

AD-A168 514

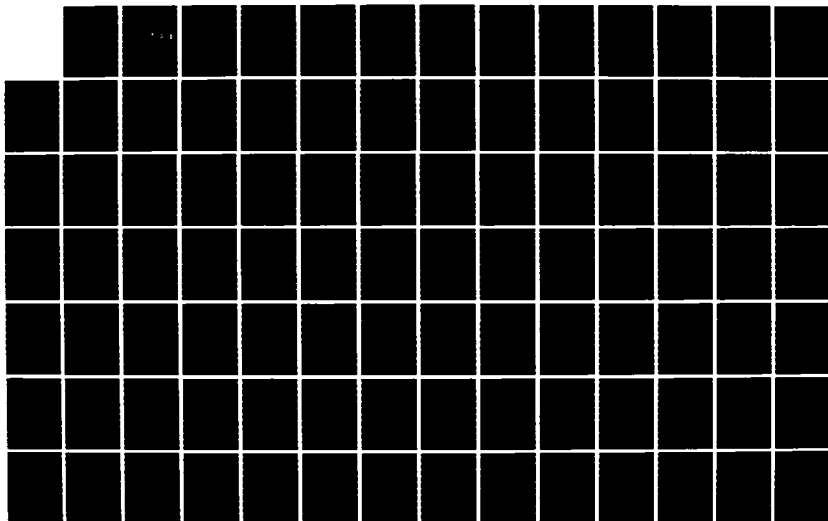
A SIMULATION MODEL OF ISSUE PROCESSING AT NAVAL SUPPLY  
DEPOT YOKOSUKA JAPAN(U) NAVAL POSTGRADUATE SCHOOL  
MONTEREY CA M S CLIFT MAR 86

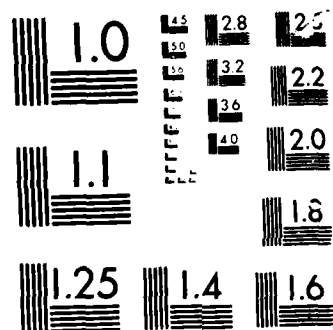
1/2

UNCLASSIFIED

F/G 15/5

NL





# NAVAL POSTGRADUATE SCHOOL

Monterey, California

AD-A168 514



DTIC  
ELECTE  
JUN 20 1986  
S D

## THESIS

A SIMULATION MODEL OF ISSUE PROCESSING AT NAVAL  
SUPPLY DEPOT YOKOSUKA, JAPAN

by

Michael S. Clift

MAY 1976

Thesis Advisor:

F. M. Perry

Approved for public release; distribution is unlimited.

DTIC FILE COPY

## REPORT DOCUMENTATION PAGE

|                                                                                                                                                                                                                                                                                                                                                                               |       |                                     |                                                                                  |                                      |                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------------------|----------------------------------------------------------------------------------|--------------------------------------|---------------------------|
| 1a REPORT SECURITY CLASSIFICATION                                                                                                                                                                                                                                                                                                                                             |       |                                     | 1b. RESTRICTIVE MARKINGS                                                         |                                      |                           |
| 2a SECURITY CLASSIFICATION AUTHORITY                                                                                                                                                                                                                                                                                                                                          |       |                                     | 3 DISTRIBUTION/AVAILABILITY OF REPORT                                            |                                      |                           |
| 2b DECLASSIFICATION/DOWNGRADING SCHEDULE                                                                                                                                                                                                                                                                                                                                      |       |                                     | Approved for public release; distribution is unlimited                           |                                      |                           |
| 4 PERFORMING ORGANIZATION REPORT NUMBER(S)                                                                                                                                                                                                                                                                                                                                    |       |                                     | 5 MONITORING ORGANIZATION REPORT NUMBER(S)                                       |                                      |                           |
| 6a. NAME OF PERFORMING ORGANIZATION                                                                                                                                                                                                                                                                                                                                           |       | 6b OFFICE SYMBOL<br>(If applicable) | 7a. NAME OF MONITORING ORGANIZATION                                              |                                      |                           |
| Naval Postgraduate School                                                                                                                                                                                                                                                                                                                                                     |       | Code 54                             | Naval Postgraduate School                                                        |                                      |                           |
| 6c ADDRESS (City, State, and ZIP Code)                                                                                                                                                                                                                                                                                                                                        |       |                                     | 7b. ADDRESS (City, State, and ZIP Code)                                          |                                      |                           |
| Monterey, CA 93943-5000                                                                                                                                                                                                                                                                                                                                                       |       |                                     | Monterey, CA 93943-5000                                                          |                                      |                           |
| 8a NAME OF FUNDING/SPONSORING ORGANIZATION                                                                                                                                                                                                                                                                                                                                    |       | 8b OFFICE SYMBOL<br>(If applicable) | 9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER                                   |                                      |                           |
|                                                                                                                                                                                                                                                                                                                                                                               |       |                                     |                                                                                  |                                      |                           |
| 8c ADDRESS (City, State, and ZIP Code)                                                                                                                                                                                                                                                                                                                                        |       |                                     | 10 SOURCE OF FUNDING NUMBERS                                                     |                                      |                           |
|                                                                                                                                                                                                                                                                                                                                                                               |       |                                     | PROGRAM<br>ELEMENT NO                                                            | PROJECT<br>NO                        | TASK<br>NO                |
|                                                                                                                                                                                                                                                                                                                                                                               |       |                                     |                                                                                  |                                      | WORK UNIT<br>ACCESSION NO |
| 11 TITLE (Include Security Classification) A SIMULATION MODEL OF ISSUE PROCESSING AT NAVAL SUPPLY<br>DEPOT YOKOSUKA, JAPAN                                                                                                                                                                                                                                                    |       |                                     |                                                                                  |                                      |                           |
| 12 PERSONAL AUTHOR(S)<br>MICHAEL S. CLIFT                                                                                                                                                                                                                                                                                                                                     |       |                                     |                                                                                  |                                      |                           |
| 13a TYPE OF REPORT                                                                                                                                                                                                                                                                                                                                                            |       | 13b TIME COVERED                    |                                                                                  | 14 DATE OF REPORT (Year, Month, Day) |                           |
| Master's Thesis                                                                                                                                                                                                                                                                                                                                                               |       | FROM _____ TO _____                 |                                                                                  | 1986 March 27                        |                           |
| 15 PAGE COUNT<br>139                                                                                                                                                                                                                                                                                                                                                          |       |                                     |                                                                                  |                                      |                           |
| 16 SUPPLEMENTARY NOTATION                                                                                                                                                                                                                                                                                                                                                     |       |                                     |                                                                                  |                                      |                           |
| 17 COSATI CODES                                                                                                                                                                                                                                                                                                                                                               |       |                                     | 18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number) |                                      |                           |
| FIELD                                                                                                                                                                                                                                                                                                                                                                         | GROUP | SUB-GROUP                           | SIMULATION, MODELING, GPSS, NAVAL SUPPLY DEPOT                                   |                                      |                           |
|                                                                                                                                                                                                                                                                                                                                                                               |       |                                     |                                                                                  |                                      |                           |
|                                                                                                                                                                                                                                                                                                                                                                               |       |                                     |                                                                                  |                                      |                           |
| 19 ABSTRACT (Continue on reverse if necessary and identify by block number)                                                                                                                                                                                                                                                                                                   |       |                                     |                                                                                  |                                      |                           |
| A computer simulation program has been written in IBM's GPSS V to model the issue processing functions of U.S. Naval Supply Depot Yokosuka, Japan. The results of simulation experiments that may be conducted with the model can be used by analysts in the Planning Division of the Naval Supply Depot to predict actual Depot performance under conditions of surge demand |       |                                     |                                                                                  |                                      |                           |
| 20 DISTRIBUTION/AVAILABILITY OF ABSTRACT                                                                                                                                                                                                                                                                                                                                      |       |                                     | 21 ABSTRACT SECURITY CLASSIFICATION                                              |                                      |                           |
| <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS                                                                                                                                                                                                                                           |       |                                     | unclassified                                                                     |                                      |                           |
| 22a NAME OF RESPONSIBLE INDIVIDUAL                                                                                                                                                                                                                                                                                                                                            |       |                                     | 22b TELEPHONE (Include Area Code)                                                |                                      | 22c OFFICE SYMBOL         |
| F. M. PERRY                                                                                                                                                                                                                                                                                                                                                                   |       |                                     | 408 646-2938                                                                     |                                      | 55Pj                      |

Approved for public release; distribution is unlimited.

A Simulation Model of Issue Processing  
at  
Naval Supply Depot Yokosuka, Japan

by

Michael S. Clift  
Lieutenant, Supply Corps, United States Navy  
B.A., Oakland University, 1977

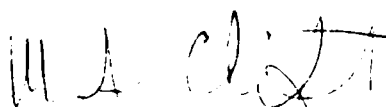
Submitted in partial fulfillment of the  
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION SYSTEMS

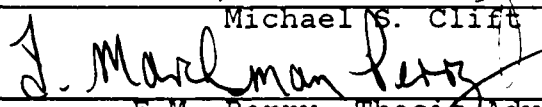
from the

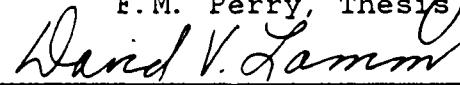
NAVAL POSTGRADUATE SCHOOL  
March 1986

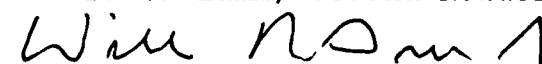
Author:

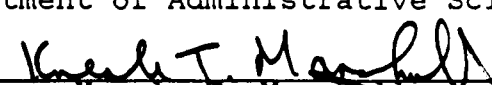
  
Michael S. Clift

Approved by:

  
F.M. Perry, Thesis Advisor

  
D. V. Lamm, Second Reader

  
Willis R. Greer, Jr., Chairman,  
Department of Administrative Sciences

  
Kneale T. Marshall  
Dean of Information and Policy Sciences

# ABSTRACT

A computer simulation program has been written in IBM's GPSS V to model the issue processing functions of U.S. Naval Supply Depot Yokosuka, Japan. The results of simulation experiments that may be conducted with the model can be used by analysts in the Planning Division of the Naval Supply Depot to predict actual Depot performance under conditions of surge demand.

## TABLE OF CONTENTS

|      |                                        |    |
|------|----------------------------------------|----|
| I.   | INTRODUCTION . . . . .                 | 7  |
|      | A. THE PROBLEM . . . . .               | 7  |
|      | B. THESIS OBJECTIVE . . . . .          | 9  |
|      | C. SCOPE . . . . .                     | 9  |
|      | D. LIMITATIONS . . . . .               | 10 |
|      | 1. Data Collection . . . . .           | 10 |
|      | 2. Microcomputer Simulation . . . . .  | 10 |
|      | E. ORGANIZATION OF THESIS . . . . .    | 11 |
| II.  | MODELING TECHNIQUES . . . . .          | 12 |
|      | A. OPERATION RESEARCH . . . . .        | 12 |
|      | B. SIMULATION . . . . .                | 13 |
|      | C. SIMULATION LANGUAGES . . . . .      | 16 |
|      | D. GPSS . . . . .                      | 18 |
| III. | THE SYSTEM TO BE MODELED . . . . .     | 21 |
| IV.  | THE MODEL . . . . .                    | 27 |
|      | A. DEFINITION . . . . .                | 27 |
|      | B. STRUCTURE . . . . .                 | 28 |
|      | 1. Requisition Generation . . . . .    | 29 |
|      | 2. Work Scheduling . . . . .           | 31 |
|      | 3. Workcenter Operations . . . . .     | 32 |
|      | 4. Requisition Flow Control . . . . .  | 33 |
|      | 5. Printer Operations . . . . .        | 35 |
|      | 6. Transportation Operations . . . . . | 35 |
|      | 7. Duty Section Operations . . . . .   | 37 |
| V.   | VERIFICATION AND VALIDATION . . . . .  | 40 |
|      | A. INTRODUCTION . . . . .              | 40 |
|      | B. VERIFICATION . . . . .              | 43 |

|                           |                                                           |     |
|---------------------------|-----------------------------------------------------------|-----|
| C.                        | VALIDATION . . . . .                                      | 44  |
| VI.                       | EXPERIMENTATION . . . . .                                 | 47  |
| VII.                      | SUMMARY . . . . .                                         | 51  |
| A.                        | CONCLUSIONS . . . . .                                     | 51  |
|                           | 1. Discrete Event Simulation Using GPSS V . .             | 51  |
|                           | 2. Discrete Event Simulation Using<br>GPSS/PC . . . . .   | 51  |
| B.                        | RECOMMENDATIONS . . . . .                                 | 51  |
|                           | 1. Data Collection . . . . .                              | 51  |
|                           | 2. Model Experimentation . . . . .                        | 52  |
|                           | 3. Microcomputer Implementation of the<br>Model . . . . . | 52  |
| APPENDIX A:               | PROGRAM LISTING . . . . .                                 | 53  |
| APPENDIX B:               | GPSS BLOCK DIAGRAM . . . . .                              | 99  |
| APPENDIX C:               | PROGRAM OUTPUT . . . . .                                  | 125 |
| LIST OF REFERENCES        | . . . . .                                                 | 136 |
| BIBLIOGRAPHY              | . . . . .                                                 | 137 |
| INITIAL DISTRIBUTION LIST | . . . . .                                                 | 138 |



|                    |                          |
|--------------------|--------------------------|
| Accession For      |                          |
| NTIS               | CRA&I                    |
| DTIC               | TAB                      |
| Unannounced        | <input type="checkbox"/> |
| Justification      | <input type="checkbox"/> |
| By                 |                          |
| Distribution/      |                          |
| Availability Codes |                          |
| Dist               | Avail and/or<br>Special  |
| A-1                |                          |

## LIST OF FIGURES

|     |                           |    |
|-----|---------------------------|----|
| 3.1 | Physical Layout . . . . . | 22 |
| 3.2 | Flow Diagram . . . . .    | 24 |

## I. INTRODUCTION

### A. THE PROBLEM

The U.S. Naval Supply Depot Yokosuka, Japan (NSD Yokosuka), is tasked with providing logistics support to U.S. Navy fleet units and shore activities in the Japan and Northern Pacific operating areas. As the major U.S. Navy logistics installation in Japan, NSD Yokosuka is the primary source of logistics support for all Navy and Marine Corps shore activities based in Japan. Fleet units supported by NSD Yokosuka include eleven homeported ships as well as deployed ships of the Seventh Fleet. Although NSD Yokosuka's major function is material support, it also provides essential supply services. The Freight Terminal Division is responsible for transshipment to the requisitioner of issue priority group one material received from stateside Naval Supply Centers and Defense Logistics Agency (DLA) activities. The Depot also manages a variety of other support services including contracting, data processing, accounting, disbursing and personal property shipment.

In addition to its basic fleet support role, NSD Yokosuka is tasked with tri-service support responsibilities for fuel and subsistence. NSD Yokosuka is the DLA Designated Specialized Support Point for provisions in Japan, providing subsistence support to all fleet units, DoD commissaries and troops in the Japan operating area. As the DLA agent for fuel, NSD Yokosuka operates the largest fuel complex in the Pacific. The Fuel Department provides bulk petroleum products to all military activities in the Western Pacific and maintains Prepositioned War Reserve Stock (PWRS) inventory levels to meet the anticipated combined requirements of the services in that area.

NSD Yokosuka is strategically positioned to support contingency operations in the Far East. Any conflict in the Northern Pacific, Korea, or other Southeast Asian country requiring extensive deployment of ships, aircraft and troops will result in a surge of activity for NSD Yokosuka. If the conflict is not short-term in duration, the increased operating tempo could be expected to result in new manpower requirements, multi-shift operation of the NSD and its detachments, possible expansion of physical storage facilities and the acquisition of additional material handling equipment. NSD Yokosuka's ability to respond to a surge in demand for logistics support brought about by a period of increased tension or open conflict is a critical issue to planning military operations in the Far Eastern theater. The NSD's effectiveness in this type of scenario hinges on its ability to escalate operations in a short time frame. Counter to the rapid response required of NSD Yokosuka in a contingency situation is the relative difficulty of mobilizing the necessary manpower and other resources on short notice. Planning specific requirements in advance and identifying sources to fill those needs is essential to maintaining supply readiness at NSD Yokosuka.

Predicting future resource requirements of the Depot is a primary function of the Planning and Comptroller Department, more specifically, the Planning Division. In any operating environment, NSD Yokosuka seeks to minimize the processing time associated with issuing material to customers while maximizing the availability of other support services required. To this end, the Planning Division projects the volume of demand that the Depot will be expected to support in various operational scenarios, i.e., positioning of an additional carrier battle group or a build-up in troop levels. Divisional requirements in support of those levels of operation are estimated. The

consolidated requirements of the Depot are quantified and plans outlining the allocation of resources among divisions are formulated.

#### B. THESIS OBJECTIVE

The objective of this thesis is to provide a predictive and quantitative tool to support the contingency planning efforts of (NSD) Yokosuka. A computer program modeling the issue processing functions of the Depot will be constructed. The program will be written in IBM's General Purpose Simulation System V (GPSS V). The completed program may be used to conduct experiments simulating Depot performance under conditions of surge demand. The information gathered in a controlled series of experiments with the model can be used to help formulate operating policy and resource distribution plans to cope with contingency situations.)

#### C. SCOPE

The scope of the model will be limited to those functions of NSD Yokosuka in direct support of issue processing operations, from requisition receipt to the point of availability of the issue for shipment to the requisitioner (or the point of actual delivery to the requisitioner in the case of bearer walkthroughs, quick picks and issues delivered to Naval Base Yokosuka activities by NSD tractor trains). A detailed list of the actual processes to be simulated is provided in Chapter IV. Other Depot operations have been excluded for the following reasons:

1. The complexity of a model can be expected to increase as the scope of the system to be simulated is expanded. Limiting the scope of the system to mainstream issue processing functions will provide important information to analysts while keeping model modification and experimentation within the capability of personnel without extensive simulation experience.
2. The scope of the system to be simulated is also limited by the capabilities of the software and hardware on which it is implemented. The memory requirements of a program written to simulate all major functions of the Depot would exceed the maximum amount of memory addressable by GPSS V.

3. Model design and validation imposes substantial data collection responsibilities on the NSD Planning Division. Depot personnel resources were taxed to meet the data requirements imposed during development of the model of issue processing functions.
4. Some functions of the Depot are sufficiently complex to form the basis of major simulation projects by themselves. Inventory Control Department, Data Processing Service Center (DPSC) and Freight Terminal Division operations are all candidates for separate simulation projects.
5. Not all systems can be simulated with discrete simulation methods. The Fuel Department manages several processes that are best modeled by continuous simulation methods.

#### D. LIMITATIONS

##### 1. Data Collection

Construction and validation of the model was hampered by difficulties experienced by the author during data collection. Due to the physical separation of NSD Yokosuka from the Naval Postgraduate School, the data collection effort was managed by the NSD Planning Division. Personnel from cognizant divisions of the Depot were tasked with collecting the data from retained records or by observation of the physical processes. The time-intensive nature of random sampling slowed the process of data collection. This was aggravated by competing operational requirements in the Inventory Control and Material Departments. At the time of this writing, the collection of service time samples for the Packing Section and half of the material storage areas remained incomplete.

##### 2. Microcomputer Simulation

The initial objective of this thesis was to model NSD issue processing operations on a microcomputer. Efforts in that direction were blocked by the memory requirements of

the program. The technical details of this limitation are discussed briefly in Chapter II of the thesis.

#### E. ORGANIZATION OF THESIS

The balance of this thesis is devoted to the examination of simulation as a logistics planning tool and to the development and validation of a program to be used for simulation experimentation. In Chapter II, the suitability of simulation and other operations research disciplines to supporting logistics planning efforts is reviewed. A description of issue processing at NSD Yokosuka, the system to be modeled, forms the basis of Chapter III. Chapter IV utilizes GPSS block diagrams to explain the simulation program structure. Program verification and a discussion of program validation are presented in Chapter V. Guidance in experimentation techniques and a discussion of simulation experiments conducted by the author are included in Chapter VI. Recommendations and conclusions in Chapter VII will address further simulation experimentation and the observed benefits of simulation in supporting logistics planners.

## II. MODELING TECHNIQUES

### A. OPERATION RESEARCH

NSD Yokosuka's ability to provide the level of logistics support required by DoD activities in the Japan operating area is a product of the combined efforts of several work-centers. The DPSC Department and the Customer Services, Requirements, Storage, Labor and Equipment and Freight Terminal Divisions all perform tasks integral to the processing of requisitions received by NSD Yokosuka. Because a decision made in one division may affect the operations of another, the performance of individual divisions must be evaluated in terms of their contribution to overall Depot performance. This interaction between functional areas must be taken into account by the Planning Division during the formulation of operating strategies for surge demand environments. Operations research techniques incorporate the systems approach and can serve as an important logistics planning tool.

Operations research is a collection of mathematical tools that may be applied to solve practical decision problems within a system [Ref. 1]. The aim of operations research analysis is to evaluate the probable consequences of decision choices. These choices are typically concerned with the allocation of scarce resources within the system. Most methods of operations research use models to study the actual system [Ref. 2: p. 4]. Models represent objects of interest within the system as entities, the characteristics of entities as attributes and the interactions causing change within the system as activities. Models are employed when experimentation with the actual system is not a practical approach to analyzing operations. Accordingly, formulation of a model is a suitable method of predicting the

performance of a supply depot under conditions of surge demand.

Specialized operations research techniques have evolved to handle certain well-defined classes of systems problems. Network analysis may be used to solve transportation problems. Inventory algorithms are used to make inventory control decisions. These techniques are well suited to narrowly-defined problems and are regularly employed by the military to solve logistics problems. The study of broader, less well-defined systems require more generalized mathematical techniques.

Mathematical analysis is applied to systems management problems by representing attributes of the system as variables and activities as mathematical functions that interrelate the variables [Ref. 3: pp. 8-9]. Mathematical analysis is a sophisticated operations research technique that can be used only by analysts with extensive backgrounds in mathematics. It is not always possible to formulate a complete mathematical model of a complex system. The combined effects of uncertainty, dynamic interaction between decisions, interdependency among variables and the representation of processes over long time horizons are difficult to represent mathematically and may require alternative methods of research [Ref. 4: p. 142]. Stock point analysis problems fall into this category. The stochastic nature of requisition arrival and processing times, overlap between the operations of separate divisions within a supply depot, the relationship of requisition priority and type to the processing procedures followed and the need to observe operations over extended periods of time all support the use of computer simulation as a research tool.

## B. SIMULATION

Simulation is the process of designing a model that duplicates the dynamic behavior of the essential

characteristics of a system for the purpose of studying that system [Ref. 5]. It is a popular technique among operations research practitioners. In a survey by Weston [Ref. 6] of 1000 U. S. firms, it was the most frequently employed quantitative tool. Simulation is also used extensively by the military to evaluate weapons and logistics systems. Because the structure of a simulation model bears a close relation to the logical structure of the real system, model development is simplified. Schmidt [Ref. 7] notes that the level of mathematical sophistication required to develop a simulation model of a complex system is generally less extensive than that required to develop a mathematical model, underscoring simulation's relative ease of use. It is this simplicity that makes simulation intuitively popular to analysts.

Simulation is a versatile operations research technique. It may be used as a descriptive tool (to describe a current system) or as a predictive tool (to explore a hypothetical system or design improvements to a current system). Simulation is also flexible with respect to changes in the actual system. Variables can be modified before a simulation is run, or dynamically, to align the model with real system conditions.

There are drawbacks to the use of simulation. Simulation does not optimize in the sense that calculus-based analytical methods do [Ref. 3: p. 38]. Optimal solutions may be obtained only through repetition of simulation experiments. Simulation models produce less precise results than does mathematical analysis [Ref. 2: p. 13]. Due to the probabilistic nature of simulation, the results of simulation experiments repeated in succession can be expected to vary and the sensitivity of a simulation model to changes in the value of input variables is not subject to exact measurement. Simulation models experience the same problems as

models employed in other techniques of operations research. They may appear to accurately reflect the real system, when in fact, they do not. Simulation models, as all others, will yield incorrect results if they are not validated carefully.

There are two major types of simulation, continuous and discrete [Ref. 4: p. 143]. Continuous simulation is concerned with systems that change continuously with respect to time and with measurements that are not restricted to integers. Refinery operations and rocket trajectories are examples of systems that are studied by the use of continuous simulation. In discrete simulation, the simulated time advances in a stepwise discrete fashion. A discrete simulation is time-oriented if the simulation clock is updated at regular time intervals. If the clock is updated by the scheduled occurrence of events, the simulation is termed event-oriented. Discrete event simulation lends itself especially well to the modeling of queuing systems and, therefore, is generally applicable to modeling the performance of service organizations that can be represented as a collection of service facilities and queues [Ref. 8].

Discrete event simulation is frequently used to model military supply depot operations. The use of discrete event simulation as a forecasting tool offers several advantages to logistics planners. Queue statistics gathered during the simulation pinpoint processing bottlenecks that may be expected to occur. Server utilization statistics collected for each functional area may be used to support resource allocation decisions. System throughput data can be quantified by measuring the processing time for the different classes of requisitions passing through the system. In addition, the model may be easily modified to reflect increasing levels of demand, changes in net effectiveness or the addition of personnel.

### C. SIMULATION LANGUAGES

Discrete event simulation programs may be written in a general purpose programming language like FORTRAN or PASCAL, or in a special purpose simulation language. As computer simulation evolved as an operations research technique in the late 1950s, all simulations were written in general purpose or specific-machine languages. As researchers began to recognize the fact that many situations being simulated were composed of functionally similar processes, the need to develop special purpose languages in which single operators would perform common functions became apparent. Emshoff and Sisson [Ref. 9: p. 116] enumerated the functions common to all simulations that distinguish simulation languages from general purpose programming languages:

1. create random numbers
2. create random variates
3. advance time, either by one unit or to the next event
4. record data for output
5. perform statistical analyses on recorded data
6. arrange outputs in specified formats
7. detect and report logical inconsistencies and other error conditions

Kiviat [Ref. 10] cited programming convenience and concept articulation as the two major advantages of using a simulation language as opposed to a general purpose language.

Concept articulation refers to the ability of simulation languages to communicate the structure of a system being modeled through the use of a descriptive vocabulary. This is especially important to analysts in the model development phase. It also improves communication in that simulations are more easily explained to management and other non-programming oriented users.

The programming convenience of simulation languages is evidenced by the reduction in both program length and

development effort required. Jennergren [Ref. 11] concluded that simulation programs written in PASCAL average twice the length of their simulation language counterparts. Emshoff and Sisson [Ref. 9: p. 117] estimate the savings in model development effort resulting from the use of simulation languages to be on the order of a factor of 10. Several factors contribute to the programming convenience of simulation languages. The subroutines provided as standard features of simulation languages provide programmers with simple tools to represent simulation-unique functions and concepts. The ease with which simulation languages define classes of system entities, differentiate among entities within those classes and permit adjustment of the number or type of entities in the system is also helpful. The convenience of simulation languages is not achieved without sacrifice. The structuring of entities and activities in simulation languages increases their flexibility in that changes to the system require only simple modifications to the program. These generalized structures, however, limit the ability of simulation languages to represent system detail. Though simulation languages automatically collect and display data generally desired by analysts, they are less flexible than general purpose programming languages with respect to the variety of output formats. Finally, programs written in simulation languages can expect to experience slower execution times than general purpose language programs.

The initial concern of most organizations in the process of selecting a simulation language is ensuring that the chosen language is compatible with installed hardware and that its use is within the capability of the organization's analysts. Other questions should be answered in the second phase of the selection process. The relative ease of learning, availability of users manuals, machine

portability, quality of error diagnostics, language efficiency and cost of the languages under consideration should be explored. Finally, the ability of the chosen simulation language to naturally describe the system in question should be studied. The suitability of a simulation language to a given problem may be assessed by examining its "world view."

The world view of a simulation language is the way that it conceptualizes the entities of a system, the attributes that further describe those entities, and the interaction between those entities and the activities of the system [Ref. 12: p. 17]. World views of simulation are grouped into two schools of simulation thought, one emphasizing the use of flowcharts to describe models, the other relying on program statements.

Flowchart languages are regarded by users as somewhat easier to learn and interpret, while statement oriented languages are more flexible [Ref. 12: p. 18]. Statement oriented languages are characterized by three world views--activity, event and process. Flowchart oriented simulation languages adhere to the transaction world view. The transaction world view models systems by tracing the flow of transactions through specialized activity blocks. Simulated time advances as transactions pass through the blocks which are used to represent actual processes or real system decisions. Users familiar with flowcharting techniques and the system being modeled find the transaction view convenient to use and easy to learn. IBM's GPSS is the predominant language in this category.

#### D. GPSS

The transaction world view of GPSS is structurally similar to the complex queuing problems posed by requisition flow in a supply depot. GPSS uses block diagrams to visualize transactions moving from process to process within the

system. Each GPSS block is implemented by a code segment representing an action relative to the system simulation. The close relationship between the block diagram and program code to the logical structure of the system being simulated makes GPSS easy to use. System throughput, resource utilization and queuing statistics collected as standard features of GPSS may be tailored to support the information requirements of the logistics planner.

GPSS is particularly attractive to the inexperienced user. The block diagram structure reduces the complexity of model development and communicates an understanding of the simulation program to users. Statistics gathering and display require minimal effort on the part of the user. Because GPSS is the most popular and widely used simulation language [Ref. 13], numerous companies market GPSS products and provide comprehensive documentation. In addition several academic texts on GPSS have been published, offering another source of information to users.

Minuteman Software has developed a microcomputer version of GPSS, marketed under the name of GPSS/PC, to take advantage of the increased CPU and memory capacities of modern microcomputers. Designed for use on IBM compatible microcomputers, the structure and syntax of GPSS/PC are nearly identical to that of the mainframe version, enabling it to retain its attractiveness as a discrete event simulation language. The primary advantages of using a simulation language designed for the microcomputer are reduced software expenses and the convenience to the analyst of working on a dedicated microcomputer. While the general design of GPSS/PC is suited to the simulation of supply depot operations, it is constrained by its inability to address more than 640 kilobytes of random access memory, a limit shared by all applications programs running on IBM's Disk Operating System (DOS). Due to this inherited limitation, GPSS/PC is not

useful in the simulation of large queuing systems such as NSD Yokosuka.

Discrete event simulation, utilizing GPSS, could be effectively used to support logistics planning efforts of NSD Yokosuka. Note the following points:

1. Issue processing procedures at NSD Yokosuka are permeated with the type of queuing phenomena that discrete event simulation languages, GPSS in particular, are designed to model.
2. The standard format of discrete simulation output is suited to the information requirements of Depot planners.
3. Experimentation, including minor modifications, with existing simulation models is within the capability of analysts in the NSD Yokosuka Planning Division.
4. The block diagram structure of GPSS improves user understanding of program structure, easing the process of making program modifications required by changes in NSD facilities or procedures.
5. Owing to its popularity, GPSS documentation, training, and technical assistance are all readily available to the NSD.

While discrete event simulation can be a useful tool to logistics planners, its disadvantages must also be recognized. Drawbacks to the use of computer simulation in logistics planning include:

1. Validating a simulation model requires substantial effort and is a continuing process as the model must be maintained to reflect real system changes. If the basic model does not accurately reflect actual system operations or supporting data is erroneous, simulation results will not be useful.
2. Though experimentation and minor modifications are within the capability of NSD Yokosuka personnel, major revision would require outside training or assistance.
3. Because the simulation model is a simplification of the actual system, detail useful to planners is lost. In addition, limiting the scope of the model leaves planners without information on other essential Depot functions.

The practical limitations of discrete event simulation must be accepted before it is employed as a logistics planning tool. In combination with other operations research techniques, discrete event simulation using GPSS can be an effective method of forecasting NSD Yokosuka performance under conditions of surge demand.

### III. THE SYSTEM TO BE MODELED

NSD Yokosuka's main administrative offices and storage facilities are located on U. S. Naval Base Yokosuka, of which the NSD is a tenant activity. Figure 3.1 shows the physical layout of NSD facilities on Naval Base Yokosuka. Yokohama Cold Storage, located approximately 20 miles from Yokosuka, is the only modeled activity of the NSD not located within the confines of Naval Base Yokosuka.

NSD Yokosuka has 54 U. S. Civil Service and 905 Japanese National employees in addition to the 176 military personnel authorized. Normal working hours are 0800 to 1645 Monday through Friday with a 45 minute lunch break. Non-duty hour processing of issue priority group one (IPG1) requisitions and IPG2 bearer walkthrough and Casualty Reporting System (CASREPT) requisitions is handled by the duty section on weekends and by the Customer Services Division evening and midnight shifts during the week. DPSC maintains seven day a week, around-the-clock computer center operations in support of issue processing.

The Depot receives an average of 43,000 requisitions a month, of which approximately 90% are for standard stock items. Of the total demand for standard stock items, NSD Yokosuka typically makes 30,000 issues per month from its \$43,000,000 inventory of over 78,000 line items. 75% of those issues are for material stored in the general storage locations of the Depot. The remaining 25% are for provisions stored in Yokosuka Cold Storage (Building 1390), Yokosuka Dry Storage (B-47) and Yokohama Cold Storage.

Figure 3.2 is a basic flow diagram of NSD Yokosuka issue operations. Requisition input to the system arrives in two forms, hard copy or online. Online requisitions are received via Automatic Digital Network (AUTODIN), Disk

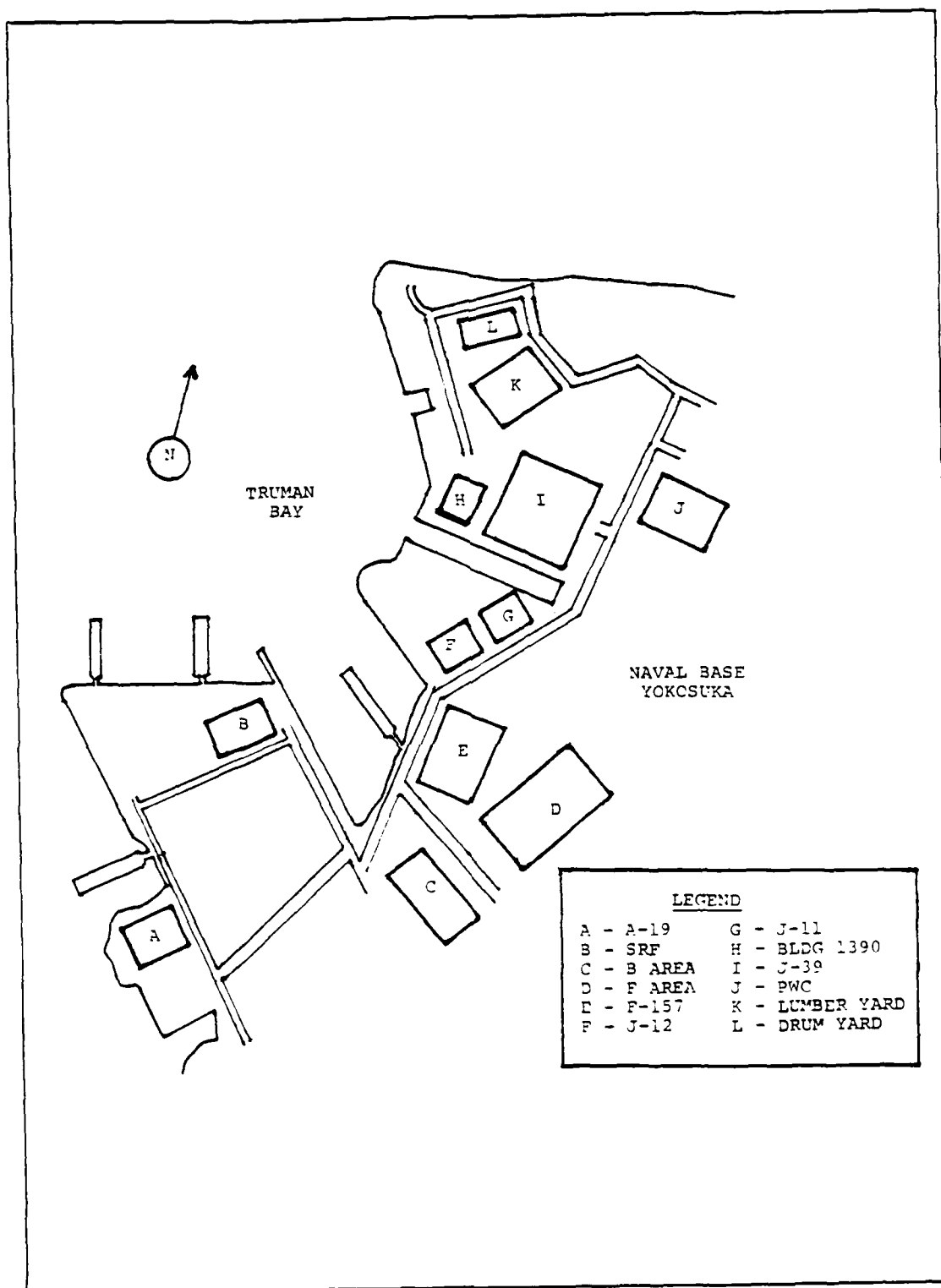


Figure 3.1 Physical Layout.

Oriented Supply System (DOSS) and local customer remote terminal entry. The requirements of activities without installed remote terminal entry equipment and all perishable provisions (9MP/9MB), ships store stock (1Q) and bearer requisitions are received in hard copy form. Requisitions for 9MP, 9MB and 1Q material are initially routed to the Requirements Division for stock check. IPG1 requisitions, IPG2 bearer walkthrough, CASREPT and quick pick requisitions and all 9MP, 9MB and 1Q requisitions (regardless of priority) received by NSD are entered via remote terminal in Customer Services. All other requisitions are transferred to DPSC for entry. Requisitions are handled throughout the Depot on a first come, first served, within priority level basis. Priority levels, from highest to lowest, are as follows:

1. IPG1 bearer walkthrough all other IPG1
2. IPG2 bearer walkthrough
3. IPG2 CASREPT (not bearer walkthrough)
4. IPG2 quick pick
5. all other IPG2
6. all IPG3

Regardless of their origin, all IPG1, CASREPT, bearer walkthrough, quick pick, dry provisions (9MF) and 1Q requisitions wait in a queue file to be processed by Uniform Automated Data Processing System (UADPS) programs UC02 and UC96. The queue file is emptied frequently (every 5 minutes) into UC02/UC96 for processing. Issue documents for material determined to be in stock are output immediately in Customer Services. 9MP and 9MB requisitions are entered under local procedures and issue documents are printed on the Customer Services printer. The balance of IPG2 and all IPG3 requisitions are processed in batch mode by UC02/UC96 and local programs LC06, LC07 and LC08. Issue documents for material determined to be in stock are output in Storage Control.

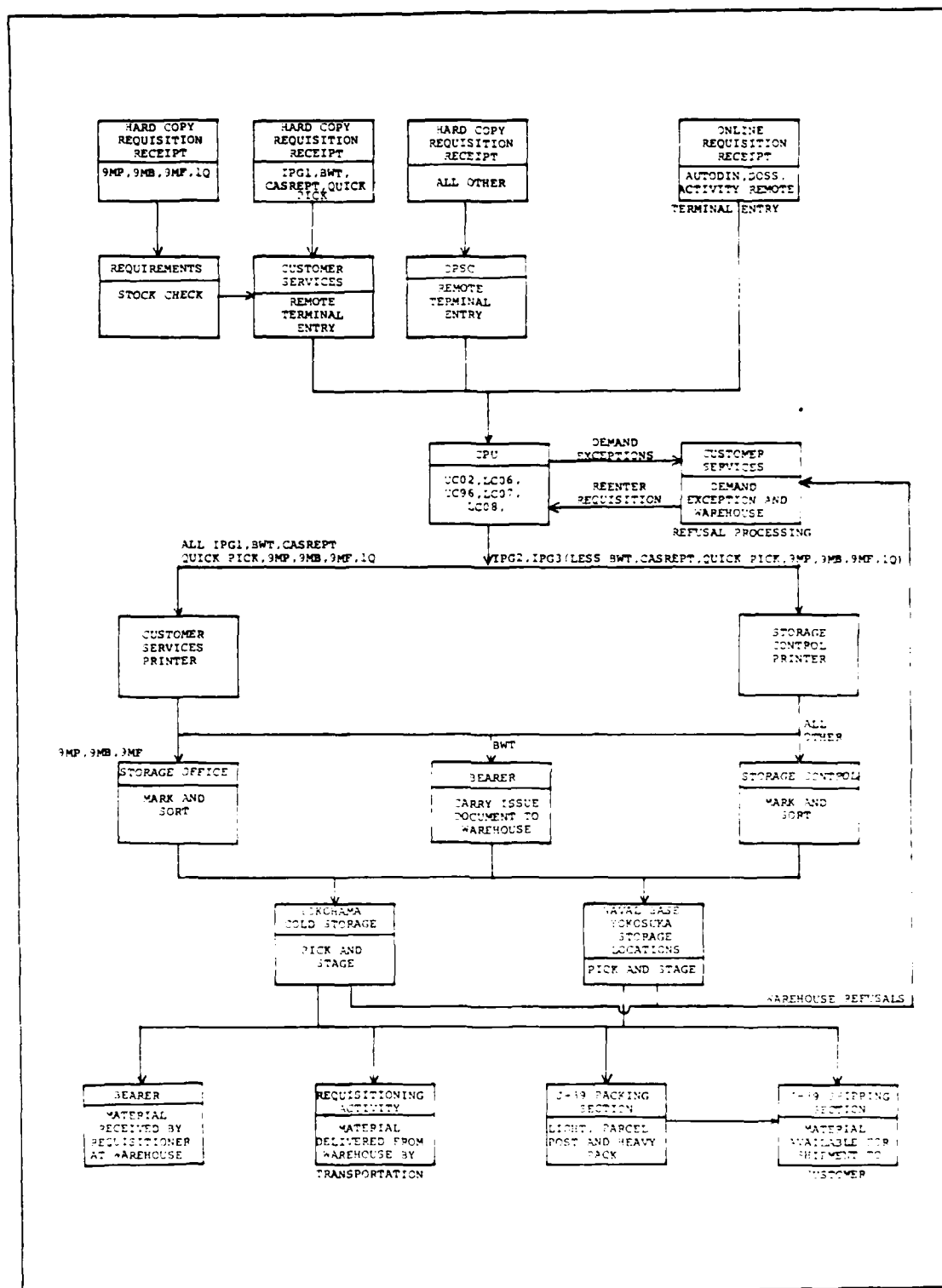


Figure 3.2 Flow Diagram.

Issue documents for provisions are output in Customer Services. Demand exceptions are reviewed by exception clerks in Customer Services and re-entered into the system.

All issue documents printed in Customer Services are annotated or stamped as appropriate (quick pick, CASREPT, etc.) and are routed for further processing. Provisions issue documents are delivered to the Storage Office. Issue documents produced for bearer walkthrough requisitions are released to the bearer to be hand carried to the warehouse storing the material. All other issue documents are delivered to Storage Control.

Storage Control personnel sort those issue documents printed by the Storage Control printer and those received from Customer Services by warehouse and deliver the document batches by bicycle messenger to their respective storage locations. Provisions documents received in the Storage Office are also sorted by storage location. Issue documents for provisions in Building 1390 and B-47 are delivered by the bicycle messenger. Issue documents for perishable provisions stocked in Yokohama are delivered by a truck that leaves Yokosuka at 0900 on workdays, arriving in Yokohama later the same morning.

Upon receipt of issue documents, warehouse personnel pick the requisitioned material, attach copies of the issue document, and segregate it by destination. In general storage locations, material is staged separately for delivery to the Publics Works Center (PWC), the Ship Repair Facility (SRF) and the Packing and Shipping Sections of the Freight Terminal. In provisions warehouses, the majority of material is staged within the facility to be delivered directly to the requisitioner. Provisions issues for off-base delivery or bearer pick-up are staged separately. All bearer issues are turned over to the customer at the warehouse. Warehouse refusals are annotated as such on issue

documents which are returned to Customer Services for processing (i.e. investigation, transaction reversal, referral or cancellation).

Material segregated for delivery in general storage locations to PWC, SRF, or the Freight Terminal is transported by Labor and Equipment Division tractor trains to its next destination. Tractor trains run on two separate routes at 0815, 1015, 1300 and 1400 on workdays. Material requisitioned by PWC and SRF is delivered enroute to Building J-39. All material requiring packing prior to shipment is unloaded in the Packing Section of J-39. The remaining material is delivered to the Shipping Section. Tractor trains run on an as required basis to deliver provisions from B-47 and Building 1390 to the Freight Terminal.

Material transported to the Packing Section is packaged for further transportation to the customer. Three basic types of pack are used--light, parcel post or heavy--as appropriate to the material. When packing is completed the material is delivered to the Shipping Section, adjacent to the end of the packing line, for further processing.

The Uniform Material Movement and Issue Priority System (UMMIPS) treats issues received in the Shipping Section as available for shipment to the requisitioner and issue processing statistics maintained by the Depot do not record handling time in the Shipping Section. Shipping Section operations, beyond receipt of material, are not modeled in the simulation program.

#### IV. THE MODEL

##### A. DEFINITION

The computer program is written in IBM's GPSS V. The program simulates all NSD Yokosuka functions that directly support issue processing operations, from requisition receipt to the point of availability of the issue for shipment to the requisitioner. Specific functions simulated are:

1. Requirements Division stock check of perishable provision and ships store stock requisitions.
2. Customer Services and DPSC remote terminal entry of hard copy requisitions.
3. Customer Services demand exception and warehouse refusal processing
4. Customer Services and Storage Control issue document printer operations
5. Storage Control and Storage Office sorting and handling of issue documents
6. Delivery of issue documents to Yokohama Cold Storage and Naval Base Yokosuka storage locations
7. Warehouse pick and stage operations (and shipment preparations in provisions storage locations)
8. Tractor train delivery of issues to SRF, PWC and the packing and shipping sections of the Freight Terminal
9. Packing operations
10. Duty section and late shift operations

A copy of the program code is provided as Appendix A. Listings of program variables, functions, transaction parameters and storages referenced during the simulation are all included in the program code. A GPSS block diagram of the program structure is provided as Appendix B. The succeeding section refers to segments of the GPSS block diagram to relate the structure of the simulation program to actual Depot operations.

## B. STRUCTURE

GPSS simulates actual system performance by generating requisitions (referred to as transactions) at time intervals modeled after real system arrivals and permitting the generated transactions to proceed through block paths representing real system processes. Each GPSS block executes a subroutine which may delay, modify, remove or control the flow of the entering transaction. In a large system composed of separate workcenters, such as NSD Yokosuka, transactions move through a varied series of processes before an issue results. Although these processes differ physically, many are logically similar (e.g., transactions enter a workcenter, wait for service, are processed and then leave the workcenter for the next processing step). Consequently, GPSS is able to simulate a wide variety of processes with a relatively small vocabulary of blocks.

GPSS can also generate control transactions in separate modules to alter system status (i.e., control storage availability, trigger scheduled events). The generation of control transactions and their flow through the program blocks is timed to coincide with operating schedules of the Depot. Time is divided into units of .01 hours in the simulation. The reader is therefore reminded to carefully interpret simulation time in the program (i.e., 30 minutes is represented as 50, 8 hours and 45 minutes as 875, etc.).

This section of the chapter groups logically similar processes into categories and references modules in the GPSS block diagram in Appendix B to demonstrate how actual processes are modeled in the program. All GPSS blocks discussed in this section appear in upper case to set them apart from the text. Assumptions made in modeling the real system processes are presented as are special programming details that may not be apparent to the user. An understanding of this section will improve the reader's

comprehension of the program code. It will also serve to assist the user in making program changes for the purpose of system experimentation or reflecting real system changes.

1. Requisition Generation

Requisition generation and priority assignment is modeled in the requisition generation module of the program. GPSS V limits each model to 32,767 concurrently active transactions. To remain within that limitation during simulation experiments, the number of transactions generated has been reduced by structuring the program to permit a single transaction to represent three requisitions. All succeeding program modules, with the exception of the duty section module, process each transaction as if it were 3 separate requisitions to maintain an operational pace equivalent to actual Depot operations.

The number of demands generated in one week of simulated time is computed by multiplying the monthly demand level input by the user by a factor of .231 (based on an average of 4.33 weeks per month). The daily distribution of those demands is determined by function FTHNN which is derived from daily demand data supplied by the NSD. The daily demand level is then divided by 3 to obtain the number of transactions generated during each simulated day.

Daily requisition arrival rates utilized in the simulation are constant over the weekend, but are computed to force generation of 89% of weekday demands during normal operating hours, consistent with the pattern of workday requisition arrivals actually experienced by the Depot. As data supporting an alternative distribution of requisition arrivals is not available at this time, transactions are allowed to proceed into the model at a uniform rate. Although the clumping of requisition arrivals expected during actual operation is not duplicated, requisition flow similar to that experienced by the NSD is restored early in

the requisition processing cycle by the simulation of the batch printing of issues documents in the printer queue handling module.

The first three requisition generation subsections of the requisition generation module are responsible for generating requisitions on weekdays--before, during and after normal operating hours respectively. The fourth requisition generation subsection generates weekend arrivals. The GENERATE block in each subsection creates a single transaction each simulated day at the beginning of its assigned time period (i.e., 0001 for the AM subsection, 0800 for the operating hours subsection). Because all of the requisition generation subsections create a single transaction each day of the week, transactions generated in the weekday generation subsections must be terminated on weekends and transactions generated in the weekend generation subsection must be terminated on weekdays. The TEST blocks permits the generated transaction to proceed on workdays in the first three subsections and on weekends in the last subsection. Transactions failing that test are transferred to the TERMINATE block labeled RQTRM and removed from the model.

All transactions that are not terminated continue through the requisition generation subsections. The SPLIT and ADVANCE blocks combine to transform the previously generated single transactions into a uniform flow of transactions representing the arrival of requisitions at the NSD. Transactions entering the SPLIT block are split into the number of transactions expected during the period. The ADVANCE block then permits the newly created transactions to pass to the next block at a uniform rate, where they are transferred to the ASSIGN block PRIAS. The ASSIGN block references function FONE and stochastically assigns an integer value representing requisition priority to parameter 1 of each transaction. The following PRIORITY block copies

the parameter 1 value to assign transaction priorities referenced during program execution to determine processing order. All transactions are then routed by their parameter 1 value through a path of SAVEVALUE blocks that serve as requisition counters.

## 2. Work Scheduling

Operating schedules for Depot workcenters during the normal workday, the late shift and duty section, the issue document printers and the tractor trains are all managed by control transactions in schedule control sections. With the exception of normal workday scheduling, which is controlled in separate modules, all schedule control sections are located in the module whose operations they control.

As an example of how work scheduling is managed by the program, the schedule control section of the duty section module is explained below. The first block in the section generates a control transaction at the beginning of each day. On weekdays the control transaction proceeds through the module, alternately entering ADVANCE blocks to simulate the passage of time and UNLINK blocks positioned to coordinate the flow of transactions with the operating status of the duty section. After 1675 time units have passed, marking the end of the normal workday at 1645, the control transaction is terminated and the process is repeated at the beginning of the next simulated day. On weekends the control transaction is routed directly to the TERMINATE block labeled DTEND and removed from the model, permitting the duty section to remain in continuous operation over the weekend. Scheduling of the issue document printer and tractor train operations differ only in that control transactions are created at more frequent intervals during the day to trigger the repetitively scheduled processes.

### 3. Workcenter Operations

NSD workcenters supporting issue processing operations are represented throughout the program as storages. A storage is an entity provided by GPSS to simulate homogenous parallel servers, that is, personnel working side by side performing similar duties at similar rates of speed. Each storage referenced in the simulation is included in the storage definition section where its symbolic name, capacity and description is provided. Storages that have been thus defined may then be referenced in the program to simulate the actual processing of requisitions.

SKCK is the symbolic name of the storage referenced by the requisition receipt module. It simulates the stock check of perishable provision and ships store stock requisitions in the Requirements Division and has a defined capacity of two personnel. Storage references are commonly accompanied by two block pairs, QUEUE/DEPART and ENTER/LEAVE. The function of the QUEUE and DEPART blocks is to collect statistics regarding the time spent by transactions waiting for the storage to become available and related queue data. The ENTER and LEAVE blocks perform the function of controlling access to the ADVANCE block, limiting its current contents to the defined capacity of the storage. After a simulation is run, statistics detailing the time spent waiting for service and the active processing time at each defined storage are presented. See Chapter V for a more detailed description of output statistics.

The time that it takes to process a single transaction in the Requirements Division is simulated in the ADVANCE block labeled SKCK. The ADVANCE block delays each transaction for an explicit period of time equal to the value of the variable V\$SKCKS named in the A operand. In recognition of the fact that each transaction represents 3 requisitions, the service times used in the model are

computed by summing 3 individual service times. Individual service times are drawn from functions containing frequency distributions of service times observed during actual operations at NSD Yokosuka. The service times of workcenters for which frequency distributions were not available to the author are computed from mean service times provided by NSD and are assumed to follow the negative exponential distribution. These included all provisions storage locations and the main warehouse (F-157). Mean service times were also used for all Requirements Division, Customer Services Division, Storage Office and Storage Control requisition and issue document handling processes due to the brief and uniform nature of those functions. Mean service times were not available for packing operations, so Packing Section service times employed in the model were computed by dividing the manhours recorded for each pack type on the NSD Yokosuka Uniform Management Reports by the number of issues packed.

#### 4. Requisition Flow Control

Most modules modeling workcenter operations begin with flow control sections that serve two primary purposes. First, program execution efficiency is improved by placing transactions that are about to attempt entry into a storage on a "user chain" until the storage has available capacity. Managing waiting transactions in this manner frees the computer from continuously scanning each transaction attempting to enter a storage. Secondly, the unlinking of transactions from user chains at the end of the workday provides positive control of high priority requisitions that require transfer to the duty section module for processing after normal operating hours.

Though flow control sections in the program differ slightly in structure, the flow control section in the Requirements Division module is representative of the basic

structure employed throughout the program. The first three TEST blocks following SKCKQ route transactions that have joined the queue. Transactions entering during lunch are transferred to the LINK block labeled SKCKL where they are placed on the user chain SKCKC. Transactions entering outside of the normal workday are transferred to the TEST block SKCKT which routes transactions based on their priority. High priority transactions (those handled by the duty section) are assigned a progress indicator in parameter 3 that marks their stage in processing. They are then removed from the QSKCK queue and are transferred to the duty section module for processing. Low priority requisitions (those not handled by the duty section) are transferred to the advance block labeled SKCKA where they are delayed a single time unit to avoid an endless loop of linking and unlinking. The transactions are then transferred to SKCKL and placed on user chain SKCKC. Those transactions arriving during normal operating hours proceed directly to the ENTER block labeled SKCKE if the storage SKCK has remaining capacity. Otherwise, the transactions are transferred to SKCKL and placed on user chain SKCKC. Those entering during working hours when the storage has no available capacity proceed to the LINK block labeled SKCKL where they are placed on user chain SKCKC.

During normal operating hours one transaction is unlinked from the user chain to enter the storage for each transaction leaving the storage, maintaining full utilization of the storage as long as transactions remain on the user chain. All transactions are unlinked from user chain SKCKC at the end of the workday by a control transaction in the schedule control module so that high priority transactions residing on the user chain may be identified and routed to the duty section module. Low priority requisitions are relinked to user chain SKCKC to await processing during the next scheduled workday.

## 5. Printer Operations

The NSD Yokosuka issue document printers are currently located in DPSC and Customer Services. However, the modeling of printer operations in the program reflects NSD Yokosuka plans to relocate the DPSC printer to Storage Control in Fiscal Year 1986.

Customer Services printer operations including the schedule control section are modeled in the printer queue handling module. IPG1, IPG2 (CASREPT, quick pick and bearer walkthrough) and all provisions transactions are routed to the block labeled CSPRQ and placed in the QCSPR queue. The LINK block places all transactions on user chain ONE. The transactions are released at simulated time intervals of 5 minutes by the UNLINK block labeled UNLNK in the schedule control section, matching queue file processing procedures followed by UC02/UC96. The "printed" transactions are removed from the QCSPR queue by the DEPART block. They proceed through ENTER and LEAVE blocks referencing the CSPR storage without an intervening advance block because the processing delay actually experienced by requisitions waiting for UC96/UC02 to empty the queue file is simulated by the delay on the user chain.

## 6. Transportation Operations

Issue processing functions of the Depot include the transportation of issue documents and material between stationary workcenters. The programming technique used to simulate transportation processes involves linking transactions to user chains and using control transactions generated in corresponding schedule control sections to unlink them to succeeding modules. Transportation processes that, in actual operations, are essentially without maximum capacities are modeled as such (e.g., the number of issue documents that may be transported to Yokohama Cold Storage during a single delivery run is essentially unlimited).

Modeling transportation processes with known capacities is more complex.

Operations of the "B" route tractor train are simulated in the tractor train delivery module. Control transactions are created in the schedule control section at simulated times corresponding to the actual train schedule and are transferred to the UNLINK block LOADB on workdays. The loading of IPG1 and IPG2 transactions on the tractor train is managed by LOADB and the succeeding UNLINK blocks in the loading section which release all transactions on the JCF, BCH and ACH user chains to the test block BTEST in the operations section.

The operations section controls transaction access to the tractor trains. BTEST permits IPG1 and IPG2 transactions to proceed to the following TEST block. The weight of each transaction is then checked to ensure that it does not exceed the remaining capacity of the storage BTRN. Transactions meeting that test are transferred to BTRNE to enter the storage (i.e. are loaded on the train), depart QBTRN in the following block and are linked to user chain BTRNC in the succeeding LINK block. All IPG3 transactions and those transactions whose weight exceeds the remaining capacity of the storage (signifying that the train has been loaded to capacity) pass through the following ADVANCE block and are transferred back to their respective warehouse module to await the next train. By screening IPG1 and IPG2 transactions in advance of the normal loading cycle, IPG3 transactions at the first tractor train stop are prevented from effectively denying transportation to IPG1 and IPG2 transactions at later stops. This is consistent with tractor train loading procedures of NSD Yokosuka.

The succeeding blocks in the loading section govern the loading of IPG3 transactions returned to the warehouse. The control transaction passes through an ADVANCE block

which delays it to simulate movement of the tractor train from J-39 to its first stop, J warehouse area. The following UNLINK block releases, in priority order, all transactions waiting on user chain JCH to the TEST block BTRNT. The unlinked transactions are then loaded on the tractor train, capacity permitting, in the manner described by the previous paragraph. The control transaction continues through alternating ADVANCE and UNLINK blocks to repeat this process for transactions waiting at warehouse areas A and B.

After linking waiting transactions to the user chain BTRNC, the control transaction in the loading section enters an ADVANCE block which delays it to simulate movement of the train to the first unloading points, PWC and SRF. When the control transaction enters the succeeding UNLINK block, all transactions on the user chain BTRNC leave the storage BTRN and proceed to the TEST block TMTST. Transactions with a parameter 4 value indicating delivery to PWC and SRF are transferred for termination simulating delivery to requisitioner. All other transactions are delayed by an ADVANCE block to simulate transportation to the Freight Terminal.

#### 7. Duty Section Operations

The flow control sections throughout the program are designed to forward IPG1 and IPG2 CASREPT and bearer walkthrough transactions to the duty section module at the end of the workday and on weekends. Processing steps in the duty section module are similar to normal workday procedures except that all transactions are stock checked before remote terminal entry and transportation delays are modeled to recognize the fact that requisitions handled by the duty section are processed continuously from receipt to issue. Additionally, all 9MP and 9MB issues are made from Building 1390, as nearly all after hours provisions issues made by NSD Yokosuka are for requisitions received from inport ships.

So that transportation delays due to single issue processing by the duty section are accurately modeled, each transaction (representing three requisitions at this point) entering the storage DUTY is split into three identical transactions, each representing a single requisition. The number of transactions that may be simultaneously processed in the duty section module is limited to the duty section storage capacity of 2 which is consistent with the number of personnel actually available in the late shifts and duty section to handle issues.

The storage DUTY is unique in that it has several ADVANCE blocks between the ENTER and LEAVE blocks, each representing a step in actual issue processing. The first block in the operations section joins all transactions to the queue DUTYQ. The succeeding TEST blocks send entering transactions directly to the block labeled DUTYS if the storage DUTY has available capacity. Those entering before 1646 on workdays or when the storage is full are linked to the user chain DUTYC to await processing.

Transactions transferred directly, as well as those unlinked from user chain DUTYC for processing, proceed to the SPLIT block labeled DUTYS. There, each transaction is split into 3 separate transactions, each representing a single requisition as previously explained. The following TRANSFER block sends the original transaction directly to the ENTER block DUTYE. The newly created transactions are first transferred to QSPLT to be joined to DUTYQ before proceeding to the ENTER block. Transactions proceed beyond the ENTER block as the defined capacity of DUTY permits. They are removed from DUTYQ in the next block and then transferred to the starting point in the duty section module appropriate to the progress indicator stored in parameter 3.

The complete processing of each transaction is then simulated as the transaction passes through the remainder of

the module blocks. When processing is completed, each transaction passes through the dummy ADVANCE block labeled DUTTR, placed to provide a count of leaving transactions that is referenced by the following TEST block. The TEST block allows every third transaction to pass through the next block which unlinks a single transaction (representing 3 requisitions) to DUTYS. The above process is then repeated for the unlinked transaction.

The TRANSFER block SEND transfers transactions that complete processing in the duty section module to termination blocks appropriate to each transaction. At the start of the following workday, any unprocessed transactions remaining on the user chain DUTYC are unlinked to DUTYD by a control transaction in the schedule section. Those transactions are removed from DUTYQ and transferred back to their point of origin indicated by parameter 3. The processing of all transactions that have been split into individual requisitions is completed in the duty section module.

## V. VERIFICATION AND VALIDATION

### A. INTRODUCTION

This chapter will review verification of the program structure and discuss procedures to be used in the validation of simulation results. Verification and validation are terms used to describe the process of establishing the credibility of simulation models. The verification process entails ensuring that the logic of the computer program corresponds to that of the real system. Validation takes the process a step further, by testing the model to determine if it reasonably reflects real system processes.

Program output used during verification and validation is produced at the end of the simulation. The output is divided into 4 "snapshots" presenting a set of cumulative statistics at the end of each simulated week. The final snapshot of the program output used to verify this model is provided as Appendix C. The sections listed below are of particular interest:

1. Queue statistics
2. Storage statistics
3. Savevalues--total requisition generation count (REQCT), requisition generation count by issue priority group (PRONE, PRTHO and PRTHR), NIS requisition count (NISCT), warehouse refusal count (WRCT) and tractor train run count (ANUM, BNUM and PNUM)
4. Tables--throughput time distribution for all issues (ALL) and throughput time distribution for issues by issue priority group (IPGON, IPGTW, IPGTH)
5. Block counts

Storage statistics provide information regarding the active processing time experienced by transactions (requisitions) during the simulation as well storage (workcenter) utilization information. For each storage defined in the model, GPSS provides standard output that can be used to study system performance. Storage names and capacities are

provided under the corresponding headings. The total number of transactions processed during the simulation may be found in the column labeled "ENTRIES." The average processing time for those transactions that have been processed should closely approximate the mean of the service time data supplied to the program and may be verified by examining data in the column headed "AVERAGE TIME/UNIT". Statistics measuring storage utilization during operating hours are of particular interest to the user. The percentage of time that a storage is available for normal operations is given in the column "PERCENT AVAILABILITY" (e.g., the storage SKCK available 23.8% of the time or  $.238 \times 168 \text{ hours} = 40 \text{ hours per week}$ ). During this period of availability, average utilization may be found under the "AVAIL. TIME" heading. For the storage SKCK, this value was .135 or 13.5%

Queue statistics detail the waiting times experienced by transactions attempting to enter storages in the model. They are provided immediately following storage statistics in a similar format. The maximum, average and total number of requisitions awaiting processing in each of the queues listed in the first column are provided in the next three columns. The column headed "AVERAGE TIME/TRANS" provides the average time spent waiting for processing by all transactions joining the queue. This information is used to isolate delays in transaction processing and is particularly useful during experimentation in identifying system "bottlenecks."

Savevalues are employed as "counters" during the simulation. Savevalues tally the total number of transactions entering the system and provide subtotals by issue priority groups. They are also used to count NIS and warehouse refusal transactions experienced during the simulation. During validation, the output values for savevalues defined in the program may be compared to input parameters to verify

the demand level and mix, acting as a yardstick for evaluating system performance.

Tables defined in the program are designed to provide system throughput data that may be compared to Uniform Material Movement and Issue Priority System (UMMIPS) statistics maintained by the Depot. Tabulate blocks are positioned in the termination module to collect statistics at the point of issue or availability for shipment. The system entry time of each transaction entering a TABULATE block is subtracted from the current simulation clock time, recording the difference as the total issue processing time. The elapsed processing times of all transactions representing issues are aggregated and presented as a frequency distribution table.

The first row of data in each table presents the total number of transactions tabulated, the mean throughput time and the standard deviation. In the body of the frequency distribution table, the data is grouped into predefined intervals whose upper limits are listed in the first column. Because simulated time in the model is based on units of .01 hours, the listed upper limits must be divided by 100 to obtain the correct time in hours. The frequency of occurrence, percentage of total occurrences and cumulative percentage of occurrences in each interval are presented in the next three columns. As in the savevalue output section, one table is used to tabulate all transactions leaving the system and three separate tables present tabulations for the three issue priority groups.

While the block count section of the program does not provide useful information during the validation phase, it is a valuable tool during verification to review transaction flow. A current and total transaction count is provided for each block in the program. This data can be compared to corresponding block operands, especially flow control blocks

like TEST or TRANSFER, to ensure that program logic is consistent with real system operations.

#### B. VERIFICATION

Steps in the verification phase are designed to expose coding and logic errors. Transaction generation and flow are reviewed using block count and savevalue statistics to verify that the characteristics of requisition flow at NSD Yokosuka is duplicated by the simulation model. The verification phase was completed using the final snapshot in the output listing provided by Appendix C.

The savevalue REQCT counted 39,780 transactions entering the model during the four weeks of simulated operations conducted at a monthly demand level of 43,00 requisitions. Assuming 4.33 weeks to the month, the entry of 39,692 transactions ( $(43,000/4.33) \times 4$  weeks) would have been expected. The difference between the requisition receipt rate experienced from that expected is due to truncation during GPSS variable computation and may be compensated for by slightly increasing the demand level.

The characteristics of transactions entering the system were also reviewed. Block counts of the SPLIT blocks in the workday requisition generation subsections were used to compute the percentage of transactions entering during the normal operating hours of the workday. 89% of all workday transactions entered the model during the simulated time period of 0800 - 1645, matching the pattern of real system arrivals. Priority assignment recorded by the savevalues PRION, PRITW and PRITH were compared to the priority assignment input data in function FONE. The recorded number of transactions in each priority group matched expected results.

Requisition flow points representing the routing of online requisitions, perishable provisions requisitions stock checked in Requirements Division, demand exceptions,

NIS requisitions and warehouse refusals were all verified by reviewing block count statistics. All observed counts differed from expected values by less than 1% with the exception of the warehouse refusal count. The difference in warehouse refusals observed from the number expected was 4% and is attributed to the smaller sample size of 67 warehouse refusals.

Warehouse location assignment in the model is handled by the ASSIGN block labeled LOCAS in the warehouse assignment module. A temporary TABULATE block was inserted following LOCAS to determine and verify the assignments to each warehouse area. Observed differences from expected assignments ranged from .01% to 13%. Fluctuations in warehouse arrivals of this magnitude are exceeded by those experienced in normal Depot operations and do not result in appreciable differences in simulation results.

#### C. VALIDATION

Service time observation data necessary to validate this model is not available to the author. Before validation of the model can begin, frequency distributions of observed service times in F-157, all provisions storage locations and the packing section must be completed and entered as functions in the model. After all of the data distributions are established and verified in the models, the following validation procedure should be used.

In the validation phase, the credibility of the model is established by developing a set of actual performance statistics to compare to queue storage and table statistics produced by the program. Depot performance statistics from a period of at least one month of normal operating tempo should be collected to provide both the demand level to be simulated and the real system performance data used to judge model performance.

The first step in validation should be to review overall system performance. Problems observed in this step will serve as starting points in the identification of module-level problems. Statistics reported by NSD in the Issue Processing Analysis Section of the Supply Distribution and Inventory Control Report (NAVSUP 1144) should be compared to the IPGON, IPGTW and IPGTH tables in the output section of the program. More specifically, for each issue priority group, the cumulative percentage figure for the interval with the upper limit matching the corresponding UMMIPS processing time standard (one, two and eight days respectively) should be compared to the percent shipped on time figure reported on the NAVSUP 1144. Three different basic observations may be made at this point.

1. Simulation throughput time statistics closely approximate real system performance
2. Simulation throughput time statistics differ from real system performance uniformly across issue priority groups.
3. Simulation throughput time statistics differ from real system performance inconsistently across issue priority groups.

In the case of the first observation, remaining validation steps can be limited to a review of queue and storage program output sections. Observation of either of the other two results may require a detailed analysis of the input data used by the model (i.e., service times, storage capacities) and the program logic representing decision rules employed by NSD personnel.

If transaction throughput times by issue priority groups differ uniformly from real system performance, queue and storage data should be compared to corresponding workcenter workloads. For example, if simulated throughput times were uniformly slower than real system operation, queue "AVERAGE CONTENTS" and "AVERAGE TIME/TRANS" data should be examined. Queues reflecting high average contents and reporting long average time per transaction values relative to other queues

should be reviewed first. Conversely, storages reporting high "UTILIZATION DURING AVAIL. TIME" should be examined before storages reporting low utilization. Real system workcenter backlogs, utilization rates and throughput should be compared to data from the suspect queues and storages. Discrepancies identified between actual workcenter performance and corresponding queue and storage statistics will most likely result from understated capacities, overstated or poorly defined service times, or both.

When deviation from real system performance does not occur uniformly across issue priority groups, program logic based on decision rules provided by NSD Yokosuka may not accurately reflect actual operations. For example, if simulated throughput times for IPG1 transactions were significantly faster than real system performance, while IPG2 and IPG3 performance was substantially as expected, handling of IPG1 requisitions in the program should be reviewed. Code segments modeling UC02/UC96 queue files and special delivery of IPG1 issue documents missing normal delivery runs should be compared to real system decision rules. If this review fails to produce an explanation for the discrepancy, intermediate MARK and TABULATE blocks should be inserted to measure throughput time in smaller segments of the program by issue priority groups in an effort to localize the problem.

The validation procedures discussed above are by no means all inclusive, however, they should serve as a guide to the validation process. Simulation model validation is an iterative process. After identified problems have been corrected, the program should be run and the results compared again against real system performance data. When validation is completed, input parameters and output statistics should be retained as a baseline for model experimentation.

## VI. EXPERIMENTATION

One major purpose of simulation is to perform experimentation that will provide predictive information regarding real system performance under controlled changes to the system and its conditions. Simulation experiments reviewed in this chapter were conducted for the purpose of demonstrating experimentation techniques. The baseline program used during experimentation models NSD issue processing operations under a normal load of 43,000 requisitions a month and is identical to the program listing provided as Appendix A. The baseline program output referenced is the program output included as Appendix C. As the baseline program has not been validated, it should be emphasized that the results of this series of simulation experiments are useful for illustrative purposes only.

Consider the following demonstration of experimentation procedures. NSD Yokosuka Planning Division analysts have estimated that the support of an additional Carrier Battle Group (CBG) under peacetime conditions would result in a 70% increase in requisitions received. The objective of this series of experiments was to observe simulated issue processing operations of NSD Yokosuka for a period of four weeks under those conditions. The information obtained from the experimental models could be used to estimate the additional resources the Depot might require to continue providing approximately the same level of support.

The experimentation plan calls for an initial run to simulate NSD operations at a monthly demand level of 73,100 requisitions to identify processing bottlenecks in the system. After evaluation of the initial run is completed, adjustments to the model will be made reflecting options that would be available to the Depot during actual operation

(i.e., additional personnel, shift changes, scheduling of additional tractor train runs.) After modifications to the model are completed, the simulation run will be repeated. The results of the second simulation will then be evaluated and the process will continue in an iterative manner until a satisfactory solution is obtained. This plan was executed and the results are explained below.

The throughput time tables, storage and queue statistics produced by the first experiment were compared to Appendix C. The percentage of issues, by issue priority group, made within UMMIPS time standards with UMMIPS performance statistics recorded during normal operating levels did not indicate a serious problem at first glance. IPG1 and IPG2 UMMIPS performance remained essential unchanged. The percentage of IPG3 issues made within the UMMIPS time standard of seven days (16,800 simulation time units) fell from 99.1% under normal conditions to 95.3%. The first indication of a problem was in the actual number of IPG3 issues. The 18,693 IPG3 issues recorded reflected an increase of only 9% over the 17,157 IPG3 issues made during the baseline experiment, though the number of requisitions received increased by 70%. A review of queue statistics explained the modest increase in IPG3 issues. Snapshot queue statistics confirmed that warehouse area A, the main warehouse, the B route tractor train and packing queues steadily increased in length indicating that arrival rates in those areas exceeded the service rates. This was confirmed by utilization rates in the corresponding storages approaching or equaling 100%. The Savevalue count BNUM (the B route tractor train count) underscored the issue transportation problem. The B route required 97 runs to transport issues from warehouse areas A, B, and J, exceeding the scheduled 80 runs by 21%.

Based on these changes in system performance due to the increase in load conditions, the "system" was modified in

the following manner. Since processing bottlenecks were localized in relatively few workcenters, spot adjustments, as opposed to blanket shift changes, were made to compensate for the additional workload. The warehouse area A and main warehouse storage capacities were increased from 2 to 3 and from 8 to 11, respectively. Each modification required a change to the capacity listed in the storage definition block and to the number of transactions unlinked in the user chain control module. The number of heavy pack crews was increased from 3 to 4 and the number of personnel in the light pack line was increased from 5 to 7 by changes to the program code similar to those made to the warehouse storages. Additional tractor train runs on the B route were scheduled at 1500 and 1700 each workday. A single additional run was scheduled on the A route to handle the anticipated increase in issues from the main warehouse. The changes were implemented by duplicating code from an earlier train run, changing only the control transaction generation time. The management discretion train routes previously scheduled for 1500 were rescheduled to 1800 by changing the control transaction generation times.

After the changes were completed, the second simulation experiment was run. The number of IPG1 and IPG2 issues and their UMMIPS performance statistics remained stable in the second run. IPG3 issues increased from 18,693 to 26,403, an increase of 41% over the previous experiment and 54% over the baseline issues. The percentage of IPG3 issues made within UMMIPS time standards increased to 97.1%. The storage and queue statistics of warehouse area A and the main warehouse were returned to acceptable levels by the capacity increases. The A route tractor train queue lengths recorded in the snapshot statistics produced during the second experiment increased only slightly, indicating that the single additional run scheduled was sufficient to handle the

increase in main warehouse issues that had been anticipated. The B route tractor train queue lengths showed significant improvement, however, the average transaction queue waiting time was an unacceptable 117 hours. Packing Section utilization remained at 100% with the increase in storage capacity partially offset by the increase in issues transported by the additional tractor train runs.

The results of the second run indicated that changes to the system were still required in the issue transportation and packing sections. In the third experiment, additional tractor train runs on the B route were scheduled at 0925 and 1125 on workdays to reduce the delay experienced by transactions waiting for transportation on the B route tractor train. The capacity of the heavy pack storage was increased from 4 to 5 and the light pack storage from 7 to 9. The simulation was repeated and results of third simulation experiment were examined. IPG1 and IPG2 statistics remained stable. The number of IPG3 issues rose to 28,683 with 97.8% of all issues made within UMMIPS time standards. All storage utilization rates had fallen sufficiently below 100% to eliminate the exploding queue characteristics observed in the previous experiments.

Experimentation could be continued to restore IPG3 UMMIPS performance standards observed in the baseline simulation by following the same procedures employed in the first three experiments. As observed during this series of experiments, obtaining the desired results is an iterative process. Modifications made to the model depend on the observed conditions unique to each experiment and are easily made by personnel with only a limited background in simulation techniques and GPSS.

## VII. SUMMARY

### A. CONCLUSIONS

#### 1. Discrete Event Simulation Using GPSS V

Simulation using GPSS V can be an effective predictive tool for NSD Yokosuka planning personnel. The NSD is composed of interrelated queueing systems that may be accurately modeled by discrete event simulation techniques. The system throughput, resource utilization and queue statistics produced by GPSS V during simulation experimentation are well suited to the information requirements of logistics planners. Making program changes during system experimentation is a relatively simple process, well within the capability of personnel with only an introduction to GPSS.

#### 2. Discrete Event Simulation Using GPSS/PC

NSD Yokosuka issue processing operations could not be modeled with Minuteman Software's GPSS/PC because of the substantial memory requirements of the model. Manufacturer suggestions that GPSS/PC will handle 2000 concurrently active transactions indicates that input stream compression on the order of 20 requisitions to each transaction will be necessary to keep memory requirements within the 640 kilobytes permitted by DOS.

### B. RECOMMENDATIONS

#### 1. Data Collection

The data collection efforts of NSD Yokosuka should be completed to permit model validation and experimentation using the present GPSS V program. The use of existing mean times to model requisition and issue document handling processes (i.e., remote terminal entry, document sorting) should not have an adverse impact on model performance due

to the brief and uniform nature of the tasks. However, the greater length and variability of service times in warehouse locations and the Packing Section do not permit accurate modeling with estimated mean times. The construction of frequency distributions from random samples of actual service times in the provisions storage locations, F-157 and the Packing Section will be necessary to complete model validation.

## 2. Model Experimentation

If data collection and model validation efforts can be completed under the coordination of NSD Yokosuka, the cooperation of an activity equipped with an IBM mainframe computer operating under the VM/CMS operating system will be necessary to permit experimentation with the model. Other activities in Japan, the Naval Postgraduate School and the Navy Fleet Material Support Office all offer support possibilities.

## 3. Microcomputer Implementation of the Model

Eventual implementation of a microcomputer version of the model would permit NSD Yokosuka Planning Division analysts to experiment with the model interactively. If validation of the present model is completed, it should be converted to GPSS/PC and the modifications necessary to compress the input stream should be made. Validation of the GPSS/PC version should then be completed in the same manner as the original model.

APPENDIX A  
PROGRAM LISTING

TABLE OF CONTENTS

|                                                    |    |
|----------------------------------------------------|----|
| Program Execution Control Module . . . . .         | 54 |
| Input Parameters Module. . . . .                   | 55 |
| Variable Computation Module. . . . .               | 57 |
| Boolean Variable Computation Module. . . . .       | 59 |
| Transaction Parameter Module . . . . .             | 60 |
| Storage Definition Module. . . . .                 | 61 |
| Functions Module . . . . .                         | 63 |
| Master Schedule Control Module . . . . .           | 66 |
| Storage Control Module . . . . .                   | 67 |
| User Chain Control Module. . . . .                 | 68 |
| Requisition Generation Module. . . . .             | 69 |
| Requisition Receipt Module . . . . .               | 71 |
| NSD Remote Terminal Entry Module . . . . .         | 72 |
| CPU Tests Module . . . . .                         | 73 |
| Printer Queue Handling Module. . . . .             | 74 |
| Demand Exception Handling Module . . . . .         | 75 |
| Warehouse Assignment Module. . . . .               | 76 |
| Storage Control/Storage Office Module. . . . .     | 77 |
| Yokohama Issue Document Delivery Module. . . . .   | 78 |
| Bicycle Messenger Delivery Module. . . . .         | 79 |
| Warehouses Module. . . . .                         | 80 |
| Provisions Tractor Train Delivery Module . . . . . | 88 |
| Tractor Train Delivery Module. . . . .             | 89 |
| Freight Terminal Module. . . . .                   | 92 |
| Duty Section Module. . . . .                       | 94 |
| Termination Module . . . . .                       | 97 |
| Simulation Run Control Module. . . . .             | 98 |

```
//YOKO JOB (4939,9999), 'MIKE CLIFT', CLASS=G
// *MAIN LINES=(40)
// EXEC GPSSV, REGION.GO=2048K
//SYSIN DD *
```

```
REALLOCATE XAC, 20000
REALLOCATE FAC, 0
REALLOCATE LOG, 0
REALLOCATE TAB, 10
REALLOCATE FSV, 15
REALLOCATE HSV, 0
REALLOCATE BSV, 0
REALLOCATE LSV, 0
REALLOCATE GRP, 0
REALLOCATE FMS, 0
REALLOCATE HMS, 0
REALLOCATE BMS, 0
REALLOCATE LMS, 0
REALLOCATE STO, 100
REALLOCATE QUE, 100
REALLOCATE COM, 500000
```

```
*****
**          PROGRAM EXECUTION CONTROL          **
** THE SIMULATE STATEMENT MUST FOLLOW ALL JCL STATEMENTS AND GPSS **
** REALLOCATE STATEMENTS. IT MARKS THE BEGINNING OF THE EXECUTABLE **
** PROGRAM. THE PRECEDING REALLOCATE STATEMENTS ARE USED TO ALLOCATE **
** ADDRESSABLE MEMORY AMONG VARIOUS ENTITIES DEFINED IN THE PROGRAM. **
*****
```

```
*
      SIMULATE          BEGIN SIMULATION
*
```

```

*****
**                INPUT PARAMETERS                **
** INPUT PARAMETER VARIABLES ARE ASSIGNED VALUES FROM DATA PROVIDED **
** BY NSD. INPUT PARAMETER VARIABLES ARE USED TO CONTROL THE NUMBER **
** AND TYPE OF TRANSACTIONS GENERATED IN THE SIMULATION. THEY MAY **
** BE CHANGED FOR THE PURPOSE OF EXPERIMENTATION.                **
*****
**DEMAND LEVEL INPUT PARAMETER*****
*
**TOTAL DEMANDS PER MONTH**
  DMAND VARIABLE    43000
*
**INPUT PARAMETERS EXPRESSED IN NUMBER PER 1000 REQS REC'D*****
*
**GROSS AVAILABILITY**
  GROSS VARIABLE    651
*
**REQUISITIONS RECEIVED VIA AUTODIN, DOSS OR LOCAL CUSTOMER RTE**
  ONLIN VARIABLE    447
*
**NO OF WEEKDAY DEMANDS REC'D DURING WORKDAY**
  DAYDD VARIABLE    891
*
**DEMAND EXCEPTIONS**
  DMDEX VARIABLE    63
*
**PERISHABLE PROVISIONS REQS - 9MP/9MB**
  PERPV VARIABLE    177
*
**DRY PROVISIONS REQS - 9MF**
  DRYPV VARIABLE    67
*
**SHIPS STORE STOCK REQS - 1Q**
  SSS  VARIABLE     13
*
***INPUT PARAMETERS EXPRESSED IN NUMBER PER 1000 ISSUES*****
*
**WAREHOUSE REFUSALS**
  WHREF VARIABLE     3
*
**INPUT PARAMETERS EXPRESSED IN AVERAGE WEIGHT IN LBS OF THREE ISSUES **
**FOR EACH WAREHOUSE AREA (TWO THOUSAND LBS PER MEASUREMENT TON)      **
*
**YOKOHAMA COLD STORAGE**
  YMCSW VARIABLE     1245
*
**YOKOSUKA COLD STORAGE (BLDG 1390)**
  YKCSW VARIABLE     1647
*
**DRY (B-47) WAREHOUSE**
  DRYWW VARIABLE     999
*
**A WAREHOUSE**
  AWHW VARIABLE      1881
*
**B WAREHOUSE**
  BWHW VARIABLE      2124
*
**MAIN (F-157) WAREHOUSE**
  MAINW VARIABLE      381
*
**F WAREHOUSE**
  FWHW VARIABLE      2283
*
**J WAREHOUSE**
  JWHW VARIABLE      3096

```

\*\*INPUT PARAMETER - ENTER ISSUE BACKLOG THRESHOLD (LBS) \*\*\*\*\*  
\*\*REQUIRED TO SCHEDULE AN ADDITIONAL TRACTOR TRAIN RUNS \*\*\*\*\*  
\*  
\*\*ATRN ROUTE\*\*  
  AXTRA VARIABLE   64000  
\*  
\*\*BTRN ROUTE\*\*  
  BXTRA VARIABLE   64000  
\*  
\*\*PROVISIONS WAREHOUSE ROUTE\*\*  
  PXTRA VARIABLE   32000  
\*  
\*\*INPUT PARAMETER EXPRESSED IN NO. PER 1000 ISSUES RECEIVED IN PACKING\*\*  
\*  
\*\*NO. ISSUES FOR LIGHT OR PARCEL POST PACK\*\*  
  LITEP VARIABLE   911

```

*****
**          VARIABLE COMPUTATION          **
** SYMBOLIC NAME, COMPUTATION AND DEFINITION OF VARIABLES REFERENCED**
** DURING THE SIMULATION. VARIABLE VALUES ARE COMPUTED FROM INPUT **
** PARAMETER VARIABLES, OTHER DEFINED VARIABLES OR FUNCTIONS.      **
*****
*
*****COMPUTE DAY OF WEEK INDICATOR*****
**MON=1 TUES=2 WED=3 THU=4 FRI=5 SAT=6 SUN=0**
DAY VARIABLE N$DAYC@7
*
**COMPUTE TIME OF DAY**
TIME VARIABLE C1@2400
*
**NO OF WEEKDAY DEMANDS NOT REC'D DURING WORKDAY PER 1000 REQS REC'D**
NITDD VARIABLE 1000-V$DAYDD
*
**WEEKLY DEMANDS GIVEN MONTHLY DEMAND LEVEL**
WDMND VARIABLE (V$DMAND*231)/1000
*
**DAILY DEMANDS GIVEN MONTHLY DEMAND**
DDMND VARIABLE ((V$WDMND*FN$FTHNN)/1000)/3
*
**DEMANDS RECEIVED DURING THE WORKDAY**
WRKDD VARIABLE (V$DDMND*V$DAYDD)/1000
*
**DEMANDS RECEIVED DURING THE WORKDAY AM**
AMDD VARIABLE (((V$DDMND*V$NITDD)/1000)*800)/1525
*
**DEMANDS RECEIVED DURING THE WORKDAY PM**
PMDD VARIABLE (((V$DDMND*V$NITDD)/1000)*725)/1525
*
**NO REQS SENT TO REQUIREMENTS DIV. FOR STOCK CHECK PER 1000 REQS REC'D**
RQCHK VARIABLE V$PERPV+V$SSS
*
**NO REQS SENT TO REQUIREMENTS DIV. FOR STOCK**
**CHECK PER 1000 HARD COPY REQS REC'D **
RQDIV VARIABLE 1000*V$RQCHK/(1000-V$ONLIN)
*
**PROVISIONS REQS PER 1000 REQS REC'D**
PROV VARIABLE V$PERPV+V$SSS+V$DRYPV
*
**NO OF DEMAND EXCEPTIONS PER MONTH**
NUMEX VARIABLE V$DMAND*V$DMDEX/1000
*
**NET DEMAND EXCEPTIONS PER 1000 ISSUES**
NETEX VARIABLE V$NUMEX*1000/((V$GROSS*V$DMAND)/1000)
*
**TRANSACTIONS NOT DEMAND EXCEPTION PER 1000 ISSUES**
NOTEX VARIABLE 1000-V$NETEX
*
**ISSUES NOT WAREHOUSE REFUSALS PER 1000 ISSUE DOCS SENT TO WAREHOUSE**
NOTWR VARIABLE 1000-V$WREF
*
**SERVICE TIME VARIABLES (SUM OF 3 FUNCTION CALLS)*****
*
INEXP FVARIABLE FN$FFORT+FN$FFORT+FN$FFORT+.5

```

\*\*SERVICE TIME VARIABLES FOR GROUPS OF THREE - SERVICE TIME MEAN \*\*\*\*  
 \*\*MULTIPLIED BY VSINEXP FOR SERVICE TIME CONSTRUCTED FROM MEANS - \*\*\*\*  
 \*\*SUM OF THREE SERVICE TIME FUNCTION CALLS FOR SERVICE TIMES \*\*\*\*  
 \*\*CONSTRUCTED FROM CONTINUOUS DISTRIBUTIONS \*\*\*\*

SKCKS VARIABLE FN\$FELEV\*V\$INEXP  
 \*  
 RTES VARIABLE FN\$FTWEL\*V\$INEXP  
 \*  
 DEEXS VARIABLE FN\$FHTN\*V\$INEXP  
 \*  
 SCSOS VARIABLE FN\$FSXTN\*V\$INEXP  
 \*  
 YMCSS VARIABLE FN\$FEITN\*V\$INEXP  
 \*  
 YKCSS VARIABLE FN\$FNNTN\*V\$INEXP  
 \*  
 DRYWS VARIABLE FN\$FTWEN\*V\$INEXP  
 \*  
 AWHES VARIABLE FN\$FTWON+FN\$FTWON+FN\$FTWON  
 \*  
 BWHES VARIABLE FN\$FTWTW+FN\$FTWTW+FN\$FTWTW  
 \*  
 MAINS VARIABLE FN\$FTWTH\*V\$INEXP  
 \*  
 FWHES VARIABLE FN\$FTWFR+FN\$FTWFR+FN\$FTWFR  
 \*  
 JWHES VARIABLE FN\$FTWV+FN\$FTWV+FN\$FTWV  
 \*  
 HVYPS VARIABLE FN\$FTWSX\*V\$INEXP  
 \*  
 LITPS VARIABLE FN\$FTWSV\*V\$INEXP  
 \*  
 \*\*ESTIMATED WEIGHT OF TRANSACTIONS AWAITING THE TRACTOR TRAINS\*\*\*\*\*  
 \*  
 \*\*ATRN ROUTE\*\*  
 AWGHT VARIABLE (CH\$MAINC\*V\$MAINW)+(CH\$FCH\*V\$FWHEW)  
 \*  
 \*\*BTRN ROUTE\*\*  
 BWGHT VARIABLE (CH\$ACH\*V\$AWHEW)+(CH\$BCH\*V\$BWHEW)+(CH\$JCH\*V\$JWHEW)  
 \*  
 \*\*PROVISIONS WAREHOUSE ROUTE\*\*  
 PWGHT VARIABLE CH\$PTRNC\*((V\$YKCSW+V\$DRYWW)/2)  
 \*  
 \*\*VARIABLE COUNTS GROUPS OF 3 LEAVING DUTY SECTION MODULE\*\*\*\*\*  
 COUNT VARIABLE N\$DUTTR@3

```

*****
**          BOOLEAN VARIABLE COMPUTATION          **
** SYMBOLIC NAME, COMPUTATION AND DEFINITION OF BOOLEAN VARIABLES **
** REFERENCED IN THE SIMULATION. BOOLEAN VARIABLES ARE USED IN THE **
** SIMULATION TO CONTROL OPERATIONS SCHEDULING. **
*****
**WORKDAY INDICATOR, TRUE (1) IF MONDAY THROUGH FRIDAY**
WKDAY BVARIABLE V$DAY'GE'K1*V$DAY'LE'K5
*
**LUNCHTIME INDICATOR, TRUE IF 1201 - 1245 ON WORKDAY
LUNCH BVARIABLE V$TIME'GE'K1201*V$TIME'LE'K1275*BV$WKDAY'E'K1
*
**NIGHTTIME INDICATOR, TRUE IF BEFORE 0801 OR AFTER 1645 ON WORKDAY
NIGHT BVARIABLE (V$TIME'GE'K1676+V$TIME'LE'K800)*BV$WKDAY'E'K1
*
**WORKING HOURS INDICATOR, TRUE IF 0801 - 1200 OR 1246 - 1645 ON WORKDAY
WORKH BVARIABLE BV$LUNCH'E'K0*BV$NIGHT'E'K0*BV$WKDAY'E'K1
*
**DEPOT OPEN INDICATOR, TRUE IF 0801 - 1645 ON WORKDAY
OPEN BVARIABLE BV$LUNCH'E'K1+BV$WORKH'E'K1
*
PTIME BVARIABLE V$TIME'E'800+V$TIME'E'1000+V$TIME'E'1275+V$TIME'E'1475
*                               SET TO TRUE AT IPG2 PRINT TIMES
*
PRTWO BVARIABLE BV$WKDAY'E'K1*BV$PTIME'E'K1
*                               SET TO TRUE ON WORKDAYS TO PRINT
*                               IPG2 BATCH
*
PRTHR BVARIABLE BV$WKDAY'E'1*V$TIME'E'800
*                               SET TO TRUE ON WORKDAYS TO PRINT
*                               IPG3 BATCH
*
BTIME BVARIABLE V$TIME'E'900+V$TIME'E'1100+V$TIME'E'1375+V$TIME'E'1525
*                               SET TO TRUE AT ISSUE DOC DELIVERY
*                               TIMES
*
DTIME BVARIABLE BV$WKDAY'E'K1*BV$BTIME'E'K1
*                               SET TO TRUE AT DELIVERY TIME ON
*                               WORKDAYS
*
**BOOLEAN VARIABLE SET TO TRUE IF ISSUE FOR BEARER PICK-UP**
BEAR BVARIABLE P1'E'K7+P1'E'K5+P1'E'K3
*
**BOOLEAN VARIABLE SET TO TRUE ON EVERY THIRD TRANSACTION LEAVING DUTY**
THREE BVARIABLE V$COUNT'E'0

```

```

*****
**          TRANSACTION PRIORITIES AND PARAMETERS          **
** KEY TO PRIORITIES AND PARAMETERS ASSIGNED AND REFERENCED DURING **
** THE SIMULATION.                                          **
*****
*
*PRIORITY      REQ PRIORITY      MATCHES P1
*
*P1            REQ PRIORITY      IPG1 BWT          = 7
*                                IPG1 (ALL OTHER)    = 6
*                                IPG2 BWT          = 5
*                                IPG2 CASREPT
*                                (NOT BWT)          = 4
*                                IPG2 QUICK PICK     = 3
*                                IPG2 (ALL OTHER)    = 2
*                                IPG3              = 1
*
*P2            STORAGE AREAS      YOKOHAMA COLD STORAGE = 1
*                                YOKOSUKA COLD STORAGE = 2
*                                (BUILDING 1390)
*                                DRY PROVISIONS      = 3
*                                (B-47)
*                                A AREA WAREHOUSES   = 4
*                                (A-19)
*                                B AREA WAREHOUSES   = 5
*                                (B-33,B-45,B-46)
*                                MAIN WAREHOUSE      = 6
*                                (F-157)
*                                F AREA WAREHOUSES   = 7
*                                (F-8,F-9,F-10,F-11,
*                                F-12,F-13,F-14)
*                                J AREA WAREHOUSES   = 8
*                                (J-11,J-12 AND GAS,
*                                LUMBER AND DRUM YARDS)
*
*P3            TRANSACTION POINT OF      PARAMETER VALUES EVALUATED
*            PROGRESS PARAMETER          BY FUNCTIONS FTHIR AND FTHON
*            (SPECIFIES DUTY SECTION
*            PROCESSING REQUIRED AND/
*            OR POINT OF RETURN FOR
*            TRANSACTIONS NOT
*            PROCESSED BY THE DUTY
*            SECTION)
*
*P4            NSD TRANSPORTATION      MAJOR CUSTOMER (PWC,SRF) = 1
*            DESTINATIONS              NOTE: NOT ASSIGNED IN
*                                PROVISIONS STORAGE LOCATIONS
*                                PACKING DIVISION    = 2
*                                FREIGHT TERMINAL DIVISION = 3
*
*P5            ISSUE WEIGHT            WEIGHT ASSIGNED TO TRANSACTIONS
*                                EXPRESSED IN LBS
*
*P6            STOCK STATUS            NIS/NC      = 1
*                                IN STOCK = 2
*
*P7            DEMAND EXCEPTION STATUS  PROCESSED DEMAND EXCEPTION = 1
*
*P8            WAREHOUSE REFUSAL STATUS WAREHOUSE REFUSAL = 1

```

```

*****
**          STORAGE DEFINITIONS          **
** SYMBOLIC ADDRESS, CAPACITY AND BRIEF EXPLANATION OF NSD          **
** FUNCTIONAL AREAS MODELED AS STORAGES WITHIN THE SIMULATION.      **
** CAPACITIES REFLECT NUMBER OF PERSONNEL WORKING IN THE MODELED    **
** WORKCENTER EXCEPT FOR THE ATRN AND BTRN STORAGES WHICH REFLECT  **
** TRACTOR TRAIN CAPACITY IN POUNDS.                                  **
*****
*
*   STORAGE   $$$KCK,6           NO OF CLERKS IN REQUIREMENTS
*                                     PERFORMING STOCK CHECKS
*
*   STORAGE   $$$CRTE,5         NO OF RTE OPERATORS IN CUST SERV
*                                     ENTERING REQS
*
*   STORAGE   $$$DRTE,2         NO OF RTE OPERATORS IN DPSC
*                                     ENTERING REQS
*
*   STORAGE   $$$DEEX,2         NO OF CLERKS IN CUST SERV
*                                     PROCESSING DEMAND EXCEPTIONS
*
*   STORAGE   $$$CPR,100000     STORAGE CONTROL PRINTER, UNLIMITED
*                                     CAPACITY
*
*   STORAGE   $$$CSPR,100000    CUST SERV PRINTER, UNLIMITED
*                                     CAPACITY
*
*   STORAGE   $$$CNT,4          NO OF STORAGE CONTROL PERSONNEL
*                                     MARKING,BURSTING AND SORTING
*                                     ISSUE DOCUMENTS
*
*   STORAGE   $$$STOF,1         NO OF STORAGE OFFICE PERSONNEL
*                                     MARKING,BURSTING AND SEGREGATING
*                                     ISSUE DOCUMENTS
*
*   STORAGE   $$$DLVR,100000    ISSUE DOC DELIVERY TO YOKOHAMA
*                                     COLD STORAGE, UNLIMITED CAPACITY
*
*   STORAGE   $$$YMCS,11        NO. OF WAREHOUSE PERSONNEL AT
*                                     YOKOHAMA COLD STORAGE IN ISSUE AND
*                                     SHIPMENT PREP OPERATIONS
*
*   STORAGE   $$$YKCS,4         NO. OF WAREHOUSE PERSONNEL AT
*                                     BUILDING 1390 (YOKSUKA COLD STOR.)
*                                     IN ISSUE AND SHIPMENT PREP
*                                     OPERATIONS
*
*   STORAGE   $$$DRYW,2         NO. OF WAREHOUSE PERSONNEL AT
*                                     YOKOSUKA DRY STORAGE (B-47) IN
*                                     ISSUE AND SHIPMENT PREP OPERATIONS
*
*   STORAGE   $$$AWHE,2         NO. OF WAREHOUSE PERSONNEL AT
*                                     A AREA WAREHOUSES IN ISSUE OPS
*
*   STORAGE   $$$BWHE,2         NO. OF WAREHOUSE PERSONNEL AT
*                                     B AREA WAREHOUSES IN ISSUE OPS
*
*   STORAGE   $$$MAIN,8         NO. OF WAREHOUSE PERSONNEL AT
*                                     F-157 IN ISSUE OPS
*
*   STORAGE   $$$FWHE,1         NO. OF WAREHOUSE PERSONNEL AT
*                                     F AREA WAREHOUSES IN ISSUE OPS
*
*   STORAGE   $$$JWHE,4         NO. OF WAREHOUSE PERSONNEL AT
*                                     J AREA WAREHOUSES IN ISSUE OPS

```

|   |         |                |                                    |
|---|---------|----------------|------------------------------------|
| * | STORAGE | S\$ATRN,32000  | CAPACITY, EXPRESSED IN POUNDS, OF  |
| * |         |                | THE ON-BASE TRACTOR                |
| * |         |                | TRAIN (A-ROUTE)                    |
| * | STORAGE | S\$BTRN,32000  | CAPACITY, EXPRESSED IN POUNDS OF   |
| * |         |                | THE ON-BASE TRACTOR                |
| * |         |                | TRAIN (B-ROUTE)                    |
| * | STORAGE | S\$PTRN,32000  | PROVISIONS TRACTOR TRAIN,          |
| * |         |                | CAPACITY NOT REFERENCED DURING     |
| * |         |                | SIMULATION                         |
| * | STORAGE | SSLITP,5       | NO OF PACKERS IN LIGHT PACK LINE   |
| * | STORAGE | S\$HVYP,3      | NO OF HEAVY PACK CREWS             |
| * | STORAGE | S\$DUTY,2      | TWO MAN DUTY SECTION               |
| * | STORAGE | S\$BIKE,100000 | BICYCLE MESSENGER DELIVERING ISSUE |
| * |         |                | DOCUMENTS TO YOKOSUKA STORAGE      |
| * |         |                | LOCATIONS                          |

```

*****
**                FUNCTIONS                **
** DEFINITION OF FUNCTIONS USED IN THE SIMULATION PROGRAM. FUNCTIONS **
** ARE PARTIONED BY TYPE.                **
*****
**PARAMETER ASSIGNMENT FUNCTIONS*****
*
  FONE FUNCTION    RN1,D7                REQ PRIORITY
0.66696,1/.96695,2/.96978,3/.96995,4/.98713,5/.99983,6/1.0,7
*
  FTWO FUNCTION    RN1,D8                WAREHOUSE LOCATION ASSIGNMENT
0.17127,1/.22920,2/.30846,3/.35334,4
0.40118,5/.90023,6/.94454,7/1.0,8
*
  FTHRE FUNCTION   P2,E8                ASSIGNS FUNCTION TO PROVIDE ISSUE
1,FNSFFOUR/2,FNSFFOUR/3,FNSFFIVE/4,FNSFSIX/5,FNSFSEVE
6,FNSFEIGH/7,FNSFNINE/8,FNSFTEN
*
  FFOUR FUNCTION   RN1,D2                BLDG 1390 ISSUE DEST. ASSIGN.
0.9326,1/1.0,2
*
  FFIVE FUNCTION   RN1,D2                B-47 ISSUE DESTINATION ASSIGNMENT
0.6264,1/1.0,2
*
  FSIX FUNCTION    RN1,D3                A AREA ISSUE DESTINATION ASSIGN.
0.0389,1/.6897,2/1.0,3
*
  FSEVE FUNCTION   RN1,D3                B AREA ISSUE DESTINATION ASSIGN.
0.2888,1/.7744,2/1.0,3
*
  FEIGH FUNCTION   RN1,D3                F-157 ISSUE DESTINATION ASSIGN.
0.0167,1/.6772,2/1.0,3
*
  FNINE FUNCTION   RN1,D3                F AREA ISSUE DESTINATION ASSIGN.
0.3662,1/.8054,2/1.0,3
*
  FTEN FUNCTION    RN1,D3                J AREA ISSUE DESTINATION ASSIGN.
0.1357,2/.7312,2/1.0,3
*
**SERVICE TIME ASSIGNMENT FUNCTIONS*****
*
  FELEV FUNCTION   RN1,D2                STOCK CHECK SERVICE TIME
0.0,0/1.0,1
*
  FTWEL FUNCTION   RN1,D2                REMOTE TERMINAL ENTRY SERVICE TIME
0.0,0/1.0,1
*
  FHTN FUNCTION    P8,E2                FUNCTION ASSIGNMENT FOR DEMAND
0,FNSFFRTN/1,FNSFFFTN
*
  FFRTN FUNCTION   RN1,D2                DEMAND EXCEP. PROCESSING TIME
0.0,0/1.0,1
*
  FFFTN FUNCTION   RN1,D2                WAREHOUSE REF. PROCESSING TIME
0.0,0/1.0,5
*
  FSXTN FUNCTION   RN1,D2                STORAGE CONTROL/STORAGE OFFICE
0.0,0/1.0,1

```



\* FTHON FUNCTION P3,D23 TRANSFER LOCATION WITHIN DUTY  
 SECTION BASED ON P3  
 0,PZERO/1,PONE/3,PTHRE/4,PFOUR/5,PFOUR/6,PSIX/7,PSIX/8,PEIGH  
 9,PEIGH/10,PEIGH/11,PEIGH/12,PEIGH/13,PEIGH/14,PEIGH/15,PEIGH/16,PSXTN  
 17,PSXTN/18,PSXTN/19,PSXTN/20,PSXTN/21,PSXTN/22,PTWTW/23,PTWTH  
 \* FHTW FUNCTION P2,D8 WAREHOUSE LOCATION TRANSFER  
 1,YMCSQ/2,YKCSQ/3,DRYWQ/4,AWHEQ/5,BWHEQ/6,MAINQ/7,FWHEQ/8,JWHEQ  
 \* FHTH FUNCTION P1,D8 CONTROL TRANSACTION DESTINATION  
 IN SIMULATION TIME CONTROL MODULE  
 1,SONE/2,STWO/3,STHRE/4,SFOUR/5,SFIVE/6,SSIX  
 7,SSEVE/8,SEIGH  
 \* FTHFR FUNCTION P2,D2 TRANSFER LOCATION FOR TRACTOR  
 TRAIN OVERFLOW (A ROUTE)  
 6,MLINK/7,FLINK  
 \* FTHFV FUNCTION P2,D3 TRANSFER LOCATION FOR TRACTOR  
 TRAIN OVERFLOW (B ROUTE)  
 4,ALINK/5,BLINK/8,JLINK  
 \*\*TRANSPORTATION TIME ASSIGNMENT FUNCTIONS\*\*\*\*\*  
 \* FTHSX FUNCTION P2,D7 BICYCLE MESSENGER ROUTE TIME  
 ASSIGN. FOR ISSUE DOC DELIVERY  
 2,73/3,18/4,50/5,28/6,7/7,7/8,75  
 \* FTHSV FUNCTION P2,D8 CUSTOMER SERVICE TO WAREHOUSE  
 TRANSPORTATION TIMES  
 1,150/2,10/3,3/4,15/5,5/6,2/7,3/8,13  
 \* FTHEI FUNCTION P2,D7 WAREHOUSE LOCATION TO BLDG J-39  
 TRANSPORTATION TIMES  
 2,12/3,7/4,13/5,3/6,5/7,8/8,7  
 \*\*DAILY DEMAND LEVEL ASSIGNMENT FUNCTIONS\*\*\*\*\*  
 \* FTHNN FUNCTION VSDAY,D7 AVERAGE % OF WEEKLY DEMANDS  
 EXPERIENCED ON EACH DAY  
 0,21/1,168/2,150/3,200/4,201/5,205/6,55  
 \*\*STANDARD DISTRIBUTION FUNCTIONS\*\*\*\*\*  
 \* FFORT FUNCTION RN1,C24 INVERSE EXPONENTIAL FUNCTION  
 0.0,0/.1,.104/.2,.222/.3,.355/.4,.509/.5,.69  
 0.6,.915/.7,1.2/.75,1.38/.8,1.6/.84,1.83/.88,2.12  
 0.9,2.3/.92,2.52/.94,2.81/.95,2.99/.96,3.2/.97,3.5  
 0.98,3.9/.99,4.6/.995,5.3/.998,6.2/.999,7/.9998,8

```

*****
**          MASTER SCHEDULE CONTROL          **
** SIMULATE ONE WEEK OF OPERATIONS IN INCREMENTS OF .01 HOURS. A **
** CONTROL TRANSACTION IS GENERATED AT THE BEGINNING OF EACH DAY. **
** ADVANCE BLOCKS ARE USED TO MOVE THE TRANSACTION THROUGH A **
** WORKDAY SCHEDULE. AT APPROPRIATE TIMES, STORAGES REPRESENTING **
** DEPOT WORKCENTERS ARE OPENED AND CLOSED AND TRANSACTIONS ARE **
** LINKED TO AND UNLINKED FROM USER CHAINS BY SENDING THE CONTROL **
** TRANSACTION TO THE STORAGE CONTROL AND USER CHAIN CONTROL **
** MODULES. **
*****
*
*          GENERATE      16800          GENERATE SIMULATION CONTROL
*                                     TRANSACTION
*          TERMINATE      1          TERMINATE SIMULATION
*
**GENERATE A CONTROL TRANSACTION AT THE BEGINNING OF EACH DAY*****
*
* DAYC  GENERATE      2400,0,1          GENERATE CONTROL TRANSACTION
*
*          TEST E      BV$WKDAY,K1,SEIGH  SEND TO SEIGH IF SAT/SUN ELSE NEXT
*                                     BLOCK
*          ASSIGN      1,K1          TAG FOR RETURN
*          TRANSFER    ,UNAVL        SEND TO UNAVL
*
* SONE  ADVANCE      800          ADVANCE TO 0801
*          ASSIGN      1,K2          TAG FOR RETURN
*          TRANSFER    ,AVAIL        SEND TO AVAIL
* STWO  ASSIGN      1,K3          TAG FOR RETURN
*          TRANSFER    ,START        SEND TO START
*
* STHRE ADVANCE      400          ADVANCE TO 1201
*          ASSIGN      1,K4          TAG FOR RETURN
*          TRANSFER    ,UNAVL        SEND TO UNAVL
*
* SFOUR ADVANCE      75          ADVANCE TO 1246
*          ASSIGN      1,K5          TAG FOR RETURN
*          TRANSFER    ,AVAIL        SEND TO AVAIL
* SFIVE ASSIGN      1,K6          TAG FOR RETURN
*          TRANSFER    ,START        SEND TO START
*
* SSIX  ADVANCE      400          ADVANCE TO 1646
*          ASSIGN      1,K7          TAG FOR RETURN
*          TRANSFER    ,UNAVL        SEND TO UNAVL
* SSEVE ASSIGN      1,K8          TAG FOR RETURN
*          TRANSFER    ,FNISH        SEND TO FNISH
* SEIGH TERMINATE
*                                     TERMINATE CONTROL TRANSACTION

```

```

*****
**                               STORAGE CONTROL                               **
** AVAILABILITY OF STORAGES IS CONTROLLED BY THE MASTER SCHEDULE             **
** CONTROL MODULE. SUNAVAIL CLOSES STORAGES, SAVAIL OPENS THEM               **
** TO COINCIDE WITH NSD NORMAL WORKDAY SCHEDULE. PROCESSING OF               **
** TRANSACTIONS IN STORAGES WHEN THEY ARE MADE UNAVAILABLE IS               **
** COMPLETED.                                                                **
*****

```

\*

```

UNAVL SUNAVAIL SKCK
      SUNAVAIL CRTE
      SUNAVAIL DRTE
      SUNAVAIL DEEX
      SUNAVAIL SCNT
      SUNAVAIL STOF
      SUNAVAIL YMCS
      SUNAVAIL YKCS
      SUNAVAIL DRYW
      SUNAVAIL AWHE
      SUNAVAIL BWHE
      SUNAVAIL MAIN
      SUNAVAIL FWHE
      SUNAVAIL JWHE
      SUNAVAIL LITP
      SUNAVAIL HVYP
      TRANSFER FN,FTHTH

```

RETURN TO SIMULATION TIME CONTROL

\*

```

AVAIL SAVAIL SKCK
      SAVAIL CRTE
      SAVAIL DRTE
      SAVAIL DEEX
      SAVAIL SCNT
      SAVAIL STOF
      SAVAIL YMCS
      SAVAIL YKCS
      SAVAIL DRYW
      SAVAIL AWHE
      SAVAIL BWHE
      SAVAIL MAIN
      SAVAIL FWHE
      SAVAIL JWHE
      SAVAIL LITP
      SAVAIL HVYP
      TRANSFER FN,FTHTH

```

RETURN TO SIMULATION TIME CONTROL

```

*****
**                                USER CHAIN CONTROL                                **
** TRANSACTIONS ARE PLACED ON USER CHAINS TO SAVE EXECUTION TIME                **
** AND TO MAINTAIN CONTROL OF TRANSACTIONS THAT MUST BE WORKED BY                **
** THE DUTY SECTION. THE "FNISH" SEGMENT REMOVES ALL TRANSACTIONS                **
** FROM LISTED USER CHAINS AT THE END OF THE WORKDAY AND, WITHIN                **
** THEIR RESPECTIVE MODULES, HIGH PRIORITY REQUISITIONS ARE SENT TO              **
** THE DUTY SECTION MODULE FOR PROCESSING. THE "START" SEGMENT                  **
** RELEASES ENOUGH TRANSACTIONS TO FILL THE RESPECTIVE STORAGES                  **
** EACH WORKDAY MORNING AND IMMEDIATELY AFTER LUNCH.                            **
*****
*
  FNISH UNLINK      SKCKC,SKCKT,ALL,BACK
        UNLINK      CRTEC,CRTET,ALL,BACK
        UNLINK      DEEXC,DEEXT,ALL,BACK
        UNLINK      SCNTC,SCNTT,ALL,BACK
        UNLINK      STOFc,STOFT,ALL,BACK
        UNLINK      YMCSC,YMCST,ALL,BACK
        UNLINK      YKCSC,YKCST,ALL,BACK
        UNLINK      DRYWC,DRYWT,ALL,BACK
        UNLINK      AWHEC,AWHET,ALL,BACK
        UNLINK      BWHEC,BWHET,ALL,BACK
        UNLINK      MAINC,MAINT,ALL,BACK
        UNLINK      FWHEC,FWHET,ALL,BACK
        UNLINK      JWHEC,JWHET,ALL,BACK
        UNLINK      HVYPC,HVYPT,ALL,BACK
        UNLINK      LITPC,LITPT,ALL,BACK
        TRANSFER    FN,FTHTH
*
*                                RETURN TO SIMULATION TIME CONTROL
*
  START UNLINK      SKCKC,SKCKE,6,BACK
        UNLINK      CRTEC,CRTET,5,BACK
        UNLINK      DRTEC,DRTEE,2,BACK
        UNLINK      DEEXC,DEEXE,2,BACK
        UNLINK      SCNTC,SCNTE,4,BACK
        UNLINK      STOFc,STOFE,1,BACK
        UNLINK      YMCSC,YMCSE,11,BACK
        UNLINK      YKCSC,YKCSE,4,BACK
        UNLINK      DRYWC,DRYWE,2,BACK
        UNLINK      AWHEC,AWHEE,2,BACK
        UNLINK      BWHEC,BWHEE,2,BACK
        UNLINK      MAINC,MAINE,8,BACK
        UNLINK      FWHEC,FWHEE,1,BACK
        UNLINK      JWHEC,JWHEE,4,BACK
        UNLINK      HVYPC,HVYPE,3,BACK
        UNLINK      LITPC,LITPE,5,BACK
        TRANSFER    FN,FTHTH
*                                RETURN TO SIMULATION TIME CONTROL

```

```

*****
**          REQUISITION GENERATION          **
** IN THIS MODULE, SPLIT BLOCKS REFERENCE VARIABLES DEFINED IN **
** TERMS OF INPUT PARAMETERS SET BY THE USER TO GENERATE      **
** TRANSACTIONS AT THE DEMAND LEVEL SPECIFIED BY THE USER.    **
** TRANSACTIONS ARE ADVANCED INTO THE MODEL AT A UNIFORM RATE, **
** THOUGH THE RATES ARE ADJUSTED TO MATCH REAL SYSTEM ARRIVAL **
** CHARACTERISTICS. FOLLOWING GENERATION, REQUISITIONS ARE ASSIGNED **
** A PRIORITY MATCHING THE PARAMETER 1 ASSIGNMENT. SAVEVALUES THEN **
** RECORD THE TOTAL NUMBER OF REQS GENERATED AND THE NUMBER   **
** IN EACH PRIORITY GROUP.                                     **
*****
**          NOTE:                                     **
** ENTITIES FLOWING THROUGH GPSS PROGRAMS ARE KNOWN AS TRANSACTIONS. **
** THE TERM "TRANSACTION" WILL BE USED IN THIS PROGRAM AS A GENERIC **
** TERM FOR REQUISITIONS IN ANY STAGE OF PROCESSING. IN MODULE **
** DESCRIPTIONS AND COMMENTS, TRANSACTIONS MAY BE CALLED REQS **
** (REQUISITIONS), ISSUE DOCS (ISSUE DOCUMENTS) OR ISSUES (AFTER **
** WAREHOUSE PICK) AS APPROPRIATE TO THE MODULE TO CLARIFY THE **
** PROCESS BEING MODELED. TRANSACTIONS USED IN SCHEDULE CONTROL **
** SECTIONS WILL ALWAYS BE REFERRED TO AS CONTROL TRANSACTIONS. **
*****
**          NOTE:                                     **
** GPSS QUEUE AND DEPART BLOCKS ARE PAIRED BEFORE MOST STORAGES TO **
** GATHER QUEUE STATISTICS PROVIDED IN THE OUTPUT. SO THAT QUEUE **
** STATISTICS REFLECT ACTUAL DEMAND LEVELS SIMULATED, ALL      **
** TRANSACTIONS JOINING AND DEPARTING QUEUES ARE COUNTED AS THREE. **
** TRANSACTIONS ARE SPLIT AND INDIVIDUALLY QUEUED IN THE DUTY **
** SECTION MODULE. STORAGES ARE BRACKETED BY ENTER AND LEAVE **
** STATEMENTS TO LIMIT TRANSACTION ACCESS TO THE DEFINED CAPACITY **
** OF THE STORAGE. BECAUSE THE PURPOSES OF THESE BLOCKS ARE STANDARD **
** THROUGHOUT THE PROGRAM, THEY WILL NOT GENERALLY BE COMMENTED. **
*****
**AM REQUISITION GENERATION (WEEKDAY)*****
*   GENERATE    2400,,1,,8PH      GENERATE A SINGLE TRANSACTION AT
*                                   0001 EACH DAY
*   TEST E      BV$WKDAY,K1,RQTRM  TRANSFER TO NEXT BLOCK IF ON A
*                                   WORKDAY, ELSE TO ROTRM
*   SPLIT       V$AMDD,AMAD        SPLIT TRANSACTION INTO THE NUMBER
*                                   OF REQS REC'D DURING WORKDAY AM
*   AMAD ADVANCE 400,400          SPREAD REQUISITION FLOW UNIFORMLY
*                                   THROUGHOUT WORKDAY AM
*   TRANSFER    ,PRIAS            TRANSFER ALL TO PRIAS
**WORKING HOURS REQUISITION GENERATION (WEEKDAY)*****
*   GENERATE    2400,,801,,8PH    GENERATE A SINGLE TRANSACTION AT
*                                   0801 EACH DAY
*   TEST E      BV$WKDAY,K1,RQTRM  TRANSFER TO NEXT BLOCK IF A
*                                   WORKDAY, ELSE TO ROTRM
*   SPLIT       V$WRKDD,DAYAD      SPLIT TRANSACTION INTO THE NUMBER
*                                   OF REQS REC'D DURING WORKDAY
*   DAYAD ADVANCE 437,437        SPREAD REQUISITION FLOW UNIFORMLY
*                                   THROUGHOUT WORKDAY
*   TRANSFER    ,PRIAS            TRANSFER ALL TO PRIAS
**PM REQUISITION GENERATION (WEEKDAY)*****
*   GENERATE    2400,,1676,,8PH   GENERATE A SINGLE TRANSACTION AT
*                                   1646 EACH DAY
*   TEST E      BV$WKDAY,K1,RQTRM  TRANSFER TO NEXT BLOCK IF ON A
*                                   WORKDAY, ELSE TO ROTRM
*   SPLIT       V$PMDD,PMAD        SPLIT TRANSACTION INTO THE NUMBER
*                                   OF REQS REC'D DURING WORKDAY PM
*   PMAD ADVANCE 362,362        SPREAD REQUISITION FLOW UNIFORMLY
*                                   THROUGHOUT WORKDAY PM
*   TRANSFER    ,PRIAS            TRANSFER ALL TO PRIAS

```

```

**WEEKEND REQUISITION GENERATION*****
*      GENERATE      2400,,1,,,8PH      GENERATE A SINGLE TRANSACTION AT
*                                     0001 EACH DAY
*      TEST E      BV$WKDAY,KO,RQTRM      TRANSFER TO NEXT BLOCK IF ON A
*                                     WEEKEND, ELSE TO RQTRM
*      SPLIT      V$DDMND,WKDAD      SPLIT TRANSACTION INTO THE NUMBER
*      WKDAD ADVANCE      1200,1200      OF REQS REC'D DURING WEEKEND DAY
*      TRANSFER      ,PRIAS      SPREAD REQUISITION FLOW UNIFORMLY
*                                     THROUGHOUT WORKDAY PM
*      ROTRM TERMINATE      TERMINATE DISCARDED TRANSACTIONS
**PRIORITY ASSIGNMENT AND STATISTICS SECTION*****
*      PRIAS ASSIGN      1,FN$FONE      ASSIGNMENT OF REQ PRIORITY TO P1
*      PRIORITY      P1      ASSIGNMENT OF ACTUAL TRANSACTION
*                                     PRIORITY (MATCHES P1 ASSIGN.)
*      SAVEVALUE      REQCT+,1,XF      COUNTS TOTAL NO OF REQS GENERATED
*      SAVEVALUE      REQCT+,1,XF      COUNTS TOTAL NO OF REQS GENERATED
*      SAVEVALUE      REQCT+,1,XF      COUNTS TOTAL NO OF REQS GENERATED
*      TEST NE      P1,1,CNTTH      SEND IPG3 REQS TO CNTTH, ALL
*                                     OTHERS TO NEXT BLOCK
*      TEST G      P1,5,CNTTW      SEND IPG2 REQS TO CNTTW, ALL
*                                     OTHERS TO NEXT BLOCK
*      SAVEVALUE      PRION+,1,XF      COUNT IPG1 REQS
*      SAVEVALUE      PRION+,1,XF      COUNT IPG1 REQS
*      SAVEVALUE      PRION+,1,XF      COUNT IPG1 REQS
*      TRANSFER      ,RECPT      TRANSFER ALL TO RECPT
*      CNTTW SAVEVALUE      PRITW+,1,XF      COUNT IPG2 REQS
*      SAVEVALUE      PRITW+,1,XF      COUNT IPG2 REQS
*      SAVEVALUE      PRITW+,1,XF      COUNT IPG2 REQS
*      TRANSFER      ,RECPT      TRANSFER ALL TO RECPT
*      CNTTH SAVEVALUE      PRITH+,1,XF      COUNT IPG3 REQS
*      SAVEVALUE      PRITH+,1,XF      COUNT IPG3 REQS
*      SAVEVALUE      PRITH+,1,XF      COUNT IPG3 REQS

```

```

*****
** REQUISITION RECEIPT **
** THE SOURCE OF EACH REQ ENTERING SYSTEM IS DETERMINED. ONLINE REQS **
** ARE SENT TO THE CPU TEST MODULE, 9MP,9MB,1Q REQS TO SKCKQ FOR **
** STOCK CHECK AND OTHER HARD COPY REQS TO THE NSD REMOTE TERMINAL **
** ENTRY MODULE. AFTER 9MP,9MB,1Q REQS ARE STOCK CHECKED, NIS REQS **
** ARE TERMINATED. ALL OTHERS ARE TAGGED AS IN STOCK AND SENT TO **
** SENT TO THE NSD REMOTE TERMINAL ENTRY MODULE. **
*****
** NOTE: **
** NON-WORK HOUR TRANSACTION HANDLING IS MANAGED THROUGHOUT THE **
** PROGRAM BY CODE SEGMENTS SIMILAR TO THAT SEPARATED BELOW BY **
** ASTERISKS. THE FIRST THREE TEST STATEMENTS LINK TRANSACTIONS TO **
** THE NAMED USER CHAIN 1) DURING LUNCH; 2) DURING WORKING HOURS **
** IF THE STORAGE IS FULL; 3) AFTER WORKING HOURS EXCEPT FOR HIGH **
** PRIORITY TRANSACTIONS (P1=4,5,6,7) WHICH ARE ASSIGNED A PROGRESS **
** PARAMETER, REMOVED FROM THE QUEUE AND TRANSFERRED TO THE DUTY **
** SECTION MODULE. TRANSACTIONS ARE UNLINKED FROM THE USER CHAIN TO **
** THE STORAGE ENTER BLOCK AT THE BEGINNING OF THE WORKDAY AND AFTER **
** LUNCH TO INITIALLY FILL THE STORAGE. TRANSACTIONS ARE UNLINKED **
** AT THE END OF THE WORKDAY, SO THAT HIGH PRIORITY TRANSACTIONS **
** MAY BE TRANSFERRED TO THE DUTY SECTION MODULE (LOW PRIORITY **
** TRANSACTIONS ARE RELINKED). FINALLY TRANSACTIONS ARE UNLINKED **
** TO THE STORAGE ENTER BLOCK ON A ONE FOR ONE BASIS WITH **
** TRANSACTIONS LEAVING THE STORAGE. THIS SECTION OF CODE APPEARS **
** IN MOST MODULES CONTAINING STORAGES, AND WILL NOT BE COMMENTED **
** ON EXCEPT AS IT DIFFERS FROM THE STANDARD FORMAT. **
*****
RECPT TRANSFER .V$ONLIN,,NISTE SEND ONLINE REQS TO NIS TEST,
* TRANSFER .V$RQDIV,,SKCKQ HARD COPY REQS TO NEXT BLOCK
* TRANSFER .V$GROSS,,RTETE SEND 1Q,9MP,9MB TO SKCKQ, ALL
* OTHERS TO NEXT BLOCK
* ASSIGN 6,K1 TAG NIS REQS
TRANSFER ,RTETE TRANSFER ALL TO RTETE
SKCKQ QUEUE QSKCK,3
**FLOW CONTROL SEGMENT*****
* TEST E BV$LUNCH,KO,SKCKL SEND ALL TO SKCKL DURING LUNCH,
* TEST E BV$WORKH,K1,SKCKT ELSE NEXT BLOCK
* TEST E R$SKCK,KO,SKCKE SEND ALL TO NEXT BLOCK DURING
WORKING HOURS, ELSE SEND TO SKCKT
* SKCKL LINK SKCKC,1PH SEND ALL TO SKCKE IF STORAGE IS
SKCKT TEST GE P1,K4,SKCKA NOT FULL, ELSE NEXT BLOCK
* ASSIGN 3,KO LINK TO USER CHAIN SKCKC
DEPART QSKCK,3 SEND HI PRI REQS TO NEXT BLOCK,
TRANSFER ,DUTSC ALL OTHERS TO SKCKA
SKCKA ADVANCE 1 ASSIGN PROGRESS PARAMETER
TRANSFER ,SKCKL REMOVE FROM QSKCK
SEND HI PRI REQS TO DUTSC
DUMMY
SEND ALL TO SKCKL
**END OF FLOW CONTROL SEGMENT*****
SKCKE ENTER SKCK
SKCKD DEPART QSKCK,3
SKCK ADVANCE V$SKCKS STOCK CHECK ON 9MP,9MB,9Q
SKCKV LEAVE SKCK
* TEST E BV$WORKH,K1,NISTR DURING WORKING HOURS, SEND ALL TO
NEXT BLOCK, ELSE NISTR
* UNLINK SKCKC,SKCKE,1,BACK RELEASE ONE TRANSACTION FROM SKCKC
* NISTR TRANSFER .V$GROSS,NISTM,ISTAG SEND NIS REQUISITIONS TO NISTM,
* ALL OTHERS TO ISTAG
ISTAG ASSIGN 6,K2 TAG STOCKED CHECKED REQS
* TRANSFER ,CRTEQ FOUND IN STOCK
TRANSFER ALL TO CRTEQ

```

```

*****
**          NSD REMOTE TERMINAL ENTRY          **
** 9MP,9MB,1Q AND ALL REQS (P1 = 3,4,5,6,7) ENTERED VIA CUST SERV **
** RTE, REQS (P1 = 1,2) ARE ENTERED VIA DPSC RTE. NIS REQS ARE **
** TRANSFERRED TO TERMINATION AND ALL OTHERS ARE SENT TO THE CPU **
** CPU TEST MODULE. **
*****
*
RTETE TEST GE      P1,K3,DRTEQ          SEND IPG3 AND NON 1Q,9MB,9MP IPG2
*                                     REQS TO DRTEQ, ALL OTHERS TO NEXT
*                                     BLOCK
*
**CUSTOMER SERVICES REMOTE TERMINAL ENTRY*****
*
CRTEQ QUEUE        QCRTE,3
* TEST E          BV$LUNCH,KO,CRTTEL    SEND ALL TO CRTEL DURING LUNCH,
*                                     ELSE NEXT BLOCK
* TEST E          BV$WORKH,K1,CRTET     SEND ALL TO NEXT BLOCK DURING
*                                     WORKING HOURS, ELSE SEND TO CRTEL
* TEST E          R$CRTE,KO,CRTTE      SEND ALL TO CRTEE IF STORAGE IS
*                                     NOT FULL, ELSE NEXT BLOCK
CRTEL LINK         CRTEC,1PH
* CRTET TEST GE    P1,K4,CRTTEA        LINK TO USER CHAIN CRTEC
*                                     SEND HI PRI REQS TO NEXT BLOCK,
*                                     ALL OTHERS TO CRTEA
* ASSIGN          3,K1                 ASSIGN PROGRESS PARAMETER
DEPART            QCRTE,3              REMOVE FROM QCRTE
* TRANSFER        ,DUTSC               SEND HI PRI REQS TO DUTSC
CRTEA ADVANCE     1                   DUMMYY
* TRANSFER        ,CRTEL              SEND ALL TO CRTEL
CRTEE ENTER       CRTE
* DEPART          QCRTE,3
CRTE ADVANCE      V$RTES              ENTER REQS VIA CUST SERV RTE
* LEAVE          CRTE
* TEST E          BV$WORKH,K1,CSTR     RELEASE ONE TRANSACTION FROM CTWO
* UNLINK         CRTEC,CRTEE,1,BACK
* CSTR TEST E     P6,1,PRTE           SEND NIS REQS TO NEXT BLOCK, ALL
*                                     OTHER TO PRTE
* TRANSFER        ,NISTM              TRANSFER NIS REQS TO NISTM
*
**DPSC REMOTE TERMINAL ENTRY*****
*
DRTEQ QUEUE        QDRTE,3
* TEST E          BV$WORKH,K1,DRTEL    SEND ALL TO NEXT BLOCK DURING
*                                     WORKING HOURS, ELSE SEND TO DRTEL
* TEST E          R$DRTE,KO,DRTEE      SEND ALL TO DRTEE IF STORAGE IS
*                                     NOT FULL, ELSE NEXT BLOCK
DRTEL LINK        DRTEC,1PH
* DRTEE ENTER     DRTE
* DEPART          QDRTE,3
DRTE ADVANCE      V$RTES              ENTER REQS VIA DPSC RTE
* LEAVE          DRTE
* TEST E          BV$WORKH,K1,DPTE     RELEASE ONE TRANSACTION FROM DRTEC
* UNLINK         DRTEC,DRTEE,1,BACK
* DPTE TEST E     P6,1,PRTE           SEND NIS REQS TO NEXT BLOCK, ALL
*                                     OTHER TO PRINTER TEST
* TRANSFER        ,NISTM              TRANSFER NIS REQS TO NISTM

```

```

*****
**                                CPU TESTS                                **
** TEST FOR, PROCESS AND RE-ENTER DEMAND EXCEPTIONS. TEST FOR AND **
** TRANSFER ONLINE NIS REQS. ROUTE IPG3 AND NON 9MP,9MB,9MF AND 1Q **
** IPG2 REQS TO STOR CONT PRINTER, BALANCE TO CUST SERV PRINTER IN **
** THE PRINTER QUEUE HANDLING MODULE.                                **
*****
*
* NISTE TRANSFER .V$GROSS,NISTM,PRTE SEND NIS REQS TO NISTM, ALL
*                                OTHERS TO PRTE
*
* PRTE TEST L      P1,K3,CSPRQ      SEND REQS (P1 = 3,4,5,6,7) TO
*                                CSPRQ, ALL OTHERS TO NEXT BLOCK
*
* TRANSFER .V$PROV,SCPRQ,CSPRQ SEND 9MF,9MP,9MB,1Q REQS TO
*                                CSPRQ, ALL OTHERS TO SCPRQ

```

```

*****
**          PRINTER QUEUE HANDLING          **
** LINK IPG3 REQS ON USER CHAIN THREE, UNLINK THEM TO PRINT ISSUE **
** DOCUMENTS IN STORAGE CONTROL AT 0800 ON WORKDAYS. LINK IPG2 REQS **
** ON USER CHAIN TWO, UNLINK THEM TO PRINT ISSUE DOCUMENTS IN **
** STORAGE CONTROL AT 0800,1000,1245,1445 ON WORKDAYS. LINK ALL **
** IPG1,BWT,CASREPT,QUICK PICK,9MF,9MP,9MB,1Q REQS ON USER CHAIN **
** ONE, UNLINK TO PRINT ISSUE DOCUMENTS ON THE CUST SERV PRINTER **
** EVERY FIVE MINUTES. ALL ISSUE DOCS PRINTED ALL SENT TO THE **
** DEMAND EXCEPTION HANDLING MODULE. PRINTER OPERATIONS ARE **
** MODELED BY THE CONTROL TRANSACTION IN THE PARTIONED SCHEDULE **
** CONTROL SECTION. **
*****
**PRINTER CONTROL SECTION*****
*
*      GENERATE      25      GENERATE CONTROL TRANSACTION TO
*                               TRIGGER PRINTER EVERY 15 MIN
*
*      UNLINK        THREE,SCPRE,ALL,BV$PRTHR
*                               SEND ALL REQS ON USER CHAIN THREE
*                               TO THE STORAGE CONTROL PRINTER
*
*      UNLINK        TWO,SCPRE,ALL,BV$PRTWO
*                               SEND ALL REQS ON USER CHAIN TWO
*                               TO THE STORAGE CONTROL PRINTER
*
*      TERMINATE
*                               TERMINATE CONTROL TRANSACTION
*
*      GENERATE      5      GENERATE CONTROL TRANSACTION TO
*                               TRIGGER CUST SERV PRINTER EVERY
*                               5 MINUTES
*
*      UNLNK UNLINK  ONE,CSPRE,ALL,BACK  SEND ALL REQS ON USER CHAIN ONE
*                               TO THE CUST SERV PRINTER
*
*      TERMINATE
*                               TERMINATE CONTROL TRANSACTION
*
**STORAGE CONTROL PRINTER OPERATIONS SECTION*****
*
*      SCPRQ QUEUE    QSCPR,3      ENTER STORAGE CONT PRINTER QUEUE
*
*      TEST E        P1,K1,LKTWO    SEND IPG2 REQS TO LKTWO,
*                               IPG3 TO NEXT BLOCK
*
*      LKTWO LINK     THREE,1PH      LINK IPG3 ON USER CHAIN THREE
*      TWO,1PH        TWO,1PH        LINK IPG2 ON USER CHAIN TWO
*
*      SCPRE ENTER    SCPR
*      DEPART         QSCPR,3      DEPART QUEUE
*      SCPR ADVANCE   PRINT ISSUE DOCS
*      LEAVE          SCPR
*
*      TRANSFER      ,DEXTE      TRANSFER ALL TO DEXTE
*
**CUSTOMER SERVICES PRINTER OPERATIONS SECTION*****
*
*      CSPRQ QUEUE    QCSPR,3      ENTER CUST SERV PRINTER QUEUE
*
*      LINK          ONE,1PH      LINK ALL TO USER CHAIN ONE
*
*      CSPRE ENTER    CSPR
*      DEPART         QCSPR,3      DEPART QUEUE
*      CSPR ADVANCE   PRINT ISSUE DOCS
*      LEAVE          CSPR

```

```

*****
**          DEMAND EXCEPTION HANDLING          **
** TRANSACTIONS ARE RECEIVED FROM THE PRINTER QUEUE HANDLING MODULE **
** AND THE WAREHOUSE MODULE. PREVIOUSLY PROCESSED DEMAND EXCEPTIONS **
** ARE SENT TO THE WAREHOUSE ASSIGNMENT MODULE, WAREHOUSE REFUSALS **
** ARE PROCESSED AS SUCH AND TERMINATED. NEW DEMAND EXCEPTIONS ARE **
** PROCESSED, TAGGED AS COMPLETED AND SENT BACK TO THE PRINTER **
** QUEUE HANDLING MODULE. TRANSACTIONS NOT RESULTING IN DEMAND **
** EXCEPTIONS ARE SENT DIRECTLY TO THE WAREHOUSE ASSIGNMENT MODULE. **
*****
*
DEXTE TEST NE      P7,K1,LOCAS      SEND PROCESSED DEMAND EXCEPTIONS
*                                TO LOCAS, OTHERS TO NEXT BLOCK
*      TRANSFER    .V$NOTEX,,LOCAS  SEND REQS WITH DEMAND EXCEPTIONS
*                                TO NEXT BLOCK, SEND OTHERS TO
*                                LOCAS
*
DEEXQ QUEUE        QDEEX,3
* TEST E          BV$LUNCH,KO,DEEXL SEND ALL TO DEEXL DURING LUNCH,
*                                ELSE NEXT BLOCK
*      TEST E      BV$WORKH,K1,DEEXT SEND ALL TO NEXT BLOCK DURING
*                                WORKING HOURS, ELSE SEND TO DEEXT
*      TEST E      RSDEEX,KO,DEEXE  SEND ALL TO DEEXE IF STORAGE IS
*                                NOT FULL, ELSE NEXT BLOCK
*
DEEXL LINK         DEEXC,1PH
DEEXT TEST GE      P1,K4,DEEXA     LINK TO USER CHAIN DEEXC
*                                SEND HI PRI REQS TO NEXT BLOCK,
*                                ALL OTHERS TO DEEXA
*      TEST NE     P8,K1,DEEXA     SEND WAREHOUSE REFUSALS TO DEEXA,
*                                ALL OTHERS TO NEXT BLOCK
*
*      ASSIGN      3,K3
*      DEPART      QDEEX,3
*      TRANSFER    ,DUTSC
DEEXA ADVANCE      1
*      TRANSFER    ,DEEXL
DEEXE ENTER        DEEX
*      DEPART      QDEEX,3
DEEX ADVANCE       VSDEEXS
*      LEAVE       DEEX
*      ASSIGN      7,K1
*      TEST E      BV$WORKH,K1,WRTE TAG PROCESSED DEMAND EXCEPTIONS
*                                DURING WORKING HOURS SEND ALL TO
*                                NEXT BLOCK, ELSE WRTE
*      UNLINK      DEEXC,DEEXE,K1,BACK RELEASE ONE TRANSACTION FROM DEEXC
*      WRTE TEST E  P8,K1,PRTE     SEND WAREHOUSE REFUSALS TO NEXT
*                                BLOCK, ALL OTHERS TO PRTE
*
*      TRANSFER    ,WRTRM          TRANSFER ALL TO WRTRM

```

```

*****
**          WAREHOUSE ASSIGNMENT MODULE          **
** ALL ISSUE DOCUMENTS ARE ASSIGNED A WAREHOUSE LOCATION. THOSE **
** ISSUE DOCUMENTS IDENTIFIED AS WAREHOUSE REFUSALS ARE TAGGED AS **
** SUCH. BEARER WALKTHROUGH ISSUE DOCS ARE TAGGED AND ARE **
** TRANSFERRED TO THE WAREHOUSE MODULE WITH A DELAY ASSIGNED BY **
** LOCATION. ALL OTHER ISSUE DOCUMENTS ARE SENT TO THE STORAGE **
** OFFICE/STORAGE CONTROL MODULE. **
*****
*
LOCAS ASSIGN      2, FN$FTWO          ASSIGN WAREHOUSE LOCATION TO P2
*
*      TRANSFER      .V$NOTWR, ,DESTE  SEND WAREHOUSE REFUSALS TO NEXT
*                                     BLOCK, ALL OTHERS TO DESTE
*      ASSIGN      8, K1              TAG WAREHOUSE REFUSALS
*
DESTE TEST NE     P1, K5, BWTAD       SEND IPG2 BWT TO BWTAD,
*                                     ALL OTHERS TO NEXT BLOCK
*
*      TEST NE     P1, K7, BWTAD       SEND IPG1 BWT TO BWTAD,
*                                     ALL OTHERS TO NEXT BLOCK
*
*      TEST G      P2, K3, STOFQ       SEND PROV. REQS TO STORAGE OFF,
*                                     ALL OTHERS TO NEXT BLOCK
*
*      TRANSFER     , SCNTQ           TRANSFER ALL TO SCNTQ
*
BWTAD ADVANCE     FN$FTHSV           DELAY TO SIMULATE BEARER
*                                     TRANSPORTATION TO THE WAREHOUSE
*
*      TRANSFER     FN, FTHTW         SENT ALL TO RESPECTIVE WAREHOUSE
*

```

```

*****
**          STORAGE CONTROL/STORAGE OFFICE          **
** PROVISIONS ISSUE DOCUMENTS ENTER AT STOFQ, ALL OTHERS AT SCNTQ. **
** ISSUE DOCUMENTS ARE MARKED, BURST AND SORTED BY LOCATION. ALL **
** ISSUE DOCUMENTS EXCEPT THOSE BOUND FOR YOKOHAMA COLD STORAGE ARE **
** SENT TO THE BIKE MESSENGER DELIVERY MODULE. YOKOHAMA ISSUE DOCS **
** ARE SENT TO THE YOKOHAMA ISSUE DOCUMENT DELIVERY MODULE. **
*****
**STORAGE CONTROL SECTION*****
*
SCNTQ QUEUE      QSCNT,3
  TEST E        BV$LUNCH,K0,SCNTL      SEND ALL TO SCNTL DURING LUNCH,
*                                     ELSE NEXT BLOCK
*       TEST E        BV$WORKH,K1,SCNTT  SEND ALL TO NEXT BLOCK DURING
*                                     WORKING HOURS, ELSE SEND TO SCNTT
*       TEST E        R$SCNT,K0,SCNTE   SEND ALL TO SCNTE IF STORAGE IS
*                                     NOT FULL, ELSE NEXT BLOCK
SCNTL LINK      SCNTC,1PH
SCNTT TEST GE   P1,K4,SCNTA            LINK TO USER CHAIN SCNTC
*                                     SEND HI PRI REQS TO NEXT BLOCK,
*                                     ALL OTHERS TO SCNTA
*       ASSIGN      3,K4                ASSIGN PROGRESS PARAMETER
*       DEPART      QSCNT,3             REMOVE FROM QSCNT
*       TRANSFER    ,DUTSC              SEND HI PRI REQS TO DUTSC
SCNTA ADVANCE   1                      DUMMY
*       TRANSFER    ,SCNTL              SEND ALL TO SCNTL
SCNTE ENTER     SCNT
*       DEPART      QSCNT,3
SCNT ADVANCE    V$SCSOS                MARK,BURST,SORT ISSUE DOCS
*       LEAVE       SCNT
*       TEST E      BV$WORKH,K1,SCTE    DURING WORKING HOURS SEND ALL TO
*                                     NEXT BLOCK, ELSE TO SCTE
*       UNLINK      SCNTC,SCNTE,1,BACK  RELEASE ONE TRANSACTION FROM SCNTC
*
SCTE TRANSFER   ,BIKEQ                SEND ALL TO BIKEQ
*****STORAGE OFFICE SECTION*****
*
STOFQ QUEUE     QSTOF,3
  TEST E        BV$LUNCH,K0,STOFL      SEND ALL TO STOFL DURING LUNCH,
*                                     ELSE NEXT BLOCK
*       TEST E        BV$WORKH,K1,STOFT  SEND ALL TO NEXT BLOCK DURING
*                                     WORKING HOURS, ELSE SEND TO STOFT
*       TEST E        R$STOF,K0,STOFE   SEND ALL TO STOFE IF STORAGE IS
*                                     NOT FULL, ELSE NEXT BLOCK
STOFL LINK      STOFC,1PH
STOFT TEST GE   P1,K4,STOFA            LINK TO USER CHAIN STOFC
*                                     SEND HI PRI REQS TO NEXT BLOCK,
*                                     ALL OTHERS TO STOFA
*       ASSIGN      3,K5                ASSIGN PROGRESS PARAMETER
*       DEPART      QSTOF,3             REMOVE FROM QSTOF
*       TRANSFER    ,DUTSC              SEND HI PRI REQS TO DUTSC
STOFA ADVANCE   1                      DUMMY
*       TRANSFER    ,STOFL              SEND ALL TO STOFL
STOFE ENTER     STOF
*       DEPART      QSTOF,3
STOF ADVANCE    V$SCSOS                REMOVE FROM QSTOF
*       LEAVE       STOF                MARK,BURST,SORT ISSUE DOCS
*       TEST E      BV$WORKH,K1,SOTE    DURING WORKING HOURS SEND ALL TO
*                                     NEXT BLOCK, ELSE TO SOTE
*       UNLINK      STOFC,STOFE,1,BACK  RELEASE ONE TRANSACTION FROM STOFC
*
SOTE TEST E     P2,K1,BIKEQ            SEND YOKOHAMA CS DOCS TO NEXT
*                                     BLOCK, SEND ALL OTHERS TO BIKEQ
*
*       TRANSFER    ,DLVRT              SEND ALL TO DLVRT

```

```

*****
**      YOKOHAMA ISSUE DOCUMENT DELIVERY      **
** DELIVERY OF ISSUE DOCUMENTS BY PICKUP TRUCK IS SIMULATED IN THIS **
** MODULE. ISSUE DOCS ARRIVING ARE PLACED ON USER CHAIN DLVRC WHICH **
** IS UNLINKED TO YMCSQ WITH AN APPROPRIATE TIME DELAY AT 0830 ON **
** WORKDAYS. BECAUSE DURING ACTUAL OPERATIONS, HIGH PRIORITY ISSUE **
** DOCUMENTS ARRIVING AFTER 0830 ARE NOT DELAYED UNTIL THE NEXT DAY, **
** THOSE HIGH PRIORITY DOCUMENTS ARRIVING DURING THE WORKDAY AFTER **
** 0830 ARE TRANSFERRED DIRECTLY TO YMCSQ TO AVOID UNREALISTIC **
** DELAYS ON THE DLVRC USER CHAIN. HIGH PRIORITY ISSUE DOCUMENTS **
** ARRIVING AFTER WORKING HOURS OR ON WEEKENDS ARE TRANSFERRED TO **
** THE DUTY SECTION MODULE. PICKUP DELIVERY OPERATION SCHEDULING IS **
** CONTROLLED BY THE PARTITIONED SCHEDULE CONTROL SECTION. **
*****
**SCHEDULE CONTROL SECTION*****
*
*      GENERATE      2400,,850      GENERATE CONTROL TRANSACTION TO
*                                  TRIGGER YOKOHAMA DELIVERY
*      UNLINK      DLVRC,DLVRE,ALL,BV$WKDAY      SEND ISSUE DOCS ON DELIVER USER
*                                  CHAIN TO DLVRE
*
*      TERMINATE      TERMINATE CONTROL TRANSACTION
*
**OPERATIONS SECTION*****
*
*      DLVRT TEST G      P1,K3,DLVRQ      SEND LOW PRI ISSUE DOCS TO DLVRQ,
*                                  ALL OTHERS TO NEXT BLOCK
*      TEST E      BV$OPEN,K1,DLVTR      IF OUTSIDE OF DEPOT WORKING HOURS,
*                                  SEND TO DLVTR, ELSE NEXT BLOCK
*      TEST G      V$TIME,K0850,DLVRQ      IF AFTER DAILY RUN, SEND TO NEXT
*                                  BLOCK, ELSE DLVRQ
*      TRANSFER      ,YMCSQ      TRANSFER ALL TO YMCSQ
*
*      DLVTR ASSIGN      3,K6      ASSIGN PROGRESS PARAMETER
*      TRANSFER      ,DUTSC      SEND ALL TO DUTSC
*
*      DLVRQ QUEUE      QDLVR,3      ENTER QUEUE FOR REQ DELIVERY
*                                  TO YOKOHAMA CS
*
*      DLVRL LINK      DLVRC,1PH      WAIT ON USER CHAIN DLVRC
*
*      DLVRE ENTER      DLVR
*      DEPART      QDLVR,3
*      ADVANCE      150,50
*      LEAVE      DLVR
*
*      TRANSFER      ,YMCSQ      TRANSFER ALL TO YOKOHAMA COLD
*                                  STORAGE QUEUE

```

```

*****
**          BICYCLE MESSENGER DELIVERY          **
** THIS MODULE DELIVERS ISSUE DOCUMENTS TO WAREHOUSE LOCATIONS BY **
** BICYCLE MESSENGER AT 0900,1100,1345 AND 1515 ON WORKDAYS. HIGH **
** PRIORITY REQS ARRIVING DURING WORKING HOURS AFTER THE LAST RUN **
** ARE TRANSFERRED TO THE WAREHOUSE MODULE DIRECTLY TO SIMULATE **
** DELIVERY BY OFFICE PERSONNEL IN ACCORDANCE WITH ACTUAL **
** PROCEDURES. THE SCHEDULE CONTROL SECTION IS PARTIONED IN THE **
** TOP HALF OF THE MODULE. **
*****
**SCHEDULE CONTROL SECTION*****
*
*      GENERATE      25      GENERATE CONTROL TRANSACTION TO
*                               TRIGGER PRINTER EVERY 15 MIN
*
*      UNLINK      BIKEC,BIKEE,ALL,BV$DTIME
*                               SEND ALL ISSUE DOCS ON USER CHAIN
*                               BIKEC TO BIKEQ
*
*      TERMINATE      TERMINATE CONTROL TRANSACTION
*
**OPERATIONS SECTION*****
*
*      BIKEQ QUEUE      OBIKE,3
*      TEST GE      P1,K4,BIKEL      SEND LOW PRI REQS TO BIKEL,
*                               ALL OTHERS TO NEXT BLOCK
*      TEST G      V$TIME,K1525,BIKEL      IF BEFORE LAST MESSENGER RUN, SEND
*                               ALL TO BIKEL, ELSE NEXT BLOCK
*      TEST L      V$TIME,K1676,BIKTR      IF DURING WORKING HOURS SEND TO
*                               NEXT BLOCK, ELSE BIKTR
*
*      DEPART      OBIKE,3
*      ADVANCE      FNSFTHSV      OFFICE PERSONNEL DELIVER
*      TRANSFER      ,WHTR      SEND HI PRI REQS TO WHTR
*
*      BIKTR DEPART      OBIKE,3
*      ASSIGN      3,K7      ASSIGN PROGRESS PARAMETER
*      TRANSFER      ,DUTSC      SEND HI PRI REQS TO DUTSC
*
*      BIKEL LINK      BIKEC,1PH      LINK ALL ISSUE DOCUMENTS AWAITING
*                               TRANSPORTATION TO BIKEC
*
*      BIKEE ENTER      BIKE
*      DEPART      OBIKE,3
*      ADVANCE      FNSFTHSX      DELIVER ISSUE DOCS TO WAREHOUSES
*      LEAVE      BIKE

```

```

*****
**                               WAREHOUSES                               **
** ISSUE DOCUMENTS ARE SENT TO THE WAREHOUSE INDICATED BY P2.           **
** PICKING, STAGING AND SHIPMENT PREPARATION (PROVISIONS WAREHOUSES    **
** ONLY) FUNCTIONS ARE SIMULATED. WAREHOUSE REFUSALS ARE TRANSFERRED**
** TO THE DEMAND EXCEPTION MODULE FOR PROCESSING. BWT AND QUICK         **
** PICK ISSUES ARE TRANSFERRED TO TERMINATION AS WELL AS ISSUES         **
** MADE AVAILABLE FOR SHIPMENT DIRECTLY FROM PROVISIONS WAREHOUSES.    **
** ISSUES FROM YOKOSUKA COLD STORAGE AND B-47 REQUIRING PACKING        **
** OR SHIPMENT FROM THE FREIGHT TERMINAL ARE TRANSFERRED TO THE        **
** PROVISIONS TRACTOR TRAIN MODULE. ALL OTHER ISSUES FROM GENERAL      **
** STORAGE LOCATIONS ARE SENT TO THE TRACTOR TRAIN DELIVERY MODULE.    **
** WAREHOUSE SUBMODULES ARE PARTITIONED AND LABELED.                   **
*****
*
  WHTR  TRANSFER    FN,FTHTW                TRANSFER ISSUE DOCS TO STORAGE
*                                           LOCATION
*
*YOKOHAMA COLD STORAGE*****
*
  YMC SQ  QUEUE      QYMCS,3
        TEST E      BV$LUNCH,KO,YMCSL      SEND ALL TO YMCSL DURING LUNCH,
*                                           ELSE NEXT BLOCK
*           TEST E      BV$WORKH,K1,YMCST    SEND ALL TO NEXT BLOCK DURING
*                                           WORKING HOURS, ELSE SEND TO YMCST
*           TEST E      R$YMCS,KO,YMCSE      SEND ALL TO YMCSE IF STORAGE IS
*                                           NOT FULL, ELSE NEXT BLOCK
  YMC SL  LINK       YMCSC,1PH
  YMC ST  TEST GE    P1,K4,YMCSA            LINK TO USER CHAIN YMCSC
*                                           SEND HI PRI REQS TO NEXT BLOCK,
*                                           ALL OTHERS TO YMCSA
        ASSIGN      3,K8
        DEPART      QYMCS,3
        TRANSFER    ,DUTSC
  YMC SA  ADVANCE    1                     ASSIGN PROGRESS PARAMETER
        TRANSFER    ,YMCSL                 REMOVE FROM QYMCS
  YMC SE  ENTER      YMCS                  SEND HI PRI REQS TO DUTSC
        DEPART      QYMCS,3               DUMMY
  YMC S   ADVANCE    V$YMCSS              SEND ALL TO YMCSL
        LEAVE       YMCS
        TEST E      BV$WORKH,K1,YMTE      PICK, PREPARE FOR SHIP AND STAGE
*                                           DURING WORKING HOURS SEND ALL TO
*                                           NEXT BLOCK, ELSE TO YMTE
*           UNLINK    YMCSC,YMCSE,1,BACK   RELEASE ONE TRANSACTION FROM YMCSC
*
  YMTE   TEST NE     P8,K1,DEEXQ          SEND WAREHOUSE REFUSALS TO
*                                           EXCEPTION HANDLING
*
*           TRANSFER  ,TERM                TERMINATE REQS AVAILABLE FOR
*                                           SHIPMENT

```

```

**YOKOSUKA COLD STORAGE*****
YKCSQ QUEUE QYKCS,3
* TEST E BV$LUNCH,K0,YKCSL SEND ALL TO YKCSL DURING LUNCH,
ELSE NEXT BLOCK
* TEST E BV$WORKH,K1,YKCST SEND ALL TO NEXT BLOCK DURING
WORKING HOURS, ELSE SEND TO YMCST
* TEST E R$YKCS,K0,YKCSE SEND ALL TO YKCSE IF STORAGE IS
NOT FULL, ELSE NEXT BLOCK
YKCSL LINK YKCSC,1PH LINK TO USER CHAIN YKCSC
YKCST TEST GE P1,K4,YKCSA SEND HI PRI REQS TO NEXT BLOCK,
* ALL OTHERS TO YKCSA
ASSIGN 3,K9 ASSIGN PROGRESS PARAMETER
DEPART QYKCS,3 REMOVE FROM QYKCS
YKCSA ADVANCE 1, DUTSC SEND HI PRI REQS TO DUTSC
TRANSFER ,YKCSL DUMMY
YKCSE ENTER YKCS SEND ALL TO YKCSL
DEPART QYKCS,3
YKCS ADVANCE V$YKCSS PICK AND STAGE MATERIAL
LEAVE YKCS DURING WORKING HOURS SEND ALL TO
* TEST E BV$WORKH,K1,YKTE NEXT BLOCK, ELSE TO YKTE
* UNLINK YKCSC,YKCSE,1,BACK RELEASE ONE TRANSACTION FROM YKCSC
* YKTE TEST NE P8,K1,DEEXQ SEND WAREHOUSE REFUSALS TO
* EXCEPTION HANDLING
* TEST E BV$BEAR,K0,TERM SEND BEARER ISSUES TO TERM,
* ALL OTHERS TO NEXT BLOCK
* ASSIGN 4,FN$FFOUR ASSIGN ISSUE DESTINATIONS TO P4
* ASSIGN 5,V$YKCSW ASSIGN ISSUE WEIGHT
* TEST NE P4,K1,TERM SEND ISSUES FOR PACKING OR FREIGHT
* TERMINAL SECTION TO NEXT BLOCK,
* ALL OTHERS TO TERM
* TRANSFER ,PTRNQ TRANSFER ALL TO PTRNQ

```

```

**B-47 (DRY PROVISIONS)*****
DRYWQ QUEUE QDRYW,3
* TEST E BV$LUNCH,KO,DRYWL SEND ALL TO DRYWL DURING LUNCH,
ELSE NEXT BLOCK
* TEST E BV$WORKH,K1,DRYWT SEND ALL TO NEXT BLOCK DURING
WORKING HOURS, ELSE SEND TO DRYWT
* TEST E R$DRYW,KO,DRYWE SEND ALL TO DRYWE IF STORAGE IS
NOT FULL, ELSE NEXT BLOCK
DRYWL LINK DRYWC,1PH LINK TO USER CHAIN DRYWC
DRYWT TEST GE P1,K4,DRYWA SEND HI PRI REQS TO NEXT BLOCK,
ALL OTHERS TO DRYWA
* ASSIGN 3,K10 ASSIGN PROGRESS PARAMETER
DEPART QDRYW,3 REMOVE FROM QDRYW
DRYWA TRANSFER ,DUTSC SEND HI PRI REQS TO DUTSC
ADVANCE 1 DUMMY
DRYWL TRANSFER ,DRYWL SEND ALL TO DRYWL
DRYWE ENTER DRYW
DEPART QDRYW,3
DRYW ADVANCE V$DRYWS PICK AND STAGE MATERIAL
LEAVE DRYW
TEST E BV$WORKH,K1,DRYT DURING WORKING HOURS SEND ALL TO
NEXT BLOCK, ELSE TO DRYT
* UNLINK DRYWC,DRYWE,1,BACK RELEASE ONE TRANSACTION FROM DRYWC
* DRYT TEST NE P8,K1,DEEXQ SEND WAREHOUSE REFUSALS TO
EXCEPTION HANDLING
* TEST E BV$BEAR,KO,TERM SEND BEARER ISSUES TO TERM, ALL
OTHERS TO NEXT BLOCK
* ASSIGN 4,FN$FFIVE ASSIGN ISSUE DESTINATION
* ASSIGN 5,V$DRYWW ASSIGN ISSUE WEIGHT
* TEST NE P4,K1,TERM SEND ISSUES FOR PACKING OR FREIGHT
TERMINAL SECTION TO NEXT BLOCK,
ALL OTHERS TO TERM
* TRANSFER ,PTRNQ TRANSFER ALL TO PTRNQ

```

```

*A WAREHOUSE AREA (A-19)*****
AWHEQ QUEUE QAWHE,3
* TEST E BV$LUNCH,KO,AWHEL SEND ALL TO AWHEL DURING LUNCH,
* ELSE NEXT BLOCK
* TEST E BV$WORKH,K1,AWHET SEND ALL TO NEXT BLOCK DURING
* TEST E R$AWHE,KO,AWHEE SEND ALL TO AWHEE IF STORAGE IS
* NOT FULL, ELSE NEXT BLOCK
AWHEL LINK AWHEC,1PH LINK TO USER CHAIN AWHEC
AWHET TEST GE P1,K4,AWHEA SEND HI PRI REQS TO NEXT BLOCK,
* ALL OTHERS TO AWHEA
* ASSIGN 3,K11 ASSIGN PROGRESS PARAMETER
DEPART QAWHE,3 REMOVE FROM QAWHE
TRANSFER ,DUTSC SEND HI PRI REQS TO DUTSC
AWHEA ADVANCE 1 DUMMY
AWHEE ENTER ,AWHEL SEND ALL TO AWHEL
DEPART QAWHE,3
AWHE ADVANCE V$AWHES PICK AND BIN MATERIAL
LEAVE AWHE
* TEST E BV$WORKH,K1,AWHT DURING WORKING HOURS SEND ALL TO
* UNLINK AWHEC,AWHEE,1,BACK NEXT BLOCK, ELSE TO AWHT
* AWHT TEST NE P8,K1,DEEXQ RELEASE ONE TRANSACTION FROM AWHEC
* SEND WAREHOUSE REFUSALS TO
* EXCEPTION HANDLING
* TEST E BV$BEAR,KO,TERM SEND BEARER ISSUES TO TERM, ALL
* OTHERS TO NEXT BLOCK
* ASSIGN 4,FN$FSIX ASSIGN ISSUE DESTINATION
* ASSIGN 5,V$AWHEW ASSIGN ISSUE WEIGHT
* TEST G V$TIME,1450,AQUE IF LAST TRACTOR TRAIN OF DAY HAS
* DEPARTED, SEND TO NEXT BLOCK, ELSE
* TEST GE P1,K4,AQUE AQUE
* SEND HI PRI REQS TO NEXT BLOCK,
* ALL OTHERS TO AQUE
* ASSIGN 3,K17 ASSIGN PROGRESS PARAMETER
* TRANSFER ,DUTSC TRANSFER ALL TO DUTSC
* AQUE QUEUE QBTRN,3
ALINK LINK ACH,1PH PLACE TRANSACTIONS ON A USER CHAIN
* AWAITING ON-BASE TRANSPORTATION

```

```

**B WAREHOUSE AREA (B-34,B-45,B-46)*****
BWHEQ QUEUE QBWHE,3
* TEST E BV$LUNCH,KO,BWHEL SEND ALL TO BWHEL DURING LUNCH,
* TEST E BV$WORKH,K1,BWHET ELSE NEXT BLOCK
* TEST E R$BWHE,KO,BWHEE SEND ALL TO NEXT BLOCK DURING
* BWHEL LINK BWHEC,1PH WORKING HOURS, ELSE SEND TO BWHET
BWHET TEST GE P1,K4,BWHEA SEND ALL TO BWHEE IF STORAGE IS
* ASSIGN 3,K12 NOT FULL, ELSE NEXT BLOCK
DEPART QBWHE,3 LINK TO USER CHAIN BWHEC
TRANSFER ,DUTSC SEND HI PRI REQS TO NEXT BLOCK,
BWHEA ADVANCE 1 ALL OTHERS TO BWHEA
TRANSFER ,BWHEL ASSIGN PROGRESS PARAMETER
BWHEE ENTER BWHE REMOVE FROM QBWHE
DEPART QBWHE,3 SEND HI PRI REQS TO DUTSC
BWHE ADVANCE V$BWHEE DUMMY
LEAVE BWHE SEND ALL TO BWHEL
* TEST E BV$WORKH,K1,BWHT PICK AND STAGE MATERIAL
* UNLINK BWHEC,BWHEE,1,BACK DURING WORKING HOURS SEND ALL TO
* BWHT TEST NE P8,K1,DEEXQ NEXT BLOCK, ELSE TO BWHT
* SEND WAREHOUSE REFUSALS TO
* TEST E BV$BEAR,KO,TERM EXCEPTION HANDLING
* ASSIGN 4,FNSFSEVE SEND BEARER ISSUES TO TERM, ALL
* ASSIGN 5,V$BWHEW OTHERS TO NEXT BLOCK
* TEST G V$TIME,1433,BQUE ASSIGN ISSUE DESTINATION
* TEST GE P1,K4,BQUE ASSIGN ISSUE WEIGHT
* ASSIGN 3,K18 IF LAST TRACTOR TRAIN OF DAY HAS
* TRANSFER ,DUTSC DEPARTED, SEND TO NEXT BLOCK, ELSE
* BQUE QUEUE QBTRN,3 BQUE
BLINK LINK BCH,1PH SEND HI PRI REQS TO NEXT BLOCK,
* ALL OTHERS TO BQUE
ASSIGN PROGRESS PARAMETER
TRANSFER ALL TO DUTSC
PLACE TRANSACTIONS ON A USER CHAIN
AWAITING ON-BASE TRANSPORTATION

```

```

**F-157*****
MAINQ  QUEUE      QMAIN,3
      TEST E      BV$LUNCH,KO,MAINL  SEND ALL TO MAINL DURING LUNCH,
*                                     ELSE NEXT BLOCK
*      TEST E      BV$WORKH,K1,MAINT  SEND ALL TO NEXT BLOCK DURING
*      TEST E      R$MAIN,KO,MAINE   WORKING HOURS, ELSE SEND TO MAINT
*                                     SEND ALL TO MAINE IF STORAGE IS
MAINL  LINK        MAINC,1PH          NOT FULL, ELSE NEXT BLOCK
MAINT  TEST GE     P1,K4,MAINA        LINK TO USER CHAIN MAINC
*                                     SEND HI PRI REQS TO NEXT BLOCK,
*                                     ALL OTHERS TO MAINA
      ASSIGN       3,K13              ASSIGN PROGRESS PARAMETER
      DEPART       QMAIN,3            REMOVE FROM QMAIN
      TRANSFER     ,DUTSC              SEND HI PRI REQS TO DUTSC
MAINA  ADVANCE     1                  DUMMY
      TRANSFER     ,MAINL              SEND ALL TO MAINL
MAINE  ENTER       MAIN
      DEPART       QMAIN,3
MAIN   ADVANCE     V$MAINS
      LEAVE        MAIN
      TEST E       BV$WORKH,K1,TMAIN  PICK AND STAGE MATERIAL
*                                     DURING WORKING HOURS SEND ALL TO
*                                     NEXT BLOCK, ELSE TO TMAIN
*      UNLINK      MAINC,MAINE,1,BACK  RELEASE ONE TRANSACTION FROM MAINC
*      TMAIN TEST NE P8,K1,DEEXQ      SEND WAREHOUSE REFUSALS TO
*                                     EXCEPTION HANDLING
*      TEST E      BV$BEAR,KO,TERM    SEND BEARER ISSUES TO TERM, ALL
*                                     OTHERS TO NEXT BLOCK
*      ASSIGN      4,FNSFEIGH        ASSIGN ISSUE DESTINATION
*      ASSIGN      5,V$MAINW         ASSIGN ISSUE WEIGHT
*      TEST G      V$TIME,1410,MQUE  IF LAST TRACTOR TRAIN OF DAY HAS
*                                     DEPARTED, SEND TO NEXT BLOCK, ELSE
*      TEST GE     P1,K4,MQUE        MQUE
*                                     SEND HI PRI REQS TO NEXT BLOCK,
*                                     ALL OTHERS TO MQUE
*      ASSIGN      3,K19              ASSIGN PROGRESS PARAMETER
*      TRANSFER     ,DUTSC            TRANSFER ALL TO DUTSC
*      MQUE  QUEUE  QATRN,3
*      MLINK LINK   MCH,1PH          PLACE TRANSACTIONS ON A USER CHAIN
*                                     AWAITING ON-BASE TRANSPORTATION

```

```

**F WAREHOUSE AREA (F-8 - F-14)*****
FWHEQ QUEUE QFWHE,3
* TEST E BV$LUNCH,KO,FWHEL SEND ALL TO FWHEL DURING LUNCH,
ELSE NEXT BLOCK
* TEST E BV$WORKH,K1,FWHET SEND ALL TO NEXT BLOCK DURING
WORKING HOURS, ELSE SEND TO FWHET
* TEST E R$FWHE,KO,FWHEE SEND ALL TO FWHEE IF STORAGE IS
NOT FULL, ELSE NEXT BLOCK
FWHEL LINK FWHEC,1PH LINK TO USER CHAIN FWHEC
FWHET TEST GE P1,K4,FWHEA SEND HI PRI REQS TO NEXT BLOCK,
ALL OTHERS TO FWHEA
* ASSIGN 3,K14 ASSIGN PROGRESS PARAMETER
DEPART QFWHE,3 REMOVE FROM QFWHE
TRANSFER ,DUTSC SEND HI PRI REQS TO DUTSC
FWHEA ADVANCE 1 DUMMY
FWHEE ENTER ,FWHEL SEND ALL TO FWHEL
FWHEE DEPART FWHE
FWHE ADVANCE QFWHE,3
LEAVE V$FWHES
TEST E FWHE
BV$WORKH,K1,FWHT PICK AND STAGE MATERIAL
DURING WORKING HOURS SEND ALL TO
NEXT BLOCK, ELSE TO FWHT
* UNLINK FWHEC,FWHEE,1,BACK RELEASE ONE TRANSACTION FROM FWHEC
* FWHT TEST NE P8,K1,DEEXQ SEND WAREHOUSE REFUSALS TO
EXCEPTION HANDLING
*
* TEST E BV$BEAR,KO,TERM SEND BEARER ISSUES TO TERM, ALL
OTHERS TO NEXT BLOCK
*
* ASSIGN 4,FN$FNINE ASSIGN ISSUE DESTINATION
*
* ASSIGN 5,V$FWHEW ASSIGN ISSUE WEIGHT
*
* TEST G V$TIME,1410,FQUE IF LAST TRACTOR TRAIN OF DAY HAS
DEPARTED, SEND TO NEXT BLOCK, ELSE
* FQUE
* TEST GE P1,K4,FQUE SEND HI PRI REQS TO NEXT BLOCK,
ALL OTHERS TO FQUE
*
* ASSIGN 3,K20 ASSIGN PROGRESS PARAMETER
*
* TRANSFER ,DUTSC TRANSFER ALL TO DUTSC
*
FQUE QUEUE QATRN,3
FLINK LINK FCH,1PH PLACE TRANSACTIONS ON A USER CHAIN
AWAITING ON-EASE TRANSPORTATION

```

```

**J WAREHOUSE AREA (J-11,J-12 AND GAS, LUMBER AND DRUM YARDS)*****
JWHEQ QUEUE QJWHE,3
* TEST E BV$LUNCH,K0,JWHEL SEND ALL TO JWHEL DURING LUNCH,
* TEST E BV$WORKH,K1,JWHET SEND ALL TO NEXT BLOCK DURING
* TEST E R$JWHE,K0,JWHEE WORKING HOURS, ELSE SEND TO JWHET
* JWHEL LINK JWHEC,1PH SEND ALL TO JWHEE IF STORAGE IS
JWHET TEST GE P1,K4,JWHEA NOT FULL, ELSE NEXT BLOCK
* LINK TO USER CHAIN JWHEC
* SEND HI PRI REQS TO NEXT BLOCK,
* ASSIGN 3,K15 ALL OTHERS TO JWHEA
* DEPART QJWHE,3 ASSIGN PROGRESS PARAMETER
* TRANSFER ,DUTSC REMOVE FROM QJWHE
JWHEA ADVANCE 1 SEND HI PRI REQS TO DUTSC
* TRANSFER ,JWHEL DUMMY
* JWHEE ENTER JWHE SEND ALL TO JWHEL
* DEPART QJWHE,3
* ADVANCE VSJWHES PICK AND STAGE MATERIAL
* LEAVE JWHE
* TEST E BV$WORKH,K1,JWHT DURING WORKING HOURS SEND ALL TO
* UNLINK JWHEC,JWHEE,1,BACK NEXT BLOCK, ELSE TO JWHT
* JWHT TEST NE P8,K1,DEEXQ RELEASE ONE TRANSACTION FROM JWHEC
* TEST E BV$BEAR,K0,TERM SEND BEARER ISSUES TO TERM, ALL
* ASSIGN 4,FN$FTEN OTHERS TO NEXT BLOCK
* ASSIGN 5,V$JWHEW ASSIGN ISSUE DESTINATION
* TEST G V$TIME,1410,JQUE ASSIGN ISSUE WEIGHT
* TEST GE P1,K4,JQUE IF LAST TRACTOR TRAIN OF DAY HAS
* ASSIGN 3,K21 DEPARTED, SEND TO NEXT BLOCK, ELSE
* TRANSFER ,DUTSC JQUE
* JQUE QUEUE OBTRN,3 SEND HI PRI REQS TO NEXT BLOCK,
* JLINK LINK JCH,1PH ALL OTHERS TO JQUE
* PLACE TRANSACTIONS ON A USER CHAIN
* AWAITING ON-BASE TRANSPORTATION

```

```

*****
**          PROVISIONS TRACTOR TRAIN DELIVERY          **
** IN ACTUAL NSD YOKOSUKA OPERATIONS, SPECIAL TRACTOR TRAIN RUNS **
** ARE SCHEDULED TO MEET OPERATIONAL REQUIREMENTS OF THE **
** REQUISITIONER. THESE SPECIAL RUNS ARE TYPICALLY SCHEDULED AFTER **
** NORMALLY SCHEDULED RUNS ARE COMPLETED. THOUGH THE SCHEDULE IS NOT **
** FIXED, IN THE INTEREST OF MAINTAINING ACCURATE THROUGHPUT STATS, **
** A PROVISIONS TRACTOR TRAIN IS SCHEDULED FOR 1600 EACH DAY, WITH **
** A SECOND RUN AT USER DISCRETION. ALL HIGH PRIORITY ISSUES THAT **
** ARRIVE AFTER 1530 ARE ROUTED TO THE DUTY SECTION MODULE. THE **
** PROVISIONS TRACTOR TRAIN SCHEDULE CONTROL SECTION IS PARTIONED **
** AT THE TOP OF THE MODULE. **
*****
**SCHEDULE CONTROL SECTION*****
*      GENERATE      2400,,1600      GENERATE CONTROL TRANSACTION
*                                     REPRESENTING DAILY TRACTOR
*                                     TRAIN FOR PROVISIONS AT 1600
*      TEST NE      BV$WKDAY,K1,SPLTP      SEND TRAIN TO SPLTP IF WORKDAY,
*                                     ELSE NEXT BLOCK
*      TERMINATE
*      SPLTP SPLIT      1,LOADP      TERMINATE CONTROL TRANSACTION
*                                     SPLIT CONTROL TRANSACTION, SEND
*                                     ONE COPY TO NEXT BLOCK AND ONE TO
*                                     LOADP
*      ADVANCE      10      DUMMY ADVANCE TO SEPARATE TRAINS
*      TEST L      V$PWGHT,V$PXTRA,LOADP
*                                     IF THE ESTIMATED WEIGHT OF
*                                     ISSUES WAITING FOR THE PTRN
*                                     EXCEEDS PXTRA, SEND TO LOADP,
*                                     ELSE NEXT BLOCK
*      TERMINATE      TERMINATE CONTROL TRANSACTION
*      LOADP UNLINK      PTRNC,PTRNT,ALL,BACK      UNLINK ALL TRANSACTIONS FROM PTRNC
*                                     TO PTRNT
*      SAVEVALUE      PNUM+,1,XF      COUNT PTRN RUNS
*      TERMINATE      TERMINATE CONTROL TRANSACTION
*****
**OPERATIONS SECTION*****
*      PTRNQ TEST G      V$TIME,1610,PQUE      IF LAST TRACTOR TRAIN OF DAY HAS
*                                     DEPARTED, SEND TO NEXT BLOCK, ELSE
*                                     PQUE
*      TEST GE      P1,K4,PQUE      SEND HI PRI REQS TO NEXT BLOCK,
*                                     ALL OTHERS TO PQUE
*      ASSIGN      3,K16      ASSIGN PROGRESS PARAMETER
*      TRANSFER      ,DUTSC      TRANSFER ALL TO DUTSC
*      PQUE QUEUE      QPTRN,3
*      PLINK LINK      PTRNC,1PH      PLACE TRANSACTIONS ON A USER CHAIN
*                                     AWAITING ON-BASE TRANSPORTATION
*      PTRNT TEST L      R$PTRN,P5,PTRNE      IF THERE IS SUFFICIENT REMAINING
*                                     CAPACITY IN PTRN SEND TO PTRNE,
*                                     ELSE NEXT BLOCK
*      TEST LE      P1,K3,PTRNE      SEND HI PRI ISSUES TO PTRNE, ALL
*                                     OTHERS TO NEXT BLOCK
*      ADVANCE      1      DUMMY ADVANCE
*      TRANSFER      ,PLINK      TRANSFER ALL BACK TO PLINK
*      PTRNE ENTER      PTRN,PH5
*      DEPART      QPTRN,3
*      ADVANCE      8      TRANSPORTATION DELAY TO J-39
*      LEAVE      PTRN,PH5
*      TRANSFER      ,FRTTE      TRANSFER ALL TO FRTTE

```

```

*****
**          TRACTOR TRAIN DELIVERY          **
** CONTROL TRANSACTIONS REPRESENTING NSD-OPERATED TRACTOR TRAINS **
** ARE GENERATED AT 0815,1015,1300,1400. ON WORKDAYS, THE      **
** TRANSACTIONS ARE ROUTED TO UNLINK MATERIAL TRANSACTIONS WAITING **
** ON THE VARIOUS WAREHOUSE USER CHAINS. MATERIAL TRANSACTIONS ARE **
** LINKED TO THE ATRNC OR BTRNC, AS APPROPRIATE, TO THE CAPACITY OF **
** THE RESPECTIVE TRAINS REMAINING AT EACH STOP. TRANSACTIONS ARE **
** THEN UNLINKED AND MATERIAL REQUISITIONED BY SRF OR PWC IS SENT TO **
** TERMINATION TO SIMULATE DELIVERY. ALL OTHER ISSUES ARE UNLINKED **
** TO THE FREIGHT TERMINAL MODULE. HIGH PRIORITY TRANSACTIONS THAT **
** MISS THE LAST SCHEDULED TRAIN ARE SENT TO THE DUTY SECTION **
** MODULE. AT USER DISCRETION, AN ADDITIONAL TRAIN MAY BE RUN ON **
** EACH ROUTE AT 1500 TO REDUCE BACKLOG. THE TRACTOR TRAIN SCHEDULE **
** CONTROL SECTION IS PARTIONED AT THE TOP OF THE MODULE.      **
*****
**SCHEDULE CONTROL SECTION*****
*
*      GENERATE      2400,,825      GENERATE CONTROL TRANSACTION
*      TRANSFER      ,TRAIN      REPRESENTING 0815 TRAINS
*                                SEND TO WAREHOUSES ON ROUTE
*
*      GENERATE      2400,,1025     GENERATE CONTROL TRANSACTION
*      TRANSFER      ,TRAIN      REPRESENTING 1015 TRAINS
*                                SEND TO WAREHOUSES ON ROUTE
*
*      GENERATE      2400,,1300     GENERATE CONTROL TRANSACTION
*      TRANSFER      ,TRAIN      REPRESENTING 1300 TRAINS
*                                SEND TO WAREHOUSES ON ROUTE
*
*      GENERATE      2400,,1400     GENERATE CONTROL TRANSACTION
*      TRANSFER      ,TRAIN      REPRESENTING 1400 TRAINS
*                                SEND TO WAREHOUSES ON ROUTE
*
*      GENERATE      2400,,1500     GENERATE CONTROL TRANSACTION
*      TEST E        BV$WKDAY,K1,TTTRM ON WORKDAYS, SEND TO NEXT BLOCK
*      SPLIT         1,LATEB        SPLIT CONTROL TRANSACTION
*      TEST L        V$AWGHT,V$AXTRA,LOADA
*
*                                IF THE ESTIMATED WEIGHT OF
*                                ISSUES WAITING FOR THE ATRN
*                                EXCEEDS AXTRA, SEND TO LOADA,
*                                ELSE NEXT BLOCK
*                                TERMINATE CONTROL TRANSACTION
*
*      TERMINATE
*
*      LATEB TEST L    V$BWGHT,V$BXTRA,LOADB
*
*                                IF THE ESTIMATED WEIGHT OF
*                                ISSUES WAITING FOR THE BTRN
*                                EXCEEDS BXTRA, SEND TO LOADB,
*                                ELSE NEXT BLOCK
*                                TERMINATE CONTROL TRANSACTION
*
*      TERMINATE
*
*      TRAIN TEST NE   BV$WKDAY,K1,LOAD SEND TRAIN TO LOAD IF WORKDAY
*      TTTRM TERMINATE
*
*      LOAD SPLIT      1,LOADB      SPLIT CONTROL TRANSACTION, SEND
*                                ONE COPY TO NEXT BLOCK AND ONE TO
*                                LOADB

```



\*\*OPERATIONS SECTION - A TRAIN ROUTE\*\*\*\*\*

\*  
 \* ATEST TEST G P1,K1,ASEND SEND IPG3 ISSUES TO ASEND, ALL  
 \* OTHERS TO NEXT BLOCK  
 \* ATRNT TEST L R\$ATRNL,P5,ATRNE IF THERE IS SUFFICIENT REMAINING  
 \* CAPACITY IN ATRN SEND TO ATRNE,  
 \* ELSE NEXT BLOCK  
 \* ASEND ADVANCE 1 DUMMY ADVANCE  
 \* TRANSFER FN,FTHFR TRANSFER ALL BACK TO WAREHOUSE  
 \* ATRNE ENTER ATRN,PH5  
 \* DEPART QATRNL,3  
 \* LINK ATRNC,1PH LINK TO ATRNC  
 \* ATRNL LEAVE ATRN,PH5  
 \* TRANSFER ,TMTST TRANSFER ALL TO TMTST

\*\*OPERATIONS SECTION - B TRAIN ROUTE\*\*\*\*\*

\*  
 \* BTEST TEST G P1,K1,BSEND SEND IPG3 ISSUES TO BSEND, ALL  
 \* OTHERS TO NEXT BLOCK  
 \* BTRNT TEST L R\$BTRNL,P5,BTRNE IF THERE IS SUFFICIENT REMAINING  
 \* CAPACITY IN BTRN SEND TO BTRNE,  
 \* ELSE NEXT BLOCK  
 \* BSEND ADVANCE 1 DUMMY ADVANCE  
 \* TRANSFER FN,FTHFV TRANSFER ALL BACK TO WAREHOUSE  
 \* BTRNE ENTER BTRN,PH5  
 \* DEPART QBTRNL,3  
 \* LINK BTRNC,1PH LINK TO BTRNC  
 \* BTRNL LEAVE BTRN,PH5

\*\*TEST FOR PWC/PRF DELIVERY\*\*\*\*\*

\*  
 \* TMTST TEST NE P4,K1,TERM SEND ISSUES FOR SRF AND PWC TO  
 \* TERM TO SIMULATE DELIVERY BY  
 \* TRACTOR TRAIN, ALL OTHERS TO NEXT  
 \* SIMULATE TRANSPORTATION TIME TO  
 \* ADVANCE 17 FREIGHT TERMINAL

```

*****
**          FREIGHT TERMINAL MODULE          **
** TRANSACTIONS REPRESENTING MATERIAL ARE TESTED FOR PACK TYPE **
** REQUIRED AND SENT TO LIGHT OR HEAVY PACK LINES AS APPROPRIATE **
** (PARCEL POST PACKS GO TO THE LIGHT PACK LINE). PACK TIMES **
** IN THE LIGHT PACK LINE ARE OBTAINED FROM FUNCTION FTWSV. AFTER **
** PACKING IS COMPLETED, ALL ISSUES ARE ROUTED TO THE TERMINATION **
** MODULE AS AVAILABLE FOR SHIPMENT. MATERIAL RECEIVED FROM TRACTOR **
** TRAINS THAT DOES NOT REQUIRE PACKING IS SENT DIRECTLY TO THE **
** TERMINATION MODULE AS AVAILABLE FOR SHIPMENT. **
*****
*
*****
*
FRTE TEST E      P4,K2,TERM      SEND ISSUES AVAILABLE FOR SHIPMENT
*                               SHIPMENT TO TERM, ALL OTHERS TO
*                               NEXT BLOCK
*
*       TRANSFER      .V$LITEP,,LITPQ      TRANSFER ISSUES REQUIRING LIGHT OR
*                                           PARCEL POST PACK TO LITEQ, ALL
*                                           OTHERS TO NEXT BLOCK
*
*****HEAVY PACK OPERATIONS SECTION*****
*
HVYPQ QUEUE      QHVYP,3
*   TEST E      BV$LUNCH,K0,HVYPL      SEND ALL TO HVYPL DURING LUNCH,
*                                           ELSE NEXT BLOCK
*   TEST E      BV$WORKH,K1,HVYPT      SEND ALL TO NEXT BLOCK DURING
*                                           WORKING HOURS, ELSE SEND TO HVYPT
*   TEST E      R$HVYP,K0,HVYPE      SEND ALL TO HVYPE IF STORAGE IS
*                                           NOT FULL, ELSE NEXT BLOCK
*   HVYPL LINK      HVYPC,1PH      LINK TO USER CHAIN HVYPC
*   HVYPT TEST GE      P1,K4,HVYPA      SEND HI PRI REQS TO NEXT BLOCK,
*                                           ALL OTHERS TO HVYPA
*   ASSIGN      3,K22      ASSIGN PROGRESS PARAMETER
*   DEPART      QHVYP,3      REMOVE FROM QHVYP
*   TRANSFER      ,DUTSC      SEND HI PRI REQS TO DUTSC
*   HVYPA ADVANCE      1      DUMMY
*   TRANSFER      ,HVYPL      SEND ALL TO HVYPL
*   HVYPE ENTER      HVYP
*   DEPART      QHVYP,3
*   HVYP ADVANCE      V$HVYPS
*   LEAVE      HVYP
*   TEST E      BV$WORKH,K1,HVYTR      DURING WORKING HOURS SEND ALL TO
*                                           NEXT BLOCK, ELSE TO HVYTR
*   UNLINK      HVYPC,HVYPE,1,BACK      RELEASE ONE TRANSACTION FROM HVYPC
*   HVYTR TRANSFER      ,TERM

```

\*\*LIGHT AND PARCEL POST PACK OPERATIONS SECTION\*\*\*\*\*

|   |       |          |                    |                                                                    |
|---|-------|----------|--------------------|--------------------------------------------------------------------|
| * | LITPQ | QUEUE    | QLITP,3            |                                                                    |
| * |       | TEST E   | BV\$LUNCH,K0,LITPL | SEND ALL TO LITPL DURING LUNCH,<br>ELSE NEXT BLOCK                 |
| * |       | TEST E   | BV\$WORKH,K1,LITPT | SEND ALL TO NEXT BLOCK DURING<br>WORKING HOURS, ELSE SEND TO LITPT |
| * |       | TEST E   | R\$LITP,K0,LITPE   | SEND ALL TO LITPE IF STORAGE IS<br>NOT FULL, ELSE NEXT BLOCK       |
|   | LITPL | LINK     | LITPC,1PH          | LINK TO USER CHAIN LITPC                                           |
| * | LITPT | TEST GE  | P1,K4,LITPA        | SEND HI PRI REQS TO NEXT BLOCK,<br>ALL OTHERS TO LITPA             |
|   |       | ASSIGN   | 3,K23              | ASSIGN PROGRESS PARAMETER                                          |
|   |       | DEPART   | QLITP,3            | REMOVE FROM QLITP                                                  |
|   |       | TRANSFER | ,DUTSC             | SEND HI PRI REQS TO DUTSC                                          |
|   | LITPA | ADVANCE  | 1                  | DUMMY                                                              |
|   |       | TRANSFER | ,LITPL             | SEND ALL TO LITPL                                                  |
|   | LITPE | ENTER    | LITP               |                                                                    |
|   |       | DEPART   | QLITP,3            |                                                                    |
| * | LITP  | ADVANCE  | V\$LITPS           | PACK MATERIAL REQUIRING LIGHT OR<br>PARCEL POST PACK               |
|   |       | LEAVE    | LITP               |                                                                    |
| * |       | TEST E   | BV\$WORKH,K1,LITTR | DURING WORKING HOURS SEND ALL TO<br>NEXT BLOCK, ELSE TO LITTR      |
|   |       | UNLINK   | LITPC,LITPE,1,BACK | RELEASE ONE TRANSACTION FROM LITPC                                 |
|   | LITTR | TRANSFER | ,TERM              |                                                                    |

```

*****
**                                DUTY SECTION                                **
** THE SCHEDULE CONTROL SECTION GENERATES A CONTROL TRANSACTION AT **
** AT THE START OF EACH DAY TO CONTROL DUTY SECTION OPERATIONS. ON **
** WORKDAYS, ADVANCE BLOCKS MOVE THE TRANSACTION THRU THE SCHEDULE **
** CONTROL SECTION. AT APPROPRIATE TIMES, THE STORAGE REPRESENTING **
** THE DUTY SECTION IS OPENED AND CLOSED AND TRANSACTIONS ARE LINKED **
** TO AND UNLINKED FROM USER CHAINS WITHIN THE OPERATING SECTION. **
*****
** THE DUTY SECTION OPERATIONS SECTION SIMULATES NSD LATE SHIFT AND **
** DUTY SECTION OPERATIONS. THE DUTY STORAGE HAS A CAPACITY OF TWO **
** MATCHING THE NUMBER OF PERSONNEL ACTUALLY AVAILABLE IN BOTH THE **
** LATE SHIFT AND THE DUTY SECTION TO PROCESS ISSUES. TRANSACTIONS **
** ENTERING THE MODULE ARE SPLIT INTO THREE TRANSACTIONS TO RESTORE **
** THE ACTUAL DEMAND LEVEL AND ADVANCED TO THE POINT OF PROGRESS **
** INDICATED BY P3. TRANSACTIONS TRANSFERRED TO THE DUTY SECTION **
** BUT NOT PROCESSED ARE TRANSFERRED BACK TO THEIR MODULE OF ORIGIN. **
** COMPLETED ISSUES ARE TERMINATED AS APPROPRIATE (NIS OR AVAILABLE **
** FOR SHIPMENT). NOTE: BECAUSE MOST HIGH PRIORITY PERISHABLE **
** PROVISIONS ISSUES MADE OUTSIDE OF NORMAL WORKING HOURS BY NSD **
** ARE FOR FLEET ACTIVITIES, YOKOHAMA COLD STORAGE REQUISITIONS ARE **
** ROUTED INSTEAD TO YOKOSUKA COLD STORAGE. **
*****
**SCHEDULE CONTROL SECTION*****
*
*      GENERATE      2400,0,1      GENERATE CONTROL TRANSACTION
*
*      TEST E      BV$WKDAY,K1,DTEND      SEND TO DTEND IF SAT/SUN ELSE NEXT
*                                     BLOCK
*      ADVANCE      800      ADVANCE TO 0801
*      UNLINK      DUTYC,DUTYD,ALL,BACK      UNLINK TRANSACTIONS NOT PROCESSED
*                                     BY THE DUTY SECTION
*      ADVANCE      875      ADVANCE TO 1646
*      UNLINK      DUTYC,DUTYS,2,BACK      UNLINK 2 TRANSACTIONS FOR DUTY
*                                     SECTION PROCESSING
*      DTEND TERMINATE      TERMINATE CONTROL TRANSACTION

```

|       |          |                    |                                    |
|-------|----------|--------------------|------------------------------------|
| PTWTH | ADVANCE  | FNSFTWSV           | LIGHT/PARCEL POST PACK             |
| SHIP  | ASSIGN   | 3,K24              | TAG AS AVAILABLE FOR SHIPMENT      |
|       | LEAVE    | DUTY               |                                    |
| DUTTR | ADVANCE  |                    | DUMMY ADVANCE                      |
|       | TEST E   | BV\$THREE,K1,SEND  |                                    |
|       | UNLINK   | DUTYC,DUTYS,1,BACK |                                    |
| *     |          |                    | UNLINK ONE TRANSACTION FROM DUTYC  |
| *     |          |                    | FOR EVERY THREE LEAVING            |
| SEND  | TRANSFER | FN,FTHIR           | SEND ISSUES TO LOCATION DETERMINED |
| *     |          |                    | BY PROGRESS PARAMETER              |

AD-A168 514

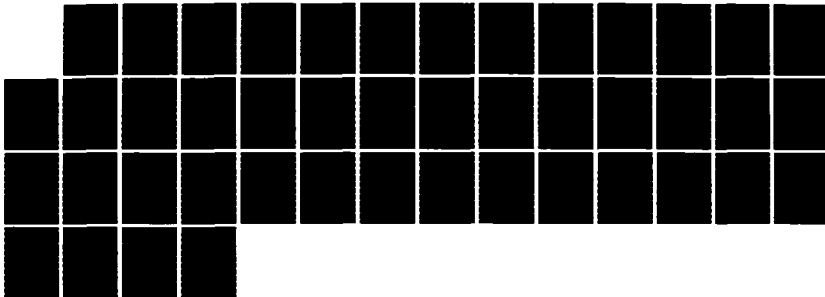
A SIMULATION MODEL OF ISSUE PROCESSING AT NAVAL SUPPLY  
DEPOT YOKOSUKA JAPAN(U) NAVAL POSTGRADUATE SCHOOL  
MONTEREY CA H S CLIFT MAR 86

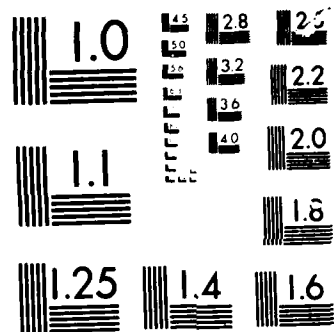
2/2

UNCLASSIFIED

F/G 15/5

NL





\*\*\*OPERATIONS SECTION\*\*\*\*\*

|   |       |          |                   |  |                                    |
|---|-------|----------|-------------------|--|------------------------------------|
| * | DUTSC | QUEUE    | DUTYO             |  |                                    |
| * |       | TEST NE  | BV\$OPEN,K1,DUTYL |  | IF OUTSIDE WORKING HOURS, SEND     |
| * |       | TEST E   | R\$DUTY,K0,DUTYS  |  | TO NEXT BLOCK, ELSE DUTYL          |
|   | DUTYL | LINK     | DUTYC,1PH         |  | IF DUTY STORAGE IS NOT FULL, SEND  |
|   | DUTYD | DEPART   | DUTYO             |  | TO DUTYS, ELSE NEXT BLOCK          |
|   |       | TRANSFER | FN,FTHIR          |  | LINK TO USER CHAIN DUTYC           |
| * |       |          |                   |  | TRANSFER ALL TRANSACTIONS NOT      |
| * |       |          |                   |  | PROCESSED BY THE DUTY SECTION BACK |
| * |       |          |                   |  | TO THE POINT OF PROGRESS INDICATED |
|   | DUTYS | SPLIT    | 2,OSPLT           |  | BY P3                              |
|   |       | TRANSFER | ,DUTYE            |  | SPLIT EACH TRANSACTION INTO THREE  |
|   | OSPLT | QUEUE    | DUTYO             |  | TRANSFER ALL TO DUTYE              |
|   | DUTYE | ENTER    | DUTY              |  | ADD SPLIT TRANSACTIONS TO QUEUE    |
|   |       | DEPART   | DUTYO             |  |                                    |
|   |       | TRANSFER | FN,FTHON          |  | TRANSFER ALL TRANSACTIONS TO BE    |
| * |       |          |                   |  | WORKED BY THE DUTY SECTION TO      |
| * |       |          |                   |  | THE POINT OF PROGRESS INDICATED BY |
| * |       |          |                   |  | P3                                 |
|   | PZERO | ADVANCE  | FNSFELEV          |  | STOCK CHECK ALL REQUISITIONS       |
| * |       | TRANSFER | .V\$GROSS,,RTE    |  | TRANSFER IN STOCK REOS TO RTE,     |
|   |       | ASSIGN   | 3,K2              |  | NIS REOS TO NEXT BLOCK             |
|   |       | LEAVE    | DUTY              |  | TAG NIS REQS                       |
|   |       | TRANSFER | ,DUTTR            |  |                                    |
|   | PONE  | TEST NE  | P6,K2,RTE         |  | SEND IN STOCK REQS TO RTE, ALL     |
| * |       | ADVANCE  | FNSFELEV          |  | OTHERS TO NEXT BLOCK               |
|   |       | TEST E   | P6,K1,RTE         |  | PERFORM STOCK CHECK                |
| * |       | ASSIGN   | 3,K2              |  | SEND NIS REQS TO NEXT BLOCK, ALL   |
|   |       | LEAVE    | DUTY              |  | OTHERS TO NEXT BLOCK               |
|   |       | TRANSFER | ,DUTTR            |  | TAG NIS REQS                       |
|   | RTE   | ADVANCE  | FNSFTWEL          |  | REMOTE TERMINAL ENTRY OF REOS      |
|   |       | TRANSFER | .V\$NOTEX,,WHEAS  |  | SEND DEMAND EXCEPTIONS TO NEXT     |
| * |       |          |                   |  | BLOCK, ALL OTHERS TO WHEAS         |
|   | PTHRE | ADVANCE  | FNSFFRTN          |  | PROCESS DEMAND EXCEPTIONS          |
|   | WHEAS | ASSIGN   | 2,FNSFTWO         |  | ASSIGN WAREHOUSE LOCATION          |
|   | WRTR  | TRANSFER | .V\$NOTWR,,PFOUR  |  | SEND WAREHOUSE REFUSALS TO NEXT    |
| * |       | ASSIGN   | 8,K1              |  | BLOCK, ALL OTHERS TO PFOUR         |
|   | PFOUR | TEST E   | P2,K1, SORT       |  | TAG WAREHOUSE REFUSALS             |
| * |       | ASSIGN   | 2,K2              |  | SEND YOKOHAMA ISSUE DOCS TO NEXT   |
|   |       |          |                   |  | BLOCK, ALL OTHERS TO SORT          |
|   | SORT  | ADVANCE  | FNSFSXTN          |  | REASSIGN YOKOHAMA REQS TO YOKOSUKA |
|   | PSIX  | ADVANCE  | FNSFTHSV          |  | COLD STORAGE                       |
|   | PEIGH | ADVANCE  | FNSFSVTN          |  | MARK,BURST ISSUE DOCS              |
|   |       | TEST E   | P8,K1,TURN        |  | DRIVE TO WAREHOUSE LOCATION        |
| * |       | ASSIGN   | 3,K25             |  | MAKE PICK                          |
|   |       | LEAVE    | DUTY              |  | SEND WAREHOUSE REFUSALS TO NEXT    |
|   |       | TRANSFER | ,DUTTR            |  | BLOCK, ALL OTHERS TO TURN          |
|   | TURN  | TEST E   | BV\$BEAR,K1,DESTA |  | TAG WAREHOUSE REFUSALS             |
| * |       | ASSIGN   | 3,K24             |  | SEND BEARER ISSUES TO NEXT BLOCK,  |
|   |       | LEAVE    | DUTY              |  | ALL OTHERS TO DESTA                |
|   |       | TRANSFER | ,DUTTR            |  | TAG BWT ISSUES                     |
|   | DESTA | ASSIGN   | 4,FNSFTHRE        |  | ASSIGN ISSUE DESTINATION TO P4     |
|   | PSXTN | ADVANCE  | FNSFTHEI          |  | DRIVE TO FREIGHT TERMINAL          |
| * |       | TEST E   | P4,K2,SHIP        |  | SEND ISSUES REQUIRING PACKING TO   |
|   |       | TRANSFER | .V\$LITEP,,PTWTH  |  | NEXT BLOCK, ALL OTHERS TO SHIP     |
| * |       |          |                   |  | SEND ISSUES REQUIRING HEAVY PACK   |
|   | PTWTW | ADVANCE  | FNSFTWSX          |  | TO NEXT BLOCK, ALL OTHERS TO PTWTH |
|   |       | TRANSFER | ,SHIP             |  | HEAVY PACK                         |
|   |       |          |                   |  | SEND ALL TO SHIP                   |

```

*****
**          TERMINATION MODULE          **
** IN THE TABLE DEFINITION SECTION, FREQUENCY DISTRIBUTION TABLES **
** ARE DEFINED TO MEASURE THROUGHPUT TIME FOR ALL ISSUES (ALL) AND **
** BY ISSUE PRIORITY GROUP (IPGON,IPGTW,IPGTH). TABULATION OF **
** ISSUES IN APPROPRIATE TABLES IS MANAGED BY ROUTING TRANSACTIONS **
** BY PARAMETER ONE VALUES. RAW COUNTS ARE MADE ON NIS AND **
** WAREHOUSE REFUSAL TRANSACTIONS. **
*****
*
**TABLE DEFINITIONS*****
*
ALL TABLE M1,0,1200,22
IPGON TABLE M1,0,1200,16
IPGTW TABLE M1,0,1200,16
IPGTH TABLE M1,0,1200,22
*
**ISSUE COUNT, TABULATION AND TERMINATION*****
*
TERM SPLIT 2,ALLCT SPLIT EACH TRANSACTION INTO 3 TO
RESTORE DEMAND LEVEL
ALLCT TABULATE ALL ENTER ALL ISSUES INTO TABLE ALL
TEST NE P1,K1,TMTHR SEND IPG3 TRANSACTIONS TO TMTHR,
* ALL OTHERS TO NEXT BLOCK
TEST G P1,K5,TMTWO SEND IPG2 TRANSACTIONS TO TMTWO,
* ALL OTHERS TO NEXT BLOCK
TMONE TABULATE IPGON ENTER IPG1 TRANSACTIONS INTO
* TABLE IPGON
TMTWO TABULATE IPGTW TERMINATE IPG1 TRANSACTIONS
ENTER IPG2 TRANSACTIONS INTO
* TABLE IPGTW
TMTHR TABULATE IPGTH TERMINATE IPG2 TRANSACTIONS
ENTER IPG3 TRANSACTIONS INTO
* TABLE IPGTH
TERMINATE IPG3 TRANSACTIONS
*
NISTM SPLIT 2,DTNIS
DTNIS SAVEVALUE NISCT+,1,XF COUNT NIS REQS
TERMINATE NIS REQS
*
WRTRM SPLIT 2,DTWR
DTWR SAVEVALUE WRCT+,1,XF COUNT WAREHOUSE REFUSALS
TERMINATE WAREHOUSE REFUSALS

```

```

*****
**                               SIMULATION RUN CONTROL                               **
** THE FIRST START STATEMENT AND THE FOLLOWING RESET STATEMENT ARE **
** USED TO BRING THE MODEL TO STEADY STATE, THAT IS, TO FILL IT **
** WITH TRANSACTIONS SO THAT THE SIMULATION DOES NOT START WITH AN **
** EMPTY SUPPLY DEPOT. THE INITIAL STATEMENT RESETS ALL SAVEVALUES **
** USED TO GATHER STATISTICS DURING THE SIMULATION TO ZERO. THE **
** FINAL START STATEMENT REFERS TO FIRST TERMINATE STATEMENT IN THE **
** MASTER SCHEDULE CONTROL MODULE, TERMINATING THE SIMULATION WHEN **
** THE 4TH TRANSACTIONS ENTERS THAT BLOCK. **
*****

```

```

*
      START      2,NP
      RESET
      INITIAL    XFSREQCT,0/XFSPRION,0/XFSPRITW,0/XFSPRITH,0
      INITIAL    XFSANUM,0/XFSBNUM,0/XFSPNUM,0
      INITIAL    XFSNISCT,0/XFSWRCT,0
      START      4,,1
      END

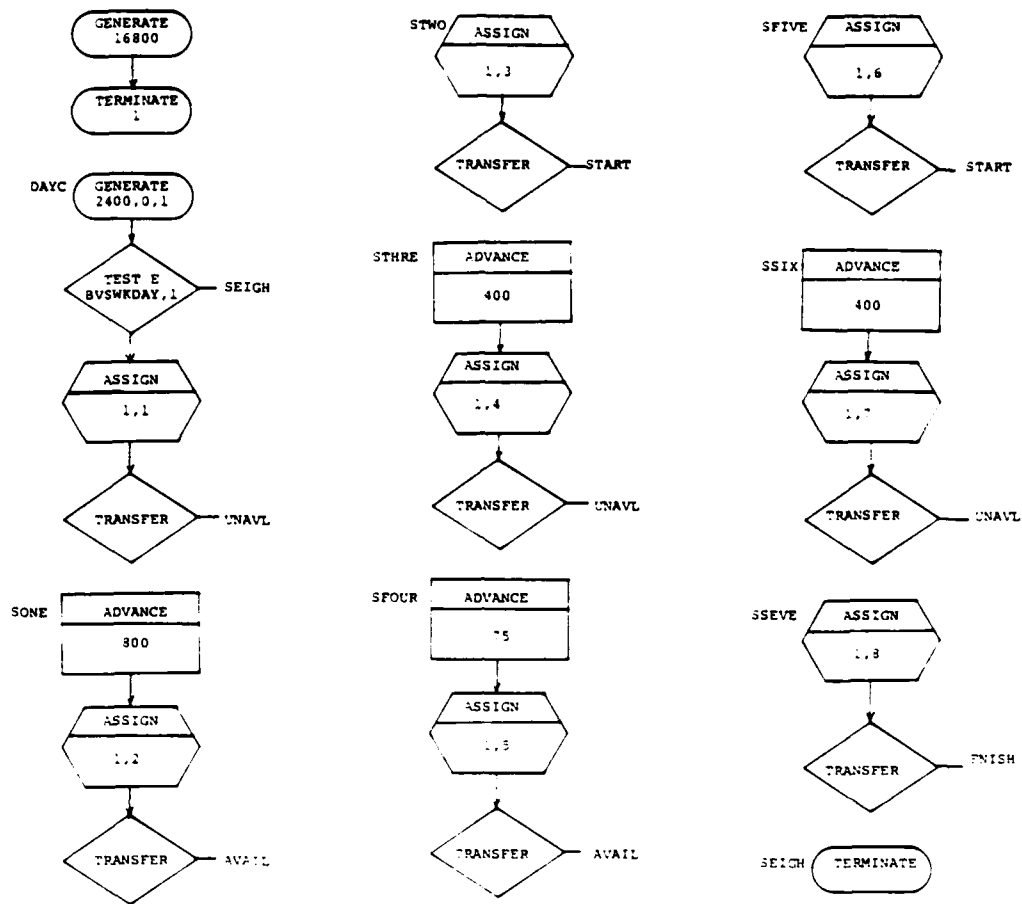
//

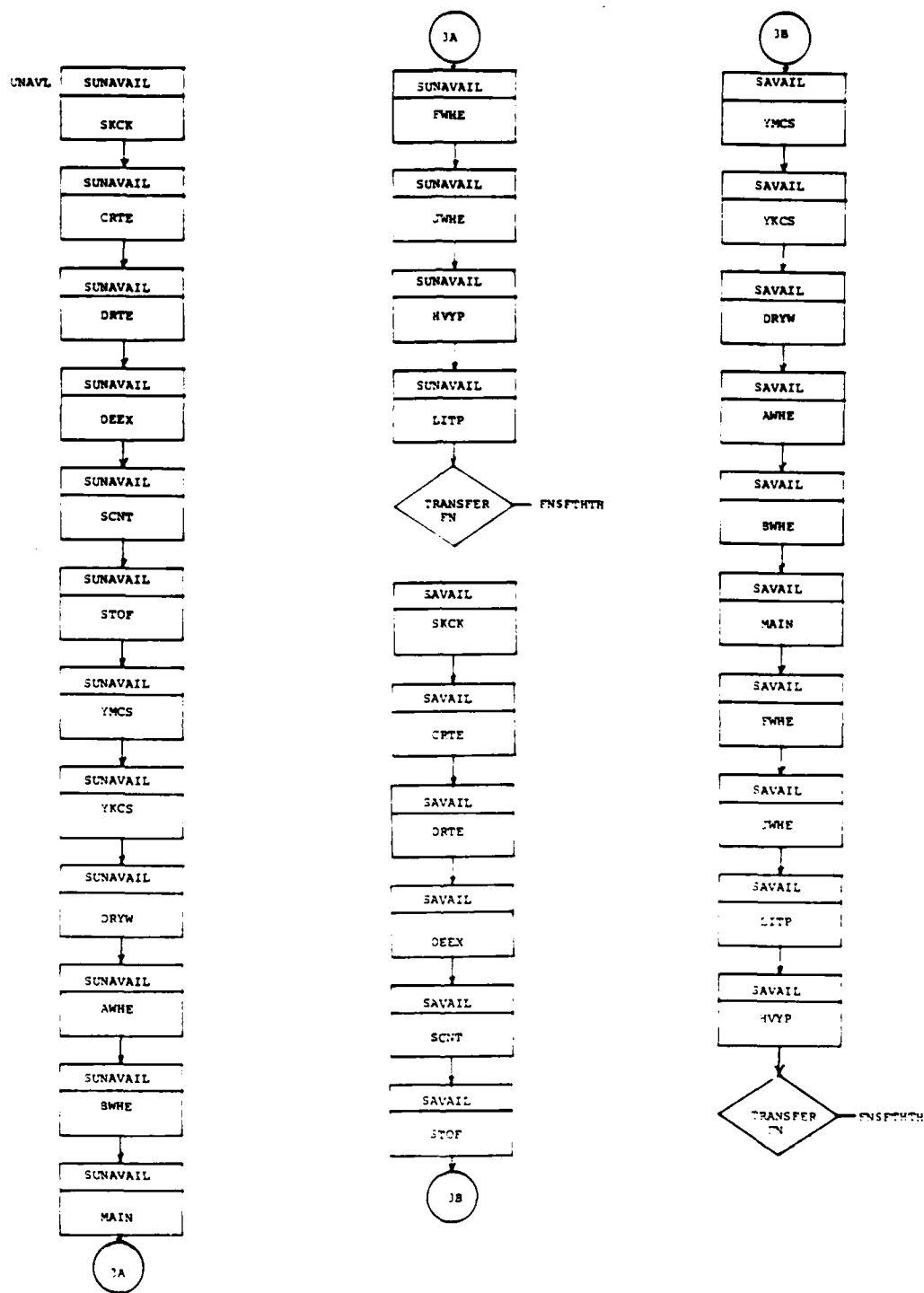
```

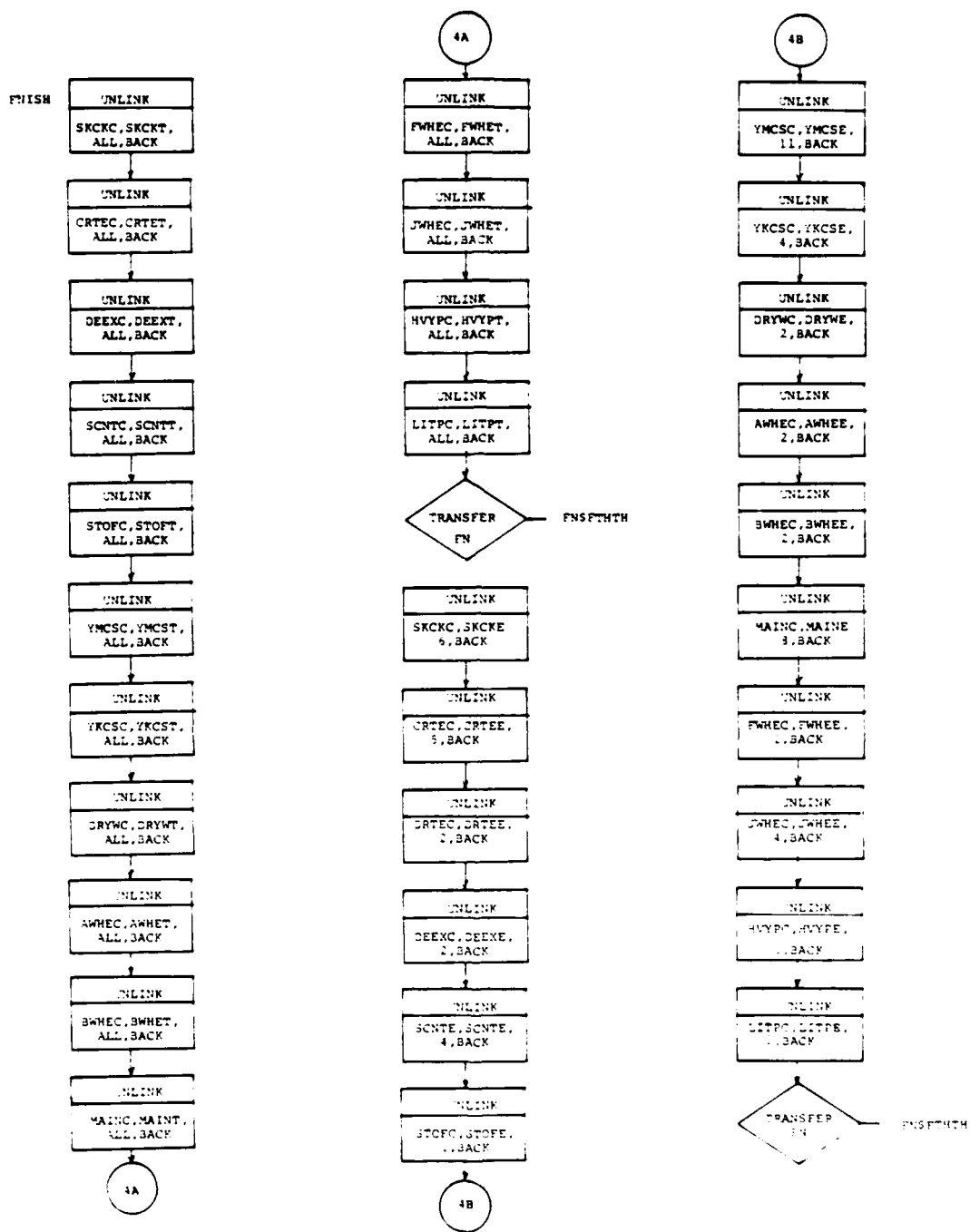
**APPENDIX B**  
**GPSS BLOCK DIAGRAM**

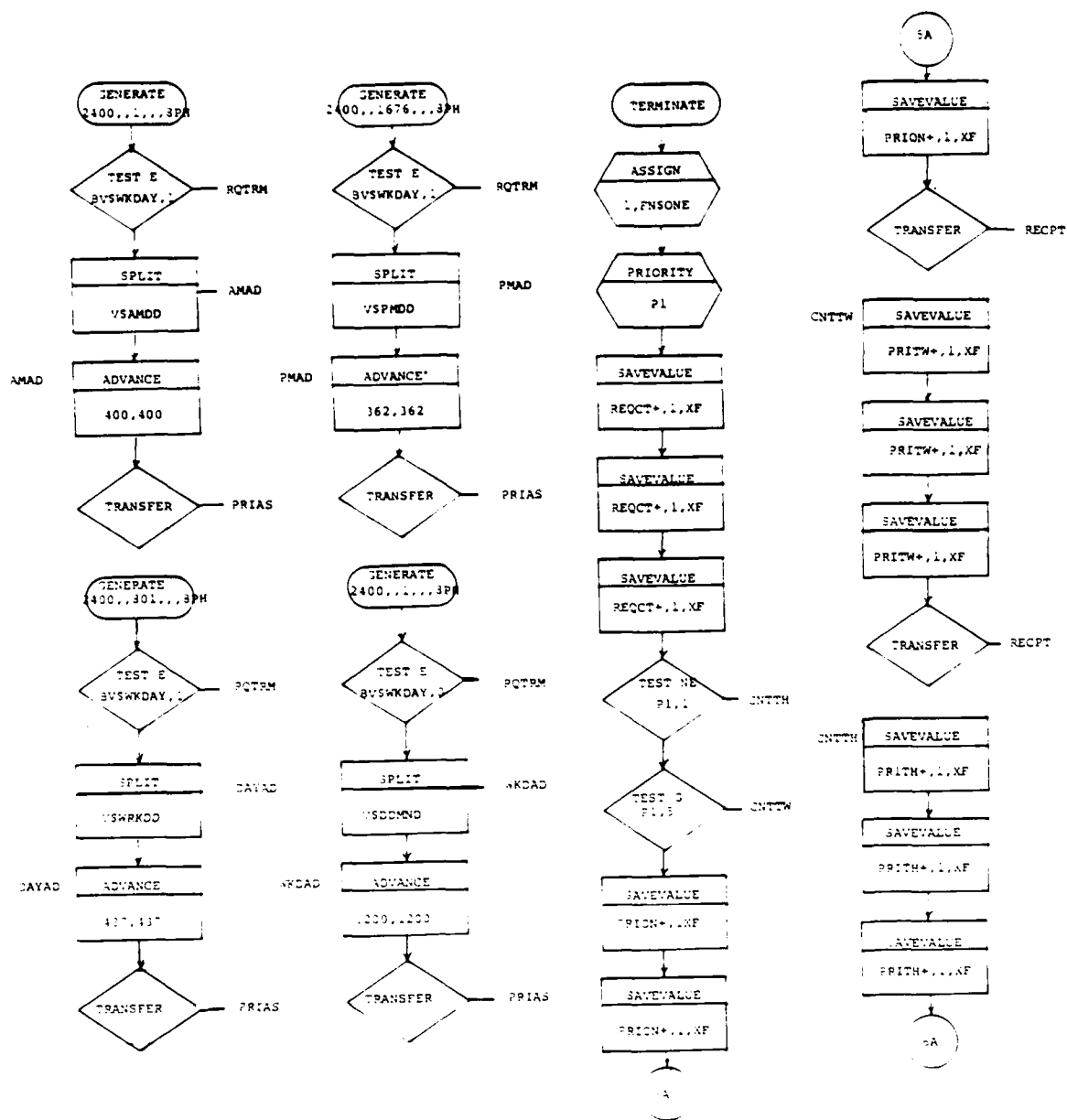
**TABLE OF CONTENTS**

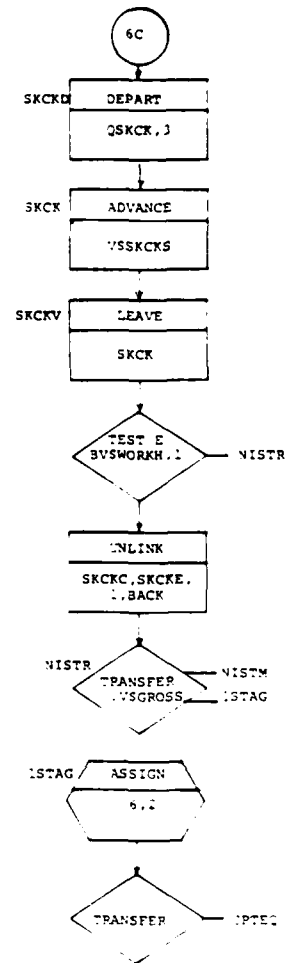
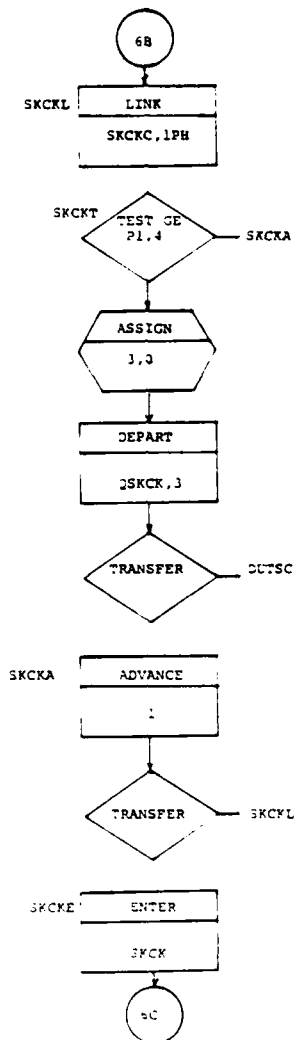
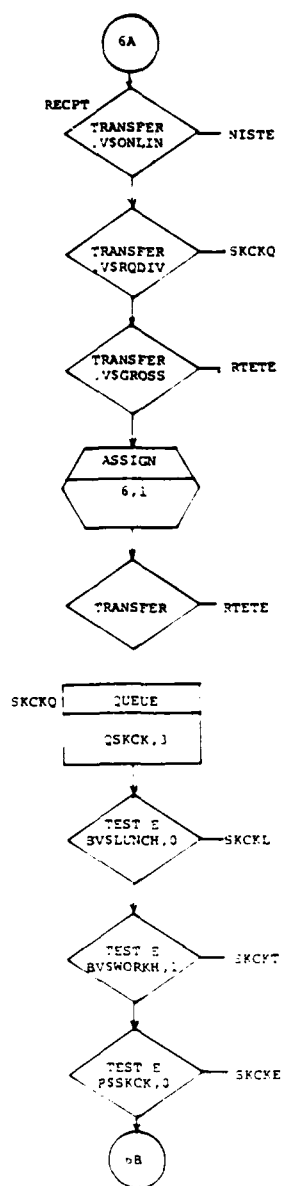
|                                                    |     |
|----------------------------------------------------|-----|
| Master Schedule Control Module . . . . .           | 100 |
| Storage Control Module . . . . .                   | 101 |
| User Chain Control Module. . . . .                 | 102 |
| Requisition Generation Module. . . . .             | 103 |
| Requisition Receipt Module . . . . .               | 104 |
| NSD Remote Terminal Entry Module . . . . .         | 105 |
| CPU Tests Module . . . . .                         | 105 |
| Printer Queue Handling Module. . . . .             | 106 |
| Demand Exception Handling Module . . . . .         | 107 |
| Warehouse Assignment Module. . . . .               | 107 |
| Storage Control/Storage Office Module. . . . .     | 108 |
| Yokohama Issue Document Delivery Module. . . . .   | 109 |
| Bicycle Messenger Delivery Module. . . . .         | 109 |
| Warehouses Module. . . . .                         | 110 |
| Provisions Tractor Train Delivery Module . . . . . | 118 |
| Tractor Train Delivery Module. . . . .             | 119 |
| Freight Terminal Module. . . . .                   | 121 |
| Duty Section Module. . . . .                       | 122 |
| Termination Module . . . . .                       | 124 |

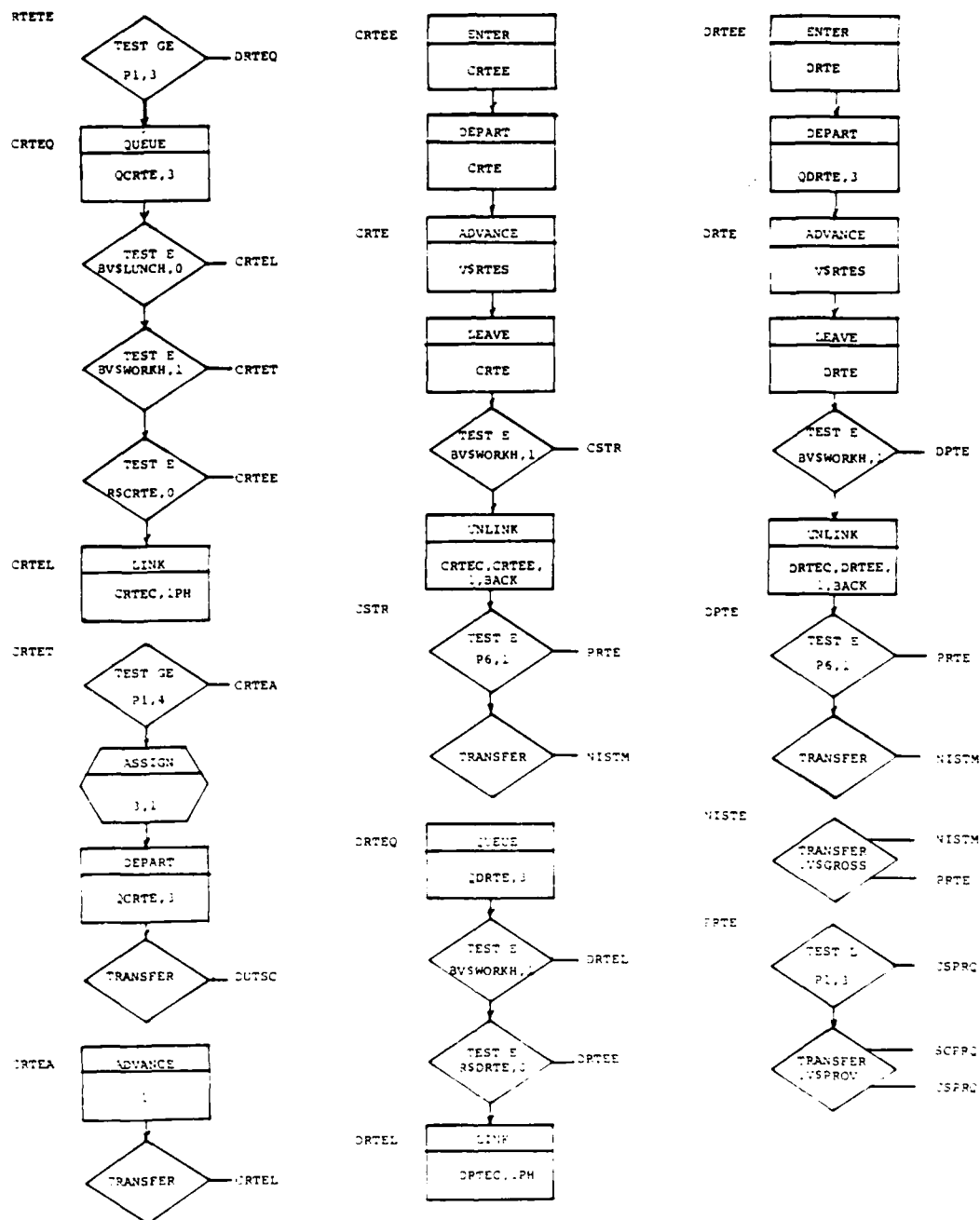


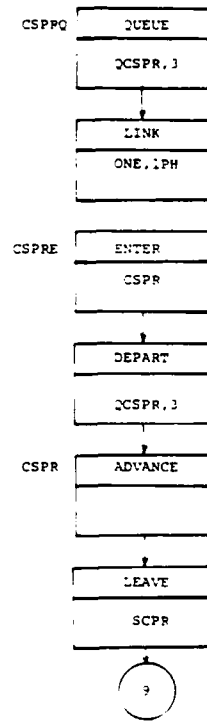
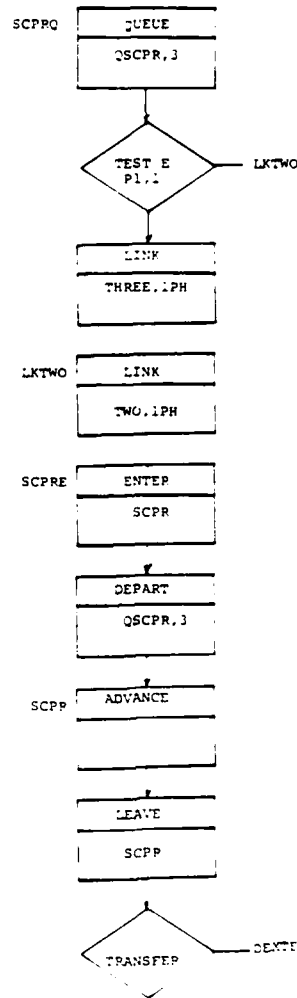
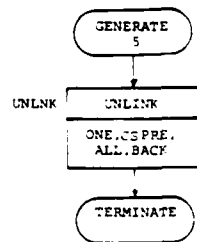
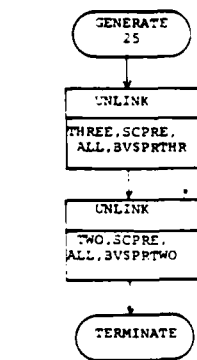


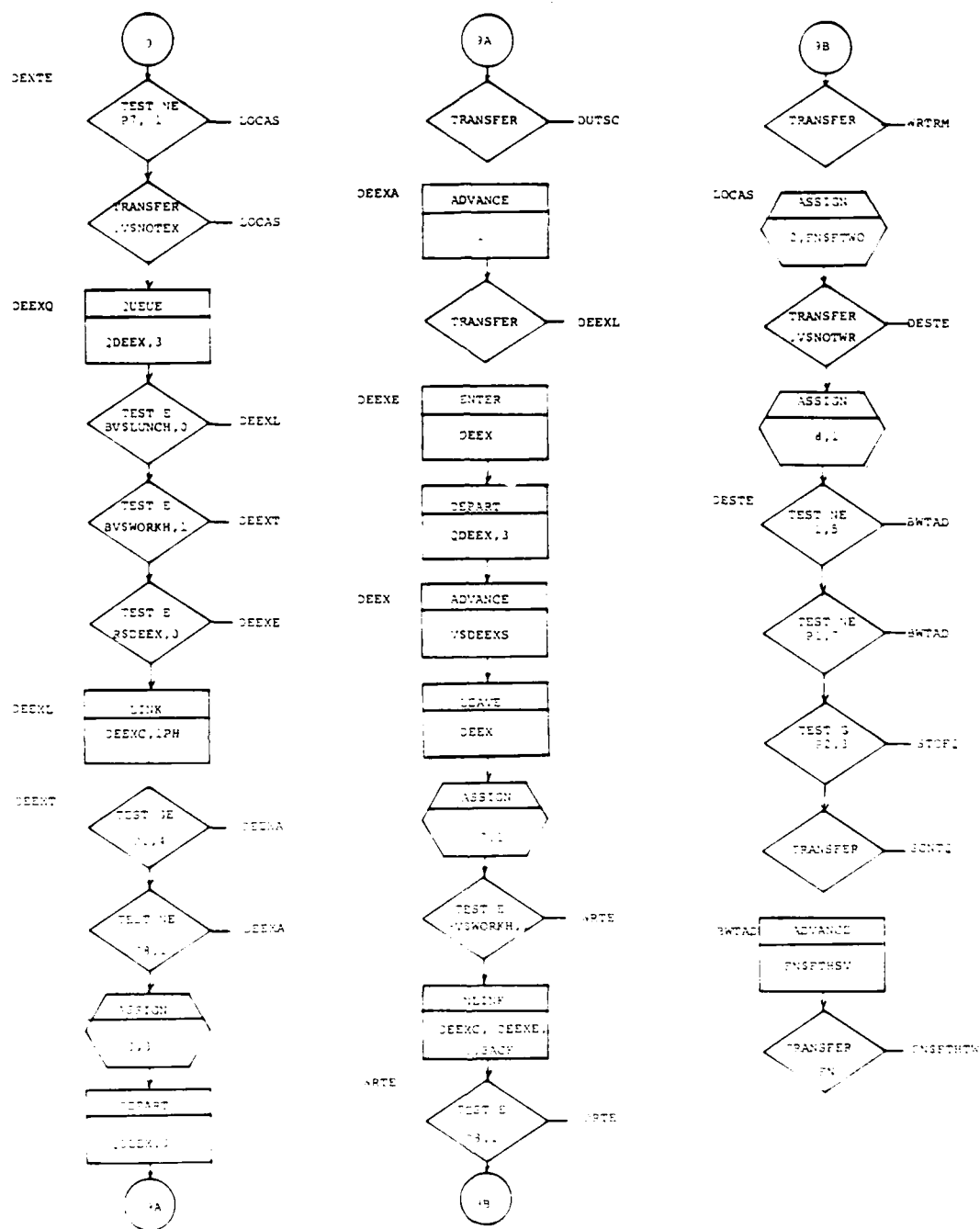


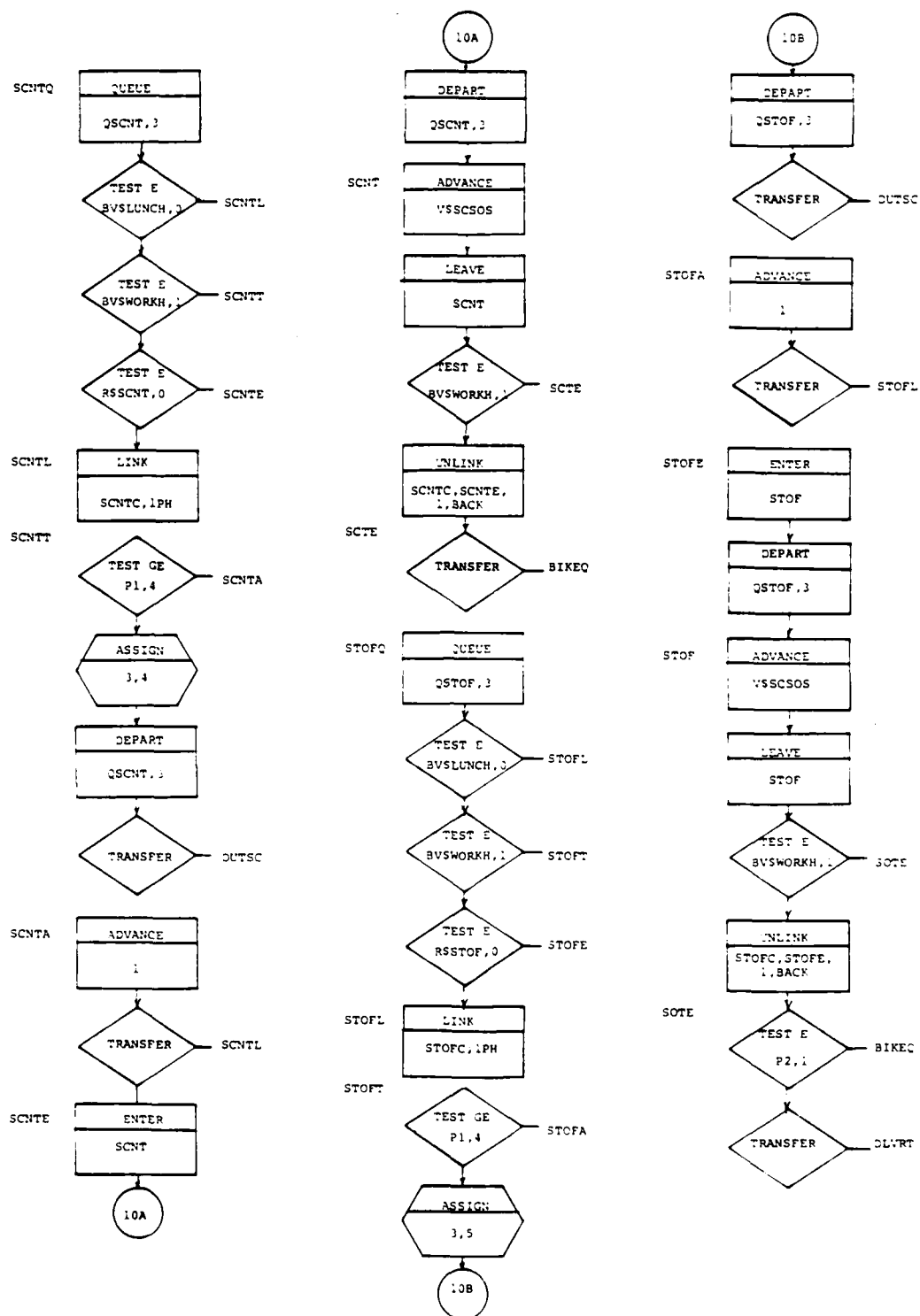


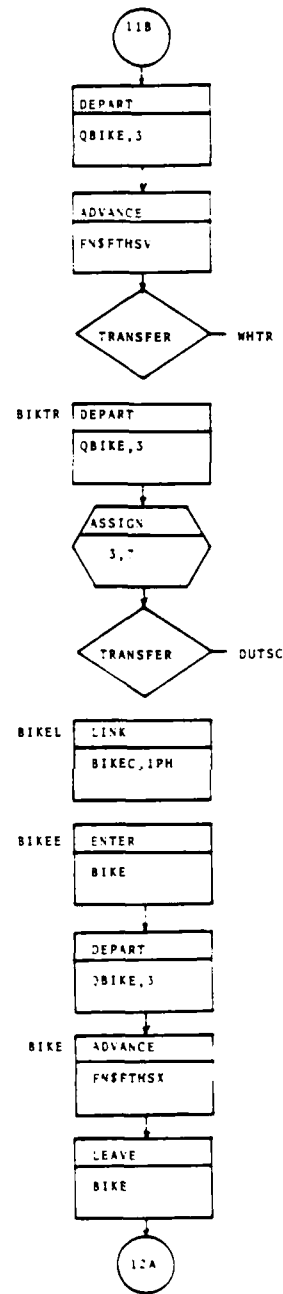
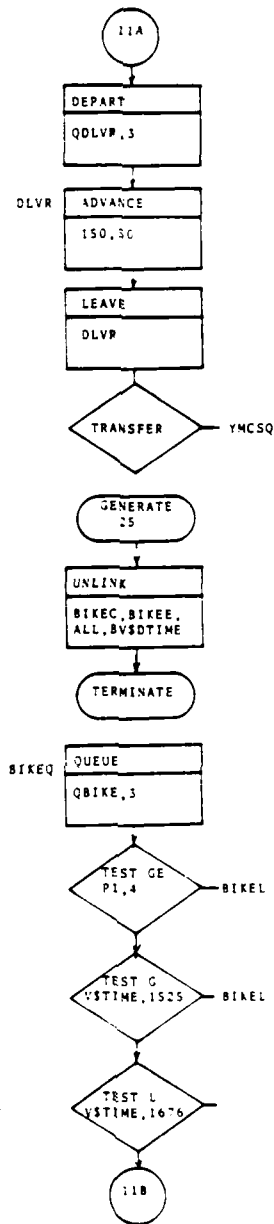
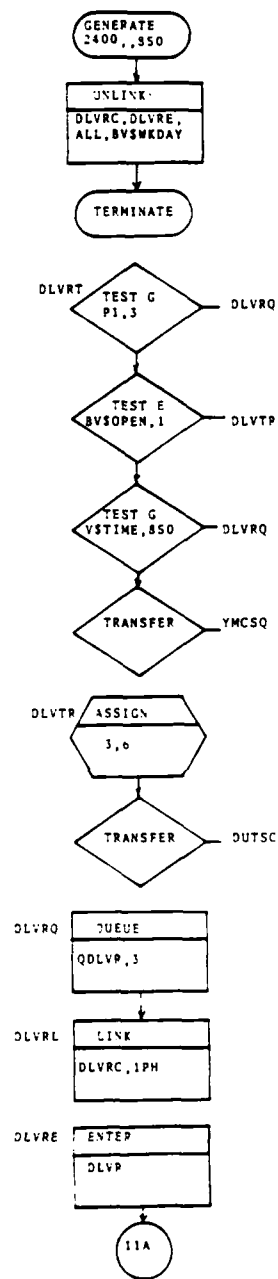


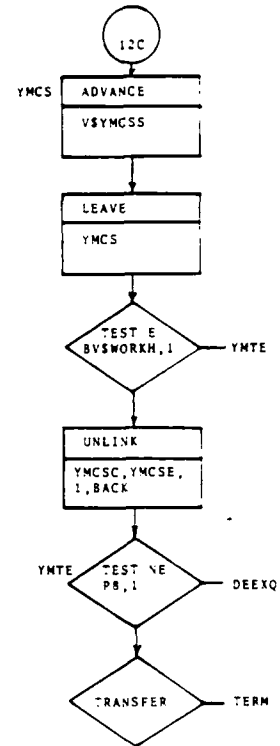
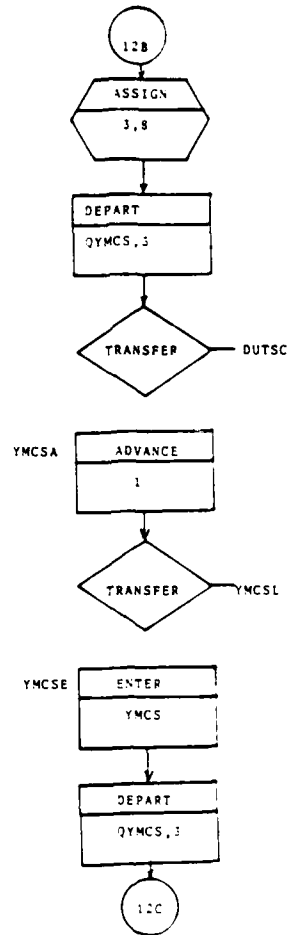
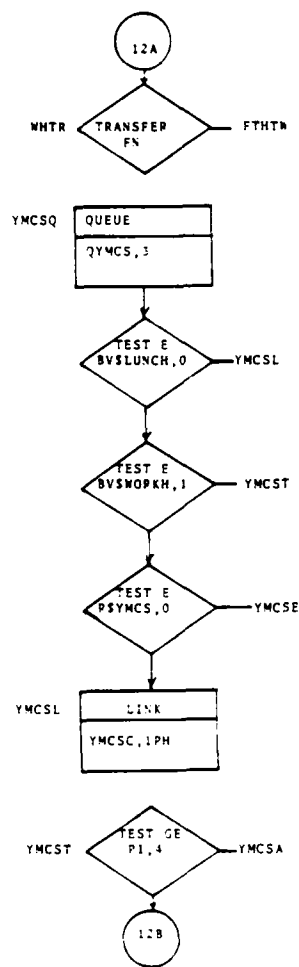


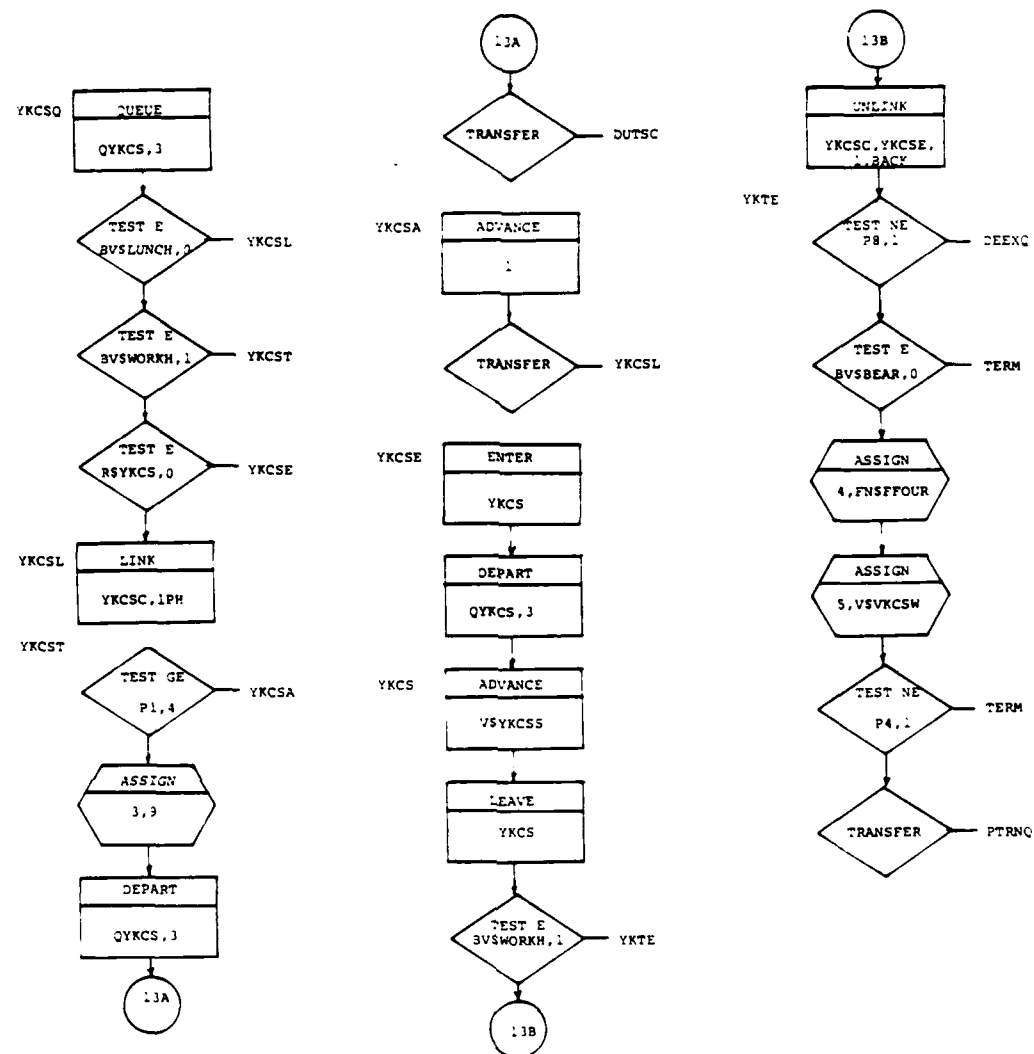


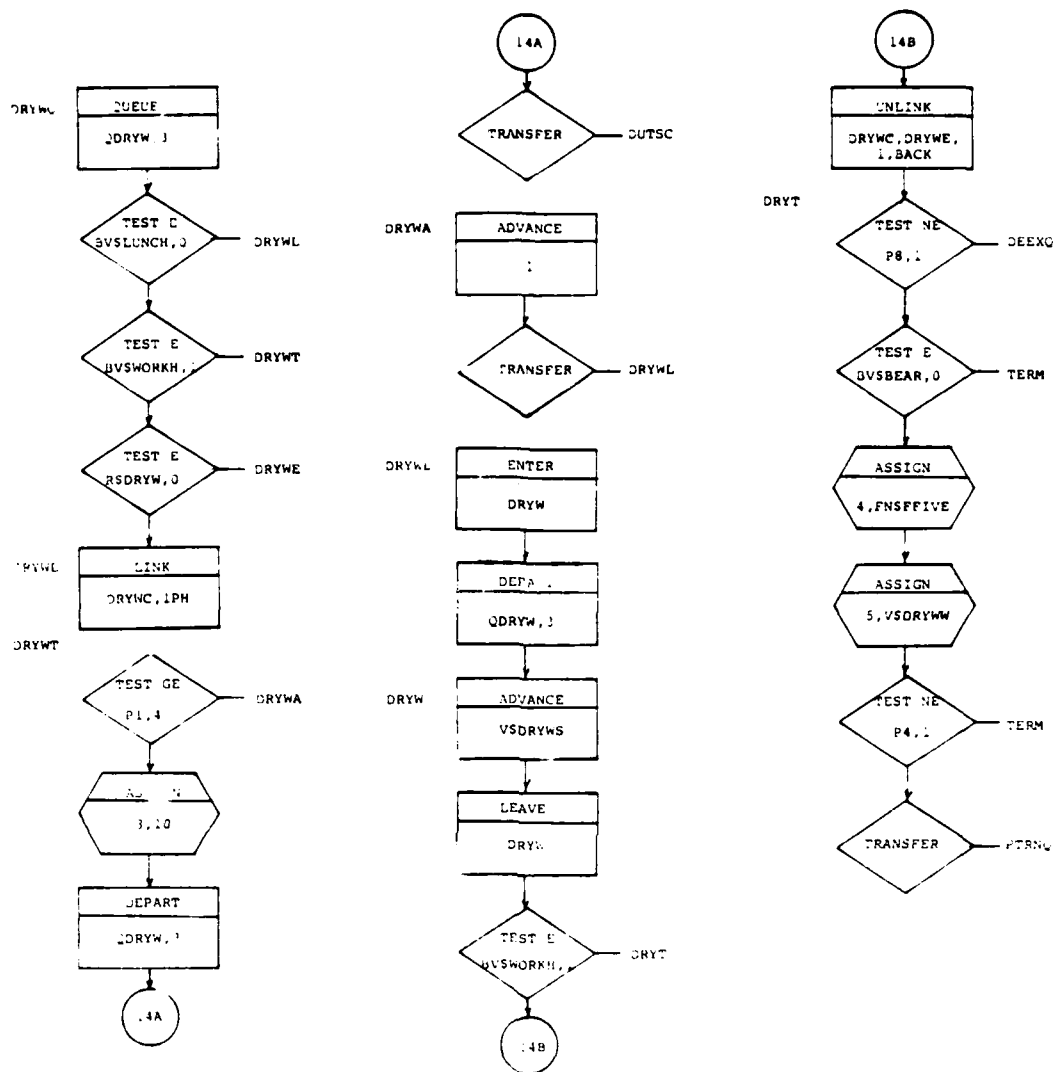


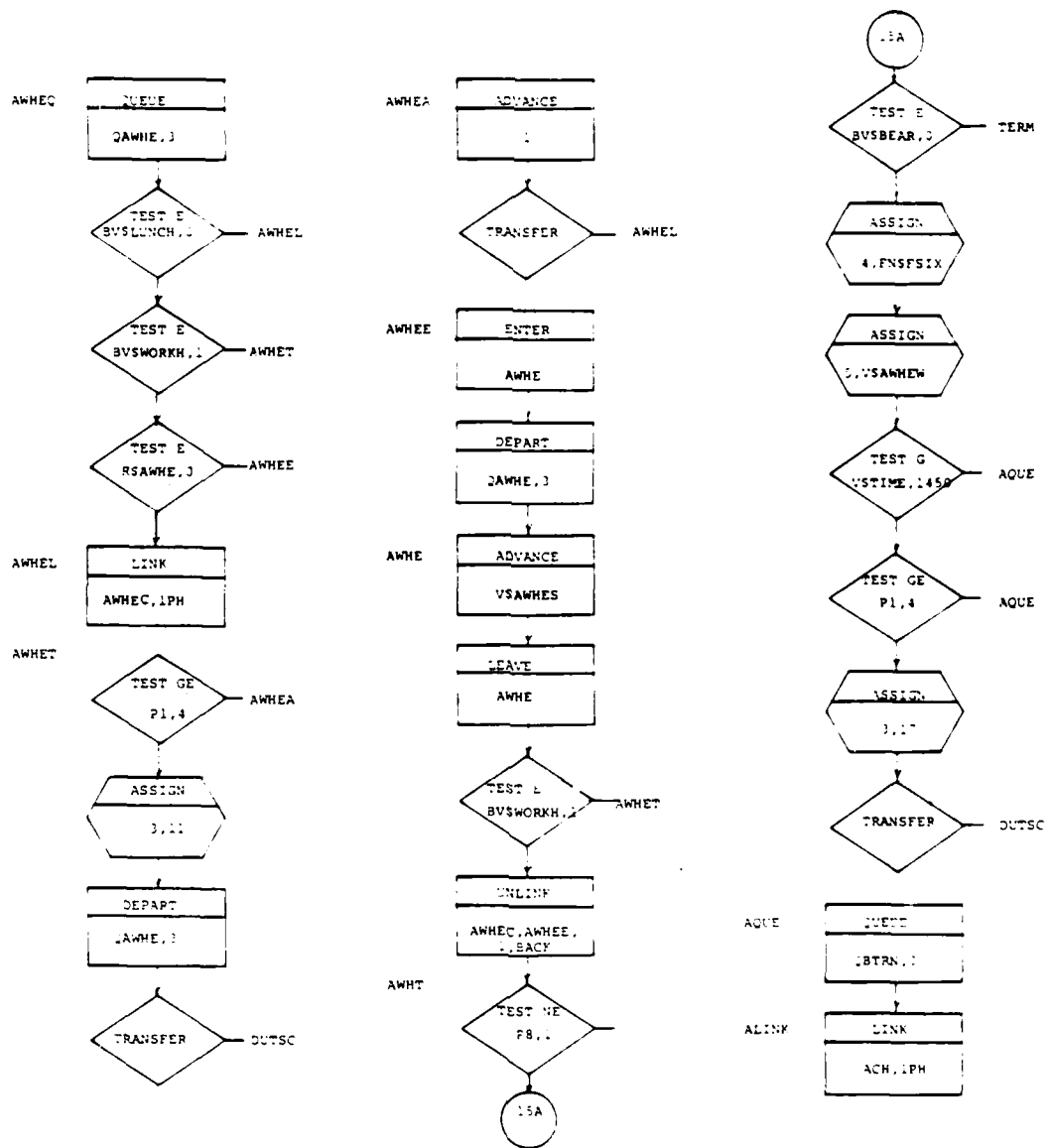


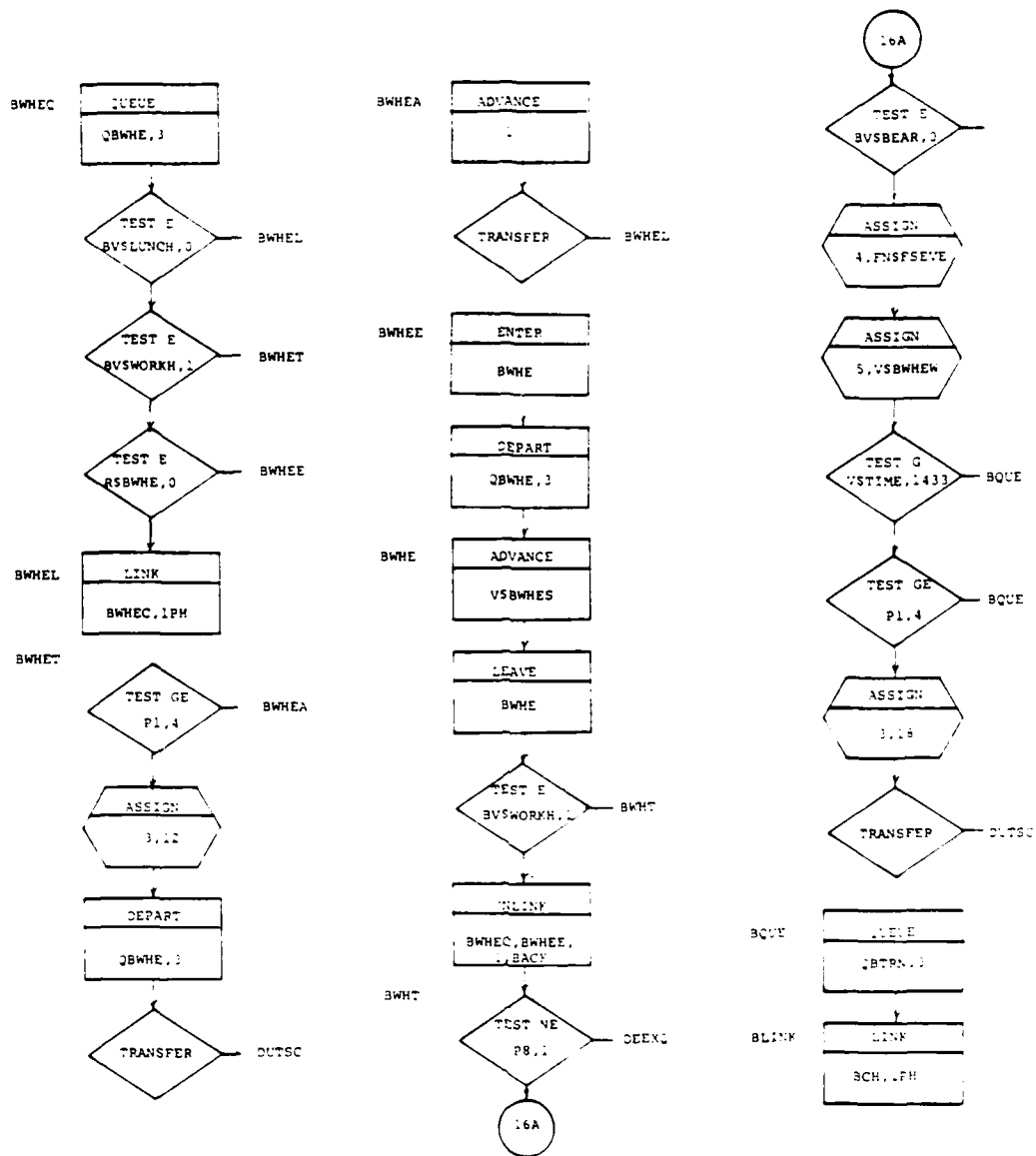


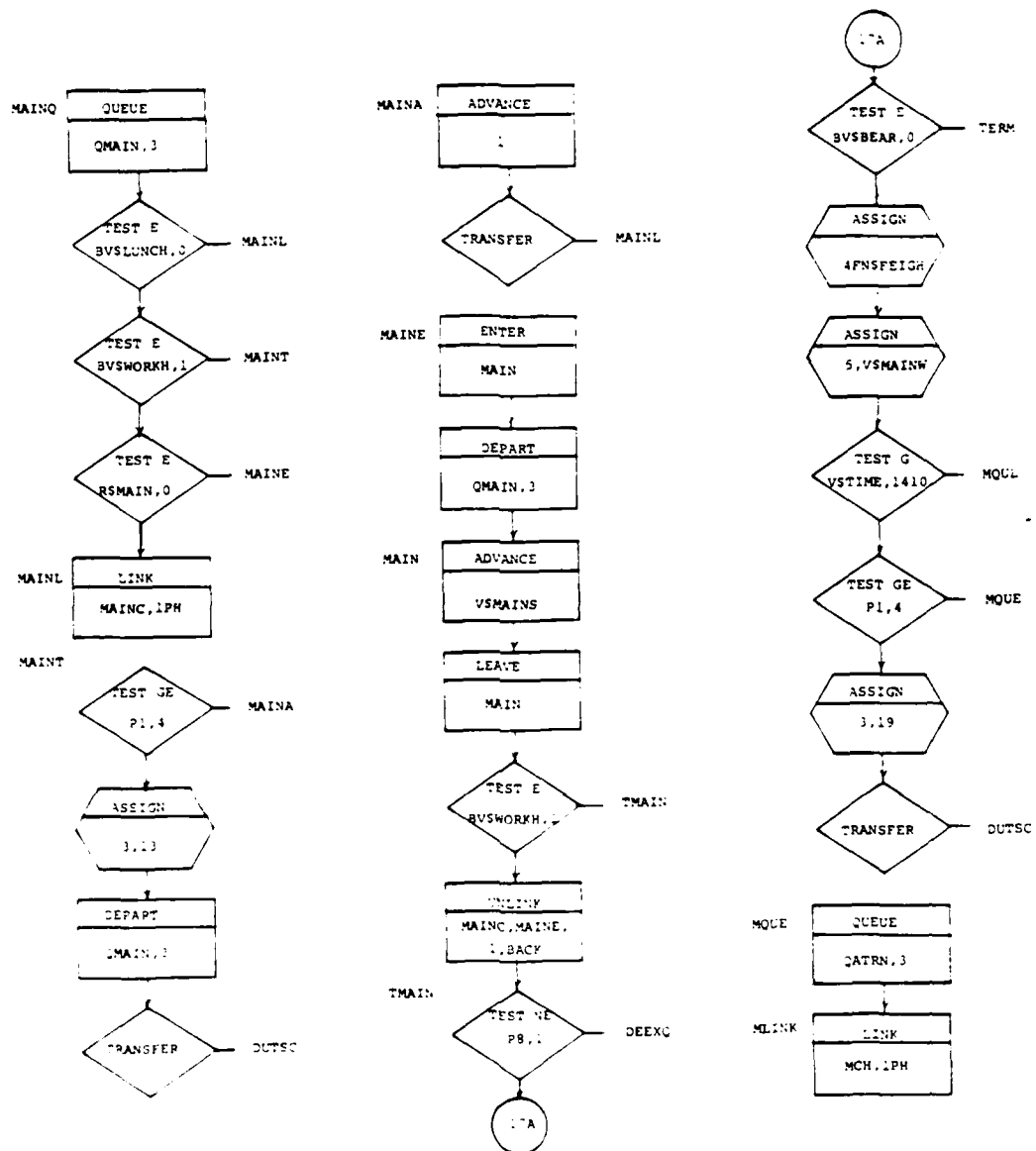


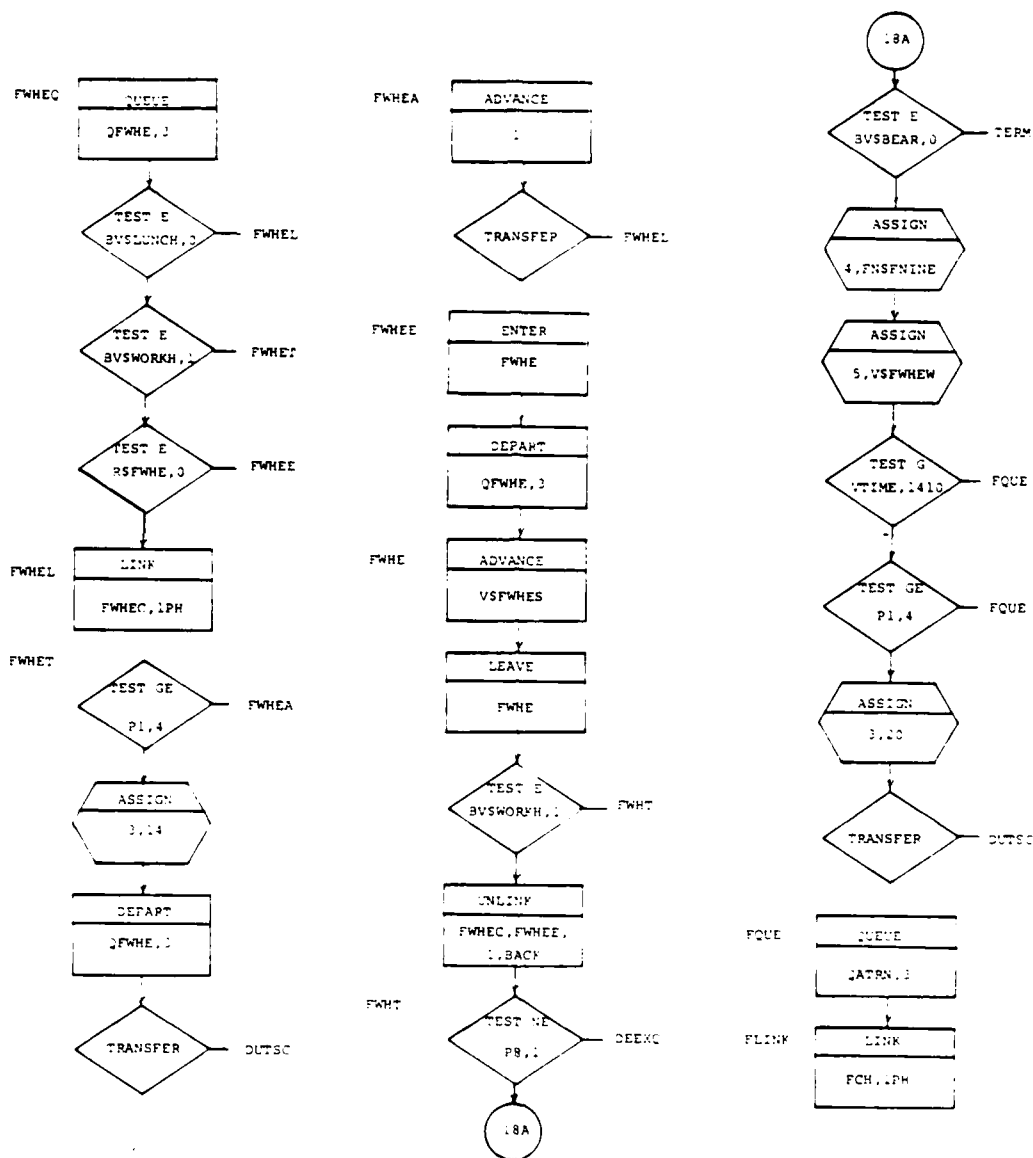


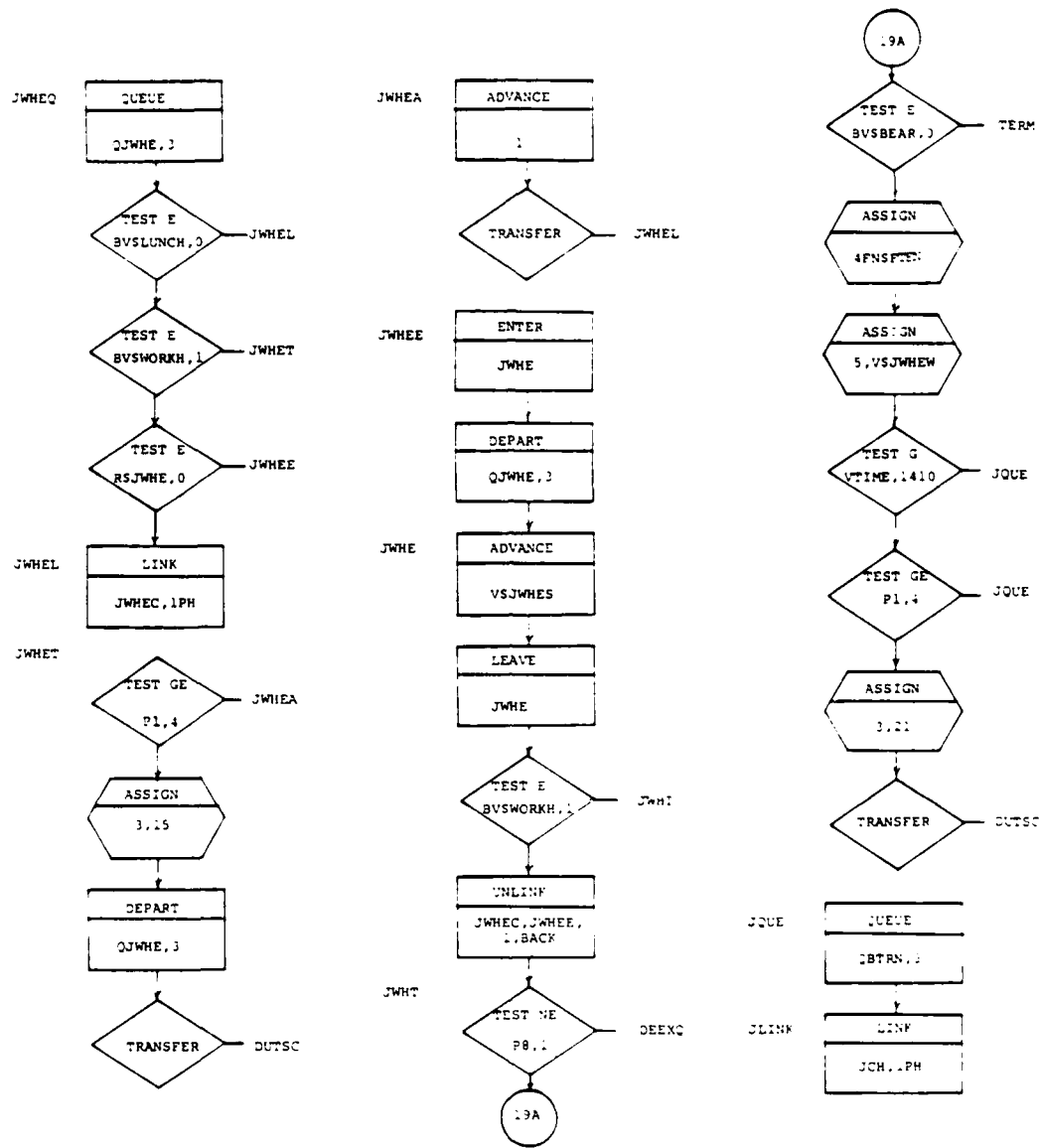


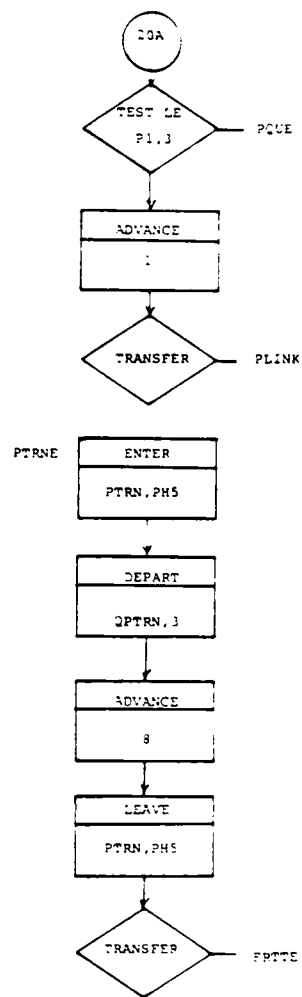
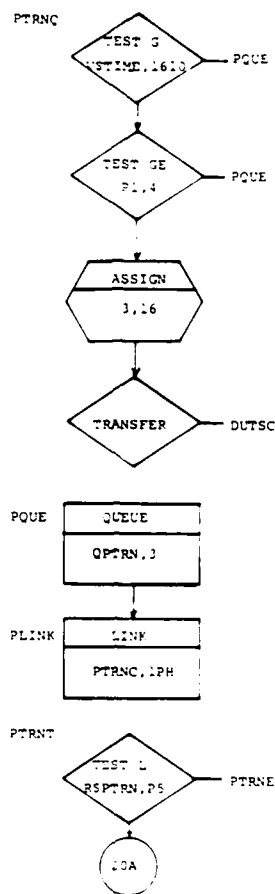
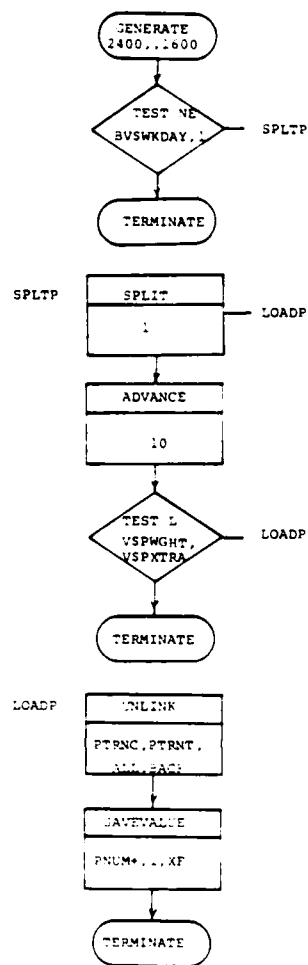


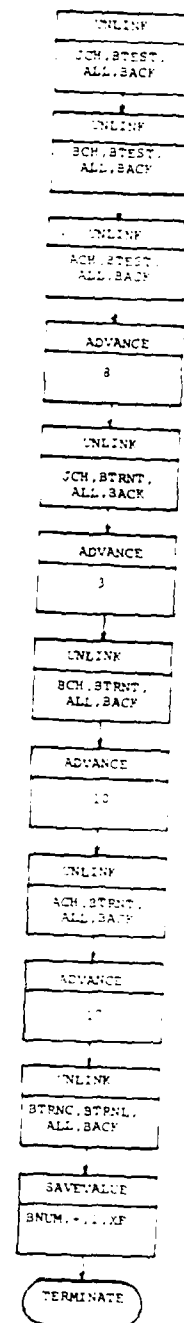
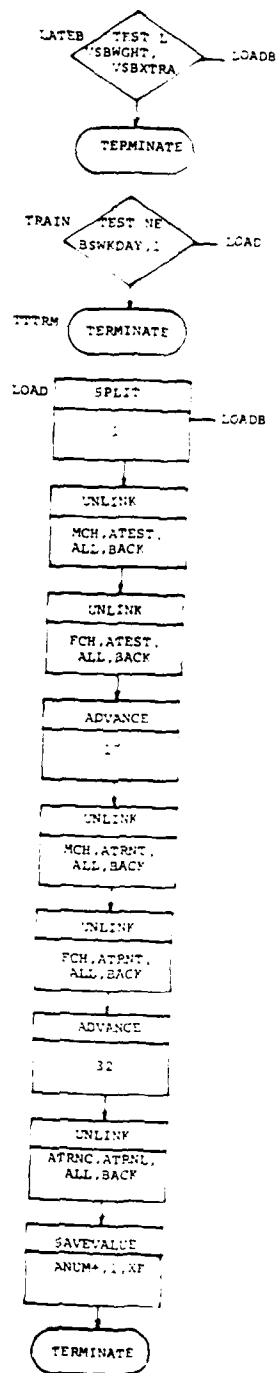
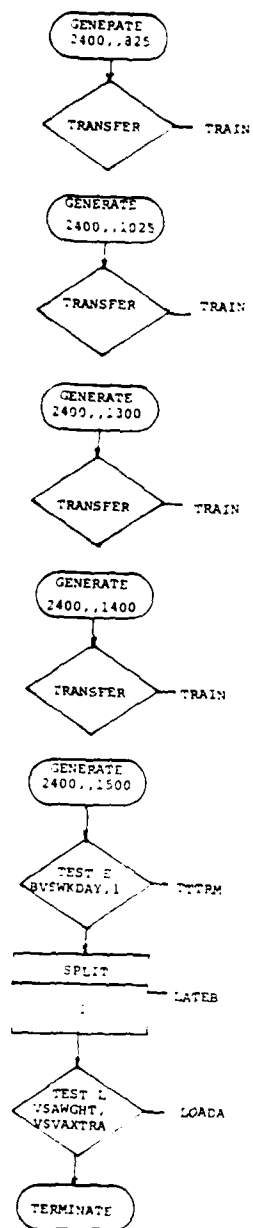


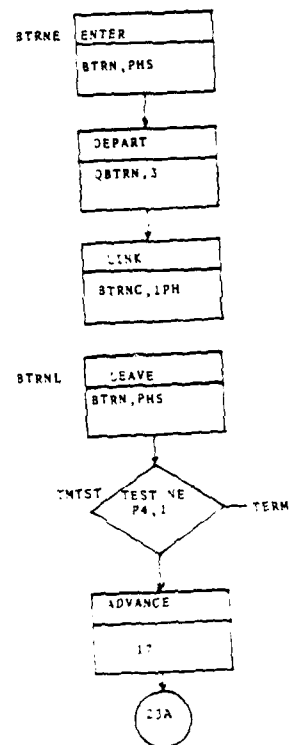
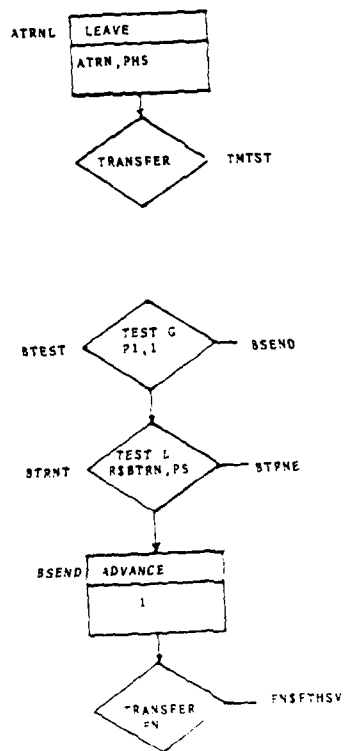
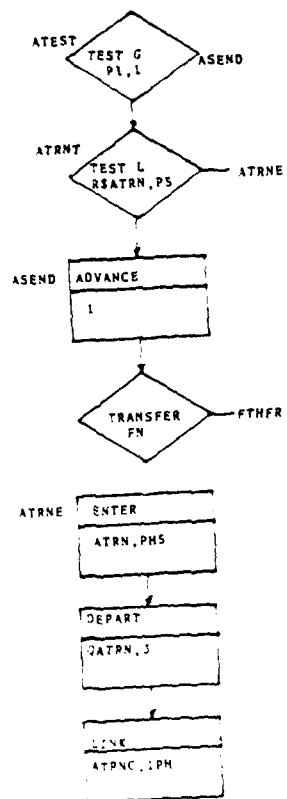


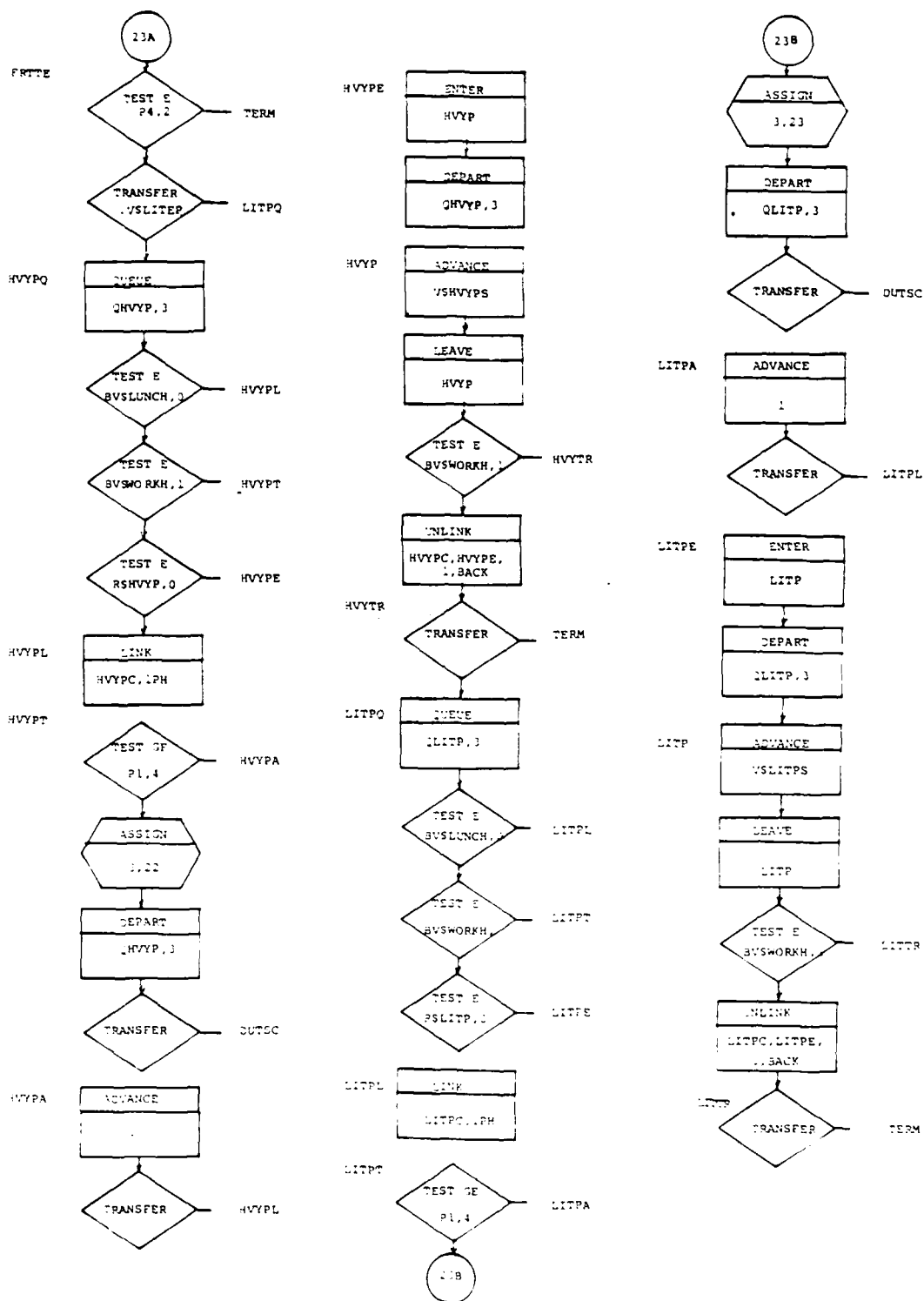


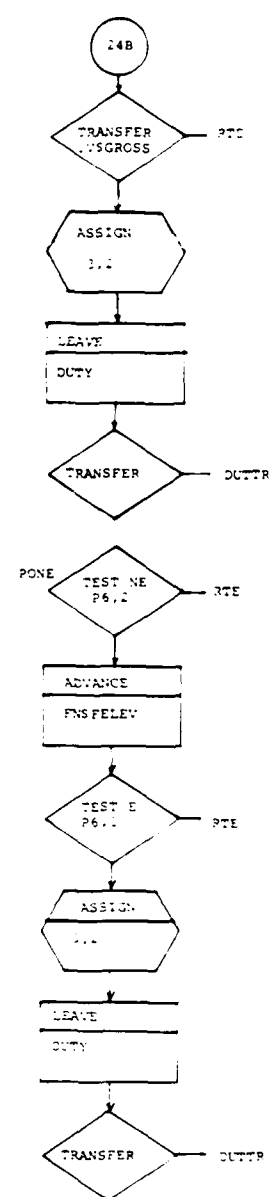
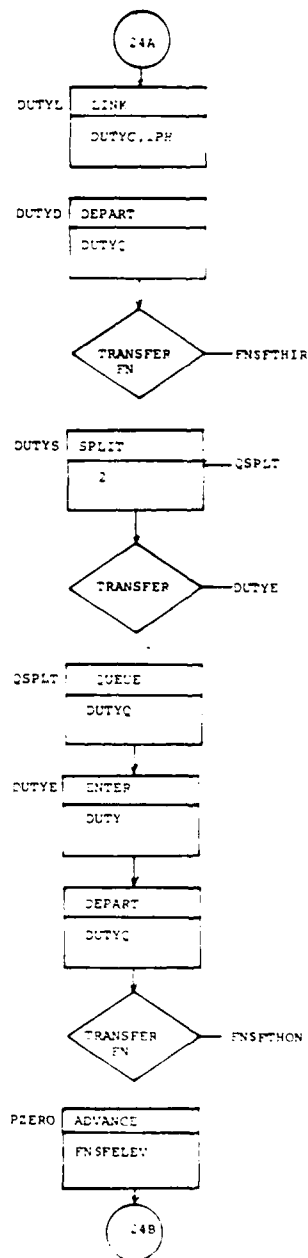
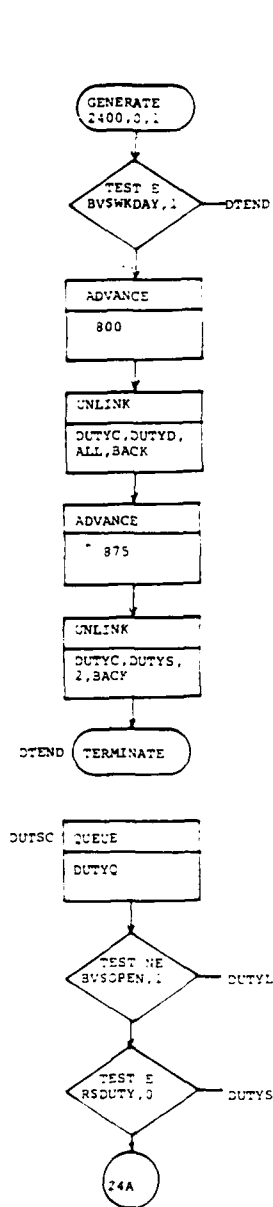


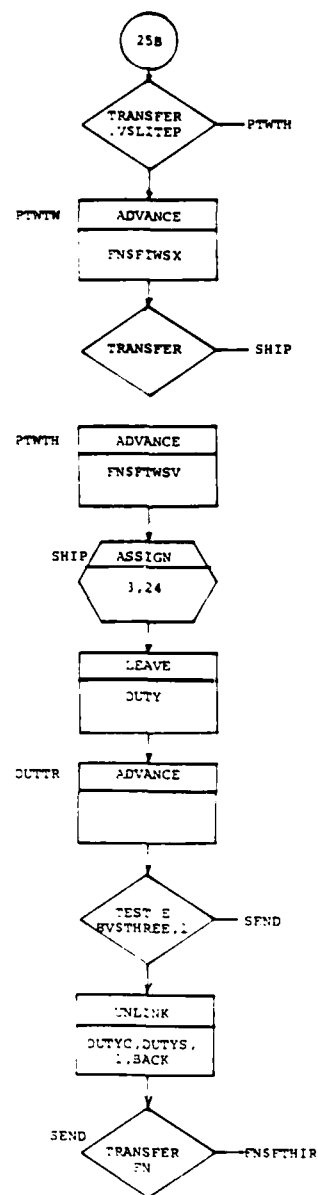
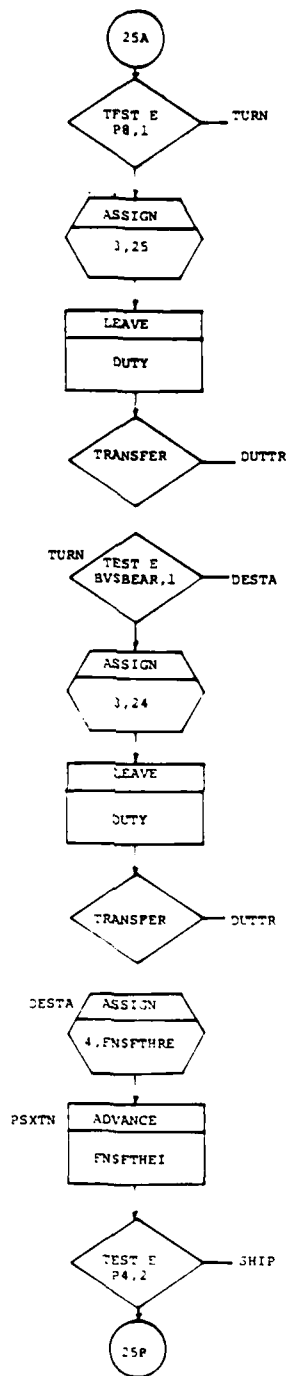
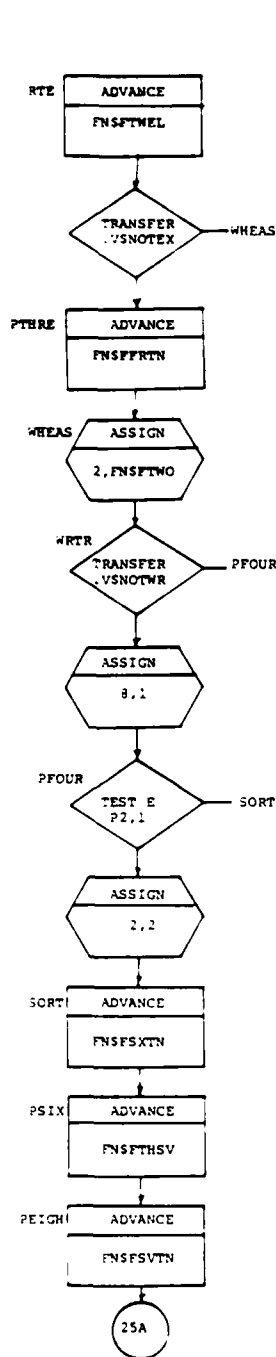


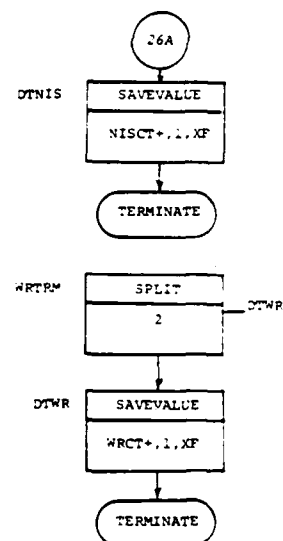
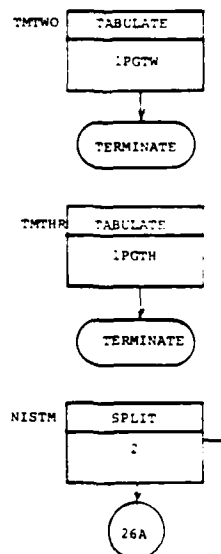
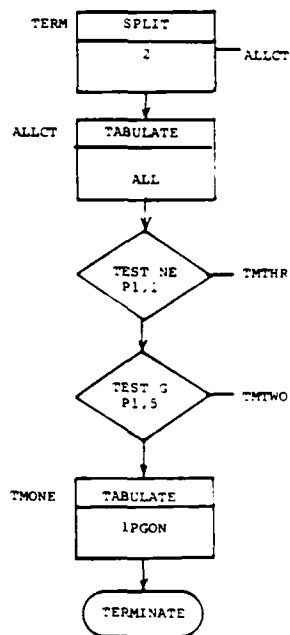












APPENDIX C  
PROGRAM OUTPUT

TABLE OF CONTENTS

|                        |     |
|------------------------|-----|
| Block Counts . . . . . | 126 |
| User Chains. . . . .   | 130 |
| Storages . . . . .     | 131 |
| Queues . . . . .       | 132 |
| Tables . . . . .       | 133 |
| Savevalues . . . . .   | 135 |

THIS IS SNAP 4 OF 4

## 67200 ABSOLUTE CLOCK 100800

## RELATIVE CLOCK

| BLOCK COUNTS | BLOCK CURRENT | TOTAL | BLOCK | BLOCK CURRENT | TOTAL | BLOCK | BLOCK CURRENT | TOTAL | BLOCK | BLOCK CURRENT | TOTAL | BLOCK | BLOCK CURRENT | TOTAL | BLOCK | BLOCK CURRENT | TOTAL |
|--------------|---------------|-------|-------|---------------|-------|-------|---------------|-------|-------|---------------|-------|-------|---------------|-------|-------|---------------|-------|
| 1            | 0             | 4     | 11    | 0             | 20    | 21    | 0             | 20    | 31    | 0             | 60    | 41    | 0             | 60    | 60    | 0             | 60    |
| 2            | 0             | 4     | 12    | 0             | 20    | 22    | 0             | 20    | 32    | 0             | 60    | 42    | 0             | 60    | 60    | 0             | 60    |
| 3            | 0             | 28    | 13    | 0             | 20    | 23    | 0             | 20    | 33    | 0             | 60    | 43    | 0             | 60    | 60    | 0             | 60    |
| 4            | 0             | 28    | 14    | 0             | 20    | 24    | 0             | 20    | 34    | 0             | 60    | 44    | 0             | 60    | 60    | 0             | 60    |
| 5            | 0             | 20    | 15    | 0             | 20    | 25    | 0             | 28    | 35    | 0             | 60    | 45    | 0             | 60    | 60    | 0             | 60    |
| 6            | 0             | 20    | 16    | 0             | 20    | 26    | 0             | 60    | 36    | 0             | 60    | 46    | 0             | 60    | 60    | 0             | 60    |
| 7            | 0             | 20    | 17    | 0             | 20    | 27    | 0             | 60    | 37    | 0             | 60    | 47    | 0             | 60    | 60    | 0             | 60    |
| 8            | 0             | 20    | 18    | 0             | 20    | 28    | 0             | 60    | 38    | 0             | 60    | 48    | 0             | 60    | 60    | 0             | 60    |
| 9            | 0             | 20    | 19    | 0             | 20    | 29    | 0             | 60    | 39    | 0             | 60    | 49    | 0             | 60    | 60    | 0             | 60    |
| 10           | 0             | 20    | 20    | 0             | 20    | 30    | 0             | 60    | 40    | 0             | 60    | 50    | 0             | 60    | 60    | 0             | 60    |

| BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL |
|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|
| 51    | 0       | 40    | 61    | 0       | 20    | 71    | 0       | 20    | 81    | 0       | 40    | 91    | 0       | 40    | 101   | 0       | 40    |
| 52    | 0       | 40    | 62    | 0       | 20    | 72    | 0       | 20    | 82    | 0       | 40    | 92    | 0       | 40    | 102   | 0       | 40    |
| 53    | 0       | 40    | 63    | 0       | 20    | 73    | 0       | 20    | 83    | 0       | 40    | 93    | 0       | 40    | 103   | 0       | 28    |
| 54    | 0       | 40    | 64    | 0       | 20    | 74    | 0       | 20    | 84    | 0       | 40    | 94    | 0       | 40    | 104   | 0       | 28    |
| 55    | 0       | 40    | 65    | 0       | 20    | 75    | 0       | 20    | 85    | 0       | 40    | 95    | 0       | 40    | 105   | 0       | 704   |
| 56    | 0       | 40    | 66    | 0       | 20    | 76    | 0       | 40    | 86    | 0       | 40    | 96    | 0       | 40    | 106   | 0       | 704   |
| 57    | 0       | 40    | 67    | 0       | 20    | 77    | 0       | 40    | 87    | 0       | 40    | 97    | 0       | 40    | 107   | 0       | 704   |
| 58    | 0       | 40    | 68    | 0       | 20    | 78    | 0       | 40    | 88    | 0       | 40    | 98    | 0       | 40    | 108   | 0       | 28    |
| 59    | 0       | 40    | 69    | 0       | 20    | 79    | 0       | 40    | 89    | 0       | 40    | 99    | 0       | 40    | 109   | 0       | 28    |
| 60    | 0       | 20    | 70    | 0       | 20    | 80    | 0       | 40    | 90    | 0       | 40    | 100   | 0       | 40    | 110   | 0       | 10904 |

| BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL |
|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|
| 101   | 0       | 10904 | 111   | 0       | 1012  | 121   | 0       | 173   | 131   | 0       | 8800  | 141   | 0       | 672   | 672   | 0       | 672   |
| 102   | 0       | 10904 | 112   | 0       | 1012  | 122   | 0       | 173   | 132   | 0       | 13260 | 142   | 0       | 461   | 461   | 0       | 461   |
| 103   | 0       | 28    | 113   | 0       | 44    | 123   | 0       | 173   | 133   | 0       | 7322  | 143   | 0       | 10    | 10    | 0       | 10    |
| 104   | 0       | 28    | 114   | 0       | 13260 | 124   | 0       | 173   | 134   | 0       | 4815  | 144   | 0       | 10    | 10    | 0       | 10    |
| 105   | 0       | 640   | 115   | 0       | 13260 | 125   | 0       | 4287  | 135   | 0       | 1646  | 145   | 0       | 10    | 10    | 0       | 10    |
| 106   | 0       | 640   | 116   | 0       | 13260 | 126   | 0       | 4287  | 136   | 0       | 1646  | 146   | 0       | 451   | 451   | 0       | 451   |
| 107   | 0       | 640   | 117   | 0       | 13260 | 127   | 0       | 4287  | 137   | 0       | 2507  | 147   | 0       | 451   | 451   | 0       | 451   |
| 108   | 0       | 28    | 118   | 0       | 13260 | 128   | 0       | 4287  | 138   | 0       | 2507  | 148   | 0       | 2489  | 2489  | 0       | 2489  |
| 109   | 0       | 28    | 119   | 0       | 13260 | 129   | 0       | 8800  | 139   | 0       | 2315  | 149   | 0       | 2489  | 2489  | 0       | 2489  |
| 110   | 0       | 1012  | 120   | 0       | 4460  | 130   | 0       | 8800  | 140   | 0       | 1054  | 150   | 0       | 2489  | 2489  | 0       | 2489  |

| BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL |
|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|
| 151   | 0       | 2489  | 161   | 0       | 1746  | 171   | 0       | 1766  | 181   | 0       | 4655  | 191   | 0       | 9277  |
| 152   | 0       | 2489  | 162   | 0       | 98    | 172   | 0       | 1766  | 182   | 0       | 4655  | 192   | 0       | 2688  |
| 153   | 0       | 2470  | 163   | 0       | 31    | 173   | 0       | 1766  | 183   | 0       | 4655  | 193   | 0       | 2688  |
| 154   | 0       | 2489  | 164   | 0       | 24    | 174   | 0       | 1752  | 184   | 0       | 4655  | 194   | 0       | 2688  |
| 155   | 0       | 1627  | 165   | 0       | 24    | 175   | 0       | 1766  | 185   | 0       | 4655  | 195   | 0       | 2688  |
| 156   | 0       | 1627  | 166   | 0       | 24    | 176   | 0       | 41    | 186   | 0       | 4624  | 196   | 0       | 13440 |
| 157   | 0       | 4815  | 167   | 0       | 7     | 177   | 0       | 4652  | 187   | 0       | 4655  | 197   | 0       | 13440 |
| 158   | 0       | 1790  | 168   | 0       | 7     | 178   | 0       | 4652  | 188   | 0       | 1593  | 198   | 0       | 13440 |
| 159   | 0       | 1790  | 169   | 0       | 1766  | 179   | 0       | 3532  | 189   | 0       | 5938  | 199   | 0       | 6931  |
| 160   | 0       | 1777  | 170   | 0       | 1766  | 180   | 0       | 2053  | 190   | 0       | 9574  | 200   | 0       | 6931  |

| BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL |
|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|
| 201   | 0       | 4772  | 211   | 0       | 2642  | 221   | 0       | 523   | 231   | 0       | 906   | 241   | 0       | 8574  |
| 202   | 0       | 2159  | 212   | 0       | 2642  | 222   | 0       | 1     | 232   | 0       | 906   | 242   | 0       | 8571  |
| 203   | 0       | 6946  | 213   | 0       | 2642  | 223   | 0       | 1     | 233   | 0       | 906   | 243   | 0       | 5953  |
| 204   | 0       | 6946  | 214   | 0       | 9588  | 224   | 0       | 1     | 234   | 0       | 904   | 244   | 1       | 135   |
| 205   | 0       | 6946  | 215   | 0       | 8708  | 225   | 0       | 1     | 235   | 0       | 906   | 245   | 0       | 134   |
| 206   | 0       | 6946  | 216   | 0       | 905   | 226   | 0       | 522   | 236   | 0       | 23    | 246   | 0       | 5953  |
| 207   | 0       | 6946  | 217   | 0       | 905   | 227   | 0       | 522   | 237   | 0       | 8706  | 247   | 0       | 5953  |
| 208   | 0       | 2643  | 218   | 0       | 854   | 228   | 0       | 906   | 238   | 0       | 8706  | 248   | 0       | 5584  |
| 209   | 0       | 2643  | 219   | 0       | 331   | 229   | 0       | 906   | 239   | 0       | 25    | 249   | 0       | 2111  |
| 210   | 0       | 2642  | 220   | 0       | 615   | 230   | 0       | 906   | 240   | 0       | 8706  | 250   | 0       | 4886  |

| BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL |
|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|
| 251   | 0       | 3473  | 261   | 0       | 5940  | 271   | 0       | 4     | 281   | 0       | 2619  | 291   | 0       | 1     |
| 252   | 0       | 10    | 262   | 0       | 5924  | 272   | 0       | 4     | 282   | 0       | 1445  | 292   | 0       | 1431  |
| 253   | 0       | 10    | 263   | 0       | 5940  | 273   | 0       | 1546  | 283   | 0       | 28    | 293   | 0       | 1431  |
| 254   | 0       | 10    | 264   | 0       | 2618  | 274   | 0       | 1546  | 284   | 0       | 28    | 294   | 0       | 1426  |
| 255   | 0       | 3463  | 265   | 0       | 2618  | 275   | 0       | 2619  | 285   | 0       | 28    | 295   | 0       | 1426  |
| 256   | 0       | 3463  | 266   | 0       | 2461  | 276   | 0       | 2619  | 286   | 0       | 1445  | 296   | 0       | 1426  |
| 257   | 0       | 5940  | 267   | 0       | 913   | 277   | 0       | 2619  | 287   | 0       | 14    | 297   | 0       | 1426  |
| 258   | 0       | 5940  | 268   | 0       | 2337  | 278   | 0       | 2619  | 288   | 0       | 13    | 298   | 0       | 1426  |
| 259   | 0       | 5940  | 269   | 0       | 1550  | 279   | 0       | 2619  | 289   | 0       | 13    | 299   | 0       | 2688  |
| 260   | 0       | 5940  | 270   | 0       | 4     | 280   | 0       | 2611  | 290   | 0       | 1     | 300   | 0       | 2688  |

| BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL |
|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|
| 301   | 0       | 2688  | 311   | 0       | 2     | 321   | 0       | 1451  | 331   | 0       | 1453  | 341   | 0       | 232   |
| 302   | 0       | 7114  | 312   | 0       | 7092  | 322   | 0       | 1206  | 332   | 0       | 1453  | 342   | 0       | 2     |
| 303   | 0       | 7114  | 313   | 0       | 7100  | 323   | 0       | 9     | 333   | 0       | 1453  | 343   | 0       | 2     |
| 304   | 0       | 84    | 314   | 0       | 7100  | 324   | 0       | 9     | 334   | 0       | 1262  | 344   | 0       | 2     |
| 305   | 0       | 22    | 315   | 0       | 7100  | 325   | 0       | 9     | 335   | 0       | 1453  | 345   | 0       | 2     |
| 306   | 0       | 20    | 316   | 0       | 7100  | 326   | 0       | 9     | 336   | 0       | 1451  | 346   | 0       | 0     |
| 307   | 0       | 20    | 317   | 0       | 7120  | 327   | 0       | 0     | 337   | 0       | 508   | 347   | 0       | 0     |
| 308   | 0       | 20    | 318   | 0       | 1462  | 328   | 0       | 0     | 338   | 0       | 508   | 348   | 0       | 506   |
| 309   | 0       | 2     | 319   | 0       | 1462  | 329   | 0       | 1453  | 339   | 0       | 508   | 349   | 0       | 506   |
| 310   | 0       | 2     | 320   | 0       | 1460  | 330   | 0       | 1453  | 340   | 0       | 506   | 350   | 0       | 506   |

|         |       |         |       |         |       |         |       |         |       |         |       |
|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|
| BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL |
| CURRENT |       | CURRENT |       | CURRENT |       | CURRENT |       | CURRENT |       | CURRENT |       |
| 351     | 0     | 361     | 0     | 371     | 0     | 381     | 0     | 391     | 0     | 400     | 0     |
| 352     | 506   | 362     | 682   | 372     | 681   | 382     | 679   | 392     | 665   | 400     | 665   |
| 353     | 0     | 363     | 0     | 373     | 0     | 383     | 0     | 393     | 0     | 400     | 0     |
| 354     | 417   | 364     | 678   | 374     | 679   | 384     | 679   | 394     | 446   | 400     | 446   |
| 355     | 0     | 365     | 537   | 375     | 679   | 385     | 679   | 395     | 446   | 400     | 446   |
| 356     | 505   | 366     | 3     | 376     | 641   | 386     | 641   | 396     | 446   | 400     | 446   |
| 357     | 0     | 367     | 3     | 377     | 679   | 387     | 679   | 397     | 446   | 400     | 446   |
| 358     | 497   | 368     | 3     | 378     | 677   | 388     | 677   | 398     | 446   | 400     | 446   |
| 359     | 0     | 369     | 0     | 379     | 665   | 389     | 665   | 399     | 446   | 400     | 446   |
| 360     | 682   | 370     | 0     | 380     | 665   | 390     | 665   | 400     | 446   | 400     | 446   |

|         |       |         |       |         |       |         |       |         |       |         |       |
|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|
| BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL |
| CURRENT |       | CURRENT |       | CURRENT |       | CURRENT |       | CURRENT |       | CURRENT |       |
| 401     | 0     | 411     | 0     | 421     | 0     | 431     | 0     | 441     | 0     | 450     | 0     |
| 402     | 445   | 412     | 410   | 422     | 410   | 432     | 410   | 442     | 402   | 450     | 402   |
| 403     | 437   | 413     | 410   | 423     | 410   | 433     | 410   | 443     | 402   | 450     | 402   |
| 404     | 0     | 414     | 267   | 424     | 410   | 434     | 410   | 444     | 402   | 450     | 402   |
| 405     | 129   | 415     | 0     | 425     | 410   | 435     | 410   | 445     | 402   | 450     | 402   |
| 406     | 0     | 416     | 0     | 426     | 384   | 436     | 384   | 446     | 402   | 450     | 402   |
| 407     | 2     | 417     | 0     | 427     | 410   | 437     | 410   | 447     | 402   | 450     | 402   |
| 408     | 435   | 418     | 0     | 428     | 408   | 438     | 408   | 448     | 402   | 450     | 402   |
| 409     | 7251  | 419     | 0     | 429     | 402   | 439     | 402   | 449     | 402   | 450     | 402   |
| 410     | 410   | 420     | 0     | 430     | 402   | 440     | 402   | 450     | 402   | 450     | 402   |

|         |       |         |       |         |       |         |       |         |       |         |       |
|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|
| BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL |
| CURRENT |       | CURRENT |       | CURRENT |       | CURRENT |       | CURRENT |       | CURRENT |       |
| 451     | 0     | 461     | 0     | 471     | 0     | 481     | 0     | 491     | 0     | 500     | 0     |
| 452     | 4308  | 462     | 26    | 472     | 0     | 482     | 0     | 492     | 401   | 500     | 401   |
| 453     | 0     | 463     | 4202  | 473     | 0     | 483     | 0     | 493     | 399   | 500     | 399   |
| 454     | 4100  | 464     | 7105  | 474     | 0     | 484     | 0     | 494     | 392   | 500     | 392   |
| 455     | 0     | 465     | 401   | 475     | 0     | 485     | 0     | 495     | 392   | 500     | 392   |
| 456     | 4308  | 466     | 401   | 476     | 401   | 486     | 401   | 496     | 50    | 500     | 50    |
| 457     | 4296  | 467     | 401   | 477     | 401   | 487     | 401   | 497     | 2     | 500     | 2     |
| 458     | 0     | 468     | 401   | 478     | 401   | 488     | 401   | 498     | 1     | 500     | 1     |
| 459     | 4228  | 469     | 328   | 479     | 401   | 489     | 401   | 499     | 1     | 500     | 1     |
| 460     | 1355  | 470     | 0     | 480     | 401   | 490     | 401   | 500     | 390   | 500     | 390   |

|         |       |         |       |         |       |         |       |         |       |         |       |
|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|---------|-------|
| BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL | BLOCK   | TOTAL |
| CURRENT |       | CURRENT |       | CURRENT |       | CURRENT |       | CURRENT |       | CURRENT |       |
| 501     | 0     | 511     | 0     | 521     | 0     | 531     | 0     | 541     | 0     | 550     | 0     |
| 502     | 0     | 512     | 455   | 522     | 455   | 532     | 455   | 542     | 289   | 550     | 289   |
| 503     | 469   | 513     | 118   | 523     | 118   | 533     | 118   | 543     | 289   | 550     | 289   |
| 504     | 0     | 514     | 3     | 524     | 3     | 534     | 3     | 544     | 289   | 550     | 289   |
| 505     | 469   | 515     | 3     | 525     | 3     | 535     | 3     | 545     | 289   | 550     | 289   |
| 506     | 0     | 516     | 452   | 526     | 452   | 536     | 452   | 546     | 289   | 550     | 289   |
| 507     | 397   | 517     | 943   | 527     | 943   | 537     | 943   | 547     | 289   | 550     | 289   |
| 508     | 469   | 518     | 28    | 528     | 28    | 538     | 28    | 548     | 289   | 550     | 289   |
| 509     | 468   | 519     | 28    | 529     | 28    | 539     | 28    | 549     | 289   | 550     | 289   |
| 510     | 455   | 520     | 8     | 530     | 8     | 540     | 8     | 550     | 289   | 550     | 289   |

| BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL |       |         |       |       |         |       |       |         |       |       |         |       |       |         |       |
|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|-------|---------|-------|
| 551   | 0       | 28    | 561   | 0       | 81    | 571   | 0       | 97    | 581   | 0       | 97    | 591   | 0       | 97    | 552   | 0       | 28    | 562   | 0       | 81    | 572   | 0       | 97    | 582   | 0       | 97    | 592   | 0       | 4798  |       |         |       |       |         |       |
| 553   | 0       | 40    | 563   | 0       | 81    | 573   | 0       | 97    | 583   | 0       | 97    | 593   | 0       | 5128  | 554   | 0       | 20    | 564   | 0       | 81    | 574   | 0       | 97    | 584   | 0       | 5504  | 594   | 0       | 8047  |       |         |       |       |         |       |
| 555   | 0       | 19    | 565   | 0       | 81    | 575   | 0       | 97    | 585   | 0       | 97    | 595   | 0       | 4667  | 556   | 0       | 20    | 566   | 0       | 81    | 576   | 0       | 97    | 586   | 0       | 4667  | 596   | 0       | 8047  |       |         |       |       |         |       |
| 556   | 0       | 20    | 566   | 0       | 81    | 576   | 0       | 97    | 586   | 0       | 97    | 596   | 0       | 4667  | 557   | 0       | 3     | 567   | 0       | 81    | 577   | 0       | 97    | 587   | 0       | 4573  | 597   | 0       | 1263  |       |         |       |       |         |       |
| 558   | 0       | 112   | 568   | 0       | 81    | 578   | 0       | 97    | 588   | 0       | 97    | 598   | 0       | 4573  | 559   | 0       | 40    | 569   | 0       | 81    | 579   | 0       | 97    | 589   | 0       | 4573  | 599   | 0       | 1263  |       |         |       |       |         |       |
| 560   | 0       | 160   | 570   | 0       | 97    | 580   | 0       | 97    | 590   | 0       | 97    | 600   | 0       | 4573  |       |         |       |       |         |       |       |         |       |       |         | 5836  |       |         |       |       |         |       |       |         |       |
|       |         |       |       |         |       |       |         |       |       |         |       |       |         |       |       |         |       | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL |
| 601   | 0       | 5478  | 611   | 0       | 0     | 621   | 0       | 337   | 631   | 0       | 337   | 641   | 0       | 565   | 602   | 0       | 5768  | 612   | 0       | 0     | 622   | 0       | 3672  | 632   | 0       | 565   | 642   | 0       | 20    |       |         |       |       |         |       |
| 603   | 0       | 4003  | 613   | 0       | 28    | 623   | 0       | 3672  | 633   | 0       | 3672  | 643   | 0       | 3660  | 604   | 0       | 331   | 614   | 0       | 28    | 624   | 0       | 3672  | 634   | 0       | 3660  | 644   | 0       | 20    |       |         |       |       |         |       |
| 605   | 0       | 331   | 615   | 0       | 337   | 625   | 0       | 3672  | 635   | 0       | 3672  | 645   | 0       | 3660  | 606   | 0       | 331   | 616   | 0       | 337   | 626   | 0       | 4093  | 636   | 0       | 3660  | 646   | 0       | 28    |       |         |       |       |         |       |
| 607   | 0       | 331   | 617   | 0       | 337   | 627   | 0       | 565   | 637   | 0       | 565   | 647   | 0       | 3660  | 608   | 0       | 221   | 618   | 0       | 337   | 628   | 0       | 3470  | 638   | 0       | 3660  | 648   | 0       | 111   |       |         |       |       |         |       |
| 609   | 0       | 28    | 619   | 0       | 337   | 629   | 0       | 337   | 639   | 0       | 337   | 649   | 0       | 3660  | 610   | 0       | 0     | 620   | 0       | 263   | 630   | 0       | 640   | 650   | 0       | 28    | 650   | 0       | 43    |       |         |       |       |         |       |
|       |         |       |       |         |       |       |         |       |       |         |       |       |         |       |       |         |       | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL |
| 651   | 0       | 0     | 661   | 0       | 10    | 671   | 0       | 56    | 681   | 0       | 173   | 691   | 0       | 186   | 652   | 0       | 0     | 662   | 0       | 10    | 672   | 0       | 6     | 682   | 0       | 0     | 692   | 0       | 112   |       |         |       |       |         |       |
| 653   | 0       | 333   | 663   | 0       | 10    | 673   | 0       | 59    | 683   | 0       | 0     | 693   | 0       | 6     | 654   | 0       | 111   | 664   | 0       | 72    | 674   | 0       | 59    | 684   | 0       | 0     | 694   | 0       | 6     |       |         |       |       |         |       |
| 655   | 0       | 222   | 665   | 0       | 72    | 675   | 0       | 0     | 685   | 0       | 173   | 695   | 0       | 106   | 656   | 0       | 333   | 666   | 0       | 72    | 676   | 0       | 101   | 686   | 0       | 101   | 696   | 0       | 106   |       |         |       |       |         |       |
| 657   | 0       | 333   | 667   | 0       | 36    | 677   | 0       | 30    | 687   | 0       | 101   | 697   | 0       | 186   | 658   | 0       | 333   | 668   | 0       | 36    | 678   | 0       | 101   | 688   | 0       | 101   | 698   | 0       | 186   |       |         |       |       |         |       |
| 659   | 0       | 30    | 669   | 0       | 36    | 679   | 0       | 110   | 689   | 0       | 72    | 699   | 0       | 333   | 660   | 0       | 30    | 670   | 0       | 56    | 680   | 0       | 173   | 690   | 0       | 186   | 700   | 0       | 111   |       |         |       |       |         |       |
| 660   | 0       | 30    | 670   | 0       | 56    | 680   | 0       | 173   | 690   | 0       | 173   | 700   | 0       | 186   |       |         |       |       |         |       |       |         |       |       |         | 111   |       |         |       |       |         |       |       |         |       |
|       |         |       |       |         |       |       |         |       |       |         |       |       |         |       |       |         |       | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL | BLOCK | CURRENT | TOTAL |
| 701   | 0       | 333   | 711   | 0       | 17157 | 721   | 0       | 13590 | 731   | 0       | 13636 | 741   | 0       | 13636 | 702   | 0       | 25698 | 712   | 0       | 13590 | 722   | 0       | 13590 | 732   | 0       | 13590 | 742   | 0       | 13590 |       |         |       |       |         |       |
| 703   | 0       | 25985 | 713   | 0       | 13636 | 723   | 0       | 13636 | 733   | 0       | 13636 | 743   | 0       | 13636 | 704   | 0       | 25985 | 714   | 0       | 13636 | 724   | 0       | 13636 | 734   | 0       | 13636 | 744   | 0       | 13636 |       |         |       |       |         |       |
| 705   | 0       | 8828  | 715   | 0       | 69    | 725   | 0       | 69    | 735   | 0       | 69    | 745   | 0       | 69    | 706   | 0       | 353   | 716   | 0       | 69    | 726   | 0       | 69    | 736   | 0       | 69    | 746   | 0       | 69    |       |         |       |       |         |       |
| 707   | 0       | 353   | 717   | 0       | 69    | 727   | 0       | 69    | 737   | 0       | 69    | 747   | 0       | 69    | 708   | 0       | 8475  | 718   | 0       | 8475  | 728   | 0       | 8475  | 738   | 0       | 8475  | 748   | 0       | 8475  |       |         |       |       |         |       |
| 709   | 0       | 8475  | 719   | 0       | 17157 | 729   | 0       | 17157 | 739   | 0       | 17157 | 749   | 0       | 17157 | 710   | 0       | 17157 | 720   | 0       | 17157 | 730   | 0       | 17157 | 740   | 0       | 17157 | 750   | 0       | 17157 |       |         |       |       |         |       |

\*\*\*\*\*  
 \* USER CHAINS \*  
 \*  
 \*\*\*\*\*

| USER CHAIN | TOTAL<br>ENIRIES | AVERAGE<br>TIME/TRANS | CURRENT<br>CONTENTS | AVERAGE<br>CONTENTS | MAXIMUM<br>CONTENTS |
|------------|------------------|-----------------------|---------------------|---------------------|---------------------|
| MAINC      | 4123             | 206.674               |                     | 12.680              | 153                 |
| FCII       | 2162             | 267.294               | 3                   | 8.599               | 31                  |
| ACH        | 7279             | 350.811               | 46                  | 37.999              | 65                  |
| BCH        | 1138             | 200.007               | 3                   | 3.387               | 15                  |
| JCH        | 945              | 267.903               | 3                   | 3.767               | 16                  |
| PTRIC      | 290              | 442.155               |                     | 1.908               | 20                  |
| SKCKC      | 724              | 1507.440              | 60                  | 16.240              | 71                  |
| CRTEC      | 98               | 287.285               |                     | .418                | 5                   |
| DEEXC      | 618              | 75.906                | 1                   | .698                | 41                  |
| SCNTC      | 4899             | 111.655               | 16                  | 8.139               | 231                 |
| STOFC      | 2346             | 149.248               | 4                   | 5.210               | 105                 |
| YHCSC      | 1206             | 126.582               |                     | 2.271               | 63                  |
| YKCS       | 232              | 87.969                |                     | .303                | 14                  |
| DRYHC      | 537              | 84.059                |                     | .671                | 24                  |
| AMNEC      | 389              | 234.964               |                     | 1.360               | 18                  |
| BHNEC      | 267              | 66.715                |                     | .265                | 12                  |
| FINEC      | 328              | 80.234                |                     | .391                | 15                  |
| JHNEC      | 234              | 80.670                |                     | .280                | 11                  |
| HVYPC      | 228              | 430.140               | 1                   | 1.459               | 10                  |
| LITPC      | 4093             | 409.713               | 12                  | 24.954              | 106                 |
| DRTEC      | 2148             | 884.417               | 92                  | 28.269              | 119                 |
| THREE      | 5039             | 2850.916              | 261                 | 213.776             | 302                 |
| THO        | 2199             | 735.309               | 31                  | 24.061              | 52                  |
| ONE        | 2643             | 2.065                 | 1                   | .081                | 9                   |
| DLVRC      | 1496             | 2609.096              | 70                  | 58.083              | 91                  |
| BIKEC      | 7109             | 176.599               | 9                   | 18.682              | 200                 |
| HCH        | 7178             | 562.773               | 97                  | 60.112              | 102                 |
| ATRIC      | 4573             | 37.174                |                     | 2.529               | 81                  |
| BIRIC      | 1263             | 28.735                |                     | .540                | 17                  |
| DUTYC      | 43               | 121.534               |                     | .077                | 6                   |

## STORAGES

131

\*\*\*\*\*  
 \*  
 \*  
 \*  
 \*  
 \*\*\*\*\*  
 \*  
 \*  
 \*  
 \*  
 \*\*\*\*\*  
 \*  
 \*  
 \*  
 \*  
 \*\*\*\*\*

QUEUES

| QUEUE | MAXIMUM<br>CONTENTS | AVERAGE<br>CONTENTS | TOTAL<br>ENTRIES | ZERO<br>ENTRIES | PERCENT<br>ZEROS | AVERAGE<br>TIME/TRANS | SAVERAGE<br>TIME/TRANS | TABLE<br>NUMBER | CURRENT<br>CONTENTS |
|-------|---------------------|---------------------|------------------|-----------------|------------------|-----------------------|------------------------|-----------------|---------------------|
| QSKCK | 213                 | 48.743              | 7677             | 5502            | 71.6             | 426.674               | 1506.013               |                 | 180                 |
| QCRTE | 18                  | 1.259               | 5370             | 5136            | 95.6             | 15.755                | 361.563                |                 | 276                 |
| QDRTE | 357                 | 84.814              | 14241            | 7791            | 54.7             | 400.220               | 883.650                |                 | 876                 |
| QSCPR | 1035                | 713.513             | 21714            | 12              | .0               | 2208.166              | 2209.387               |                 | 3                   |
| QCSPR | 27                  | .243                | 7929             | 1479            | 18.6             | 2.065                 | 2.539                  |                 | 3                   |
| QDEEX | 123                 | 2.117               | 2724             | 870             | 31.9             | 52.237                | 76.750                 |                 | 3                   |
| QSCNT | 693                 | 24.574              | 17898            | 3201            | 17.8             | 92.266                | 112.362                |                 | 48                  |
| QSTOF | 315                 | 15.700              | 7881             | 849             | 10.7             | 133.872               | 150.034                |                 | 12                  |
| QDLVR | 273                 | 174.250             | 4488             | 15              | .3               | 2609.096              | 2617.845               |                 | 210                 |
| QBRIE | 600                 | 56.046              | 21393            | 174             | .8               | 176.054               | 177.498                |                 | 27                  |
| QYHCS | 189                 | 6.917               | 4386             | 975             | 22.2             | 105.980               | 136.274                |                 |                     |
| QYKCS | 42                  | .920                | 1524             | 828             | 54.3             | 40.606                | 88.913                 |                 |                     |
| QRYWM | 72                  | 2.015               | 2046             | 435             | 21.2             | 66.187                | 84.059                 |                 |                     |
| QAHHE | 54                  | 4.171               | 1338             | 219             | 16.3             | 209.488               | 250.487                |                 |                     |
| QBTRH | 258                 | 135.820             | 3945             | 42              | 1.0              | 2313.599              | 2338.495               |                 | 156                 |
| QBWHI | 36                  | .795                | 1230             | 429             | 34.8             | 43.446                | 66.715                 |                 |                     |
| QIAIN | 459                 | 38.052              | 12942            | 1068            | 8.2              | 197.582               | 215.354                |                 |                     |
| QATRN | 357                 | 206.345             | 14019            |                 | .0               | 989.117               | 989.117                |                 | 300                 |
| QFWHE | 45                  | 1.174               | 1203             | 219             | 18.2             | 65.628                | 80.234                 |                 |                     |
| QJHHE | 33                  | .851                | 1410             | 711             | 50.4             | 40.597                | 81.892                 |                 |                     |
| QPTRN | 60                  | 5.724               | 870              |                 | .0               | 442.155               | 442.155                |                 |                     |
| QIVYP | 30                  | 4.383               | 1014             | 414             | 40.8             | 290.473               | 490.899                |                 | 3                   |
| QLITP | 318                 | 74.889              | 11016            | 471             | 4.2              | 456.842               | 477.247                |                 | 36                  |
| DUTYQ | 8                   | .119                | 333              | 143             | 42.9             | 24.096                | 42.231                 |                 |                     |

SAVERAGE TIME/TRANS = AVERAGE TIME/TRANS EXCLUDING ZERO ENTRIES

\*\*\*\*\*  
\*  
\*  
\*  
\*  
\*  
\*  
\*  
\*  
\*  
\*\*\*\*\*

TABLES

| TABLE ALL                 |                    | MEAN ARGUMENT     |                       | STANDARD DEVIATION   |                  | SUM OF ARGUMENTS    |  | NON-WEIGHTED |  |
|---------------------------|--------------------|-------------------|-----------------------|----------------------|------------------|---------------------|--|--------------|--|
| ENTRIES IN TABLE          |                    | 4601.589          |                       | 3488.000             |                  | 119572384.000       |  |              |  |
| UPPER LIMIT               | OBSERVED FREQUENCY | PER CENT OF TOTAL | CUMULATIVE PERCENTAGE | CUMULATIVE REMAINDER | MULTIPLE OF MEAN | DEVIATION FROM MEAN |  |              |  |
| 0                         | 0                  | .00               | .0                    | 100.0                | -.000            | -1.319              |  |              |  |
| 1200                      | 4201               | 16.16             | 16.1                  | 83.8                 | .260             | -.975               |  |              |  |
| 2400                      | 889                | 3.42              | 19.5                  | 80.4                 | .521             | -.631               |  |              |  |
| 3600                      | 10155              | 39.08             | 58.6                  | 41.3                 | .782             | -.287               |  |              |  |
| 4800                      | 525                | 2.02              | 60.6                  | 39.3                 | 1.043            | .056                |  |              |  |
| 6000                      | 2538               | 9.76              | 70.4                  | 29.5                 | 1.303            | .400                |  |              |  |
| 7200                      | 624                | 2.40              | 72.8                  | 27.1                 | 1.564            | .744                |  |              |  |
| 8400                      | 2958               | 11.38             | 84.2                  | 15.7                 | 1.825            | 1.088               |  |              |  |
| 9600                      | 603                | 2.32              | 86.5                  | 13.4                 | 2.086            | 1.433               |  |              |  |
| 10800                     | 2274               | 8.75              | 95.3                  | 4.6                  | 2.347            | 1.777               |  |              |  |
| 12000                     | 189                | .72               | 96.0                  | 3.9                  | 2.607            | 2.121               |  |              |  |
| 13200                     | 669                | 2.57              | 98.6                  | 1.3                  | 2.868            | 2.465               |  |              |  |
| 14400                     | 39                 | .15               | 98.7                  | 1.2                  | 3.129            | 2.809               |  |              |  |
| 15600                     | 159                | .61               | 99.3                  | .6                   | 3.390            | 3.153               |  |              |  |
| 16800                     | 15                 | .05               | 99.4                  | .5                   | 3.650            | 3.497               |  |              |  |
| 18000                     | 96                 | .36               | 99.8                  | .1                   | 3.911            | 3.841               |  |              |  |
| 19200                     | 3                  | .01               | 99.8                  | .1                   | 4.172            | 4.185               |  |              |  |
| 20400                     | 9                  | .03               | 99.8                  | .1                   | 4.433            | 4.529               |  |              |  |
| 21600                     | 3                  | .01               | 99.8                  | .1                   | 4.694            | 4.873               |  |              |  |
| 22800                     | 18                 | .06               | 99.9                  | .0                   | 4.954            | 5.217               |  |              |  |
| 24000                     | 0                  | .00               | 99.9                  | .0                   | 5.215            | 5.561               |  |              |  |
| OVERFLOW                  | 18                 | .06               | 100.0                 | .0                   |                  |                     |  |              |  |
| AVERAGE VALUE OF OVERFLOW |                    | 25119.00          |                       |                      |                  |                     |  |              |  |

| TABLE IPGON                        |                    | MEAN ARGUMENT     |                       | STANDARD DEVIATION   |                  | SUM OF ARGUMENTS    |  | NON-WEIGHTED |  |
|------------------------------------|--------------------|-------------------|-----------------------|----------------------|------------------|---------------------|--|--------------|--|
| ENTRIES IN TABLE                   |                    | 760.742           |                       | 342.000              |                  | 268542.000          |  |              |  |
| UPPER LIMIT                        | OBSERVED FREQUENCY | PER CENT OF TOTAL | CUMULATIVE PERCENTAGE | CUMULATIVE REMAINDER | MULTIPLE OF MEAN | DEVIATION FROM MEAN |  |              |  |
| 0                                  | 0                  | .00               | .0                    | 100.0                | -.000            | -2.224              |  |              |  |
| 1200                               | 332                | 94.05             | 94.0                  | 5.9                  | 1.577            | 1.284               |  |              |  |
| 2400                               | 21                 | 5.94              | 100.0                 | .0                   | 3.154            | 4.793               |  |              |  |
| REMAINING FREQUENCIES ARE ALL ZERO |                    |                   |                       |                      |                  |                     |  |              |  |

| TABLE IPGTH                        |           | MEAN ARGUMENT |             | STANDARD DEVIATION |          | SUM OF ARGUMENTS |  | NON-WEIGHTED |  |
|------------------------------------|-----------|---------------|-------------|--------------------|----------|------------------|--|--------------|--|
| ENTRIES IN TABLE                   |           | 2720.000      |             | 2266.000           |          | 23052000.000     |  |              |  |
| UPPER                              | OBSERVED  | PER CENT      | CURTULATIVE | CUMULATIVE         | MULTIPLE | DEVIATION        |  |              |  |
| LIMIT                              | FREQUENCY | OF TOTAL      | PERCENTAGE  | REMAINDER          | OF MEAN  | FROM MEAN        |  |              |  |
| 0                                  | 0         | .00           | .0          | 100.0              | -.000    | -1.200           |  |              |  |
| 1200                               | 2918      | 34.43         | 34.4        | 65.5               | .441     | -.670            |  |              |  |
| 2400                               | 508       | 5.99          | 40.4        | 59.5               | .802     | -.141            |  |              |  |
| 3600                               | 3438      | 40.56         | 80.9        | 19.0               | 1.323    | .388             |  |              |  |
| 4800                               | 102       | 1.20          | 82.1        | 17.8               | 1.764    | .917             |  |              |  |
| 6000                               | 225       | 2.65          | 84.8        | 15.1               | 2.205    | 1.447            |  |              |  |
| 7200                               | 216       | 2.54          | 87.3        | 12.6               | 2.647    | 1.977            |  |              |  |
| 8400                               | 1041      | 12.28         | 99.6        | .3                 | 3.088    | 2.506            |  |              |  |
| 9600                               | 15        | .17           | 99.8        | .1                 | 3.529    | 3.036            |  |              |  |
| 10800                              | 12        | .14           | 100.0       | .0                 | 3.970    | 3.565            |  |              |  |
| REMAINING FREQUENCIES ARE ALL ZERO |           |               |             |                    |          |                  |  |              |  |

REMAINING FREQUENCIES ARE ALL ZERO

| TABLE IPGTH               |                    | MEAN ARGUMENT     |                       | STANDARD DEVIATION   |                  | SUM OF ARGUMENTS    |  | NON-WEIGHTED |  |
|---------------------------|--------------------|-------------------|-----------------------|----------------------|------------------|---------------------|--|--------------|--|
| ENTRIES IN TABLE          |                    | 5610.058          |                       | 3580.000             |                  | 96251840.000        |  |              |  |
| UPPER LIMIT               | OBSERVED FREQUENCY | PER CENT OF TOTAL | CUMULATIVE PERCENTAGE | CUMULATIVE REMAINDER | MULTIPLE OF MEAN | DEVIATION FROM MEAN |  |              |  |
| 0                         | 0                  | .00               | .0                    | 100.0                | -.000            | -1.567              |  |              |  |
| 1200                      | 951                | 5.54              | 5.5                   | 94.4                 | .213             | -1.231              |  |              |  |
| 2400                      | 360                | 2.09              | 7.6                   | 92.3                 | .427             | -.896               |  |              |  |
| 3600                      | 6717               | 39.15             | 46.7                  | 53.2                 | .641             | -.561               |  |              |  |
| 4800                      | 423                | 2.46              | 49.2                  | 50.7                 | .855             | -.226               |  |              |  |
| 6000                      | 2313               | 13.48             | 62.7                  | 37.2                 | 1.069            | .108                |  |              |  |
| 7200                      | 408                | 2.37              | 65.1                  | 34.8                 | 1.283            | .444                |  |              |  |
| 8400                      | 1917               | 11.17             | 76.2                  | 23.7                 | 1.497            | .779                |  |              |  |
| 9600                      | 588                | 3.42              | 79.7                  | 20.2                 | 1.711            | 1.114               |  |              |  |
| 10800                     | 2262               | 13.18             | 92.9                  | 7.0                  | 1.925            | 1.449               |  |              |  |
| 12000                     | 189                | 1.10              | 94.0                  | 5.9                  | 2.139            | 1.784               |  |              |  |
| 13200                     | 669                | 3.89              | 97.9                  | 2.0                  | 2.352            | 2.120               |  |              |  |
| 14400                     | 39                 | .22               | 98.1                  | 1.8                  | 2.566            | 2.455               |  |              |  |
| 15600                     | 159                | .92               | 99.0                  | .9                   | 2.780            | 2.790               |  |              |  |
| 16800                     | 15                 | .08               | 99.1                  | .8                   | 2.994            | 3.125               |  |              |  |
| 18000                     | 96                 | .55               | 99.7                  | .2                   | 3.208            | 3.460               |  |              |  |
| 19200                     | 3                  | .01               | 99.7                  | .2                   | 3.422            | 3.796               |  |              |  |
| 20400                     | 9                  | .05               | 99.7                  | .2                   | 3.636            | 4.131               |  |              |  |
| 21600                     | 3                  | .01               | 99.7                  | .2                   | 3.850            | 4.466               |  |              |  |
| 22800                     | 18                 | .10               | 99.8                  | .1                   | 4.064            | 4.801               |  |              |  |
| 24000                     | 0                  | .00               | 99.8                  | .1                   | 4.278            | 5.136               |  |              |  |
| OVERFLOW                  | 18                 | .10               | 100.0                 | .0                   |                  |                     |  |              |  |
| AVERAGE VALUE OF OVERFLOW |                    | 25119.00          |                       |                      |                  |                     |  |              |  |

| NUMBER - CONTENTS |       | NUMBER - CONTENTS |       | NUMBER - CONTENTS |       | NUMBER - CONTENTS |    |
|-------------------|-------|-------------------|-------|-------------------|-------|-------------------|----|
| REQCT             | 39780 | PRION             | 519   | PRITH             | 26400 | PRUM              | 20 |
| BIUM              | 97    | NISCT             | 13636 | WRCT              | 69    |                   |    |
| EFID              |       |                   |       |                   |       |                   | 81 |

\*\*\*\*\* TOTAL RUN TIME (INCLUDING ASSEMBLY) = 4.74 MINUTES \*\*\*\*\*

# LIST OF REFERENCES

1. Daellenbach, H. G. and George, J. A., Introduction to Operations Research Techniques, p. 3, Allyn and Bacon, Inc., 1978.
2. Shannon, R. E., System Simulation, The Art and Science, Prentice-Hall, Inc., 1975.
3. Gordon, G., System Simulation, 2d ed., Prentice-Hall, Inc., 1978.
4. Mittra, S. S., "Discrete System Simulation Concepts," Simulation, v. 43, no. 3, pp. 142-144, September 1984.
5. Bronson, R., "Computer Simulation: What It Is and How Its Done," Byte, v. 9, no. 3, pp. 95-102, March 1984.
6. Weston, F. C., "O. R. Techniques Relevant to Corporate Planning Function Practices, An Investigative Look," presented at 39th National Meeting, Operations Research Society of America, Operations Research Bulletin, v. 19, suppl. 2, Spring, 1971.
7. Schmidt, J. W., "Introduction to Simulation Modeling," Winter Simulation Conference Proceedings, v. 1, pp. 5-6, 1977.
8. Schriber, T. J., "Introduction to GPSS," Proceedings of the 1980 Winter Simulation Conference, pp. 343-345, 1980.
9. Emshoff, J. R. and Sisson, R. L., Design and Use of Computer Simulation Models, The McMillan Co., 1970.
10. Kiviat, P. J., "Development of Discrete Digital Simulation Languages," Simulation, v. VIII, no. 2, pp. 65-70, February 1967.
11. Jennergren, L. P., "Simulation in Microcomputers Revisited," Journal of the Operations Research Society, v. 34, no. 11, pp. 1053-1056, November 1983.
12. Shannon, R. E., "Introduction to Simulation Languages," Winter Simulation Conference Proceedings, v. 1, pp. 15-20, 1977.
13. Law, A. M. and Kelton, W. D., Simulation Modeling and Analysis, McGraw-Hill Book Company, 1982.

## BIBLIOGRAPHY

Gordon, G., The Application of GPSS V to Discrete System Simulation, Prentice-Hall, Inc., 1975.

Lynch, M. G. and Ulrich, C. H. Requisition Throughput Time Simulation at Naval Supply Center San Diego, 1973.

Schriber, T. J., Simulation Using GPSS, John Wiley & Sons, 1974.

Turban, E. and Meredith, J. R., Fundamentals of Management Science, 3d ed., Business Publications Inc., 1985.

# INITIAL DISTRIBUTION LIST

|                                                                                                                                               | No. | Copies |
|-----------------------------------------------------------------------------------------------------------------------------------------------|-----|--------|
| 1. Defense Technical Information Center<br>Cameron Station<br>Alexandria, Virginia 22304-6145                                                 |     | 2      |
| 2. Superintendent<br>Library Attn: Code 0142<br>Naval Postgraduate School<br>Monterey, California 93943-5000                                  |     | 2      |
| 3. Naval Postgraduate School<br>Computer Technology Curricular Office<br>Code 37<br>Monterey, California 93943-5000                           |     | 1      |
| 4. U.S. Naval Supply Depot<br>Code 50<br>FPO Seattle 98762-1500                                                                               |     | 2      |
| 5. LTCOL F.M. Perry<br>Code 55PJ<br>Naval Postgraduate School<br>Monterey, California 93943-5000                                              |     | 1      |
| 6. Professor D.V. Lamm<br>Code 55LT<br>Naval Postgraduate School<br>Monterey, California 93943-5000                                           |     | 1      |
| 7. LT Michael S. Clift<br>Navy Fleet Material Support Office<br>5450 Carlisle Pike<br>P.O. Box 2010<br>Mechanicsburg, Pennsylvania 17055-0787 |     | 2      |

END

DT/C

8-86