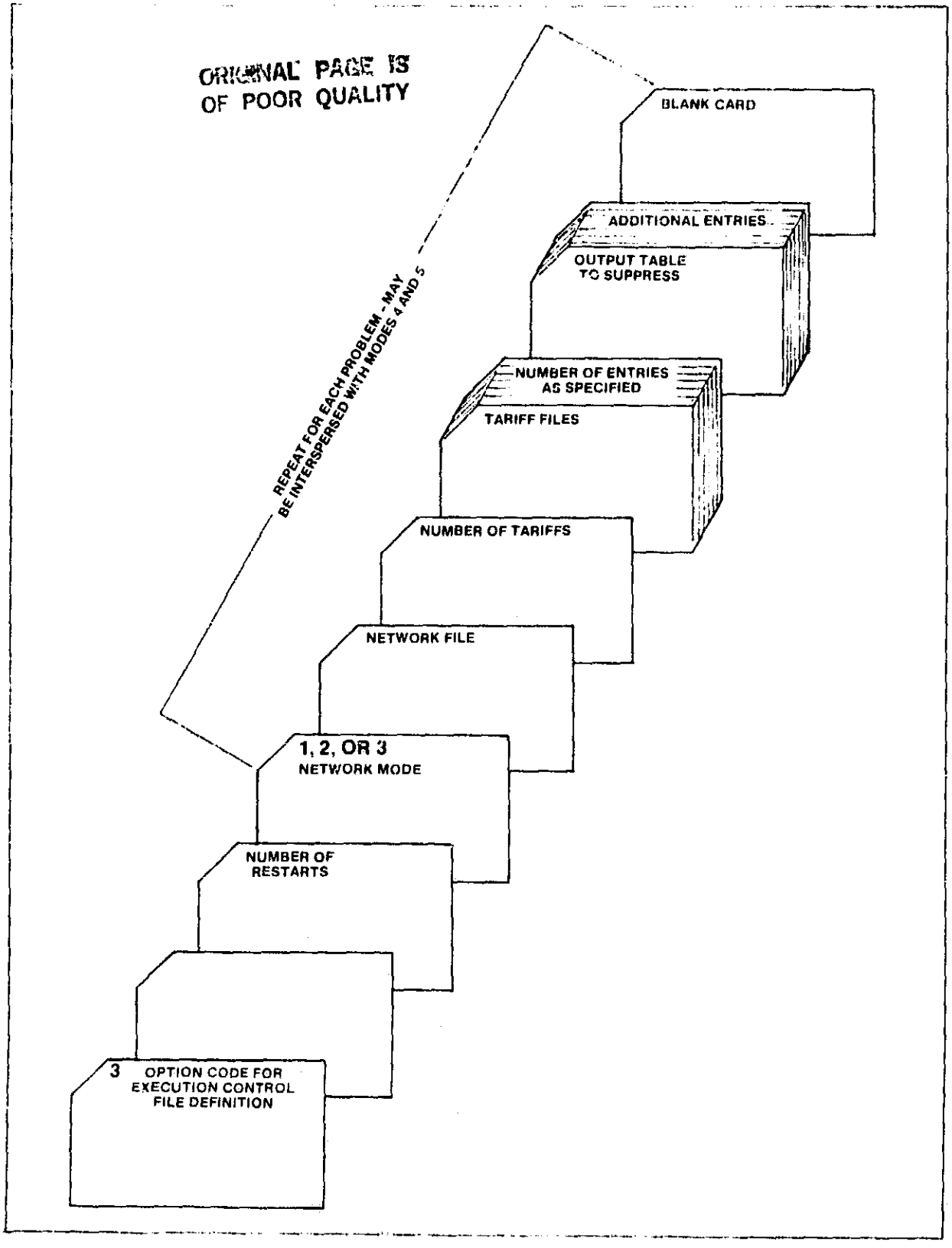

Figure 8-8. BATCH Mode Execution Control File Definition with Network Mode 1, 2, or 3

C-2

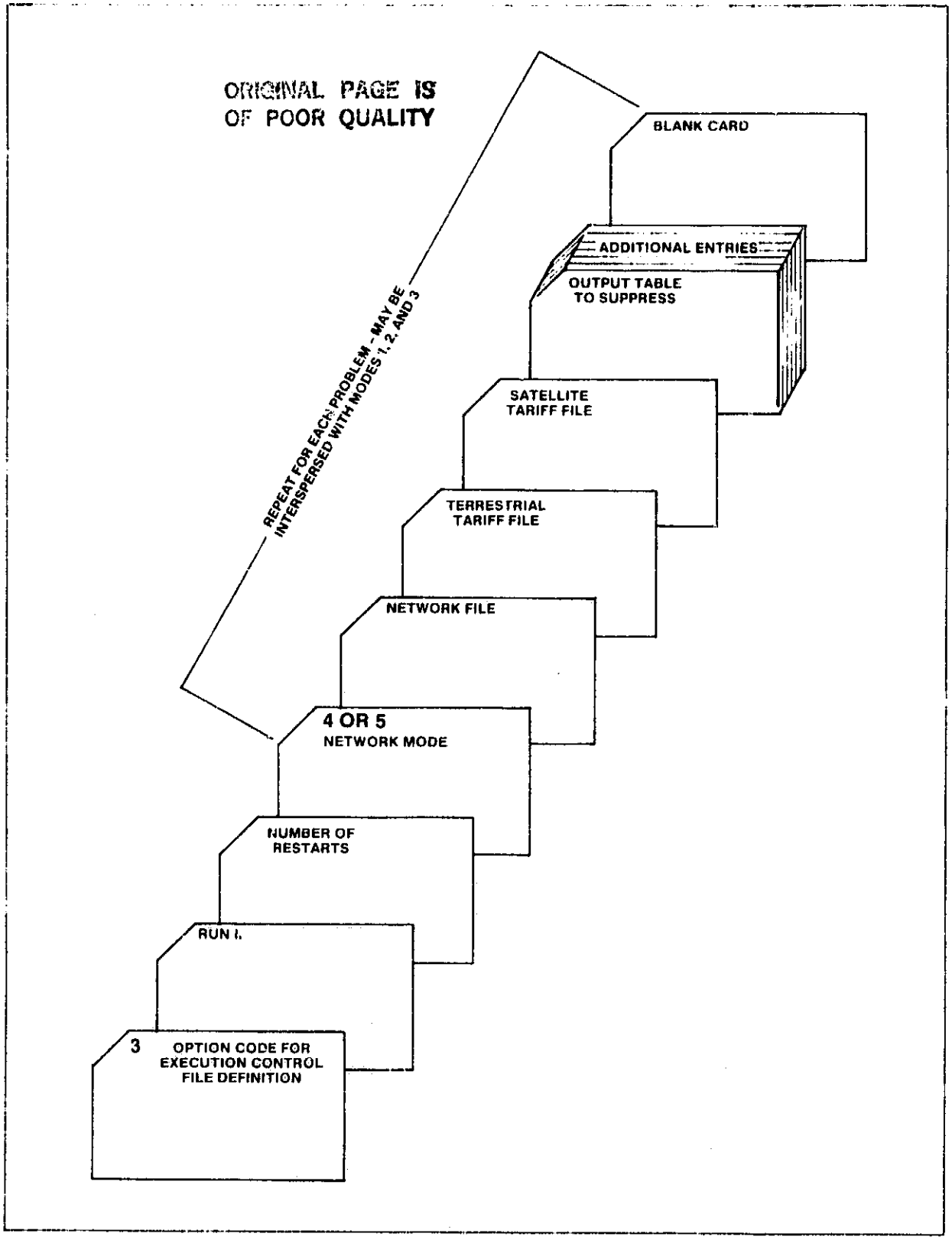

Figure 8-9. BATCH Mode Execution Control File Definition with Network Mode 4 or 5

Tables 8-1, 8-2, and 8-3 provide lists of all data items that can appear in network, tariff, and execution control file definitions along with the FORTRAN formats used, the card columns in which the data must appear, and the range of acceptable values.

8.4 SUBMITTING BATCH RUNS FOR EXECUTION

The method of submitting a batch run for execution depends on the form of the input data set. A batch run that is defined by a deck of punched cards must be submitted to the system operator to be read into the system via the high speed card reader. The card input will be handled by a system task that is provided for that purpose. When the data set is read in, it defines a nonconversational task that is executed as soon as space is available. In this case, the user has little or no involvement.

A batch run that is defined by a cataloged data set residing on disk is initiated by issuing the EXECUTE command. The command may be entered from a terminal as part of a conversational task, or given within the input data set of nonconversational task. The format of the command is EXECUTE DSNAME where DSNAME is the name of the cataloged input data set defining the run. The EXECUTE command requests creation of a nonconversational task that is independent of the user's current tasks.

Following is an example of submitting a batch run from a data set. Suppose the user wishes to run CNDC requesting option 4, execute model using current definition in the execution control file. First, a data set must be created using a text editor. This data set may be organized VI or VS. The data set created for this example, named BATCHER, is defined below:

```
LOGON USERID,TIME=24000,PACK=A
TIME 420
UNLOADA
BATRUN
4
LOGOFF
```

To submit this batch job, enter the command

```
EXECUTE BATCHER
```

The system will respond with

```
BSN=nnnn
```

where nnnn is the number by which this batch job is known to the system. The output will be written into SYSOUT.BSNnnnn and automatically printed.

Regardless of which method is used to initiate the batch run, the user's task is assigned a four-digit decimal number called the batch sequence number (BSN). This number identifies the user's nonconversational task. The status of the task can be checked by issuing the TSS command JOBS to display the user's batch work queue. When the BSN assigned to the task no longer appears in the queue, the task has been completed. A previously initiated nonconversational task can be deleted from the user's batch work queue by issuing the TSS command CANCEL followed by the batch sequence number assigned to the task. For more information about TSS commands, the user is referred to the IBM TSS Command System User's Guide and the Lewis CSUG Supplement.

TABLE 8-1. DATA ITEM DESCRIPTION FOR NETWORK FILE DEFINITION

ITEM	FORTRAN FORMAT	CARD COLUMNS	RANGE OF ACCEPTABLE VALUES
Network file name	A6	1-6	NETØØ1-NETØ2Ø
Network option	I1	1	1-4
Prestored city mnemonic	A4	1-4	Entries in Appendix A (table of prestored codes)
Percent to use in selecting pre-stored cities by the PERCENT option	F6.2	1-6	Ø.Ø-1ØØ.Ø. (include decimal point)
Traffic volume for prestored nodes	F1Ø.Ø	1-1Ø	Ø.Ø-2147483647. (include decimal point)
Additional city code	A4	1-4	Any four letter codes except those listed in Appendix A
Vertical coordi-nate	I4	6-9	ØØØ1-9999 (no decimal point)
Horizontal coordi-nate	I4	11-14	ØØØ1-9999 (no decimal point)
From city code	A4	1-4	AAAA-ZZZZ (must be a network node)
To city code	A4	6-9	AAAA-ZZZZ (must be a network node)
Additional traffic	F1Ø.Ø	11-2Ø	Ø.Ø-2147483647. (include decimal point)
Traffic table spool option	I1	1	Ø or 1 (no decimal point) Ø = No, 1 = Yes

TABLE 8-2. DATA ITEM DESCRIPTION FOR TARIFF FILE DEFINITION

ITEM	FORTRAN FORMAT	CARD COLUMNS	RANGE OF ACCEPTABLE VALUES
Tariff file name	A6	1-6	TARØØ1-TARØ12, TRFATT, TRFWU, or TRFSBS
File type	I1	1	1-3
ATT type:			
City code for listed city change	A4	1-4	AAAA-ZZZZ
Insert/delete code for listed city change	A1	6	+1 or -1 (no decimal point)
Mileage charges	F12.2	1-12	Ø.Ø - 999999999999. (include decimal point)
WU type:			
Satellite access from city code	A4	1-4	AAAA-ZZZZ
Satellite access to city code	A4	6-9	AAAA-ZZZZ
Satellite access city pair category	I1	11	Ø-3 (no decimal point)
Channel charges	F12.2	1-12	Ø.Ø - 999999999999. (include decimal point)
SBS type:			
NAC location	A4	1-4	AAAA-ZZZZ
NAC charges	F12.2	1-12	Ø.Ø - 999999999999. (include decimal point)
SCU charge	F12.2	1-12	Ø.Ø - 999999999999. (include decimal point)
FTU charge	F12.2	1-12	Ø.Ø - 999999999999. (include decimal point)
Minimum CAU charge	F12.2	1-12	Ø.Ø - 999999999999. (include decimal point)
Incremental CAU charges	F12.2	1-12	Ø.Ø - 999999999999. (include decimal point)

TABLE 8-3. DATA ITEM DESCRIPTION FOR EXECUTION CONTROL FILE DEFINITION

ITEM	FORTRAN FORMAT	CARD COLUMNS	RANGE OF ACCEPTABLE VALUES
Run ID	A8	1-8	Any 8 characters
Number of restarts	F4.2	1-4	1. - 1Ø. (include decimal point)
Network mode	I1	1	1 - 5 (no decimal point)
Network file name	A6	1-6	NETØØ1-NETØ2Ø
Number of tariffs	F4.2	1-4	1. - 13. (include decimal point)
Tariff file name	A6	1-6	TARØØ1-TARØ12, TRFATT, TRFWU, TRFSBS
Table to suppress	I1	1	1-5 (no decimal point)

CHAPTER 9 - INTERPRETATION OF CNDC MODEL OUTPUTS

9.1 OVERVIEW

Output is generated by the CNDC Model upon completion of each individual problem within a run. Output consists of six reports or tables. By default, the program will generate all six output reports. Any of the reports can be suppressed by user request. These reports include:

Table 1. Input as Output,
Table 2. Least-Cost Routes,
Table 3. Least-Cost Network,
Table 4. Output Network Totals,
Table 5. Tariff Summary, and
Table 6. Traffic Table.

The contents of the six output reports are described in the following sections.

9.2 INPUT AS OUTPUT

The user has the option of having the input data set for each problem printed as the first output report. This report is printed out by default, unless the user explicitly suppresses it via execution control file inputs. Specifically, TABLE 1 contains the following types of information, which appear annotated on figure 9-1:

1. Indication of problem type (terrestrial only, satellite only, etc.),

2. Listing of network file,

3. Total traffic level for the network,

4. List of tariff files, and

5. Listing of user input NAC cities (mixed SBS problems only).

```
**************************************************

                    SBSMXD

                     CASE  1

                   MIXED (SBS)

**************************************************


**********************************************************************
**********************   TABLE 1   INPUT   **********************
**********************************************************************

          PROBLEM  1 OF RUN SBSMXD   IS SBS MIXD (1)

     NETWORK FILE NET011 CONTAINS THE FOLLOWING     9 NODES (2)

       CODE                        CITY NAME
       ----          ------------------------------------
       ANCA.........ANAHEIM-SANTA ANA-GARDEN GROVE CA
       BAMD.........BALTIMORE MD
       CIIL.........CHICAGO IL
       DEMI.........DETROIT MI
       LOCA.........LOS ANGELES-LONG BEACH CA
       NANY.........NASSAU-SUFFOLK NY
       NENY.........NEW YORK NY-NJ
       PHPA.........PHILADELPHIA PA-NJ
       WADC.........WASHINGTON DC-MD


   TRAFFIC LEVEL FOR PRESTORED NODES IS   20000000 VOICE CIRCUITS (3)
```

Figure 9-1. Sample Table 1 Output Report – Input as Output (Sheet 1 of 3)

TARIFFS USED

TARIFF TRFATT IS PRESTORED ATT TARIFF

SCHEDULE 1

MILEAGE	CHARGE
1	$ 73.56
2- 14	$ 73.56 + $2.59 FOR EACH MILE OVER 1 MILES
15	$ 109.82
16- 24	$ 109.82 + $2.16 FOR EACH MILE OVER 15 MILES
25	$ 131.42
26- 39	$ 131.42 + $1.62 FOR EACH MILE OVER 25 MILES
40	$ 155.72
41- 59	$ 155.72 + $1.62 FOR EACH MILE OVER 40 MILES
60	$ 188.12
61- 79	$ 188.12 + $1.62 FOR EACH MILE OVER 60 MILES
80	$ 220.52
81- 99	$ 220.52 + $1.62 FOR EACH MILE OVER 80 MILES
100	$ 252.92
101- 999	$ 252.92 + $0.94 FOR EACH MILE OVER 100 MILES
1000	$ 1098.92
OVER 1000	$ 1098.92 + $0.58 FOR EACH MILE OVER 1000 MILES

SCHEDULE 2

MILEAGE	CHARGE
1	$ 75.00
2- 14	$ 75.00 + $4.77 FOR EACH MILE OVER 1 MILES
15	$ 141.78
16- 24	$ 141.78 + $4.47 FOR EACH MILE OVER 15 MILES
25	$ 186.48
26- 39	$ 186.48 + $2.89 FOR EACH MILE OVER 25 MILES
40	$ 229.83
41- 59	$ 229.83 + $1.95 FOR EACH MILE OVER 40 MILES
60	$ 268.83
61- 79	$ 268.83 + $1.95 FOR EACH MILE OVER 60 MILES
80	$ 307.83
81- 99	$ 307.83 + $1.95 FOR EACH MILE OVER 80 MILES
100	$ 346.83
101- 999	$ 346.83 + $0.94 FOR EACH MILE OVER 100 MILES
1000	$ 1192.83
OVER 1000	$ 1192.83 + $0.58 FOR EACH MILE OVER 1000 MILES

SCHEDULE 3

MILEAGE	CHARGE
1	$ 76.43
2- 14	$ 76.43 + $6.35 FOR EACH MILE OVER 1 MILES
15	$ 165.33

(4)

Figure 9-1. Sample Table 1 Output Report – Input as Output (Sheet 2 of 3)

```
 16-  24   $  165.33  +  $5.48 FOR EACH MILE OVER   15 MILES
      25   $  220.13
 26-  39   $  220.13  +  $4.03 FOR EACH MILE OVER   25 MILES
      40   $  280.58
 41-  59   $  280.58  +  $3.03 FOR EACH MILE OVER   40 MILES
      60   $  341.18
 61-  79   $  341.18  +  $2.31 FOR EACH MILE OVER   60 MILES
      80   $  387.38
 81-  99   $  387.38  +  $1.95 FOR EACH MILE OVER   80 MILES
     100   $  426.38
101- 999   $  426.38  +  $0.97 FOR EACH MILE OVER  100 MILES
    1000   $ 1299.38
OVER 1000  $ 1299.38  +  $0.58 FOR EACH MILE OVER 1000 MILES
```

(4)

```
   TARIFF FILE      A CONTAINS THE FOLLOWING   9 CATEGORY A RATE CENTERS
ANCA     BAND     CIIL     DEMI     LOCA     NANY     NENY     PHPA     NADC
```

```
                TARIFF TRFSBS IS THE PRESTORED SBS TARIFF
              THE APPROPRIATE RATES FOR THIS TARIFF ARE AS FOLLOWS

                          NAC CHARGE.....................$  17850.00
                          SCU CHARGE.....................$   5700.00
                          FTU CHARGE.....................$   2550.00
                          MINIMUM CAU CHARGE.............$  17850.00
  NUMBER CAU                                      CHARGE
-------------------------------------------------------------------------
UP TO 150 CAU     $     95.00 FOR EACH CAU
UP TO 300 CAU     $  14250.00 + $     90.00 FOR EACH CAU OVER  150 CAU
OVER  300 CAU     $  27750.00 + $     65.00 FOR EACH CAU OVER  300 CAU
```

THE PROGRAM WILL SPECIFY NAC PLACEMENT (5)

Figure 9-1. Sample Table 1 Output Report – Input as Output (Sheet 3 of 3)

9.3 LEAST-COST ROUTE SOLUTION

Output table 2 describes the facilities and circuits determined to supply communication services between each pair of cities in the network at the lowest tariffed cost. The traffic on each of the least-cost routes is provided in the form of link summaries. The contents of TABLE 2 for a single city pair are shown in figure 9-2. The outputs are repeated for all unique city pairs in the network. The numbered annotations on figure 9-2 are described as follows:

1. Unique city pair. The field identifies the unique city pair by printing the four-character city codes of the originating and terminating cities.

2. Least-cost route. This output field identifies the nodes in the least-cost route for the city pair. All nodes are referenced by the corresponding four-character city code.

3. Total circuit mileage. The total circuit mileage on the least-cost route is calculated by summing the airline mileages over the route. This number is the sum of the individual link airline mileages listed in the Link Summary.

4. Total cost of circuits. The total circuit cost in dollars is calculated by summing the cost of each link on the least-cost route. The number is the sum of the costs associated with the individual links listed in the Link Summary.

The remaining entries in TABLE 2 for a given city pair are included in a tabular summary that itemizes information about the individual links that comprise the least-cost route. Two link summaries are provided for each directional link between the cities. The upper link lists traffic inclusive of other network or "pass-through" traffic. The lower link lists traffic exclusive of pass-through traffic over the link.

The following information appears in both Link Summaries and is annotated on figure 9-2.

NOTE: The upper link summary is inclusive of traffic between only those cities included on the least-cost route.

5. Link. The entries in the first column of a Link Summary identify the character codes of the service nodes defining each link in the least-cost route.

6. Total airline mileage. This column contains the airline mileage on each link as calculated from the vertical and horizontal coordinates of the corresponding service nodes.

7. Traffic volume. The traffic volume on each link includes all voice circuit requirements between nodes.

8. Facility size. The traffic requirement on each link is used to determine the number of base groups, super groups, master groups, and jumbo groups necessary to handle the volume on the link. A base group consists of 12 4-kHz channels, a super group consists of 60 4-kHz channels, a master group consists of 600 4-kHz channels, and a jumbo group consists of 3,600 4-kHz channels.

9. Cost per circuit. This column contains the minimum tariffed cost in dollars of a single circuit providing voice communication between the respective service nodes.

10. Total cost of circuits. This column contains the total tariffed cost in dollars for each link. The total cost is the product of the cost of an individual circuit (item 9) multiplied by the link traffic volume in voice circuits (item 7).

11. Tariff. This column contains the name associated with the tariff file yielding the lowest cost per circuit for each link.

12. Service. This field contains the word "TERRESTRIAL" or the word "SATELLITE" to reflect the type of service represented by the tariff used to supply circuits on each link.

TABLE 2

NANY - LOCA (1)

THE LEAST-COST ROUTE FROM NANY TO LOCA IS (2)

NANY-NENY-LOCA

THE TOTAL CIRCUIT MILEAGE FROM NANY TO LOCA IS 2463 MILES. (3)

THE TOTAL COST OF CIRCUITS FROM NANY TO LOCA IS $ 4327542.2 (4)

LINK SUMMARY

(5) LINK	(6) TOTAL AIRLINE MILEAGE	(7) TRAFFIC VOLUME ON LINK (VC'S)	(8) FACILITY SIZE				(9) COST PER CIRCUIT (DOLLARS)	(10) TOTAL COST OF CIRCUITS (DOLLARS)	(11) TARIFF	(12) SERVICE
			JUMBO GROUPS	MASTER GROUPS	SUPER GROUPS	BASE GROUPS				
NANY-NENY	20	21560	5	5	9	2	$ 120.62	$ 2600567.20	TARIFF-1	TERRESTRIAL
NENY-LOCA	2443	1867	0	3	1	1	$ 925.00	$ 1726975.00	TARIFF-2	SATELLITE

LINK SUMMARY

(5) LINK	(6) TOTAL AIRLINE MILEAGE	(7) TRAFFIC VOLUME ON LINK (VC'S)	(8) FACILITY SIZE				(9) COST PER CIRCUIT (DOLLARS)	(10) TOTAL COST OF CIRCUITS (DOLLARS)	(11) TARIFF	(12) SERVICE
			JUMBO GROUPS	MASTER GROUPS	SUPER GROUPS	BASE GROUPS				
NANY-NENY	20	725	0	1	2	1	$ 120.62	$ 87449.53	TARIFF-1	TERRESTRIAL
NENY-LOCA	2443	725	0	1	2	1	$ 925.00	$ 670525.00	TARIFF-2	SATELLITE

Figure 9-2. Table 2 Output Report – Least Cost Routes

9.4 LEAST-COST NETWORK SOLUTION

TABLE 3 describes the least-cost routes between all city pairs, indicating on each link of the routes the medium that is necessary to satisfy the traffic requirements of the entire network. The contents of TABLE 3 for a single city pair is shown in figure 9-3. The outputs are repeated for all unique city pairs in the network. The annotated numbers are associated with the following descriptions:

1. Unique city pair. This field identifies the unique city pair by printing the four-character city codes of the originating and terminating cities.

2. Least-cost route. This output field identifies the nodes in the least-cost route for the city pair. All nodes are referenced by the corresponding four-character city code.

   The remaining entries in TABLE 3 for a given city pair are included in a tabular summary that itemizes information about the individual links that comprise the least-cost route.

3. Link. The entries in the first column of a Link Summary identify the character codes of the service nodes defining each link in the least-cost route.

4. Traffic volume. This field contains the total volume of network traffic that traverses each link in the least-cost network expressed as a number of voice circuits. If the least-cost route connecting any pair of cities in the network includes the link, the corresponding directional traffic volume between those cities is included in the total network traffic volume in the link.

5. Facility size. The total network traffic requirement on each link is used to determine the number of base groups, super groups, master groups, and jumbo groups necessary to handle the volume on the link.

6. Cost per circuit. This column contains the minimum tariffed cost in dollars of a single circuit providing voice communication between the respective service nodes.

7. Total cost of circuits. This column contains the total tariffed cost in dollars for each link. The total cost is the product of the cost of an individual circuit (item 6) multiplied by the total network traffic volume on the link in voice circuits (item 4).

8. Tariff. This column contains the name associated with the file containing the tariff that was determined to yield the lowest cost per circuit for each link.

9. Service. This field contains the word "TERRESTRIAL" or the word "SATELLITE" to reflect the type of service represented by the tariff used to supply circuits on each link.

TABLE 3

NANY - LOCA (1)

THE LEAST-COST ROUTE FROM NANY TO LOCA IS (2)

NANY-NENY-LOCA

LINK SUMMARY

(3) LINK	(4) TOTAL NETWORK TRAFFIC VOLUME ON LINK (VC'S)	(5) FACILITY SIZE				(6) COST PER CIRCUIT (DOLLARS)	(7) TOTAL COST OF CIRCUITS (DOLLARS)	(8) TARIFF	(9) SERVICE
		JUMBO GROUPS	MASTER GROUPS	SUPER GROUPS	BASE GROUPS				
NANY-NENY	22674	6	1	7	5	$ 120.62	$ 2734937.88	TRFATT-I	TERRESTRIAL
NENY-LOCA	1367	0	3	1	1	$ 925.00	$ 1726975.00	TRFNU	SATELLITE

Figure 9-3. Sample Table 3 Output Report - Least Cost Network

9.5 NETWORK TOTALS

TABLE 4 summarizes least-cost routing totals for the entire least-cost network including airline mileage, number of circuits, and circuit costs. A typical output table is shown in figure 9-4. The annotated numbers are associated with the following descriptions:

1. Total circuit mileage. The total terrestrial circuit mileage, the total satellite circuit mileage, and the combined total circuit mileage are printed. The mileage between each pair of cities is included in the appropriate satellite or terrestrial mileage total depending on the service between the cities. The total terrestrial and satellite circuit mileages sum to the combined total circuit mileage.

2. Total voice circuits. The total number of terrestrial voice circuits, the total number of satellite voice circuits, and the combined total number of voice circuits are printed. The number of voice circuits determined to be required to handle the network traffic on each link of the least-cost network is added to the appropriate total depending on the service used to provide voice communication between the cities. The total number of terrestrial and satellite voice circuits sum to the combined total.

3. Cost. The total cost of all the terrestrial circuits, satellite circuits, and combined circuits are printed. The total cost of circuits on each link is added to the appropriate total (satellite or terrestrial) depending on the service between the cities. The total cost of terrestrial and satellite circuits sum to the combined total cost of all circuits. For problems involving SBS-type tariffs, the following output is also included in TABLE 4:

4. Summary of satellite earth station equipment. A summary of all SBS earth station equipment is given, broken down into NACs, SCUs, FTUs, and CAUs.

5. Summary of optimization results. The results of each iteration of the cost optimization algorithm are printed. The program prints the total number of NACs, the total number of separate NAC locations (there may be multiple NACs at a given location), and the total system cost.

6. SBS NAC cities. Those cities which were determined to be cost effective for NAC placement are printed out by the program.

```
**********************************************************************
**************   TABLE 4.  OUTPUT NETWORK TOTALS   **************
**********************************************************************
```

(1)

```
TOTAL TERRESTRIAL CIRCUIT MILEAGE IN THE LEAST-COST NETWORK .....      504 MILES
TOTAL SATELLITE CIRCUIT MILEAGEIN THE LEAST-COST NETWORK .....    75794 MILES
COMBINED TOTAL CIRCUIT MILEAGE IN THE LEAST-COST NETWORK .....    76298 MILES
```

(2)

```
TOTAL NUMBER OF TERRESTRIAL VOICE CIRCUITS IN THE LEAST-COST NETWORK .....   110594 CIRCUITS
TOTAL NUMBER OF SATELLITE VOICE CIRCUITS IN THE LEAST-COST NETWORK .....    89992 CIRCUITS
COMBINED TOTAL NUMBER OF VOICE CIRCUITS IN THE LEAST-COST NETWORK .....   200586 CIRCUITS
```

(3)

```
TOTAL COST OF TERRESTRIAL CIRCUITS IN THE LEAST-COST NETWORK .....$    16544656.00
TOTAL COST OF SATELLITE CIRCUITS IN THE LEAST-COST NETWORK .....$    21929632.00
COMBINED TOTAL COST OF CIRCUITS IN THE LEAST-COST NETWORK .....$    38474288.00
```

```
SUMMARY OF SATELLITE EARTH STATION EQUIPMENT
--------------------------------------------
NUMBER OF NACS.....      123
NUMBER OF SCUS.....      241
NUMBER OF FTUS.....     4504
NUMBER OF CAUS.....    89992
```

(4)

```
IXED ALGORITHM TO SELECT NUMBER OF NACS WENT THROUGH   8 ITERATIONS
\L SOLUTION WAS WITH   9 NAC LOCATIONS
```

(5)

```
TOTAL COST AT EACH NUMBER OF NAC LOCATIONS IS AS FOLLOWS
     NUMBER OF NACS      TOTAL SYSTEM COST
     --------------      -----------------
                  0   $     81812396.00      0 NAC LOCATIONS
                  3   $     53081152.00      3 NAC LOCATIONS
                  4   $     48788048.00      4 NAC LOCATIONS
                  5   $     44582384.00      5 NAC LOCATIONS
                  6   $     42889696.00      6 NAC LOCATIONS
                  7   $     40659968.00      7 NAC LOCATIONS
                  8   $     40027840.00      8 NAC LOCATIONS
                  9   $     38474288.00      9 NAC LOCATIONS

                THE   9 NAC LOCATIONS ARE AS FOLLOWS
NENY    LOCA    CIIL    DEMI    BAND    PHPA    HADC    ANCA    NANY
```

(6)

```
**********
```

Figure 9-4. Sample Table 4 Output Report – Network Totals

9.6 TARIFF SUMMARY

TABLE 5 presents a summary of tariff utilization in the routing solutions. Statistics associated with each tariff are presented both as totals and as percentages of the corresponding overall network totals. A typical output table is shown in figure 9-5. The annotated numbers are associated with the following descriptions:

1. Tariff. Each tariff included in the routing solution is identified by name.

2. Total circuit mileage. The least-cost routing mileage associated with each tariff is printed. The mileage between each pair of cities is included in the appropriate tariff total depending on the tariff providing communication service between the cities. The total circuit mileages for the individual tariffs sum to the total network circuit mileage printed in TABLE 4.

3. Total voice circuits. The total number of circuits associated with each tariff is printed. The number of voice circuits between each pair of cities is included in the appropriate tariff total depending on the tariff providing communication service between the cities. The total number of voice circuits for the individual tariffs sum to the total number of voice circuits in the least-cost network as printed in TABLE 4.

4. Percent of network circuits. The total number of voice circuits associated with each tariff is expressed as a percentage of the total number of voice circuits in the least-cost network.

5. Total cost. The total least-cost routing circuit cost associated with each tariff is printed. The cost of voice circuits between each city pair is included in the appropriate tariff total depending on the tariff providing communication service between the

cities. The total costs of voice circuits for the individual tariffs sum to the total cost of voice circuits in the least-cost network as printed in TABLE 4.

6. Percent of network cost. The total cost of voice circuits associated with each tariff is expressed as a percentage of the total cost of voice circuits in the least-cost network.

7. Service. This field contains the word "TERRESTRIAL" or the word "SATELLITE" to indicate the type of service represented by each of the tariffs included in the routing solution.

****
********** TABLE 5. TARIFF SUMMARY **********
****

(1) TARIFF	(2) TOTAL CIRCUIT MILEAGE	(3) TOTAL VOICE CIRCUITS	(4) PERCENT OF NETWORK CIRCUITS	(5) TOTAL COST	(6) PERCENT OF NETWORK COST	(7) SERVICE
TRFATT	504	110594	0.55	16544656.	0.43	TERRESTRIAL
TRFSBS	75794	89992	0.45	21929632.	0.57	SATELLITE

****

Figure 9-5. Sample Table 5 Output Report – Tariff Summary

9.7 TRAFFIC TABLE

TABLE 6 presents a summary of the directional traffic between all cities in the network being evaluated. The summary is presented in the form of a Traffic Table, which is a matrix format whose entries indicate the number of voice circuits between any two cities. The number of voice circuits between any city pair is calculated based on user inputs of network traffic. Figure 9-6 provides a sample of a typical Traffic Table.

********** TABLE 6 TRAFFIC TABLE **********
****

TRAFFIC TABLE

	ANCA	BAMD	CIIL	DEMI	LOCA	NANY	NENY	PHPA
ANCA	0	240	519	327	16260	237	652	301
BAMD	240	0	1253	1230	751	1813	4594	3618
CIIL	519	1253	0	2674	1142	1114	2114	1334
DEMI	327	1230	2674	0	897	1067	2386	1353
LOCA	16260	751	1142	897	0	725	1142	800
NANY	237	1813	1114	1067	725	0	20835	3475
NENY	652	4594	2114	2386	1142	20835	0	8380
PHPA	301	3618	1334	1353	800	3475	8380	0
WADC	273	6204	1348	1342	787	1774	4201	3131

	WADC
ANCA	273
BAMD	6204
CIIL	1348
DEMI	1342
LOCA	787
NANY	1774
NENY	4201
PHPA	3131
WADC	0

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Figure 9-6. Sample Table 6 – Traffic Table

Appendix A
PRESTORED SMSA CITIES OF THE CNDC MODEL

PRESTORED SMSA CITIES (SHEET 1 OF 7)

CODE	DESCRIPTIVE NAME	VERTICAL COORDINATE	HORIZONTAL COORDINATE
ABTX	ABILENE TX	8698	4513
AKOH	AKRON OH	5637	2472
ALGA	ALBANY GA	7649	1817
ALNY	ALBANY-SCHENECTADY-TROY NY	4639	1629
ALNM	ALBUQUERQUE NM	8549	5887
ALLA	ALEXANDRIA LA	8409	3168
ALPA	ALLENTOWN-BETHLEHEM-EASTON PA-NJ	5166	1585
ATPA	ALTOONA PA	5460	1972
AMTX	AMARILLO TX	8266	5076
ANCA	ANAHEIM-SANTA ANA-GARDEN GROVE CA	9250	7810
ANIN	ANDERSON IN	6173	2958
ANSC	ANDERSON SC	6961	1894
ANMI	ANN ARBOR MI	5602	2908
ANAL	ANNISTON AL	7406	2304
APWI	APPLETON-OSHKOSH WI	5589	3776
ASNC	ASHEVILLE NC	6749	2001
ATGE	ATHENS GE	7130	1948
ATGA	ATLANTA GA	7260	2083
ATNJ	ATLANTIC CITY NJ	5284	1284
AUGA	AUGUSTA GA-SC	7089	1674
AUTX	AUSTIN TX	9005	3996
BACA	BAKERSFIELD CA	8497	8060
BAMD	BALTIMORE MD	5510	1575
BAME	BANGOR ME	3777	1322
BALA	BATON ROUGE LA	8476	2874
BAMI	BATTLE CREEK MI	5713	3124
BYMI	BAY CITY MI	5368	3085
BETX	BEAUMONT-PORT ARTHUR-ORANGE TX	8777	3344
BEWA	BELLINGHAM WA	6087	8933
BEMI	BENTON HARBOR MI	5850	3281
BIMT	BILLINGS MT	6391	6790
BIMS	BILOXI-GULFPORT MS	8296	2481
BINY	BINGHAMTON NY-PA	4943	1837
BIAL	BIRMINGHAM AL	7519	2446
BIND	BISMARK ND	5840	5736
BLIN	BLOOMINGTON IN	6417	2984
BLIL	BLOOMINGTON-NORMAL IL	6358	3483
BOID	BOISE CITY ID	7096	7869
BOMA	BOSTON MA	4422	1249
BRFL	BRADENTON FL	8270	1116
BRWA	BREMERTON WA	6349	8940
BRCT	BRIDGEPORT CT	4841	1360
BICT	BRISTOL CT	4730	1394
BRMA	BROCKTON MA	4465	1205
BRTX	BROWNSVILLE-HARLINGEN-SAN BENI TX	9820	3663
BYTX	BRYAN-COLLEGE STATION TX	8827	3788
BUNY	BUFFALO NY	5075	2326

PRESTORED SMSA CITIES (SHEET 2 OF 7)

CODE	DESCRIPTIVE NAME	VERTICAL COORDINATE	HORIZONTAL COORDINATE
BUNC	BURLINGTON NC	6364	1588
BUVT	BURLINGTON VT	4270	1808
CAOH	CANTON OH	5676	2419
CAWY	CASPER WY	6918	6297
CEIA	CEDAR RAPIDS IA	6261	4021
CHIL	CHAMPAIGN-URBANA-RANTOUL IL	6371	3336
CHSC	CHARLESTON-NORTH CHARLESTON SC	7021	1281
CHWV	CHARLESTON WV	6152	2174
CHNC	CHARLOTTE-GASTONIA NC	6657	1698
CHVA	CHARLOTTESVILLE VA	5919	1683
CHTN	CHATTANOOGA TN-GA	7098	2366
CIIL	CHICAGO IL	5986	3426
CHCA	CHICO CA	8057	8668
CIOH	CINCINNATI OH-KY	6263	2679
CLTN	CLARKSVILLE-HOPKINSVILLE TN-KY	6988	2837
CLOH	CLEVELAND OH	5574	2543
COCO	COLORADO SPRINGS CO	7679	5813
COMO	COLUMBIA MO	6901	3841
COSC	COLUMBIA SC	6901	1589
COGA	COLUMBUS GA-AL	7556	2045
COOH	COLUMBUS OH	5972	2555
COTX	CORPUS CHRISTI TX	9475	3739
CUMD	CUMBERLAND MD-WV	5650	1916
DATX	DALLAS-FORT WORTH TX	8436	4034
DACT	DANBURY CT	4829	1423
DAVA	DANVILLE VA	6270	1640
DAIA	DEVENPORT-ROCK ISLAND-MOLINE IA-IL	6273	3817
DAOH	DAYTON OH	6113	2705
DAFL	DAYTONA BEACH FL	7791	1032
DEIL	DECATUR IL	6478	3413
DECO	DENVER-BOULDER CO	7501	5899
DEIA	DES MOINES IA	6471	4275
DEMI	DETROIT MI	5536	2828
DUIA	DUBUQUE IA	6088	3925
DUMN	DULUTH-SUPERIOR MN-WI	5352	4530
EAWI	EAU CLAIRE WI	5698	4261
ELTX	EL PASO TX	9231	5655
ELIN	ELKHART IN	5895	3168
ELNY	ELMIRA NY	5029	1953
ENOK	ENID OK	7783	4505
ERPA	ERIE PA	5321	2397
EUOR	EUGENE-SPRINGFIELD OR	7128	8954
EVIN	EVANSVILLE IN-KY	6729	3019
FAMA	FALL RIVER MA-RI	4543	1170
FAND	FARGO-MOORHEAD ND-MN	5615	5182
FANC	FAYETTEVILLE NC	6501	1385
FAAR	FAYETTEVILLE-SPRINGDALE AR	7600	3872

PRESTORED SMSA CITIES (SHEET 3 OF 7)

CODE	DESCRIPTIVE NAME	VERTICAL COORDINATE	HORIZONTAL COORDINATE
FIMA	FITCHBURG-LEOMINSTER MA	4459	1374
FLMI	FLINT MI	5461	2993
FLAL	FLORENCE AL	7344	2715
FOSC	FORENCE SC	6744	1417
FOCO	FORT COLLINS CO	7331	5965
FOFL	FORT LAUDERDALE-HOLLYWOOD FL	8282	557
FRFL	FORT MYERS FL	8359	904
FOAR	FORT SMITH AR-OK	7752	3855
FTFL	FORT WALTON BEACH FL	8097	2097
FOIN	FORT WAYNE IN	5942	2982
FRCA	FRESNO CA	8669	8239
GAAL	GADSDEN AL	7355	2368
GAFL	GAINESVILLE FL	7838	1310
GATX	GALVESTON-TEXAS CITY TX	8985	3397
GAIN	GARY-HAMMOND-EAST CHICAGO IN	6017	3354
GLNY	GLENS FALLS NY	4515	1704
GRND	GRAND FORKS ND-MN	5418	5297
GRMI	GRAND RAPIDS MI	5628	3261
GRMT	GREAT FALLS MT	6120	7281
GRCO	GREELEY CO	7345	5895
GRWI	GREEN BAY WI	5512	3747
GRNC	GREENSBORO-WINSTON-SALEM-HIGH NC	6400	1638
GRSC	GREENVILLE-SPARTANBURG SC	6250	1226
HAMD	HAGERSTOWN MD	5555	1772
HAOH	HAMILTON-MIDDLETOWN OH	6210	2718
HAPA	HARRISBURG PA	5363	1733
HACT	HARTFORD CT	4687	1373
HINC	HICKORY NC	6611	1833
HOTX	HOUSTON TX	8938	3536
HUWV	HUNTINGTON-ASHLAND WV-KY	6212	2299
HUAL	HUNTSVILLE AL	7267	2535
ININ	INDIANAPOLIS IN	6272	2992
IOIW	IOWA CITY IW	6313	3972
JAMI	JACKSON MI	5663	3009
JAMS	JACKSON MS	8035	2880
JAFL	JACKSONVILLE FL	7649	1276
JANC	JACKSONVILLE NC	6412	1131
JAWI	JANESVILLE-BELIOT WI	5970	3688
JENJ	JERSEY CITY NJ	5006	1409
JOTN	JOHNSON CITY-KINGSPORT-BRISTOL TN-VA	6595	2050
JOPA	JOHNSTOWN PA	5542	2021
JOMO	JOPLIN MO	7421	4015
KAMI	KALAMAZOO-PORTAGE MI	5749	3177
KAIL	KANKAKEE IL	6149	3381
KAMO	KANSAS CITY MO-KS	7027	4203
KEWI	KENOSHA WI	5865	3526
KITX	KILLEEN-TEMPLE TX	8832	4063

PRESTORED SMSA CITIES (SHEET 4 OF 7)

CODE	DESCRIPTIVE NAME	VERTICAL COORDINATE	HORIZONTAL COORDINATE
KNTN	KNOXVILLE TN	6801	2251
KOIN	KOKOMO IN	6135	3063
LAWI	LA CROSSE WI	5874	4133
LALA	LAFAYETTE LA	8587	2996
LAIN	LAFAYETTE-WEST LAFAYETTE IN	6206	3167
LKLA	LAKE CHARLES LA	8679	3202
LAFL	LAKELAND-WINTER HAVEN FL	8084	1034
LAPA	LANCASTER PA	5348	1626
LAMI	LANSING-EAST LANSING MI	5584	3081
LATX	LAREDO TX	9681	4099
LANM	LAS CRUCES NM	9132	5742
LANV	LAS VEGAS NV	8665	7411
LAKS	LAWRENCE KS	7098	4294
LAMA	LAWRENCE-HAVERHILL MA-NH	4373	1311
LAOK	LAWTON OK	8178	4451
LEME	LEWISTON-AUBURN ME	4042	1391
LEKY	LEXINGTON-FAYETTE KY	6459	2562
LIOH	LIMA OH	5921	2799
LINE	LINCOLN NE	6823	4674
LIAR	LITTLE ROCK-NORTH LITTLE ROCK AR	7721	3451
LONJ	LONG BRANCE-ASBURY PARK NJ	5073	1348
LOTX	LONGVIEW TX	8348	3660
LOOH	LORAIN-ELYRIA OH	5623	2608
LOCA	LOS ANGELES-LONG BEACH CA	9213	7878
LOKY	LOUISVILLE KY-IN	6529	2772
LOMA	LOWELL MA-NH	4399	1320
LUTX	LUBBOCK TX	8598	4962
LYVA	LYNCHBURG VA	6093	1703
MAGA	MACON GA	7364	1865
MAWI	MADISON WI	5887	3796
MANH	MANCHESTER NH	4354	1388
MAOH	MANSFIELD OH	5783	2575
MCTX	MCALLEN-PHARR-EDINBURG TX	9856	3764
MEOR	MEDFORD OR	7503	8892
MEFL	MELBOURNE-TITUSVILLE-COCOA FL	7925	903
METN	MEMPHIS TN-AR	7471	3125
MECT	MERIDEN CT	4740	1358
MIFL	MIAMI FL	8351	527
MITX	MIDLAND TX	8934	4888
MIWI	MILWAUKEE WI	5788	3589
MIMN	MINNEAPOLIS-ST PAUL MN-WI	5781	4525
MOAL	MOBILE AL	8167	2367
MOCA	MODESTO CA	8499	8473
MOLA	MONROE LA	8148	3218
MNAL	MONTGOMERY AL	7692	2247
MUIN	MUNCIE IN	6130	2925
MUMI	MUSKEGON-NORTON SHORES-MUSKEGO MI	5622	3370

PRESTORED SMSA CITIES (SHEET 5 OF 7)

CODE	DESCRIPTIVE NAME	VERTICAL COORDINATE	HORIZONTAL COORDINATE
NANH	NASHUA NH	4394	1356
NATN	NASHVILLE-DAVIDSON TN	7010	2710
NANY	NASSAU-SUFFOLK NY	4961	1355
NEMA	NEW BEDFORD MA	4532	1131
NECT	NEW BRITAIN CT	4715	1373
NENJ	NEW BRUNSWICK-PERTH AMBOY-SAYR NJ	5085	1434
NWCT	NEW HAVEN-WEST HAVEN CT	4792	1342
NLCT	NEW LONDON-NORWICH CT-RI	4700	1242
NELA	NEW ORLEANS LA	8483	2638
NENY	NEW YORK NY-NJ	4997	1406
NWNJ	NEWARK NJ	5015	1430
NEOH	NEWARK OH	5904	2480
NWNY	NEWBRGH-MIDDLETOWN NY	4915	1556
NEVA	NEWPORT NEWS-HAMPTON VA	5908	1260
NOVA	NORFOLK-VIRGINIA BEACH-PORTSMO VA-NC	5918	1223
NOPA	NORTHEAST PENNSYLVANIA PA	5068	1719
NOCT	NORWALK CT	4877	1379
OCFL	OCALA FL	7909	1227
ODTX	ODESSA TX	8982	4930
OKOK	OKLAHOMA CITY OK	7947	4373
OLWA	OLYMPIA WA	6469	8971
OMNE	OMAHA NE-IA	6687	4595
ORFL	ORLANDO FL	7954	1031
OWKY	OWENSBORO KY	6731	2928
OXCA	OXNARD-SIMI VALLEY-VENTURA CA	9205	8050
PAFL	PANAMA CITY FL	8057	1914
PAWV	PARKERSBURG-MARIETTA WV-OH	5976	2268
PAMS	PASCAGOULA-MOSS POINT PATERSON MS	8273	2419
PANJ	PATERSON-CLIFTON-PASSAIC NJ	4984	1452
PEFL	PENSACOLA FL	8147	2200
PEIL	PEORIA IL	6362	3592
PEVA	PETERSBURG-COLONIAL HEIGHTS-HO VA	5961	1429
PHPA	PHILADELPHIA PA-NJ	5251	1458
PHAZ	PHOENIX AZ	9135	6748
PIAR	PINE BLUFF AR	7803	3358
PIPA	PITTSBURGH PA	5621	2185
PIMA	PITTSFIELD MA	4626	1539
POME	PORTLAND ME	4121	1334
POOR	PORTLAND OR-WA	6799	8914
PONH	PORTSMOUTH-DOVER-ROCHESTER NH-ME	3760	1431
PONY	POUGHKEEPSIE NY	4821	1526
PRRI	PROVIDENCE-WARWICK-PAWTUCKET RI-MA	4550	1219
PRUT	PROVO-OREM UT	7680	7006
PUCO	PUEBLO CO	7787	5742
RAWI	RACINE WI	5837	3535
RANC	RALEIGH-DURHAM NC	6344	1436
REPA	READING PA	5258	1612

PRESTORED SMSA CITIES (SHEET 6 OF 7)

CODE	DESCRIPTIVE NAME	VERTICAL COORDINATE	HORIZONTAL COORDINATE
RECA	REDDING CA	7880	8778
RENV	RENO NV	8064	8323
RIWA	RICHLAND-KENNEWICK WA	6583	8415
RIVA	RICHMOND VA	5906	1472
RICA	RIVERSIDE-SAN BERNARDINO-ONTAR CA	9172	7710
ROVA	ROANOKE VA	6196	1801
ROMN	ROCHESTER MN	5916	4326
RONY	ROCHESTER NY	4913	2195
ROIL	ROCKFORD IL	6022	3675
ROSC	ROCK HILL SC	6730	1692
SACA	SACRAMENTO CA	8304	8580
SAMI	SAGINAW MI	5404	3074
STMN	ST CLOUD MN	5721	4705
STMO	ST JOSEPH MO	6913	4301
SLMO	ST LOUIS MO-IL	6807	3482
SAOR	SALEM OR	6929	8958
SLCA	SALINAS-SEASIDE-MONTEREY CA	8722	8560
SANC	SALISBURY-CONCORD NC	6601	1679
SAUT	SALT LAKE CITY-OGDEN UT	7576	7065
SATX	SAN ANGELO TX	8944	4563
SNTX	SAN ANTONIO TX	9225	4062
SNCA	SAN DIEGO CA	9468	7629
SFCA	SAN FRANCISCO-OAKLAND CA	8492	8719
SJCA	SAN JOSE CA	8583	8619
STCA	SANTA BARBARA-SANTA MARIA-LOMP CA	9171	8150
SCCA	SANTA CRUZ CA	8664	8633
SRCA	SANTA ROSA CA	8354	8787
SAFL	SARASOTA FL	8295	1094
SAGA	SAVANNAH GA	7266	1379
SEWA	SEATTLE-EVERETT WA	6336	8896
SHPA	SHARON PA	5520	2348
SHWI	SHEBOYGAN WI	5633	3629
SHTX	SHERMAN-DENISON TX	8253	4072
SHLA	SHREVEPORT LA	8272	3495
SINE	SIOUX CITY NE-IA	6468	4768
SISD	SIOUX FALLS SD	6279	4900
SOIN	SOUTH BEND IN	5918	3206
SPWA	SPOKANE WA	6247	8180
SPIL	SPRINGFIELD IL	6539	3513
SPMO	SPRINGFIELD MO	7310	3836
SPOH	SPRINGFIELD OH	6049	2666
SPCT	SPINGFIELD-CHICOPEE-HOLYOKE CT-MA	4620	1408
STCT	STAMFORD CT	4897	1388
STPA	STATE COLLEGE PA	5360	1933
STOH	STEUBENVILLE-WEIRTON OH-WV	5689	2262
SOCA	STOCKTON CA	8435	8530
SYNY	SYRACUSE NY	4798	1990

PRESTORED SMSA CITIES (SHEET 7 OF 7)

CODE	DESCRIPTIVE NAME	VERTICAL COORDINATE	HORIZONTAL COORDINATE
TAWA	TACOMA WA	6415	8906
TAFL	TALLAHASSEE FL	7877	1716
TMFL	TAMPA-ST PETERSBURG FL	8173	1147
TEIN	TERRE HAUTE IN	6428	3145
TETX	TEXARKANA TX-AR	8111	3626
TOOH	TOLEDO OH-MI	5704	2820
TOKS	TOPEKA KS	7110	4369
TRNJ	TRENTON NJ	5164	1440
TUAZ	TUCSON AZ	9345	6485
TUOK	TULSA OK	7707	4173
TUAL	TUSCALOOSA AL	7643	2535
TYTX	TYLER TX	8417	3744
UTNY	UTICA-ROME NY	4701	1878
VACA	VALLEJO-FAIRFIELD-NAPA CA	8422	8699
VITX	VICTORIA TX	9245	3748
VINJ	VINELAND-MILLVILLE-BRIDGETON NJ	5320	1380
VICA	VISALIA-TULARE-PORTERVILLE CA	8746	8139
WATX	WACO TX	8706	3993
WADC	WASHINGTON DC-MD	5622	1583
WACT	WATERBURY CT	4761	1391
WAIA	WATERLOO-CEDAR FALLS IA	6208	4167
WAWI	WAUSAU WI	5542	4014
WEFL	WEST PALM BEACH-BOCA RATON FL	8166	607
WHWV	WHEELING WV-OH	5755	2241
WIKS	WICHITA KS	7489	4520
WITX	WICHITA FALLS TX	8326	4413
WIPA	WILLIAMSPORT PA	5200	1873
WIDE	WILMINGTON DE-NJ	5326	1485
WINC	WILMINGTON NC	6559	1143
WOMA	WORCESTER MA	4513	1330
YAWA	YAKIMA WA	6533	8607
YOPA	YORK PA	5402	1674
YOOH	YOUNGSTOWN-WARREN OH	5557	2353
YUCA	YUBA CITY CA	8181	8624

Appendix B
PRESTORED TARIFFS OF THE CNDC MODEL

Table B-1. Prestored American Telephone and Telegraph Company Listed Cities as Defined in F.C.C. No. 260 (Effective July 3, 1983) (Sheet 1 of 11)

RATE CENTER	CODE
Alabama	
Anniston	ANAL
Birmingham	BIAL
Decatur	DEAL
Huntsville	HUAL
Mobile	MOAL
Montgomery	MNAL
Troy	TRAL
Arizona	
Flagstaff	FLAR
Phoenix	PHAZ
Prescott	PRAR
Tucson	TUAZ
Yuma	YUAR
Arkansas	
Fayetteville	FAAR
Forrest City	FOAR
Hot Springs	HOAR
Jonesboro	JOAR
Little Rock	LIAR
Pine Bluff	PIAR
Searcy	SEAR
California	
Anaheim	ANCA
Bakersfield	BACA
Chico	CHCA
Eureka	EUCA
Fresno	FRCA
Garoena	GACA
Hayward	HACA
Long Beach (Los Angeles)	LOCA
Los Angeles	LOCA
Oakland (San Francisco)	SFCA
Redwood City	RDCA
Sacramento	SACA
Salinas	SLCA
San Bernardina (Riverside)	RICA
San Diego	SNCA
San Francisco	SFCA
San Jose	SJCA
San Luis Obispo	SUCA
Santa Monica	STCA
Santa Rosa	SRCA

Table B-1. Prestored American Telephone and Telegraph Company Listed Cities as Defined in F.C.C. No. 260 (Effective July 3, 1983) (Sheet 2 of 11)

RATE CENTER	CODE
California (continued)	
Stockton	SOCA
Sunnyvale	SYCA
Ukiah	UKCA
Van Nuys	VNCA
Colorado	
Colorado Springs	COCO
Denver	DECO
Fort Collins	FOCO
Fort Morgan	FRCO
Glenwood Springs	GLCO
Grand Junction	GACO
Greeley	CRCO
Montrose	MOCO
Pueblo	PUCO
Connecticut	
Bethany	BECT
Bloomfield	BLCT
Bridgeport	BRCT
Brookfield	BOCT
East Hartford	EACT
Groton	GRCT
Hamden	HMCT
Hartford	HACT
New Haven	NWCT
New London	NLCT
North Haven	NOCT
Orange	ORCT
Stamford	STCT
Stratford	SACT
West Hartford	WECT
West Haven	WSCT
Wethersfield	WTCT
Delaware	
Wilmington	WIDE
Destrict of Columbia	WADC
Florida	
Chipley	CHFL
Clearwater	CLFL
Cocoa (Melbourne)	MEFL
Crestview	CRFL
Daytona Beach	DAFL

Table B-1. Prestored American Telephone and Telegraph Company Listed Cities as Defined in F.C.C. No. 260 (Effective July 3, 1983) (Sheet 3 of 11)

RATE CENTER	CODE
Florida (continued)	
Fort Lauderdale	FOFL
Fort Meyers	FRFL
Fort Pierce	FPFL
Fort Walton Beach	FTFL
Gainesville	GAFL
Jacksonville	JAFL
Key West	KEFL
Lake City	LKFL
Miami	MIFL
Ocala	OCFL
Orlando	ORFL
Panama City	PAFL
Pensacola	PEFL
St. Petersburg (Tampa)	TMFL
Sarasota	SAFL
Tallahassee	TAFL
Tampa	TMFL
West Palm Beach	WEFL
Winter Garden	WIFL
Winter Haven (Lakeland)	LAFL
Georgia	
Albany	ALGA
Atlanta	ATGA
Augusta	AUGA
Brunswick	BRGA
Columbus	COGA
Conyers	CNGA
Dublin	DUGA
Fitzgerald	FIGA
Macon	MAGA
Rome	ROGA
Savannah	SAGA
Thomasville	THGA
Waycross	WAGA
Idaho	
Boise	BOID
Pocatello	POID
Twin Falls	TWID
Illinois	
Centralia	CEIL
Champaign-Urbana	CHIL
Chicago	CIIL
Collinsville	COIL

Table B-1. Prestored American Telephone and Telegraph Company Listed Cities as Defined in F.C.C. No. 260 (Effective July 3, 1983) (Sheet 4 of 11)

RATE CENTER	CODE
Illinois (continued)	
De Kalb	DKIL
Hinsdale	HIIL
Joliet	JOIL
Marion	MAIL
Mattoon	MTIL
Newark	NEIL
Northbrook	NOIL
Peoria	PEIL
Rockford	ROIL
Rock Island (Davenport)	DAIA
Springfield	SPIL
Woodstock	WOIL
Indiana	
Bloomington	BLIN
Evansville	EVIN
Fort Wayne	FOIN
Indianapolis	ININ
Muncie	MUIN
New Albany	NEIN
South Bend	SOIN
Terre Haute	TEIN
Iowa	
Boone	BOIA
Burlington	BUIA
Cedar Rapids	CEIA
Davenport	DAIA
Dubuque	DUIA
Iowa City	IOIW
Sioux City	SINE
Waterloo	WAIA
Kansas	
Dodge City	DOKS
Hutchinson	HUKS
Kansas City	KAMO
Manhattan	MAKS
Salina	SAKS
Topeka	TOKS
Wichita	WIKS
Kentucky	
Danville	DAKY
Frankfort	FRKY
Loutsville	LOKY

Table B-1. Prestored American Telephone and Telegraph Company Listed Cities as Defined in F.C.C. No. 260 (Effective July 3, 1983) (Sheet 5 of 11)

RATE CENTER	CODE
Kentucky (continued)	
Madisonville	MAKY
Paducah	PAKY
Winchester	WIKY
Louisiana	
Alexandria	ALLA
Baton Rouge	BALA
Lafayette	LALA
Lake Charles	LKLA
Monroe	MOLA
New Orleans	NELA
Shreveport	SHLA
Maine	
Augusta	AUME
Lewiston	LEME
Portland	POME
Maryland	
Baltimore	BAMD
Washington	WADC
Massachusetts	
Boston	BOMA
Brockton	BRMA
Cambridge	CAMA
Fall River	FAMA
Framingham	FRMA
Lawrence	LAMA
Springfield	SPCT
Worchester	WOMA
Michigan	
Detroit	DEMI
Flint	FLMI
Grand Rapids	GRMI
Houghton	HOMI
Iron Mountain	IRMI
Jackson	JAMI
Kalamazoo	KAMI
Lansing	LAMI
Petoskey	PEMI
Plymouth	PLMI
Pontiac	POMI
Saginaw	SAMI
Sault Ste. Marie	SUMI
Traverse City	TRMI

Table B-1. Prestored American Telephone and Telegraph Company Listed Cities as Defined in F.C.C. No. 260 (Effective July 3, 1983) (Sheet 6 of 11)

RATE CENTER	CODE
Minnesota	
Duluth	DUMN
Minneapolis	MIMN
St. Cloud	STMN
St. Paul (Minneapolis)	MIMN
Virginia	VIMN
Wadena	WAMN
Willmar	WIMN
Mississippi	
Biloxi	BIMS
Columbus	COMS
Greenville	GRMS
Greenwood	GEMS
Gulfport (Biloxi)	BIMS
Hattiesburg	HAMS
Jackson	JAMS
Laurel	LAMS
McComb	MCMS
Meridian	MEMS
Tupelo	TUMS
Missouri	
Cape Giradeau	
Joplin	JOMO
Kansas City	KAMO
St. Joseph	STMO
St. Louis	SLMO
Sikeston	SIMO
Springfield	SPMO
Montana	
Billings	BIMT
Glendive	GLMT
Helena	HEMT
Missoula	MIMT
Nebraska	
Grand Island	GRNE
Omaha	OMNE
Sidney	SDNE
Nevada	
Carson City	CANV
Las Vegas	LANV
Reno	RENV

Table B-1. Prestored American Telephone and Telegraph Company Listed Cities as Defined in F.C.C. No. 260 (Effective July 3, 1983) (Sheet 7 of 11)

RATE CENTER	CODE
New Hampshire	
Concord	CONH
Dover (Portsmouth)	POHN
Manchester	MANH
Nashua	NANH
New Jersey	
Atlantic City	ATNJ
Camden	CANJ
Hackensack	HANJ
Morristown	MONJ
Newark	NENJ
New Brunswick	NENJ
Trenton	TRNJ
New Mexico	
Albuquerque	ALNM
Las Cruces	LANM
Roswell	RONM
Santa Fe	SANM
New York	
Albany	ALNY
Binghamton	BINY
Buffalo	BUNY
Huntington	HUNY
Nassua	NANY
New York City	NENY
Potsdam	PTNY
Poughkeepsie	PONY
Rochester	RONY
Syracuse	SYNY
Troy (Albany)	ALNY
Westchester	WENY
North Carolina	
Asheville	ASNC
Charlotte	CHNC
Fayetteville	FANC
Gastonia (Charlotte)	CHNC
Greensboro	GRNC
Greenville	GENC
Laurinburg	LANC
New Bern	NENC
Raleigh	RANC
Rocky Mount	RONC
Wilmington	WINC
Winston-Salem (Greensboro)	GRNC

Table B-1. Prestored American Telephone and Telegraph Company Listed Cities as Defined in F.C.C. No. 260 (Effective July 3, 1983) (Sheet 8 of 11)

RATE CENTER	CODE
North Dakota	
Bismark	BIND
Casselton	CAND
Dickinson	DIND
Fargo	FAND
Grand Forks	GRND
Ohio	
Akron	AKOH
Canton	CAOH
Cincinnati	CIOH
Cleveland	CLOH
Columbus	COOH
Dayton	DAOH
Findley	FIOH
Mansfield	MAOH
Toledo	TOOH
Youngstown	YOOH
Oklahoma	
Enid	ENOK
Lawton	LAOK
Muskogee	MUOK
Oklahoma City	OKOK
Tulsa	TUOK
Oregon	
Medford	MEOR
Pendleton	PEOR
Portland	POOR
Pennsylvania	
Allentown	ALPA
Altoona	ATPA
Harrisburg	HAPA
Philadelphia	PHPA
Pittsburg	PIPA
Pottsville	POPA
Reading	REPA
Scranton	SCPA
State College	STPD
Williamsport	WIPA
Rhode Island	
Providence	PRRI

Table B-1. Prestored American Telephone and Telegraph Company Listed Cities as Defined in F.C.C. No. 260 (Effective July 3, 1983) (Sheet 9 of 11)

RATE CENTER	CODE
South Carolina	
Charleston	CHSC
Columbia	COSC
Florence	FOSC
Greenville	GRSC
Orangeburg	ORSC
Spartanburg (Greenville)	GRSC
South Dakota	
Aberdeen	ABSD
Huron	HUSD
Sioux Falls	SISD
Tennessee	
Chattanooga	CHTN
Clarksville	CLTN
Jackson	JATN
Johnson City	JOTN
Kingsport (Johnson City)	JOTN
Knoxville	KNTN
Memphis	METN
Morristown	MOTN
Nashville	NATN
Texas	
Abilene	ABTX
Amarillo	AMTX
Austin	AUTX
Beaumont	BETX
Corpus Christi	COTX
Dallas	DATX
El Paso	ELTX
Fort Worth (Dallas)	DATX
Freeport	FRTX
Harlingen (Brownsville)	BRTX
Houston	HOTX
Laredo	LATX
Longview	LOTX
Lubbock	LUTX
Midland	MITX
San Angelo	SATX
San Antonio	SNTX
Sweetwater	SWTX
Waco	WATX

Table B-1. Prestored American Telephone and Telegraph Company Listed Cities as Defined in F.C.C. No. 260 (Effective July 3, 1983) (Sheet 10 of 11)

RATE CENTER	CODE
Utah	
Logan	LOUT
Ogden (Salt Lake City)	SAUT
Provo	PRUT
Salt Lake City	SAUT
Vermont	
Burlington	BUVT
White River Junction	WHVT
Virginia	
Blacksburg	BLVA
Leesburg	LEVA
Lynchburg	LYVA
Newport News	NEVA
Norfolk	NOVA
Petersburg	PEVA
Richmond	RIVA
Roanoke	ROVA
Washington	WADC
Washington	
Billingham	BEWA
Kennewick (Richland)	RIWA
North Bend	NOWA
Seattle	SEWA
Spokane	SPWA
Yakima	YAWA
West Virginia	
Beckley	BEWV
Charleston	CHWV
Clarksburg	CLWV
Fairmont	FAWV
Huntington	HUWV
Morgantown	MOWV
Parkensburg	PAWV
Wheeling	WHWV
Wisconsin	
Appleton	APWI
Dodgeville	DOWI
Eau Claire	EAWI
Green Bay	GRWI
La Crosse	LAWI
Madison	MAWI

Table B-1. Prestored American Telephone and Telegraph Company Listed Cities as Defined in F.C.C. No. 260 (Effective July 3, 1983) (Sheet 11 of 11)

RATE CENTER	CODE
Wisconsin (Continued)	
Milwaukee	MIWI
Racine	RAWI
Stevens Port	STWI
Wyoming	
Casper	CAWY
Cheyanne	CHWY

Table B-2. American Telephone and Telegraph Company Rate Schedules as Defined in F.C.C. 260 (Effective March 3, 1982)

	Schedule I*		Schedule II**		Schedule III***	
Mileage Breakpoint	Basic Monthly Charge (Up to Breakpoint Mileage)	Incremental Monthly Charge Per Additional Mile	Basic Monthly Charge (Up to Breakpoint Mileage)	Incremental Monthly Charge Per Additional Mile	Basic Monthly Charge (Up to Breakpoint Mileage)	Incremental Monthly Charge Per Additional Mile
1	73.56	0.00	75.00	0.00	76.43	0.00
15	73.56	2.59	75.00	4.77	76.43	6.35
25	109.82	2.16	141.78	4.77	165.33	5.48
40	131.42	1.62	186.48	2.89	220.13	4.03
60	155.72	1.62	229.83	1.95	280.58	3.03
80	188.12	1.62	268.83	1.95	341.18	2.31
100	220.52	1.62	307.83	1.95	387.38	1.95
1000	252.92	0.94	346.83	0.94	426.38	0.97
over 1000	1098.92	0.58	1192.83	0.58	1299.38	0.58

Effective Date: March 3, 1982

*Applies between a pair of Category "A" Rate Centers (listed cities).

**Applies between a pair of rate centers where one is in Category "A" (listed cities) and the other is in Category "B" (nonlisted cities).

***Applies between a pair of Category "B" Rate Centers (nonlisted cities).

Table B-3. Prestored Western Union Telegraph Company Tariff as Defined in F.C.C. No. 261 (Effective May 11, 1982) (Sheet 1 of 4)

Category I: LONG HAUL

Los Angeles - Atlanta	(LOCA-ATGA)
Los Angeles - Baltimore	(LOCA-BAMD)
Los Angeles - Boston	(LOCA-BOMA)
Los Angeles - Buffalo	(LOCA-BUNY)
Los Angeles - Cincinnati	(LOCA-CIOH)
Los Angeles - Cleveland	(LOCA-CLOH)
Los Angeles - Columbus	(LOCA-COOH)
Los Angeles - Dayton	(LOCA-DAOH)
Los Angeles - Detroit	(LOCA-DEMI)
Los Angeles - New York	(LOCA-NENY)
Los Angeles - Philadelphia	(LOCA-PHPA)
Los Angeles - Pittsburgh	(LOCA-PIPA)
Los Angeles - Washington	(LOCA-WADC)
Los Angeles - Wilmington	(LOCA-WIDE)
San Francisco - Atlanta	(SFCA-ATGA)
San Francisco - Baltimore	(SFCA-BAMD)
San Francisco - Boston	(SFCA-BOMA)
San Francisco - Buffalo	(SFCA-BUNY)
San Francisco - Cincinnati	(SFCA-CIOH)
San Francisco - Cleveland	(SFCA-CLOH)
San Francisco - Columbus	(SFCA-COOH)
San Francisco - Dayton	(SFCA-DAOH)
San Francisco - Detroit	(SFCA-DEMI)
San Francisco - New York	(SFCA-NENY)
San Francisco - Philadelphia	(SFCA-PHPA)
San Francisco - Pittsburgh	(SFCA-PIPA)
San Francisco - Washington	(SFCA-WADC)
San Francisco - Wilmington	(SFCA-WIDE)
Seattle - Boston	(SEWA-BOMA)
Seattle - Cleveland	(SEWA-CLOH)
Seattle - Detroit	(SEWA-DEMI)
Seattle - New York	(SEWA-NENY)
Seattle - Philadelphia	(SEWA-PHPA)
Seattle - Pittsburgh	(SEWA-PIPA)
Seattle - Washington	(SEWA-WADC)

Category II: MEDIUM HAUL

Dallas/Ft Worth - Baltimore	(DATX-BAMD)
Dallas/Ft Worth - Boston	(DATX-BOMA)
Dallas/Ft Worth - Buffalo	(DATX-BUNY)
Dallas/Ft Worth - Los Angeles	(DATX-LOCA)
Dallas/Ft Worth - New York	(DATX-NENY)
Dallas/Ft Worth - Philadelphia	(DATX-PHPA)
Dallas/Ft Worth - San Francisco	(DATX-SFCA)
Dallas/Ft Worth - Washington	(DATX-WADC)

Table B-3. Prestored Western Union Telegraph Company Tariff as Defined in F.C.C. No. 261 (Effective May 11, 1982) (Sheet 2 of 4)

Category II: MEDIUM HAUL (Continued)

Houston - Baltimore	(HOTX-BAMD)
Houston - Boston	(HOTX-BOMA)
Houston - Cleveland	(HOTX-CLOH)
Houston - Columbus	(HOTX-COOH)
Houston - Dayton	(HOTX-DAOH)
Houston - Detroit	(HOTX-DEMI)
Houston - Los Angeles	(HOTX-LOCA)
Houston - New York	(HOTX-NENY)
Houston - Philadelphia	(HOTX-PHPA)
Houston - Pittsburg	(HOTX-PIPA)
Houston - San Francisco	(HOTX-SFCA)
Houston - Washington	(HOTX-WADC)
Houston - Wilmington	(HOTX-WIDE)
Kansas City - Boston	(KAMO-BOMA)
Kansas City - Los Angeles	(KAMO-LOCA)
Kansas City - New York	(KAMO-NENY)
Kansas City - San Francisco	(KAMO-SFCA)
Los Angeles - Chicago	(LOCA-CIIL)
*Los Angeles - Bridgeton, Mo	(LOCA-SLMO)
Los Angeles - Indianapolis	(LOCA-ININ)
Los Angeles - Milwaukee	(LOCA-MIWI)
Los Angeles - Minneapolis	(LOCA-MIMN)
Los Angeles - St Louis	(LOCA-SLMO)
Minneapolis - Boston	(MIMN-BOMA)
San Francisco - Chicago	(SFCA-CIIL)
San Francisco - Indianapolis	(SFCA-ININ)
San Francisco - Milwaukee	(SFCA-MIWI)
San Francisco - Minneapolis	(SFCA-MIMN)
San Francisco - St Louis	(SFCA-SLMO)
Seattle - Chicago	(SEWA-CIIL)
Seattle - Dallas/Ft Worth	(SEWA-DATX)
Seattle - Kansas City	(SEWA-KAMO)
Seattle - Milwaukee	(SEWA-MIWI)
Seattle - Minneapolis	(SEWA-MIMN)
Seattle - St Louis	(SEWA-SLMO)

Category III: SHORT HAUL

Atlanta - Baltimore	(ATGA-BAMD)
Atlanta - Boston	(ATGA-BOMA)
Atlanta - Chicago	(ATGA-CIIL)
Atlanta - Cleveland	(ATGA-CLOH)
Atlanta - Dallas/Ft Worth	(ATGA-DATX)
Atlanta - Detroit	(ATGA-DEMI)
Atlanta - Houston	(ATGA-HOTX)

*Bridgeton, Mo. will be viewed as St Louis, Mo.

Table B-3. Prestored Western Union Telegraph Company Tariff as Defined in F.C.C. No. 261 (Effective May 11, 1982) (Sheet 3 of 4)

Category III: SHORT HAUL (Continued)

Atlanta - Indianapolis	(ATGA-ININ)
Atlanta - Kansas City	(ATGA-KAMO)
Atlanta - Milwaukee	(ATGA-MIWI)
Atlanta - Minneapolis	(ATGA-MIMN)
Atlanta - Philadelphia	(ATGA-PHPA)
Atlanta - New York	(ATGA-NENY)
Atlanta - Washington	(ATGA-WADC)
Atlanta - Wilmington	(ATGA-WIDE)
Boston - Chicago	(BOMA-CIIL)
Boston - Cincinnati	(BOMA-CIOH)
Boston - Columbus	(BOMA-COOH)
Boston - Dayton	(BOMA-DAOH)
Boston - Indianapolis	(BOMA-ININ)
Boston - Milwaukee	(BOMA-MIWI)
Boston - St Louis	(BOMA-SLMO)
Chicago - Baltimore	(CIIL-BAMD)
Chicago - Dallas/Ft Worth	(CIIL-DATX)
Chicago - Houston	(CIIL-HOTX)
Chicago - New York	(CIIL-NENY)
Chicago - Philadelphia	(CIIL-PHPA)
Chicago - Washington	(CIIL-WADC)
Chicago - Wilmington	(CIIL-WIDE)
Dallas/Ft Worth - Cincinnati	(DATX-CIOH)
Dallas/Ft Worth - Cleveland	(DATX-CLOH)
Dallas/Ft Worth - Columbus	(DATX-COOH)
Dallas/Ft Worth - Dayton	(DATX-DAOH)
Dallas/Ft Worth - Detroit	(DATX-DEMI)
Dallas/Ft Worth - Indianapolis	(DATX-ININ)
Dallas/Ft Worth - Milwaukee	(DATX-MIWI)
Dallas/Ft Worth - Minneapolis	(DATX-MIMN)
Dallas/Ft Worth - Pittsburgh	(DATX-PIPA)
Dallas/Ft Worth - St Louis	(DATX-SLMO)
Houston - Cincinnati	(HOTX-CIOH)
Houston - Indianapolis	(HOTX-ININ)
Houston - Milwaukee	(HOTX-MIWI)
Houston - Minneapolis	(HOTX-MIMN)
Houston - St Louis	(HOTX-SLMO)
Milwaukee - Baltimore	(MIWI-BAMD)
Milwaukee - New York	(MIWI-NENY)
Milwaukee - Philadelphia	(MIWI-PHPA)
Milwaukee - Washington	(MIWI-WADC)
New York - Columbus	(NENY-COOH)
New York - Dayton	(NENY-DAOH)
New York - Indianapolis	(NENY-ININ)
New York - Minneapolis	(NENY-MIMN)
Philadelphia - Indianapolis	(PHPA-ININ)
Philadelphia - Kansas City	(PHPA-KAMO)

Table B-3. Prestored Western Union Telegraph Company Tariff as Defined in F.C.C. No. 261 (Effective May 11, 1982) (Sheet 4 of 4)

Category III: SHORT HAUL (Continued)

St Louis - Baltimore	(SLMO-BAMD)
St Louis - New York	(SLMO-NENY)
St Louis - Washington	(SLMO-WADC)
St Louis - Wilmington	(SLMO-WIDE)
Seattle - Los Angeles	(SEWA-LOCA)
Seattle - San Francisco	(SEWA-SFCA)
Washington - Indianapolis	(WADC-ININ)
Washington - Minneapolis	(WADC-MIMN)

Western Union Category I, II, and III Monthly Channel Charges

Category I: Long Haul - $925.00

Category II: Medium Haul - $695.00

Category III: Short Haul - $580.00

Table B-4. Prestored Satellite Business Systems Tariff as Defined in F.C.C. No. 2 (Effective October 1, 1982)

	Monthly Charge
Network Access Centers (NACs - minimum of 3)	$17,850.00 each
Supplemental Capacity Units (SCUs)	$5,700.00 each
Full-Time Transmission Units (FTUs)	$2,550.00 each
Minimum Connection Arrangement Unit (CAU) Charge Per NAC	$17,850.00

Incremental CAU Charges:

Breakpoint No. of CAUs	Basic Monthly Charge (Up to Breakpoint CAUs)	Incremental Monthly Charge Per Additional CAU
150	$0.00	$95.00
300	$14,250.00	$90.00
over 300	$27,750.00	$65.00

APPENDIX C - ERROR MESSAGE

The following is a list of all the error message within the model. The fatal errors cause model execution to be terminated. Fatal errors may indicate that files within the data base have errors within them. They may also indicate that codes within the model have been altered incompletely. Fatal errors require the intervention of a programmer and will not occur under normal conditions.

Nonfatal errors occur during initialization of a problem during optimization. They indicate that specifications within a problem are invalid, perhaps because the user is accessing a user defined file which is no longer valid because of tariff changes. A common cause of errors is invalid user input. Upon encountering an error condition, the user should first ensure that his input adheres to the specifications detailed in this manual.

Fatal Errors

NUMBER	MODULE	MESSAGE
1010	INIT	Execution control file header not as expected.
1020	IBUST	File header of prestored ATT tariff file not as expected.
1030	IBLNET	File header of user-defined network not as expected.
1040	IBLTRF	File header of prestored traffic table not as expected.
1050	IBLATT	Header record of tariff file not as expected.
1060	IBLATT	Header of prestored ATT file not as expected.
1070	IBLWU1	Header record of prestored WU tariff not as expected.
1080	IBLWU2	File header of user-defined WU tariff not as expected.
1090	IBLWU3	File header of prestored WU tariff not as expected.
1100	IBLWU3	File header of user-defined WU tariff not as expected.
1110	IBLSB1	File header of prestored SBS tariff not as expected.
1120	IBLSBS	File header of user-defined SBS tariff not as expected.
1130	IBLSBS	File header of prestored SBS tariff not as expected.
2010	BSTRCT	Header from traffic nodes not as expected.
2020	BSTRCT	Header from prestored ATT tariff not as expected.
2030	BSTRCT	ATT tariff levels exceeds array size in model.
2040	BSTRCT	Header from prestored SBS tariff not as expected.
2050	BSTRCT	SBS tariff levels exceeds array size in model.
2060	BSTRCT	Header from prestored WU tariff not as expected.
2070	BSTRCT	Number of items in prestored network array exceeds number allowed.
2080	BSTRCT	Number of items in prestored category A list exceeds number allowed.
2090	BSTRCT	Number of items required for WU access cities exceeds number allowed.

NUMBER	MODULE	MESSAGE
3010	NINIT	File header of network directory not as expected.
3020	NINIT	Number of files in directories exceeds the capacity of arrays.
3030	GETTFC	File header of prestored traffic table not as expected.
3040	GETPER	File header of TRFVOL file not as expected.
3050	GETPER	Desired percent not found in table.
3060	DEFNOD	Number of user-defined nodes not number put into array.
3070	NCREAT	File specified for network file already defined.
3080	NCREAT	File specified for network file not in directory.
3090	NDELET	File name to delete not in directory.
3100	NLSTFL	File specified to be printed not in directory.
3110	NLSTFL	Header record of file not as expected.
4010	TINIT	File header of tariff directory not as expected.
4020	TINIT	Number of files in directory exceeds the capacity of array in model.
4030	TCREAT	File name to create not in directory.
4040	TCREAT	File specified already created.
4050	TCREAT	File type to be created invalid.
4060	TDELET	File to be deleted not in directory.
4070	TLSTFL	File to list not in directory.
4080	TLSTFL	File to be listed empty.
4090	TLSTFL	File type of tariff to be listed in invalid.
4100	TLSTAT	File header of ATT tariff invalid.
4110	TLSTWU	File header of WU tariff invalid.
41120	TLSTSB	File header of SBS tariff invalid.
5000	ACC	Input arguments out of range.

NUMBER	MODULE	MESSAGE
5010	ATCOST	Input arguments out of range.
5020	CATEG	Input arguments out of range.
5030	LISTED	Input arguments out of range.
5040	MILES	Input arguments out of range.
5050	PTRPRS	Input arguments out of range.
5060	ROWTOT	Input arguments out of range.
5070	SBCOST	Input arguments out of range.
5080	TARTYP	Input arguments out of range.
5090	DEFPRE	File header of prestored network file not as expected.
5100	DIRGEN	File header from tariff directory not as expected.
5110	DIRGEN	File header from network directory not as expected.
5120	FACSIZ	Number of input voice circuits out of range.
5130	RUTFC	Nodes specified don't exist in user-defined network.
5140	WUCOST	Input arguments out of range.
5150	FILDEF	Directory requested is invalid.
B1000	INPUTB	Invalid option code.
B2010	NETB	Invalid network file name.
B2020	NETB	Network file already defined.
B2030	NETB	Invalid network option.
B2040	NETB	Invalid prestored city code.
B2050	NETB	Exceeded number of prestored nodes.
B2060	NETB	Invalid percent for selecting prestored nodes.
B2070	NETB	Invalid traffic level.
B2080	NETB	Maximum additional cities exceeded.
B2090	NETB	Invalid additional traffic volume.

NUMBER	MODULE	MESSAGE
22100	NETB	Additional traffic entry city not in network.
B2110	NETB	Traffic table spool option invalid.
B2120	NETB	Invalid additional city coordinate.
B3000	TARB	Invalid tariff file name.
B3010	TARB	Tariff file already defined.
B3020	TARB	Invalid tariff file type.
B3100	CRATTB	Invalid listed city addition/deletion.
B3110	CRATTB	Listed city addition/deletion duplication
B4000	EXCONB	Negative number of restarts specified.
B4010	EXCONB	Invalid option.
B4020	EXCONB	Undefined network file.
B4030	EXCONB	Undefined tariff file.
B4040	EXCONB	Tariff not ATT-type.
B4050	EXCONB	Invalid file type.
B4060	EXCONB	Negative number of tariff files specified.
B4070	EXCONB	No valid tariff files specified.

Nonfatal Errors

1510	INIT	Error encountered in building tariff input for specified problem.
1520	INIT	Number of tariffs specified in execution control file out of range.
1530	INIT	Error encountered in building network for specified problem.
1540	INIT	Error encountered in building data structured for specified case - run option out of range.
1550	INIT	Error encountered in input for specified case - proceeding to next case.
1560	IBLNET	Network file requested is not in directory.

NUMBER	MODULE	MESSAGE
1570	IBLNET	Network file requested is not defined.
1580	IBLTAR	Requested file not defined.
1590	IBLTAR	Status of file out of range.
1600	IBLTAR	Mismatch between run type and tariff file type.
1610	IBLTAR	More than two tariff files specified for mixed run.
1620	IBLTAR	Tariff option out of range.
1630	IBLTAR	For mixed mode there should be two tariffs defined - one for an ATT tariff, the other a satellite tariff.
1640	IBLLST	Number of breakpoint specified in ATT tariff exceeds array capacity in model.
1650	IBLTRF	Additional traffic specified for a node not in the user-defined network.
1660	IBLATT	Number of mileage breakpoints specified in tariff file not as expected.
1670	IBLATT	Mileage breakpoint specified in tariff file not as expected.
1680	IBLWU3	Number of satellite access codes for this problem exceeds array capacity of this model.
1690	IBLSB1	Number of entries in CAU cost table greater than capacity of arrays in model.
1700	IBLSBS	Number of breakpoints in SBS table not as expected.
1710	IBLSBS	Breakpoint values in SBS table not as in prestored tariff.
3510	NDELET	File name to delete has already been deleted.
3520	NLSTFL	File specified to be printed not defined.
4510	TDELET	File name to delete has already been deleted.
6000	OUT1	Tariff in problem has invalid type.
B2500	NETB	Prestored node duplication.
B2510	NETB	Additional city a prestored node.
B2520	NETB	Additional city duplication.

NUMBER	MODULE	MESSAGE
B2530	NETB	Additional traffic pair duplication.
B3500	CRATTB	City to be added already listed.
B3510	CRWUB	City to be deleted not a listed city.
B3600	CRWUB	Access pair category change erroneous.
B3610	CRWUB	Access pair to be deleted not in list.
B3620	CRWUB	Category out of range.
B3630	CRWUB	Access pair duplication.
B3700	CRSBSB	Duplicate NAC entry.
B7710	CRSBSB	Less than three NACs specified, zero NACs assumed.
B4500	EXCONB	Maximum problems exceeded.
B4510	EXCONB	Maximum tariffs exceeded.
B4520	EXCONB	Tariff file duplication.
B4530	EXCONB	Undefined tariff file.
B4540	EXCONB	Invalid file type.
B4550	EXCONB	Invalid output table number.