NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Bethesda, Maryland 20034

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SEABORNE MOBILE LOGISTIC SYSTEM (SMLS) MAINTENANCE OPTIMIZATION MODEL USER'S MANUAL

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SEABORNE MOBILE LOGISTICS SYSTEM (SMLS) MAINTENANCE OPTIMIZATION MODEL
USER'S MANUAL

Report 4115

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Naval Ship Research and Development Center

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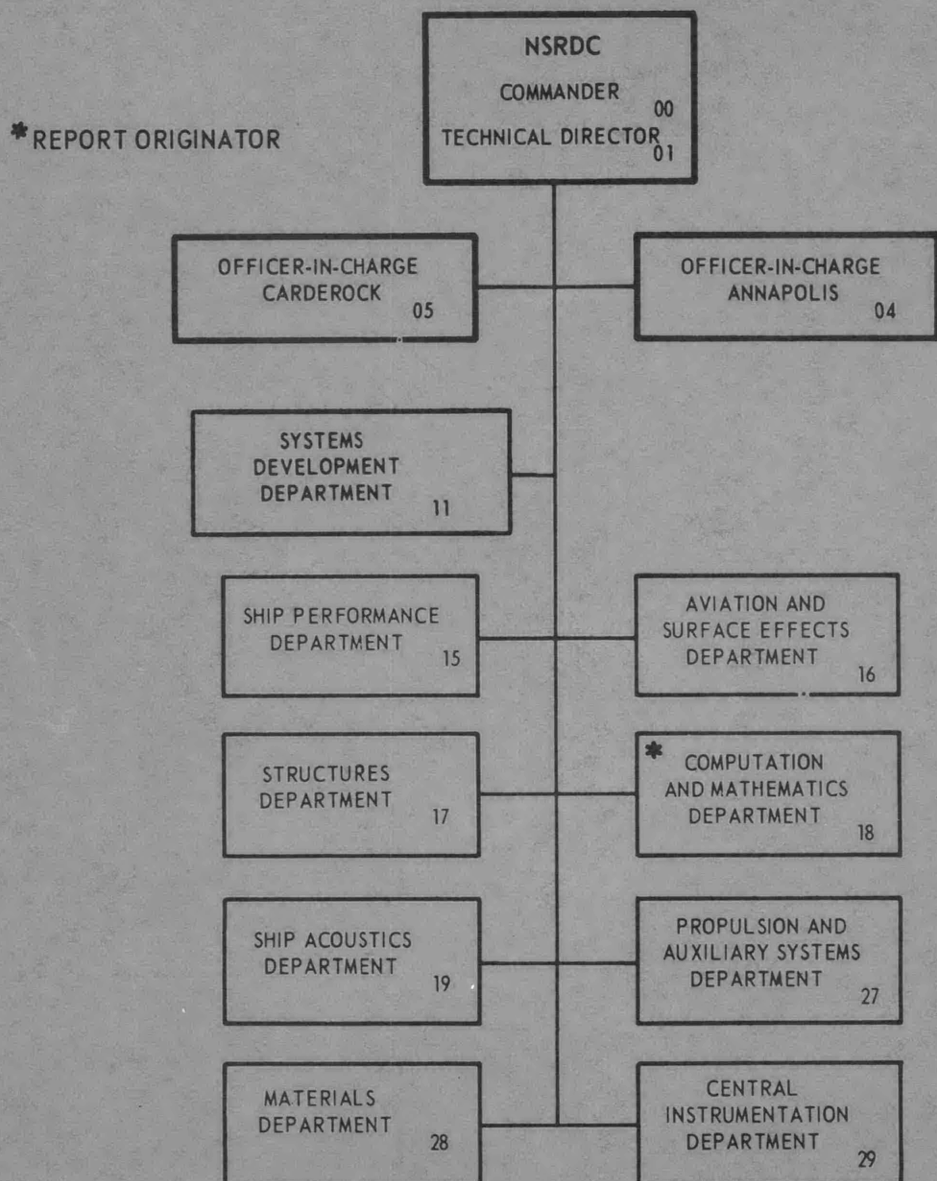

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ABSTRACT

The Maintenance Optimization Model is a computer simulation program designed to help determine optimal maintenance configurations and resource requirements for the maintenance subsystem of the Seaborne Mobile Logistic System (SMLS).

In the model, failure/repair cycles for each end item in the Landing Force are simulated over the period of a specified mission, using event generations, queuing, and Monte Carlo techniques. Measures of effectiveness such as utilization statistics for the maintenance system configuration and availability of the end item in the Landing Force are computed. In addition, the effect of the maintenance configuration on the availability of end items in the Landing Force and on requirements for resources such as operational readiness floats (ORF), maintenance personnel, and tool sets, kits, and special equipment can be examined.

This report contains a description of the computer program for the Maintenance Optimization Model, a user's guide for the program, a listing of the program, and sample output.

ADMINISTRATIVE INFORMATION

This effort was performed as a part of the SMLS Study which is jointly sponsored by the Deputy Chief of Naval Operations (Surface Warfare) and by the Assistant Chief of Staff (G-4), U.S. Marine Corps. The study is supported under Task Area R00101, Element Number 65103M. The work was carried out by the Amphibious Warfare Group (Code 1865) of the Operations Research Division.

1.0 INTRODUCTION

The Seaborne Mobile Logistic System (SMLS) defines the procedures and operations for logistic support from a seabase to a U.S. Marine Corps Landing Force positioned ashore. The seabase is composed of amphibious support ships with supplies distributed in such a way as to provide centralized logistic support. SMLS consists of the following subsystems:

- Maintenance
- Supply
- Medical
- Command and Control
- Transportation

- Communications
- Embarkation
- Services

Under SMLS the maintenance subsystem requires the use of large amounts of resources (e.g., personnel, equipment, space, etc.) in supporting the end items (operational equipment ashore) in a Marine Corps Landing Force. Consequently, a detailed analysis to determine these requirements and to determine optimal maintenance subsystem configurations is necessary. However, in order to analyze the operations and procedures of this subsystem in depth, it must be considered independently from the other subsystems in SMLS. It is therefore assumed that the basic requirements, operations, and procedures of the maintenance subsystem are essentially non-interactive with the other subsystems. The maintenance subsystem can then be referred to as a complete system.

A detailed analysis of the maintenance system was performed at the Naval Ship Research and Development Center. With this analysis as a basis, a computer simulation model, referred to as the Maintenance Optimization Model, was developed. In the model, a maintenance-system configuration and a Landing Force are defined and measures of effectiveness (MOE's) for both are computed. Specific MOE's are the availability of the end items in the Landing Force and utilization statistics of the Maintenance system. In addition, the effect of the maintenance configuration on the availability of end items in the Landing Force and on resource requirements such as operational readiness floats, maintenance personnel, and tool sets, kits and special equipment can be examined.

The configuration of the maintenance system is defined by locations of repair (i.e., maintenance done at the seabase or ashore), complexity and depth of repair available at each repair location (i.e., echelons of repair* available), number of maintenance personnel and repair spaces available, and the number of operational readiness float (ORF) items available (i.e., replacements for failed end items). The Landing Force is composed of a number of units located ashore. Each of these units is allocated a specified number of end items.

The Maintenance Optimization Model simulates actual end-item failures and then, depending on various input parameters and the maintenance configuration, decides (see section 6.12) whether the failed item will be

- repaired after being replaced
- repaired and returned to use without being replaced
- replaced and discarded without repair

The values of output variables include the availability of end items, the number of end items discarded, the number of end items repaired at each maintenance location, the time spent in repairing end items at each maintenance location, and the number of float items required. The input maintenance configuration can be changed and the resulting changes in the output variables analyzed to help determine the most effective maintenance configuration. To determine the resource requirements of each maintenance system configuration,

*In defining maintenance operations, the USMC categorizes end item failures by echelon of repair required. 1st echelon is performed by the end item user, 2nd echelon consists of minor repair, 3rd echelon consists of component and assembly replacement, 4th echelon consists of component repair, and 5th echelon consists of overhaul and rebuild. Only 2nd through 4th echelons are considered in the model.

the model also computes the tool sets, kits, and special equipment needed and the number of repair personnel required at each repair location.

The model has been programmed in FORTRAN IV to run on the CDC 6400 series computer.

2.0 BACKGROUND

The analysis required in the development of the Maintenance Optimization Model, the definition of the maintenance system and its associated operational procedures, and a detailed explanation of the maintenance concepts referred to in this report can be found in a report by Gray.[1] An overall treatment of the maintenance subsystem and its interaction with the other subsystems (supply, medical, transportation, communications, and command and control) of SMLS will be found in a report by Hubai[2] et al. Consequently only a brief description of SMLS maintenance procedures is included here to aid in understanding the operation of the Maintenance Optimization Model. When an end item in the Landing Force fails, it will either be (1) replaced and then repaired and made available whenever needed; (2) repaired without being replaced and restored to the same place to resume operation; (3) or replaced and discarded. If a replacement is required, an operational readiness float (ORF) item is removed from the inventory as soon as one is available. Repair of the end item (item alone will also be used to mean end item) can take place at the seabase or ashore, either by maintenance personnel at the unit or by a contact team (CT). Seabase repair takes place at a shop on an amphibious support ship. The shop contains a specified number of repair spaces. Repair at a unit involves a portable repair capability with a specified capacity in terms of the numbers of items which can be under repair at any given time. A CT consists of maintenance personnel deployed from the seabase to repair items ashore. There are two types of CT: nondedicated and dedicated. Nondedicated CT's are an integral part of the seabase work force. When repair ashore is completed, the nondedicate CT is transported back to the shop at the seabase. Dedicated CT's are not responsible for maintenance at the seabase. When repair is completed ashore, a dedicated CT is transported to a nearby unit to await reassignment elsewhere.

If an item is to be repaired, but maintenance resources are not available, the failed end item is placed in an appropriate queue to await repair. There are four kinds of queues: afloat in the seabase, ashore waiting to go to the seabase, ashore waiting for a CT, or ashore at one of the units.

Thus seabase repair spaces have two repair queues, one afloat and the other ashore. When the number of items in the queue afloat has research a specified upper limit, end items failing ashore will be routed first to the queue ashore, and then will be transferred to the seabase queue afloat when a space becomes available. The items waiting in the CT repair queue are not taken to a central location. When an item fails, it remains at the unit but is considered part of the CT queue.

3.0 THE SIMULATION PROCESS

The SMLS Maintenance Optimization Model continuously simulates the failure and subsequent repair of the various items which are used ashore by a Marine Corps Landing Force. These items are derived from

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[1] References are listed on page 132.

the table of equipment (T/E) of a Marine Amphibious Unit (MAU).[3] Figure 1 indicates a time-line graph of a generalized failure/repair cycle. This type of a time-line graph is simulated for each item in the Landing Force.

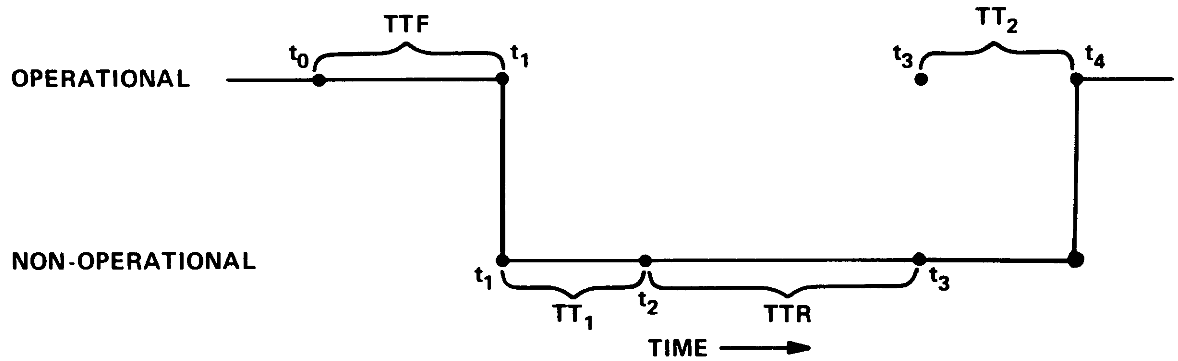

Figure 1. Failure/Repair Cycle of an Item

Assume the intervals to have the following values:

$TTF = t_1 - t_0$	time interval before failure
$TT_1 = t_2 - t_1$	time interval required for transport
$TTR = t_3 - t_2$	time interval required for repair
$TT_2 = t_4 - t_3$	time interval required for transport

In the computer application, TTF is generated from an algorithm which is a function of the item's mean time between failures (MTBF) and its utilization factor (the length of time the item is required to operate during a 24-hour period). TTR is generated from an algorithm which is a function of the item's mean time to repair (MTTR).

At time t_0, an item begins operating ashore during a time interval of TTF. An item failing at t_1 (i.e., t_0 + TTF) will either be repaired at the seabase, at a unit, or by a CT; or it will be discarded depending on the repair/replace/discard decision. If the item is to be repaired, TTR denotes the repair interval. The interval $t_2 - t_1$ denotes the time interval required to transport the failed end item to the seabase or to the unit for repair. If the item is to be repaired by a CT, this interval denotes the time interval required to transport a CT to the item. The variable t_3 indicates the time at which repair is completed. If the item has been repaired at the seabase or at a unit, it is then transported to the using unit, arriving at t_4. The interval $t_4 - t_3$ represents the needed transportation time. If the item does not need transportation (i.e., if the item was repaired by a CT) then $t_4 - t_3 = 0$. At t_4 the item is operational and can fail again; i.e., that failure/repair cycle is continued for the item over the entire mission.

The scheduling of failures, arrivals, and repairs form the basis for the Maintenance Optimization Model. In order to simulate on a digital computer the real-world situations of the failure/repair cycles and to trace the failures, arrivals, and repairs of each of the items in the Marine Corps Landing Force, the concept of "event" is utilized.

3.1 DEFINITION OF EVENT

The requirement for a specific condition (such as that an item be operational, an item or CT be transported, or an item be repaired) triggers the scheduling of an event which occurs at a later time. The event is said to have occurred when the condition has been fulfilled (i.e., the item fails, the item or CT arrives at destination, or the item is repaired when the appropriate scheduling time has elapsed) at which time decisions for subsequent action are made.

The major events in the failure/repair cycle are:

- failure of item
- arrival of item or CT at destination
- repair of item

The Maintenance Optimization Model simulates failure/repair cycles by incorporating:

- fail events, to represent item failures
- arrival events, to represent items or CT's arriving at their destination
- complete service events, to represent completion of item repairs

A fourth event which is used in the Model, but which is not involved in the failure/repair cycle, is explained in the description of Subroutine QULENTH (Section 6.16).

The event-generation process may be illustrated by a requirement for an item to be operating ashore. This requirement generates a fail event which occurs at a later time. The item remains operational from the time it begins operation ashore to the time of the failure event. When the item fails, a decision is made as to whether the item is to be repaired at the seabase, at the unit, or by a CT; or if it is going to be discarded. In another example, there is a requirement for a filed item to be transported to a maintenance location. This requirement generates an arrival event which occurs at a later time. The item is in the process of being transported from the time the transportation is made available to the time the item arrives at its destination. When the item arrives at the maintenance location, a decision is made as to whether the item will be repaired immediately or whether it will be added to the queue. The requirement for a failed item to be repaired generates a complete service event which occurs at a later time. The item is under repair from the time repair is started until the event of item repair occurs. When the item is repaired, a decision is made as to whether the item is required ashore or whether it is to be sent to the float.

3.2 SCHEDULING OF EVENTS

The large number of events which are scheduled in the model during the simulation of failure/repair cycles for the items in a Marine Corps Landing Force require a bookkeeping system. This system consists of an event list and operations which (1) store events on the list as they are generated and (2) remove events from the list systematically throughout the failure/repair cycles.

The event list refers to the locations in the computer used to store events generated during the failure/ repair cycle. Along with each event is stored the time at which it will occur* and its description. The events

*For fail and complete service events, average times are input and individual values are based on Monte Carlo choices from exponentially distributed times around these means; times for transportation events are input directly.

are arranged on the list by their simulated occurrence times. The event which will occur earliest is stored in the first location of the event list; the event with the next earliest occurrence time is stored in the second location, and so on.

Subroutine SNE performs the function of storing events on the event list. An event is simulated simply by the act of removing the event from the event list. Removal begins at the first location of the event list. Subroutine TNE performs the function of removing events from the event list. The appropriate subroutine is then entered, as indicated here, to perform subsequent actions due to the simulation of the event:

Subroutine FAIL, for a fail event
Subroutine ARRVL, for an arrival event
Subroutine COMPS, for a complete-service event.

For example, removing a fail event from the list simulates an item failure at that time. Subroutine FAIL is then entered to determine whether the item is replaced and repaired, repaired and returned to use without replacement, or replaced and discarded. (See Section 3.1 for more examples).

The simulation of failure/repair cycles by scheduling events throughout the mission duration is referred to as a simulated mission. During each simulated mission, various statistics are compiled to describe the failure and repair operations that have taken place. In the model, a number of these simulated missions (approximately 50) are run and the statistics are averaged at the end of all of the runs.

A "clock" internal to the model records the time, in hours, of each simulated mission. The time at the start of each mission is referred to as MISSION START. For this application, MISSION START equals zero. Each time an event is removed from the event list, the clock is updated to the event's occurrence time. The procedure of storing and removing events and processing subsequent actions for the event continues until the clock surpasses MISSION END.

At the start of a mission, all end items are considered fully operational at their units ashore. Initial fail events for all the end items in the Landing Force are simulated by generating successive time intervals of operation before failure (TTF) for all of the items. The generation of the initial failures is performed in Subroutine SIE. After each initial failure is generated, subroutine SNE is called to store the fail event list according to the end item's TTF. The fail event for the item with the earliest TTF, called TTF_1, is stored in the first location on the event list, the fail event for the item with the next earliest TTF, called TTF_2, is stored in the second location and so on. When all the fail events (one for each item in the LF) have been stored on the event list, the simulated mission begins. Subroutine TNE is called to start the simulation process by removing the event in the first location on the list (at MISSION START this will be a fail event) since it has the earliest occurence time of TTF_1. The clock is updated to time TTF_1. If the clock time is later than time MISSION END, the simulated mission is ended. If the clock time is less than or equal to MISSION END, the item with time to failure, TTF_1, is considered inoperable and Subroutine FAIL is entered to determine whether this failed item will be discarded and replaced, repaired and replaced, or just repaired according to decisions and information read in to the model. Other events stemming from this decision which may be generated to occur at a later point in the simulation time, are stored on the event list by subroutine SNE according to their simulated occurrence times. For example, suppose the failed item is to be transported to the seabase for repair. An input to the model is the transportation time, TRANS, required to transport the item from the unit ashore to the seabase. Hence, an arrival event at the seabase will occur at time, TTF_1 + TRANS. The arrival event is stored on the event list by calling Subroutine SNE. Suppose the failed item is to be replaced by a float item and time, TRANS, is required to transport the replacement item from the float at the seabase to the unit ashore. A time interval to failure, TTF_R, is generated for this replacement item. Hence the item begins operation in the landing force, and a fail event will occur for this item at time, TTF_1 + TRANS + TTF_R. The fail event is stored on the event list by calling Subroutine SNE. Control of the program is returned to Subroutine TNE which removes the new event from the first location on the list. Removing events from the event list, updating the clock by the occurrence time of the event, and the actual occurrence of the event removed continue until the clock time surpasses time MISSION END. Figure 2 is a flow chart summarizing this process.

3.3 MEASURES OF EFFECTIVENESS

The events mentioned simulate the failures and repairs of each end item in the Landing Force throughout the mission. During this simulation process, the total time that each item is operating and the total time each item is non-operational are recorded. From this information a measure of effectiveness, the availability of the end items in the Landing Force, is computed. The availability represents the percentage of the mission time that the end items are operational and available for use.

When items fail and repair is required, they will be scheduled for repair at one of the locations of maintenance, i.e., the seabase, unit, or by CT. A record is kept at each location of the times that items enter and leave the queues and of the repair times of the items. From this information measures of effectiveness (utilization statistics at each location of maintenance) are determined. These utilization statistics indicate the percent of the mission time that each location of maintenance is occupied performing maintenance.

4.0 INPUT

The input to the program is read from cards and from a tape. Information on the landing force and the maintenance system configuration is input on cards. Figure 3 shows the input data setup. Subroutines TITLE and INPUT instruct the computer to read the information from the cards. Information on item characteristics is input on tape. Subroutine RETRIEV instructs the computer to read this information. See Section 6.4 for a listing of the variables on the tape.

Table 1 describes the variables read in by Subroutines TITLE and INPUT. The variables read in by the same READ statement are listed in the table under a single card number. The variables listed under Cards 1 through 5 are read in by Subroutine TITLE and are used for all the commodity classes* as defined in the Table of Authorized Material.[4] The variables listed under cards 6 through 11 are read in by Subroutine INPUT and are used for a specific class (submitted by Card 7). Cards 6 through 11 are repeated for each class given. Table 2 lists the variables by their card number and card column number and gives the required format.

*All USMC end items are categorized as belonging to one of five commodity classes: Communications and Electronics, Engineer, Motor Transport, Ordnance, and General Supply. General Supply end items are not considered in this model, since they do not require maintenance.

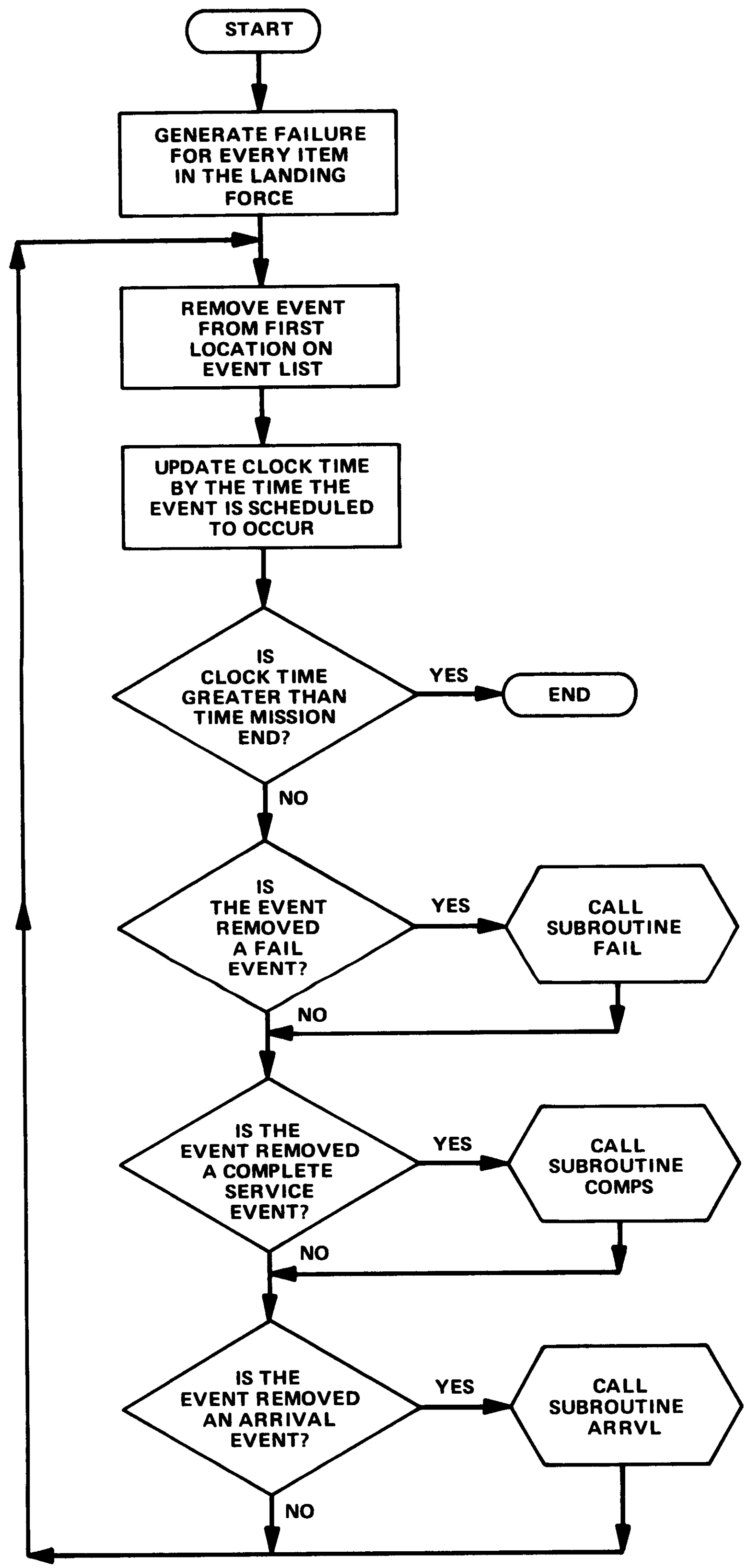

Figure 2. Flow Chart of the Event List Process

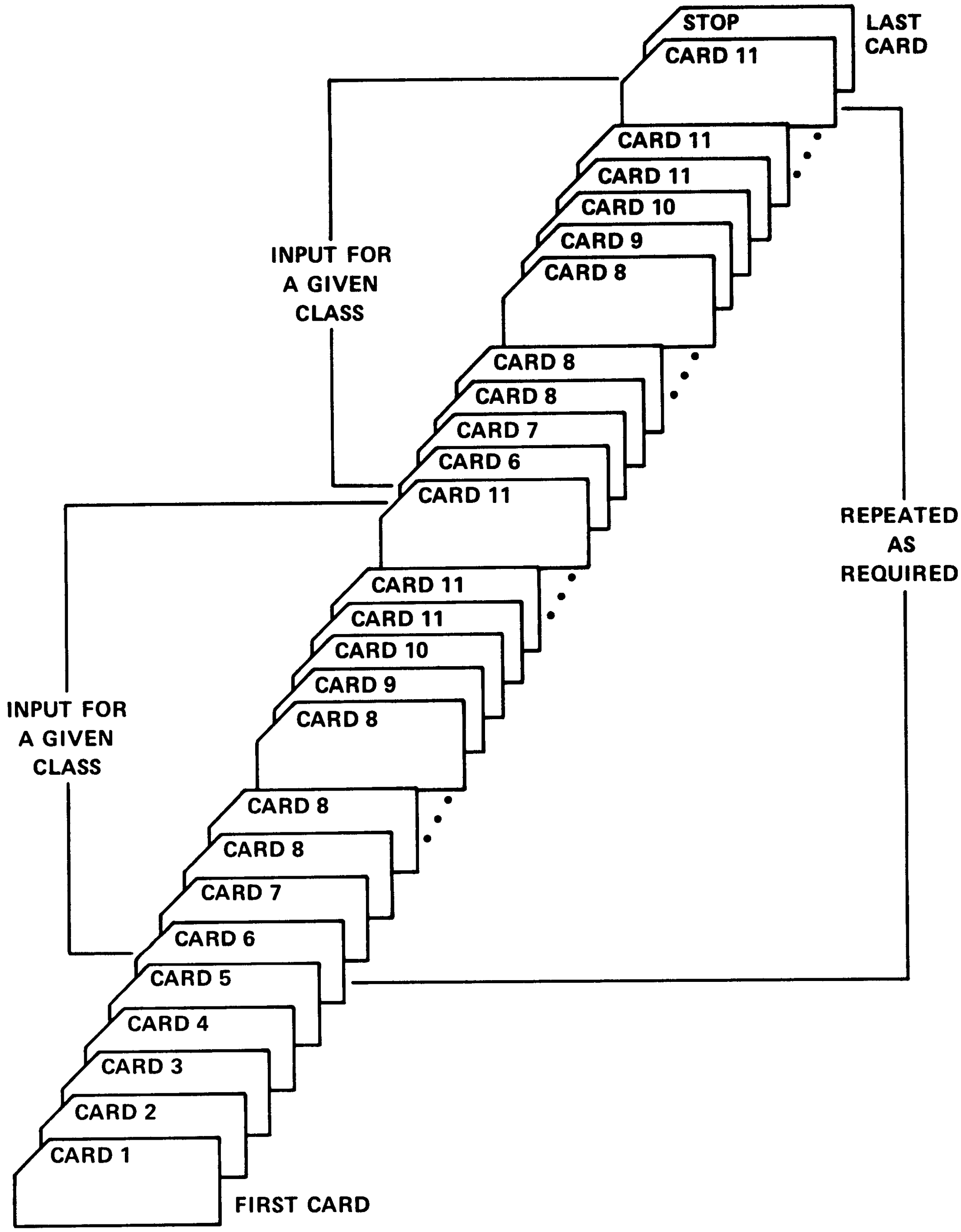

Figure 3. Input Data Setup

TABLE 1 – DESCRIPTION OF INPUT VARIABLES

VARIABLE NAME	DESCRIPTION
Card 1:	
DATE1 DATE2	Date program submitted. The use of two consecutive variables allows for a maximum alphanumeric field of 20 characters.
Card 2:	Each of the following arrays (NPRR2, NPRR3, NPRR4) uses the subscript j, where j = 1 through 4, to indicate the commodity class (1 indicates Communications/Electronics, 2 indicates Engineer, 3 indicates Motor Transport, 4 indicates Ordnance).
NPRR2(j)	Total number of personnel in commodity class j required for 2nd-echelon repair.
NPRR3(j)	Total number of personnel in commodity class j requried for 3rd-echelon repair.
NPRR4(j)	Total number of personnel in commodity class j required for 4th-echelon repair.
Card 3:	
GTIME	Mission length in hours; i.e., time interval from MISSION START to MISSION END.
TIMEINT	Time interval in hours for sampling statistics (see Section 6.16).
NMI	Number of simulated missions.
LIMDIM	Represents both maximum number of items that can be queued at one time and maximum number of requests for float items by units at one time. Presently LIMDIM = 200. To increase the value of LIMDIM beyond 200, dimensions of the following arrays, located in COMMON statements /N3/ and /N5/, must be changed: NTRQST, NURQST, TIRQST, ICTQ, ISQ, ISQA, IUQ, NPISQ, NPISQA, NUICTQ, TICTQ, TISQ, TISQA, TIUQ, NESQ, NESQA, NEUQ, and NECTQ.
T1	Transportation time, in hours, between shore and seabase (a constant).
T2	Transportation time, in hours, between any two positions ashore (a constant).
IECHAV(i)	Indicates ith-echelon repair availability at the seabase; i = 2 through 5. IECHAV(i)=1 ith-echelon repair is available IECHAV(i)=0 ith-echelon repair is not available Note: i=5 indicates that the item is either discarded or stored.
IOPT1	First write-option indicator. IOPT1=1 All explanatory write statements printed out IOPT1=0 No printing (IOPT2 and IOPT3, defined below, must be set to 0)
IOPT2	Second write-option indicator. IOPT2=1 Depending on the situation, an entire queue array will be printed out when an item is added to the queue, or an entire request array will be printed out when a request is made

TABLE 1 – DESCRIPTION OF INPUT VARIABLES (continued)

VARIABLE NAME	DESCRIPTION	
Card 3 (continued):		
IOPT2	IOPT2=0	Depending on the situation, either the location in queue where an item is added will be printed out or only the request just made will be printed out
IOPT3	Third write-option indicator.	
	IOPT3=1	One of the following arrays will be printed out: a) entire queue array when an item is removed; b) entire queue array when the priority of an item is changed; c) entire request array when a request is fulfilled. Usually used for debugging purposes.
	IOPT3=0	No printing
IDMAU	Landing Force descriptor.	
	IDMAU=1	34th MAU (see NSRDC Report 4166[1])
	IDMAU=2	Notional MAU
Card 4:		
PF(i)	Percentage of item failures at the ith echelon; i=2 through 5.	
PCTR(i)	Percentage of items repaired by a CT requiring ith-echelon repair; i=2 or 3.	
IDCT	CT requirement indicator.	
	IDCT=0	Repair by a nondedicated CT
	IDCT=1	Repair by a dedicated CT
	IDCT=2	No repair by CT
Card 5:		
MTTR2	Second-echelon mean time to repair.	
MTTR3AU	Third-echelon mean time to repair for items repaired at the seabase or at the unit.	
MTTR3CT	Third-echelon mean time to repair for items repaired by CT	
MTTR4	Fourth-echelon mean time to repair.	
Card 6:		
CONTROL	Alphanumeric input indicator.	
	CONTROL=STOP	End of input: program stops
	CONTROL≠STOP	(i.e., any 4 alphanumeric characters other than STOP) input data for another class follows
Card 7:		
NUNIT	Number of units in the Landing Force having items of the class defined by variable CLASS below.	
NOTYPE	Number of different types of items in this class (i.e., number of different TAM numbers).	
NSS	Number of repair spaces at the seabase.	
NCTS	Total number of Contact Teams available.	

VARIABLE NAME	DESCRIPTION
Card 7 (continued):	
NUS	Total maintenance capacity of each unit.
LIMIT	Maximum number of items allowed in the seabase queue afloat at one time (must be ≤ LIMDIM).
CLASS	Indicator of commodity class to be run. CLASS=1 Communications/Electronics CLASS=2 Engineer CLASS=3 Motor Transport CLASS=4 Ordnance
Card 8: Insert one card 8 for every 4 units.	
UNAME(i,1), UNAME(i,2)	Identification name of unit number i in the Landing Force; through NUNIT. Unit numbers are arbitrary. The use of two consecutive variables allows for a maximum alphanumeric field of 20 characters.
Card 9:	
IEAU(i,j)	Indicates whether or not unit number j has ith-echelon repair capability; i=2 or 3, and j=1 through NUNIT. IEAU(i,j)=1 Unit number j has ith-echelon capability IEAU(k,j)=0 Unit number j does not have ith-echelon capability
Card 10:	
NDSC(i)	Indicates decrease in repair capability at the seabase due to the departure of the ith nondedicated CT; i=1 through 5.
NPS	Number of times repair capability at the seabase is not decreased due to nondedicated CT's leaving (computed from variable NDCS(i)).
Card 11: Insert one card 11 for each different type of item (i.e., each different TAM number) in the Landing Force. The total number of these cards equals NOTYPE.	
TAMNO(i)	ith different TAM number. This array is set up in alphanumeric order from A0000 through Z9999.
MAUID(i)	Number of items with TAM number TAMNO(i).
NFI(i)	Initial number of float items with TAM number TAMNO(i).
NUTNAI	Number of units ashore which possess items with TAM number TAMNO(i)
UNITNO(k); k=1 through NUTNAI	List of units, by ID number, which contain items with TAM number TAMNO(i).
UNITDEN(k)	Total number of items with TAM number TAMNO(i) located at unit number UNITNO(k);

Note: Throughout this report the notation i=a,b will be used to represent the range that integer variable i will assume between the limits a and b, i.e., a ≤ i ≤ b.

TABLE 2 – INPUT DATA FORMAT

	VARIABLE NAME	COLUMN	FORMAT
Card 1:			
	DATE1	1–10	A10
	DATE2	11–20	A10
Card 2:			
	NPRR2(j), j=1,4	1–4	4I1
	NPRR3(j), j=1,4	6–9	4I1
	NPRR4(j), j=1,4	11–14	4I1
Card 3:			
	GTIME	1–5	F5.0
	TIMEINT	6–8	F3.0
	NMI	9–11	I3
	LIMDIM	12–14	I3
	T1	15–17	F3.1
	T2	18–20	F3.1
	IECHAV(i), i=2,5	21–24	4I1
	IOPT1	25	I1
	IOPT2	26	I1
	IOPT3	27	I1
	IDMAU	28	I1
Card 4:			
	PF(i), i=2,5	1–12	4F3.2
	PCTR(i), i=2,3	13–18	2F3.2
	IDCT	19	I1
Card 5:			
	MTTR2	1–5	F5.2
	MTTR3AU	6–10	F5.2
	MTTR3CT	11–15	F5.2
	MTTR4	16–20	F5.2
Card 6:			
	CONTROL	1–4	A4
Card 7:			
	NUNIT	1–2	I2
	NOTYPE	3–4	I2
	NSS	5–6	I2
	NCTS	7–8	I2
	NUS	9–10	I2
	LIMIT	11–12	I2
	CLASS	13–14	I2

TABLE 2 – INPUT DATA FORMAT (continued)

	VARIABLE NAME	COLUMN	FORMAT
Card 8:			
	UNAME(i,1),UNAME(i,2)	1–20	A10, A10
	•		
	•		
	•		
	UNAME(NUNIT,1),UNAME(NUNIT,2)		A10, A10
Card 9:			
	(IEAU(i,j), j=1,NUNIT), i=2,3	1–	(2*NUNIT)I1
Card 10:			
	NDCS(i), i=1,5	1–5	5I1
	NPS	6	I1
Card 11:			
	TAMNO(i)	1–5	A5
	MAUID(i)	6–8	I3
	NFI(i)	9–10	I2
	NUTNAI	11–12	I2
	UNITNO(k), k=1,NUTNAI	13–	NUTNAI*I2
	UNITDEN(k), k=1,NUTNAI		NUTNAI*I2

5.0 SUMMARIZATION OF SUBROUTINES

Brief descriptions are provided here of all the subroutines in the program. These 20 subroutines are discussed in the order that they are used in the program. Section 6 describes the subroutines in more detail.

–SUBROUTINE TITLE–

Reads input data common to all commodity classes.

–SUBROUTINE INPUT–

Reads the input data for a given class.

–SUBROUTINE RETRIEV–

Reads characteristics for all the items in a given class.

–SUBROUTINE TSEQ12–

Determines number of tool sets, kits, and special equipment required at the seabase and at the units for the repair of items in the Communications/Electronics class or the Engineer class.

–SUBROUTINE TSEQ3–

Determines for the Motor Transport class: a) number of items which require 2nd-echelon repair at the seabase and at the units; b) locations for 3rd- and 4th-echelon repairs; c) number of items with a Tam number of D1100, D1160, or D0860 which require 2nd-echelon repair at the seabase; and d) whether an item with Tam number of D1100, D1160, or D0860 will require 3rd- or 4th-echelon repair at the seabase.

–SUBROUTINE TESTEQ–

Determines number of tool sets, kits, and special equipment required at the seabase and at the units for the repair of items in the Motor Transport class.

–SUBROUTINE INITIAL–

This subroutine initializes variables internal to the program.

–SUBROUTINE SIE–

Generates initial fail events for every item in the Landing Force. Generates initial event to update variables LENTHQ and LENTHC. Initializes internal variables.

–SUBROUTINE SNE–

Stores events as they are generated on the event list.

–SUBROUTINE TNE–

Removes the event from Location 1 of the event list and transfers control of the program to an appropriate subroutine. (FAIL, COMPS, ARRVL, or QULENTH)

–SUBROUTINE FAIL–

Determines whether a failed item will be discarded; or repaired at the seabase, at the unit, or by a CT.

–SUBROUTINE REQUST–

Determines whether a float item is available. Assigns priority of the failed item.

–SUBROUTINE ARRVL–

The input parameter which indicates the type of arrival event that has occurred determines which of the following events will take place when this subroutine is called:

- When an item arrives at the seabase, the array of variables which indicate the availability of repair spaces will be examined to determine whether the item will be repaired immediately or added to the queue.

- When a nondedicated CT arrives at the seabase, the variable which indicates the number of items in the CT queue will be examined to determine whether the CT is required ashore or will remain at the seabase.
- When an item arrives at the seabase queue ashore, the variable which indicates the number of items in the queue afloat will be examined to determine whether the item will be transported to the seabase or added to the queue ashore.
- When a dedicated CT arrives at a unit ashore, the variable which indicates the number of items in the CT queue will be examined to determine whether the CT will repair an item or remain at the unit.

–SUBROUTINE COMPS–

The input parameter which indicates the type of complete service event that has occurred determines which of the following events will take place when this subroutine is called:

- When repair of an item is completed at the seabase, the array of variables which indicate the items required by units ashore is examined to determine whether the item will be transported to a unit or added to the ORF.
- When repair of an item is completed by a nondedicated CT, a time-to-failure for the repaired item is generated and the item resumes operation.
- When repair of an item is completed at a unit, a time-to-failure for the repaired item is generated and the item resumes operation.
- When repair of an item is completed by a dedicated CT, a time-to-failure for the repaired item is generated and the item resumes operation.

–SUBROUTINE QULENTH–

Updates variables LENTHQ and LENTHC.

–SUBROUTINE GENMT–

ENTRY GENTTF – Generates a time interval representing the length of time an item will operate at a unit.

ENTRY GENTTR – Generates a time interval representing the length of time required for repair.

–SUBROUTINE ENDMIS–

Updates variables representing output statistics after the completion of every simulated mission.

–SUBROUTINE OUTPUT–

Prints out statistics at the completion of all of the simulated missions for a given class.

–SUBROUTINE RITE–

ENTRY RITERQ – Prints out arrays which record requests for float items.

ENTRY RITESQ – Prints out arrays which record the items in the seabase queue afloat.

ENTRY RITSQA – Prints out arrays which record the items in the seabase queue ashore.

ENTRY RITCTQ – Prints out arrays which record the items in the CT queue.

–SUBROUTINE RITEUQ–

Prints out arrays which record the items in the unit queue.

6.0 DETAILED PROGRAM DESCRIPTIONS

The Maintenance Optimization Model was written for operation on the CDC 6400 computer under the Scope Operating System, Version 3.3 (FORTRAN IV). Presently the program will handle as many as

- 10 shore-based units
- 150 different types of items in the Landing Force
- 30 different types of items in each unit.

Figure 4 illustrates the arrangement of the deck. The Control cards used are discussed in Appendix B. The letters EOR refer to an end-of-record card which is defined by punching the numbers 7, 8, and 9 in Card Column 1. The letters EOF refer to an end-of-file card which is defined by punching the numbers 6, 7, 8, and 9 in Card Column 1. Section 6.1 describes the Executive Routine. Sections 6.2 through 6.21 describe the individual subroutines in detail. Each section contains a listing of the subroutine being described.

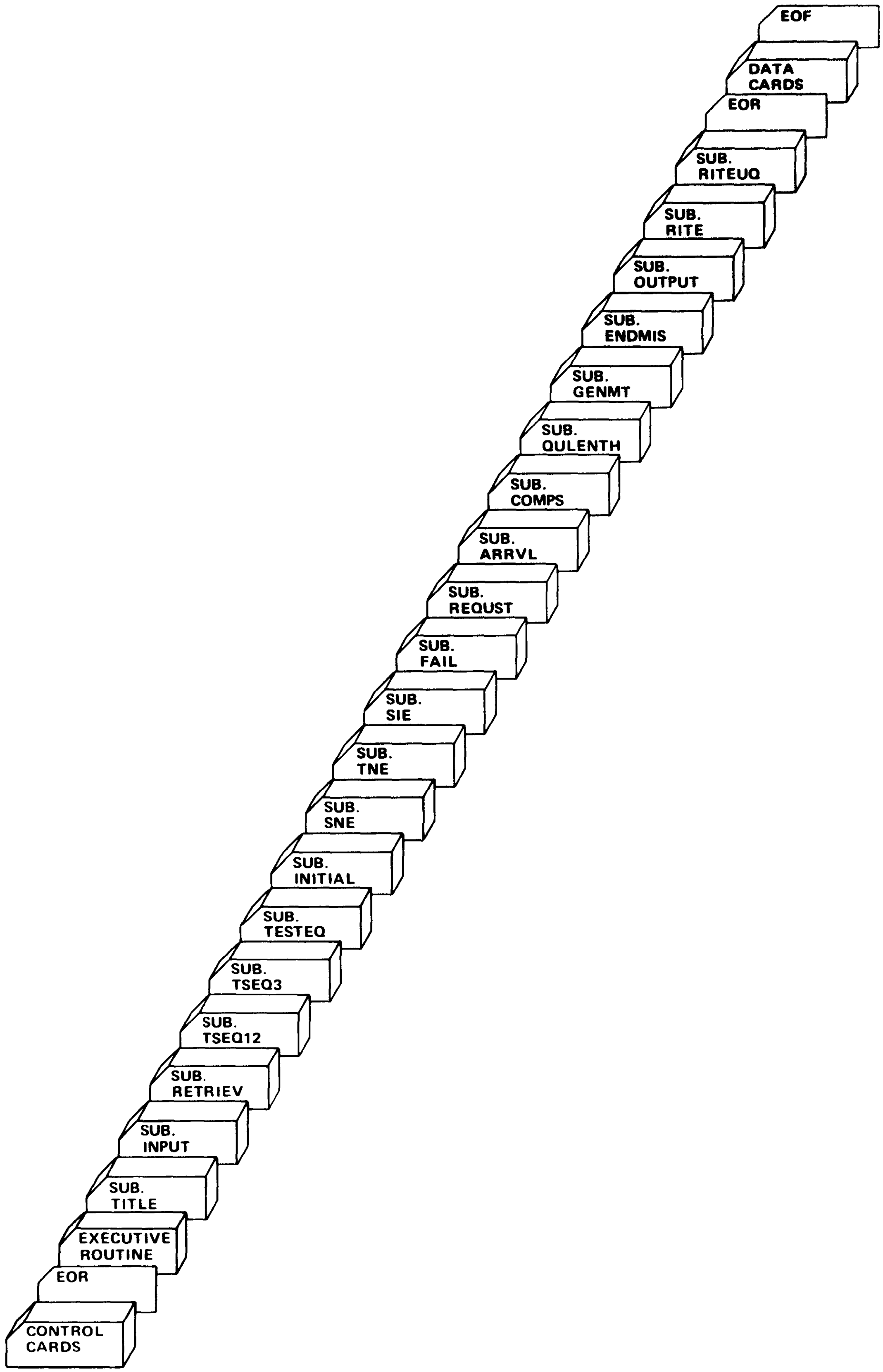

Figure 4. Deck Arrangement

6.1 EXECUTIVE ROUTINE

The Executive Routine calls subroutines that

- read the input data
- determine the maintenance equipment required
- start the simulation process
- print the output statistics

Figure 5 summarizes the logic flow of the Executive Routine.

PROGRAM MAIN

```
      PROGRAM MAIN(LMAUEI,TSEQ,INPUT,OUTPUT,TAPE1=TSEQ,TAPE5=INPUT,
     1 TAPE6=OUTPUT,TAPE2)
      INTEGER CLASS
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10)
     1 ,PCTR(3),PF(5),CLASS
      CALL TITLE
      DO 2 NRUNS=1,100
      CALL INPUT
      REWIND 1
      IF(CLASS.EQ.1.OR.CLASS.EQ.2)CALL TSEQ12
      IF(CLASS.EQ.3)CALL TSEQ3
      CALL INITIAL
      DO 1 KMI=1,NMI
      CALL SIE
      CALL TNE
      CALL ENDMIS
    1 CONTINUE
      CALL OUTPUT
    2 CONTINUE
      END
```

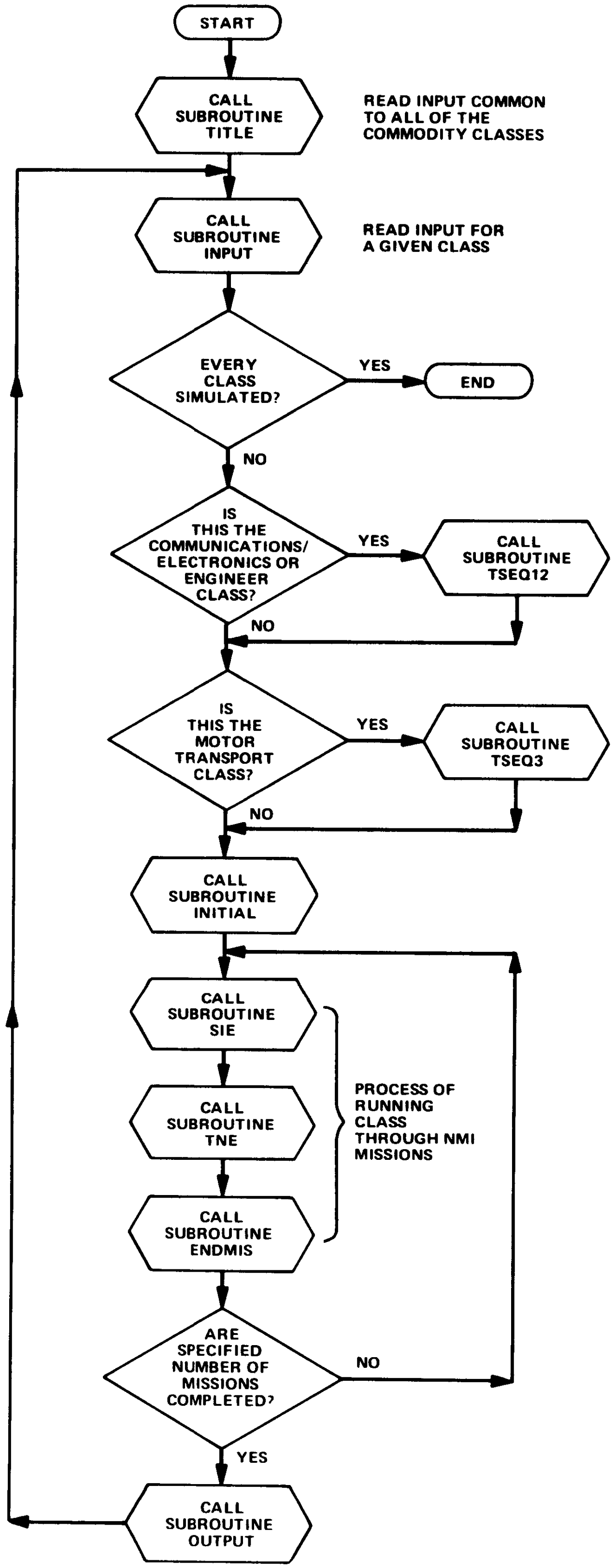

Figure 5. Flow Chart of the Executive Routine

6.2 SUBROUTINE TITLE

Called By: Executive Routine

Abstract:

This subroutine reads the input variables common to all of the commodity classes. These variables are defined in Section 4.0.

```
      SUBROUTINE TITLE
      REAL MTTR2,MTTR3AU,MTTR3CT,MTTR4
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10)
     1 ,PCTR(3),PF(5),CLASS
      COMMON/N4/MTBF(150),UF(150),MTTR2,MTTR3AU,MTTR3CT,MTTR4
      COMMON/N6/LIMDIM,LIMIT,T1,T2,ICPT1,IOPT2,IOPT3
      COMMON/N7/CTH(150,10),HCE(13),HWIQ(13),LENTHC(13),LENTHQ(13),
     1 MAXQL(13),NENTER(13),QL(13),TQBE(13),WT(13),NDISC(150),NOREQ(150)
     1 ,HCTW(10),TCTBF(10),HSSW(10),TSSBF(10),TRTS,NIER(13),IMAXQL(13)
     1 ,INENTR(13),TIMEINT,HUSW(10),TUSBF(10),NOFAIL(150,10)
      COMMON/N10/NPRR2(4),NPRR3(4),NPRR4(4)
      READ(5,6)DATE1,DATE2
    6 FORMAT(2A10)
      READ(5,1)(NPRR2(I),I=1,4),(NPRR3(I),I=1,4),(NPRR4(I),I=1,4)
    1 FORMAT(3(4I1,1X))
      READ(5,2)GTIME,TIMEINT,NMI,LIMDIM,T1,T2,(IECHAV(I),I=2,5),IOPT1,
     1 IOPT2,IOPT3,ICMAU
    2 FORMAT(F5.0,F3.0,I3,I3,F3.1,F3.1,8I1)
      READ(5,3)(PF(I),I=2,5),PCTR(2),PCTR(3),IDCT
    3 FORMAT(6F3.2,I1)
      READ(5,4)MTTR2,MTTR3AU,MTTR3CT,MTTR4
    4 FORMAT(4F5.2)
      WRITE(6,200)
  200 FORMAT(1H1,44X,42HNAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,//,
     1 52X,25HBETHESDA, MARYLAND  20034)
      WRITE(6,201)
  201 FORMAT(//////////,47X,35HSMLS MAINTENANCE OPTIMIZATION MODEL,//,35
     1X,60HDEVELOPED FOR MARINE CORPS DEVELOPMENT AND EDUCATION COMMAND,
     1 //,55X,19HSMLS PROJECT OFFICE)
      WRITE(6,202)DATE1,DATE2
  202 FORMAT(//////////,45X,39HCOMPUTATIONS AND MATHEMATICS DEPARTMENT,
     1 //,55X,2A10)
      WRITE(6,203)
  203 FORMAT(1H1,23X,71HTHE MODEL SIMULATES OPERATION AT THE MARINE AMPH
     1IBIOUS UNIT (MAU) LEVEL,//,31X,48HTHE END ITEM CONFIGURATION IS RE
     1PRESENTATIVE OF )
      IF(IDMAU.EQ.1)WRITE(6,204)
      IF(IDMAU.EQ.2)WRITE(6,205)
  204 FORMAT(1H+,79X,8H34TH MAU)
  205 FORMAT(1H+,79X,12HNOTIONAL MAU)
      WRITE(6,206)
  206 FORMAT(/,55X,10H**********,/)
      WRITE(6,208)
  208 FORMAT(     41X,37HMAINTENANCE SPECIALIST PERSONNEL DATA,///,38X,
     1 47HTOTAL NUMBER OF PERSONS REQUIRED TO REPAIR ITEM,//,50X,7HECHEL
     1ON,11X,9H2   3   4)
      WRITE(6,211)NPRR2(1),NPRR3(1),NPRR4(1)
  211 FORMAT(/,43X,9HCOMM/ELEC,16X,3(I1,3X))
      WRITE(6,210)NPRR2(2),NPRR3(2),NPRR4(2)
  210 FORMAT(/,43X,8HENGINEER,17X,3(I1,3X))
      WRITE(6,209)NPRR2(3),NPRR3(3),NPRR4(3)
  209 FORMAT(/,43X,15HMOTOR TRANSPORT,10X,3(I1,3X))
      WRITE(6,213)NPRR2(4),NPRR3(4),NPRR4(4)
  213 FORMAT(/,43X,8HORDNANCE,17X,3(I1,3X))
      WRITE(6,214)(I,I=1,5)
```

```
214   FORMAT(///,13X,84HDECREASE IN SEABASE REPAIR CAPABILITY AS C.T.'S
     1DEPART (FOR NON-DEDICATED C.T. ONLY),/,13X,56HNOTE - CAPABILITY=NU
     1MBER OF ITEMS CAN REPAIR AT ONE TIME,//,24X,32HTOTAL C.T.'S ABSENT
     1 FROM SEABASE,6X,5(I1,3X),/)
      WRITE(6,217)
      WRITE(6,216)
      WRITE(6,215)
      WRITE(6,219)
217   FORMAT(37X,9HCOMM/ELEC,16X,17HC    0    1    2    2,/)
216   FORMAT(37X,8HENGINEER,17X,17H0    1    1    2    3,/)
215   FORMAT(37X,15HMOTOR TRANSPORT,10X,17H0    0    1    2    3,/)
219   FORMAT(37X, 8HORDNANCE,                  17X,17H0    1    1    2    3,/)
      WRITE(6,218)NMI,GTIME
218   FORMAT(1H1,48X,23HMISSION CHARACTERISTICS,//,42X,32HNUMBER OF SIMU
     1LATED MISSION RUNS,I4,/,44X,25HMISSION DURATION IN HOURS,F7.0)
      WRITE(6,206)
      WRITE(6,207)MTTR2,MTTR2,MTTR3AC,MTTR3CT,MTTR4
207   FORMAT(37X,47HREPAIR INTERVALS (MEAN TIME TO REPAIR) IN HOURS,//,
     137X,28HAT SEABASE OR ASHORE AT UNIT,9X,14HASHORE BY C.T.,/,44X,
     13HECH,3X,8HINTERVAL,12X,3HECH,3X,8HINTERVAL,/,44X,3H2ND,5X,F4.1,
     1 14X,3H2ND,5X,F4.1,/,44X,3H3RD,5X,F4.1,14X,3H3RD,5X,F4.1,/,
     1 44X,3H4TH,5X,F4.1)
      WRITE(6,206)
      A1=2HNO
      A2=2HNO
      A3=2HNO
      IF(IECHAV(2).EQ.1)A1=3HYES
      IF(IECHAV(3).EQ.1)A2=3HYES
      IF(IECHAV(4).EQ.1)A3=3HYES
      WRITE(6,212)(PF(I),I=2,5),PCTR(2),PCTR(3),A1,A2,A3
212   FORMAT(73X,7H2ND ECH,3X,7H3RD ECH,3X,7H4TH ECH,3X,7HDISCARD,//,
     17X,59HPERCENTAGE OF ITEMS THAT FAIL REQUIRING THE VARIOUS ECHELON,
     18X,4(F4.2,6X),//,7X,64HPERCENTAGE OF ITEMS REPAIRED BY CT REQUIRIN
     1G THE VARIOUS ECHELON,3X,F4.2,6X,F4.2,6X,4H0.00,6X,4H0.00,//,7X,
     131HIS ECHELON AVAILABLE AT SEABASE,37X,3(A3,7X))
      WRITE(6,206)
      WRITE(6,243)T1,T2
243   FORMAT(///,50X,20HTRANSPORTATION TIMES,//,48X,14HSHIP TO SHORE=,
     1 F6.2,4H HRS,/,48X,15HSHORE TO SHORE=,F5.2,4H HRS)
      RETURN
      END
```

6.3 SUBROUTINE INPUT

Called By: Executive Routine

Abstract:

This subroutine reads the input variables for the particular commodity class under consideration. These variables are defined in Section 4.0.

SUBROUTINE INPUT

```
      SUBROUTINE INPUT
      INTEGER TYPENO,UNITNO,UNITDEN,CLASS
      REAL MTBF
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10)
     1 ,PCTR(3),PF(5),CLASS
      COMMON/N2/NCTS,NSS,NUS
      COMMON/N3/INV(150),NEI(30,10),NFI(150),NLIST(10),NR,NTRQST(200),
     1 NURQST(200),TIRQST(200),TYPENO(30,10),TAMNO(150)
      COMMON/N4/MTBF(150),UF(150),MTTR2,MTTR3AU,MTTR3CT,MTTR4
      COMMON/N6/LIMDIM,LIMIT,T1,T2,IOPT1,IOPT2,IOPT3
      COMMON/N7/DTH(150,10),HQE(13),HWIQ(13),LENTHC(13),LENTHQ(13),
     1 MAXQL(13),NENTER(13),QL(13),TQBE(13),WT(13),NDISC(150),NOREQ(150)
     1 ,HCTW(10),TCTBF(10),HSSW(10),TSSBF(10),TRTS,NIER(13),IMAXQL(13)
     1 ,INENTR(13),TIMEINT,HUSW(10),TUSBF(10),NOFAIL(150,10)
      COMMON/N9/NDCS(5),NPS
      COMMON/N10/NPRR2(4),NPRR3(4),NPRR4(4)
      DIMENSION MAUID(150),UNITNO(10),UNITDEN(10),SQ(150),CUBE(150),IUSP
     1(150),EMB(150),NOMEN(150,7),UNAME(10,2)
      READ(5,9)CONTROL
    9 FORMAT(A4)
      IF(CONTROL.EQ.4HSTOP)GOTO100
      READ(5,1)NUNIT,NOTYPE,NSS,NCTS,NUS,LIMIT,CLASS
    1 FORMAT(7I2)
      READ(5,7)((UNAME(I,J),J=1,2),I=1,NUNIT)
    7 FORMAT(8A10)
      READ(5,10) (IEAU(2,I),I=1,NUNIT),(IEAU(3,I),I=1,NUNIT)
   10 FORMAT(20I1)
      READ(5,5)(NDCS(I),I=1,5),NPS
    5 FORMAT(6I1)
      DO 11 I=1,NUNIT
   11 NLIST(I)=0
      DO 2 I=1,NOTYPE
      READ(5,3)TAMNO(I),MAUID(I),NFI(I),NUTNAI,(UNITNO(K),K=1,NUTNAI),
     1 (UNITDEN(K),K=1,NUTNAI)
    3 FORMAT(A5,I3,22I2)
      DO 4 L=1,NUTNAI
      NLIST(UNITNO(L))=NLIST(UNITNO(L))+1
      TYPENO(NLIST(UNITNO(L)),UNITNO(L))=I
    4 NEI(NLIST(UNITNO(L)),UNITNO(L))=UNITDEN(L)
    2 CONTINUE
      CALL RETRIEV(  SQ,CUBE,IUSP,EMB,NOMEN)
      WRITE(6,210)
  210 FORMAT(1H1,60X,10H**********,//,56X,18HINPUT DATA FOR THE)
      IF(CLASS.EQ.1)WRITE(6,212)
      IF(CLASS.EQ.2)WRITE(6,226)
      IF(CLASS.EQ.3)WRITE(6,227)
      IF(CLASS.EQ.4)WRITE(6,228)
  212 FORMAT(/,49X,32HCOMMUNICATIONS/ELECTRONICS CLASS)
  226 FORMAT(/,58X,14HENGINEER CLASS)
  227 FORMAT(/,55X,21HMOTOR TRANSPORT CLASS)
  228 FORMAT(/,58X,14HORDNANCE CLASS)
      WRITE(6,119)
      WRITE(6,229)
  229 FORMAT(  44X,42HPERSONNEL AND SEABASE SHOP CHARACTERISTICS)
      IF(IDCT.EQ.2)NCTS=0
```

```
      WRITE(6,231)NCTS
  231 FORMAT(/,28X,39HTOTAL NUMBER OF CONTACT TEAMS AVAILABLE,I15)
      WRITE(6,232)NSS
  232 FORMAT(/,28X,23HSEABASF REPAIR CAPACITY,I31)
      WRITE(6,233)LIMIT
  233 FORMAT(/,28X,47HNUMBER OF ITEMS ALLOWED IN SEABASE QUEUE AFLOAT,I7
     1)
      IF(IECHAV(4).EQ.1)NOP=NPRR4(CLASS)*NSS
      IF(IECHAV(4).NE.1.AND.IECHAV(3).EQ.1)NOP=NPRR3(CLASS)*NSS
      IF(IECHAV(4).NE.1.AND.IECHAV(3).NE.1.AND.IECHAV(2).EQ.1)NOP=
     1 NPRR2(CLASS)*NSS
      NOP=NOP*2
      IF(IDCT.EQ.1)NOP=NOP+NCTS
      WRITE(6,200)NOP
  200 FORMAT(/,28X,50HTOTAL NUMBER OF REPAIR PERSONS REQUIRED AT SEABASE
     1,I4,3X,17H(TWO 8-HR SHIFTS))
      NUMBUS=0
      DO 201 I=1,NUNIT
      IF(IEAU(3,I).EQ.1)NUMBUS=NUMBUS+NUS*NPRR3(CLASS)
      IF(IEAU(3,I).NE.1.AND.IEAU(2,I).EQ.1)NUMBUS=NUMBUS+NUS*NPRR2(CLASS
     1)
  201 CONTINUE
      NUMBUS=NUMBUS*2
      WRITE(6,202)NUMBUS
  202 FORMAT(/,28X,48HTOTAL NUMBER OF REPAIR PERSONS REQUIRED AT UNITS,I
     16,3X,17H(TWO 8-HR SHIFTS))
      II=NUMBUS+NOP
      WRITE(6,203)II
  203 FORMAT(/,28X,47HTOTAL NUMBER OF PERSONS REQUIRED FOR MAU REPAIRI7)
      WRITE(6,119)
  119 FORMAT(/,61X,10H**********,//)
      WRITE(6,234)
  234 FORMAT(     49X,33HREPAIR CAPABILITY OF UNITS ASHORE,//,28X,11HUNIT
     1 NUMBER,6X,9HUNIT NAME,9X,20HUNIT REPAIR CAPACITY,3X,17HECHELON AV
     1AILABLE)
      DO 236 I=1,NUNIT
      IF(IEAU(2,I).EQ.1.AND.IEAU(3,I).EQ.1)TEMP=8H2ND, 3RD
      IF(IEAU(2,I).EQ.1.AND.IEAU(3,I).NE.1)TEMP=8H  2ND
      IF(IEAU(2,I).NE.1.AND.IEAU(3,I).NE.1)TEMP=8H
      IF(IEAU(2,I).NE.1.AND.IEAU(3,I).NE.1)ITEMP=0
      IF(IEAU(2,I).EQ.1.OR.IEAU(3,I).EQ.1)ITEMP=NUS
  236 WRITE(6,237)I,(UNAME(I,J),J=1,2),ITEMP,TEMP
  237 FORMAT(32X,I2,6X,2A10,12X,I2,16X,A8)
      WRITE(6,119)
      WRITE(6,221)
  221 FORMAT(57X,17HMAU CONFIGURATION//,64X,21HTOTAL NUMBER OF ITEMS,11X
     1,5HUTIL.,19X,4HUNIT,4X,4HEMB.,/,1X,10HTAM NUMBER,20X,12HNOMENCLATU
     1RE,20X,9HEND ITEMS,3X,11HFLOAT ITEMS,3X,4HMTBF,3X,5HFACT.,2X,6HSQU
     1ARE,4X,4HCUBE,3X,5HPACK.,2X,5HINFO.)
      DO 215 I=1,NOTYPE
  215 WRITE(6,214)TAMNO(I),(NOMEN(I,J),J=1,5),MAUID(I),NFI(I),MTBF(I),
     1 UF(I),SQ(I),CUBE(I),IUSP(I),EMB(I)
  214 FORMAT(3X,A5,4X,5A10,4X,I3,9X,I3,7X,F6.1,2X,F4.0,3X,F6.2,2X,F7.2,
     1 2X,I3,5X,A2)
      WRITE(6,213)
```

SUBROUTINE INPUT

```
  213   FORMAT(/,28X,5H-----,//,28X,46HNOTE-SS DENOTES ITEMS REQUIRING SQU
       1ARE STOWAGE)
        WRITE(6,204)
  204   FORMAT(1H1,60X,10H**********,//,56X,19HOUTPUT DATA FOR THE)
        IF(CLASS.EQ.1)WRITE(6,212)
        IF(CLASS.EQ.2)WRITE(6,226)
        IF(CLASS.EQ.3)WRITE(6,227)
        IF(CLASS.EQ.4)WRITE(6,228)
        WRITE(6,119)
        RETURN
  100   STOP
        END
```

6.4 SUBROUTINE RETRIEV(SQ,CUBE,IUSP,EMB,NOMEN)

Called By: Subroutine INPUT

Parameters Used:

SQ	List of the square of all items in the LF
CUBE	List of the cube of all items in the LF
IUSP	List of the unit of standard packaging for all items in the LF
EMB	List of the embark information for all items in the LF
NOMEN	List of the nomenclature of all items in the LF

Abstract:

This subroutine reads from Tape 2 the characteristics for a given group of items which were read in by Subroutine INPUT (Appendix D gives further discussion of Tape 2 or the File For Item Characteristics).

Tape 2 contains information about items in a Landing Force for both a 10-day mission and a 90-day mission. The tape is scanned until the appropriate heading (i.e., a heading of 10 DAY if GTIME=240.0 or a heading of 90 DAY if GTIME=2160.0) is reached. Starting with i=1, the tape is scanned until the TAM number on the tape (i.e., TAMN) equals TAMNO(i) (read by Card 11 of the input data). The item characteristics are extracted from the tape by reading them as variables SQ(i), CUBE(i), MTBF(i), UF(i),* IUSP(i), EMB(i), and NOMEN(i,j) for j=1 through 7. The use of seven consecutive variables for NOMEN allows for a nomenclature of up to 65 characters. The tape is scanned to extract the item characteristics for every TAM number (i.e., TAMNO(i), i=1, through NOTYPE). If Tape 2 does not contain the information on TAMNO(i) (i.e., suppose TAMN=TAMNO(i), for every TAMN or Tape 2), the program is aborted.

When the item characteristics have been extracted for every TAM number in the Landing Force; i.e., for every i=1 through NOTYPE, control of the program is returned to Subroutine INPUT.

*MTBF and UF are Mean Time Between Failures and Utilization Factor of item i respectively. They are included in Common. (See listing for RETRIEV.)

SUBROUTINE RETRIEV

```
      SUBROUTINE RETRIEV(   SQ,CUBE,IUSP,EMB,NOMEN)
      REAL MTBF
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10)
     1 ,PCTR(3),PF(5),CLASS
      COMMON/N3/INV(150),NEI(30,10),NFI(150),NLIST(10),NR,NTRQST(200),
     1 NURQST(200),TIRQST(200),TYPENO(30,10),TAMNO(150)
      COMMON/N4/MTBF(150),UF(150),MTTR2,MTTR3AU,MTTR3CT,MTTR4
      DIMENSION      SQ(150),CUBE(150),IUSP(150),EMB(150),NOMEN(150,7)
      REWIND 2
    4 READ(2,1)A
    1 FORMAT(A6,74X)
      READ(2,2)
    2 FORMAT(80X)
      IF(GTIME.EQ.240..AND.A.EQ.6H10 DAY)GOTO3
      IF(GTIME.EQ.2160..AND.A.EQ.6H90 DAY)GOTO3
      GOTO4
    3 CONTINUE
      DO 5 I=1,NOTYPE
    8 READ(2,6)TAMN,SQ(I),CUBE(I),MTBF(I),UF(I),IUSP(I),EMB(I)
      IF(EOF(2))9,10
   10 READ(2,7)(NOMEN(I,J),J=1,7)
    6 FORMAT(A5,F6.2,F7.2,F6.0,F3.0,I3,A2,48X)
    7 FORMAT(6A10,A5,15X)
      IF(TAMN.NE.TAMNO(I))GOTO8
    5 CONTINUE
      RETURN
    9 WRITE(6,11)TAMNO(I)
   11 FORMAT(1H1,20X,7HTAM NO.,A5,14HIS NOT ON FILE)
      STOP
      END
```

6.5 SUBROUTINE TSEQ12

Called By: Executive Routine

Variables Used:

CLASS	Number which indicates commodity class
IEAU(2, j)	Availability of 2nd-echelon repair at unit j
IEAU(3, j)	Availability of 3rd-echelon repair at unit j
IECHAV(2)	Availability of 2nd-echelon repair at the seabase
IECHAV(3)	Availability of 3rd-echelon repair at the seabase
IECHAV(4)	Availability of 4th-echelon repair at the seabase
IFLAG	Indicates if maintenance equipment is a function of the number of items in a Landing Force or of the number of maintenance personnel.
N2E	Total number of items needed for repair at 2nd echelon
N3E	Total number of items needed for repair at 3rd echelon
N4E	Total number of items needed for repair at 4th echelon
NPRR2(CLASS)	Total number of personnel required in class CLASS for 2nd echelon repair
NPRR3(CLASS)	Total number of personnel required in class CLASS for 3rd echelon repair
NPRR4(CLASS	Total number of personnel required in class CLASS for 4th echelon repair
NSS	Shop repair capacity (number of items which can be under repair at a given time)
NUS	Unit repair capacity (number of items which can be under repair at a given time)

Abstract:

Subroutine TSEQ12 calculates the total number of maintenance equipment items (e.g., tool sets, kits, and special equipment items) required at the seabase and at the units for repairs either for items in the Communications/Electronics class or for items in the Engineer class.

The total number of the ith-echelon maintenance items required either at unit j (NMEQU(i, j)) or at the seabase (NMEQSB(i)) is determined by information from the Maintenance Equipment File (Appendix C describes this file) and from input information (refer to Section 4.0).

SUBROUTINE TSEQ12

```
      SUBROUTINE TSEQ12
      INTEGER CLASS
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10),
     1 PCTR(3),PF(5),CLASS
      COMMON/N2/NCTS,NSS,NUS
      COMMON/N10/NPRR2(4),NPRR3(4),NPRR4(4)
      DIMENSION NMEQU(30,10),NMEQSB(30),TTAMNO(30),ITOTAL(30),NOMEN(30,6
     1)
2     READ(1,100)ICLASS,IFLAG
100   FORMAT(2I1,78X)
      IF(ICLASS.EQ.CLASS)GOTO1
      IF(IFLAG.NE.0)READ(1,101)
101   FORMAT(80X)
      GOTO2
C DETERMINE NO. OF TEST EQUIP FOR TEST EQUIP I
1     I=0
8     I=I+1
6     READ(1,102)ICLASS,IFLAG,TTAMNO(I),CONT,N2E,N3E,N4E
102   FORMAT(2I1,A5,1X,A1,54X,3(I1,1X))
      IF(EOF(1))3,4
4     IF(ICLASS.NE.CLASS)GOTO3
      READ(1,112)(NOMEN(I,J),J=1,6)
112   FORMAT(15X,5A10,A9,6X)
      IF(IFLAG.EQ.2)GOTO5
      IF(CONT.NE.1H )GOTO6
C IF TEST EQUIPMENT IS FOR REPAIR OF END ITEMS
C AT UNIT NO. J
      DO 7 J=1,NUNIT
      NMEQU(I,J)=0
      IF(IEAU(2,J).EQ.1)NMEQU(I,J)=N2E
      IF(IEAU(3,J).EQ.1)NMEQU(I,J)=N3E+NMEQU(I,J)
7     CONTINUE
C AT SEABASE
      NMEQSB(I)=0
      IF(IECHAV(2).EQ.1)NMEQSB(I)=N2E
      IF(IECHAV(3).EQ.1)NMEQSB(I)=N3E+NMEQSB(I)
      IF(IECHAV(4).EQ.1)NMEQSB(I)=NMEQSB(I)+N4E
      GOTO8
C IF TEST EQUIPMENT IS FOR MAINTENANCE PERSONNEL
5     DO 9 J=1,NUNIT
      IF(IEAU(3,J).EQ.1)NUMBUS=NUS*NPRR3(CLASS)
      IF(IEAU(3,J).NE.1.AND.IEAU(2,J).EQ.1)NUMBUS=NUS*NPRR2(CLASS)
      NMEQU(I,J)=0
      IF(IEAU(2,J).EQ.1)NMEQU(I,J)=NUMBUS*N2E
      IF(IEAU(3,J).EQ.1)NMEQU(I,J)=NMEQU(I,J)+NUMBUS*N3E
9     CONTINUE
      IF(IECHAV(4).EQ.1)NOP=NPRR4(CLASS)*NSS
      IF(IECHAV(4).NE.1.AND.IECHAV(3).EQ.1)NOP=NPRR3(CLASS)*NSS
      IF(IECHAV(4).NE.1.AND.IECHAV(3).NE.1.AND.IECHAV(2).EQ.1)
     1 NOP=NPRR2(CLASS)*NSS
      NMEQSB(I)=0
      IF(IECHAV(2).EQ.1)NMEQSB(I)=NOP*N2E
      IF(IECHAV(3).EQ.1)NMEQSB(I)=NOP*N4E+NMEQSB(I)
      IF(IECHAV(4).EQ.1)NMEQSB(I)=NOP*N4E+NMEQSB(I)
      GOTO8
```

SUBROUTINE TSEQ12

```
      3       CONTINUE
              WRITE(6,104)
    104       FORMAT(///,42X,47HTOOL SETS, KITS, AND SPECIAL EQUIPMENT REQUIRED)
              WRITE(6,107)(L,L=1,NUNIT)
    107       FORMAT(///,85X,33HQUANTITY OF REPAIR ITEMS REQUIRED,/,86X,8HAT UNI
             1TS,15X,10HAT SEABASE,3X,5HTOTAL,/,76X,10I3)
              WRITE(6,114)
    114       FORMAT(24X,12HNOMENCLATURE,25X,12HTEST TAM NO.,/)
              NTE=I-1
              DO 110 L=1,NTE
              ITOTAL(L)=0
              DO 108 K=1,NUNIT
    108       ITOTAL(L)=NMEQU(L,K)+ITOTAL(L)
    110       ITOTAL(L)=NMEQSB(L)+ITOTAL(L)
              DO 109 I=1,NTE
              WRITE(6,103)(NOMEN(I,J),J=1,6),TTAMNO(I),(NMEQU(I,J),J=1,NUNIT)
    103       FORMAT(1X,5A10,A9,4X,A5,7X,10I3)
    109       WRITE(6,111)NMEQSB(I),ITOTAL(I)
    111       FOPMAT(1H+,113X,I2,8X,I2)
              RETURN
              END
```

6.6 SUBROUTINE TSEQ3

Called By: Executive Routine

Abstract:

Subroutine TSEQ3 calculates the variables required in determining the total number of maintenance equipment items required at the seabase and at the units for the Motor Transport Commodity class. The total number of maintenance equipment items is then calculated in another subroutine (TESTEQ).

Items in the Motor Transport class are divided into three categories:

Category 1	Gas Powered
Category 2	Diesel Powered
Category 3	Trailors

Every maintenance-equipment item required for the repair of Motor Transport items is associated with one of the above categories.

Subroutine TSEQ3 performs four operations. The first operation determines the number of end items in each category which require repair at the units and at the seabase. The notation N2U(i, j), the total number of end items of category j which require 2nd-echelon repair at unit i, is a function of the total number of end items in category j. The notation N2SB(j), the total number of end items of category j which require 2nd-echelon repair at the seabase, is a function of the total number of end items in category j which are repaired at the seabase.

The second operation determines for each category where 3rd- and 4th-echelon repairs are to be performed. The variable, LOC(i, j), denotes the units which can perform 3rd-echelon repair for items in category j. Subscript i ranges from 1 through M(j) (where M(j) is the calculated maximum number of units which require 3rd-echelon repair for category j). Variable FLAG3(j) equals 3RD if the seabase will provide 3rd-echelon repair for items in category j. The variable FLAG4(j) equals 4TH if the seabase will provide 4th-echelon repair for items in category j. These variables depend on the level of the echelon of repair available at the units and at the seabase.

The third operation determines the total number of "special-case" items; i.e., end items with a TAM number of D1100, D1160, or D0860, which require 2nd-echelon repair at the seabase. The variable N1100SB equals the total number of items with a TAM number D1100 which require 2nd-echelon repair at the seabase. The variable N1160SB equals the number of end items with a TAM number D1160 which require 2nd-echelon repair at the seabase. The variable N0860SB equals the number of end items with a TAM number D0860 which require 2nd-echelon repair at the seabase.

The fourth operation determines the total number of "special-case" items which require 3rd-echelon and 4th-echelon repair at the seabase. The variable F3D1100 equals 3RD if the seabase performs 3rd-echelon repair on item D1100. The variable F3D1160 equals 3RD if the seabase performs 3rd-echelon repair on item D1160. The variable F3D0860 equals 3RD if the seabase performs 3rd-echelon repair on item D0860. The variable F4D1100 equals 4TH if the seabase performs 4th-echelon repair on item D1100. The variable F4D1160 equals 4TH if the seabase performs 4th-echelon repair on item D1160. Variable F4D0860 equals 4TH if the seabase performs 4th-echelon repair on item D0860. These variables depend on the level of the echelons of repair available at the seabase.

Subroutine TESTEQ is then called to determine how many maintenance-equipment items are required for repair of end items at the units and at the seabase.

SUBROUTINE TSEQ3

```
               SUBROUTINE TSEQ3
               INTEGER TYPENO,TAMNO
               COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10),
              1 PCTR(3),PF(5),CLASS
               COMMON/N3/INV(150),NEI(30,10),NFI(150),NLIST(10),NR,NTRQST(200),
              1 NURQST(200),TIRQST(200),TYPENO(30,10),TAMNO(150)
               COMMON/N8/N2U(10,3),N2SB(3),LOC(10,3),FLAG3(3),FLAG4(3),M(3),
              1 N1100SB,N1160SB,N0860SB, F3D1100, F4D1100, F3D1160, F4D1160,
              1 F3D0860,F4D0860
         C TEST EQUIP FOR VEHICLES, DIESELS, TRAILORS
               DO 4 MODE=1,3
         C FOR MODE, FOLLOWING SECTIONS DETERMINES NO. OF 2ND ECH REPAIRS NEEDED AT
         C SEABASE AND AT UNIT
               DO 1 I=1,NUNIT
         1     N2U(I,MODE)=0
               N2SB(MODE)=0
               DO 2 J=1,NUNIT
               K=NLIST(J)
               DO 3 I=1,K
               L=TAMNO(TYPENO(I,J))
               IF(MODE.EQ.1.AND.(
              1   L.EQ.5HD0840.OR.L.EQ.5HD0860.OR.L.EQ.5HD0880))GOTO3
               IF(MODE.EQ.2.AND.(
              1   L.EQ.5HD1160.OR.L.EQ.5HD0840.OR.L.EQ.5HD0860.OR.L.EQ.5HD0880.
              1 OR.L.EQ.5HD0890))GOTO3
               IF(MODE.EQ.3.AND.(
              1   L.EQ.5HD0840.OR.L.EQ.5HD0860.OR.L.EQ.5HD0880))GOTO5
               IF(MODE.EQ.3)GOTO3
         5     IF(IEAU(2,J).EQ.1)N2U(J,MODE)=NEI(I,J)+N2U(J,MODE)
               IF(IEAU(2,J).EQ.0.AND.IECHAV(2).EQ.1)N2SB(MODE)=NEI(I,J)+N2SB(MODE
              1)
         3     CONTINUE
         2     CONTINUE
         C FOR MODE,FOLLOWING SECTION DETERMINES LOCATION OF 3RD AND 4TH ECH REPAIRS
               M(MODE)=0
               FLAG3(MODE)=3H
               FLAG4(MODE)=3H
               DO 7 J=1,NUNIT
               K=NLIST(J)
               DO 8 I=1,K
               L=TAMNO(TYPENO(I,J))
               IF(MODE.EQ.1.AND.(
              1   L.EQ.5HD0840.OR.L.EQ.5HD0860.OR.L.EQ.5HD0880))GOTO8
               IF(MODE.EQ.2.AND.(
              1   L.EQ.5HD1160.OR.L.EQ.5HD0840.OR.L.EQ.5HD0860.OR.L.EQ.5HD0880.
              1 OR.L.EQ.5HD0890))GOTO8
               IF(MODE.EQ.3.AND.(
              1   L.EQ.5HD0840.OR.L.EQ.5HD0860.OR.L.EQ.5HD0880))GOTO6
               IF(MODE.EQ.3)GOTO8
         6     IF(IEAU(3,J).EQ.1)GOTO9
               IF(IECHAV(3).EQ.1)FLAG3(MODE)=3H3RD
               GOTO7
         9     M(MODE)=M(MODE)+1
               LOC(M(MODE),MODE)=J
               GOTO7
```

```
      8      CONTINUE
      7      CONTINUE
             IF(IECHAV(4).EQ.1)FLAG4(MODE)=3H4TH
      4      CONTINUE
      C DETERMINE NO. OF SPECIAL CASE EQUIP REPAIRED AT SEABASE FOR 2ND ECH
             N1100SB=0
             N1160SB=0
             N0860SB=0
             DO 10 J=1,NUNIT
             K=NLIST(J)
             DO 11 I=1,K
             II=TAMNO(TYPENO(I,J))
             IF(II.NE.5HD1100.AND.II.NE.5HD1160.AND.II.NE.5HD0860)GOTO11
             IF(II.EQ.5HD1100.AND.IEAU(2,J).EQ.0.AND.IECHAV(2).EQ.1)
            1N1100SB=N1100SB+NEI(I,J)
             IF(II.EQ.5HD1160.AND.IEAU(2,J).EQ.0.AND.IECHAV(2).EQ.1)
            1 N1160SB=N1160SB+NEI(I,J)
             IF(II.EQ.5HD0860.AND.IEAU(2,J).EQ.0.AND.IECHAV(2).EQ.1)
            1 N0860SB=N0860SB+NEI(I,J)
      11     CONTINUE
      10     CONTINUE
      C DETERMINE IF SPECIAL CASE EQUIPMENTS ARE REPAIRED BY 3RD AND 4TH ECHELON AT SB
             F3D1100=3H
             F4D1100=3H
             F3D1160=3H
             F4D1160=3H
             F3D0860=3H
             F4D0860=3H
             DO 12 J=1,NUNIT
             K=NLIST(J)
             DO 13 I=1,K
             L=TAMNO(TYPENO(I,J))
             IF(L.EQ.5HD1100.AND.IEAU(3,J).NE.1.AND.IECHAV(3).EQ.1)
            1 F3D1100=3H3RD
             IF(L.EQ.5HD1160.AND.IEAU(3,J).NE.1.AND.IECHAV(3).EQ.1)
            1 F3D1160=3H3RD
             IF(L.EQ.5HD0860.AND.IEAU(3,J).NE.1.AND.IECHAV(3).EQ.1)
            1 F3D0860=3H3RD
             IF(L.EQ.5HD1100.AND.IECHAV(4).EQ.1) F4D1100=3H4TH
             IF(L.EQ.5HD1160.AND.IECHAV(4).EQ.1) F4D1160=3H4TH
             IF(L.EQ.5HD0860.AND.IECHAV(4).EQ.1) F4D0860=3H4TH
      13     CONTINUE
      12     CONTINUE
             CALL TESTEQ
             RETURN
             END
```

6.7 SUBROUTINE TESTEQ

Called By: Subroutine TSEQ3

Variables Used:

F3D0860	Indicates if seabase will repair item D0860 at 3rd echelon
F3D1100	Indicates if seabase will repair item D1100 at 3rd echelon
F3D1160	Indicates if seabase will repair item D1160 at 3rd echelon
F4D0860	Indicates if seabase will repair item D0860 at 4th echelon
F4D1100	Indicates if seabase will repair item D1100 at 4th echelon
F4D1160	Indicates if seabase will repair item D1160 at 4th echelon
FLAG3(j)	Indicates if seabase will repair items in category j at 3rd echelon
FLAG4(j)	Indicates if seabase will repair items in category j at 4th echelon
ISC	Indicates if a given maintenance-equipment item is required for "special case" items
LOC(m, k), m = 1, M(k)	Array of units capable of repairing items at 3rd echelon in category k
M(k)	Maximum number of units which repair items in category k at 3rd echelon
MODE	Category of items a maintenance-equipment item can repair
N0860SB	Total number of D0860 items which require 2nd-echelon repair at the seabase
N1100SB	Total number of D1100 items which require 2nd-echelon repair at the seabase
N1160SB	Total number of D1160 items which require 2nd-echelon repair at the seabase
N2SB(k)	Total number of items in category k which require 2nd-echelon repair at the seabase
N2U(j, k)	Total number of items in category k which require 2nd-echelon repair at unit j
N3E	Total number of maintenance equipment items required for 3rd-echelon repair
N4E	Total number of maintenance equipment items required for 4th-echelon repair
NEI(n, j)	Total number of items at unit j with TAM number, TAMNO(TYPENO(n,j))
NVS2E	Total number of items a given maintenance-equipment item can support

Abstract:

This subroutine calculates how many maintenance-equipment items i.e., tool sets, kits, and special-equipment items, are required at the seabase and at the units for the repair of items in the Motor Transport class.

The total number of the ith level of maintenance items required at either unit j (NMEQU(i,j)) or at the seabase (NMEQSB(i)) is determined by information from the Maintenance Equipment File (refer to Appendix C), input information (refer to Appendix A), and variables calculated in Subroutine TSEQ3.

SUBROUTINE TESTEQ

```
              SUBROUTINE TESTEQ
              INTEGER TYPENO,CLASS
              COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IOCT,NMI,KMI,IEAU(3,10),
             1 PCTR(3),PF(5),CLASS
              COMMON/N3/INV(150),NEI(30,10),NFI(150),NLIST(10),NR,NTRQST(200),
             1 NURQST(200),TIRQST(200),TYPENO(30,10),TAMNO(150)
              COMMON/N8/N2U(10,3),N2SB(3),LOC(10,3),FLAG3(3),FLAG4(3),M(3),
             1 N1100SB,N1160SB,N0860SB, F3D1100, F4D1100, F3D1160, F4D1160,
             1 F3D0860,F4D0860
              DIMENSION NMEQU(30,10),NMEQSB(30),TTAMNO(30),ITOTAL(30),NOMEN(30,6
             1)
        8     READ(1,111)ICLASS,IFLAG
        111   FORMAT(2I1,78X)
              IF(ICLASS.EQ.3)GOTO1
              IF(IFLAG.NE.0)READ(1,112)
        112   FORMAT(80X)
              GOTO8
        C DETERMINE NO. OF TEST EQUIPMENT FOR TEST EQUIP NO. I
        1     I=0
        2     I=I+1
        13    READ(1,113)ICLASS,IFLAG,TTAMNO(I),CONT,N2E,N3E,N4E,MODE,NVS2E,ISC
        113   FORMAT(2I1,A5,1X,A1,54X,3(I1,1X),I1,I2,I4)
              IF(EOF(1))11,12
        12    IF(ICLASS.NE.3)GOTO11
              READ(1,102)(NOMEN(I,J),J=1,6)
        102   FORMAT(15X,5A10,A9,5X)
              IF(CONT.NE.1H )GOTO13
              IF(IFLAG.EQ.2)GOTO13
              IF(ISC.EQ.1100)SC=5HD1100
              IF(ISC.EQ.1160)SC=5HD1160
              IF(ISC.EQ.0860)SC=5HD0860
              IF(ISC.EQ.0)SC=5H
        C AT UNIT NO. J
              DO 3 J=1,NUNIT
              IF(ISC.EQ.0)GOTO21
              L=NLIST(J)
              DO 15 K=1,L
              IF(SC.EQ.TAMNO(TYPENO(K,J)))GOTO21
        15    CONTINUE
              GOTO4
        21    IF(IEAU(2,J).EQ.0.OR.N2U(J,MODE).EQ.0)GOTO4
              L1=0
              L2=NVS2E
              ICNTR=0
              IF(NVS2E.EQ.0)GOTO5
        6     ICNTR=ICNTR+1
              IF(ISC.EQ.0.AND.N2U(J,MODE).GT.L1.AND.N2U(J,MODE).LE.L2)GOTO5
              IF(ISC.NE.0.AND.NEI(K,J).GT.L1.AND.NEI(K,J).LE.L2)GOTO5
              L1=L2
              L2=L2+NVS2E
              GOTO6
        5     NMEQU(I,J)=ICNTR
              IF(M(MODE).EQ.0)GOTO3
              LL=M(MODE)
              DO 7 KK=1,LL
```

SUBROUTINE TESTEQ

```
            IF(LOC(KK,MODE).NE.J)GOTO7
            NMEQU(I,J)=NMEQU(I,J)+N3E
            GOTO3
      7     CONTINUE
            GOTO3
      4     NMEQU(I,J)=0
      3     CONTINUE
      C AT SEABASE
            L1=0
            L2=NVS2E
            ICNTR=0
            IF(NVS2E.EQ.0)GOTO9
            IF(ISC.EQ.0.AND.N2SB(MODE).EQ.0)GOTO9
            IF(SC.EQ.5HD1100.AND.N1100SB.EQ.0)GOTO9
            IF(SC.EQ.5HD1160.AND.N1160SB.EQ.0)GOTO9
            IF(SC.EQ.5HD0860.AND.N0860SB.EQ.0)GOTO9
     10     ICNTR=ICNTR+1
            IF(ISC.EQ.0.AND.N2SB(MODE).GT.L1.AND.N2SB(MODE).LE.L2)GOTO9
            IF(SC.EQ.5HD1100.AND.N1100SB.GT.L1.AND.N1100SB.LE.L2)GOTO9
            IF(SC.EQ.5HD1160.AND.N1160SB.GT.L1.AND.N1160SB.LE.L2)GOTO9
            IF(SC.EQ.5HD0860.AND.N0860SB.GT.L1.AND.N0860SB.LE.L2)GOTO9
            L1=L2
            L2=L2+NVS2E
            GOTO10
      9     NMEQSB(I)=ICNTR
            IF(ISC.EQ.0.AND.FLAG3(MODE).EQ.3H3RD)NMEQSB(I)=NMEQSB(I)+N3E
            IF(ISC.EQ.0.AND.FLAG4(MODE).EQ.3H4TH)NMEQSB(I)=NMEQSB(I)+N4E
            IF(SC.EQ.5HD1100.AND. F3D1100.EQ.3H3RD)NMEQSB(I)=NMEQSB(I)+N3E
            IF(SC.EQ.5HD1100.AND. F4D1100.EQ.3H4TH)NMEQSB(I)=NMEQSB(I)+N4E
            IF(SC.EQ.5HD1160.AND. F3D1160.EQ.3H3RD)NMEQSB(I)=NMEQSB(I)+N3E
            IF(SC.EQ.5HD1160.AND. F4D1160.EQ.3H4TH)NMEQSB(I)=NMEQSB(I)+N4E
            IF(SC.EQ.5HD0860.AND. F3D0860.EQ.3H3RD)NMEQSB(I)=NMEQSB(I)+N3E
            IF(SC.EQ.5HD0860.AND. F4D0860.EQ.3H4TH)NMEQSB(I)=NMEQSB(I)+N4E
            GOTO2
     11     CONTINUE
            WRITE(6,100)
    100     FORMAT(///,42X,47HTOOL SETS, KITS, AND SPECIAL EQUIPMENT REQUIRED)
            WRITE(6,107)(L,L=1,NUNIT)
    107     FORMAT(///,85X,33HQUANTITY OF REPAIR ITEMS REQUIRED,/,86X,8HAT UNI
           1TS,15X,10HAT SEABASE,3X,5HTOTAL,/,76X,10I3)
            WRITE(6,114)
    114     FORMAT(24X,12HNOMENCLATURE,25X,12HTEST TAM NO.,/)
            NTE=I-1
            DO 110 L=1,NTE
            ITOTAL(L)=0
            DO 108 K=1,NUNIT
    108     ITOTAL(L)=NMEQU(L,K)+ITOTAL(L)
    110     ITOTAL(L)=NMEQSB(L)+ITOTAL(L)
            DO 109 I=1,NTE
            WRITE(6,103)(NOMEN(I,J),J=1,6),TTAMNO(I),(NMEQU(I,J),J=1,NUNIT)
    103     FORMAT(1X,5A10,A9,4X,A5,7X,10I3)
    109     WRITE(6,101)NMEQSB(I),ITOTAL(I)
    101     FORMAT(1H+,113X,I2,8X,I2)
            RETURN
            END
```

6.8 SUBROUTINE INITIAL

Called By: Executive Routine

Abstract:

This subroutine performs the function of initializing various variables for the class under consideration.

SUBROUTINE INITIAL

```
      SUBROUTINE INITIAL
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10)
     1 ,PCTR(3),PF(5),CLASS
      COMMON/N2/NCTS,NSS,NUS
      COMMON/N7/DTH(150,10),HQE(13),HWIQ(13),LENTHC(13),LENTHQ(13),
     1 MAXQL(13),NENTER(13),QL(13),TQBE(13),WT(13),NDISC(150),NOREQ(150)
     1 ,HCTW(10),TCTBF(10),HSSW(10),TSSBF(10),TRTS,NIER(13),IMAXQL(13)
     1 ,INENTR(13),TIMEINT,HUSW(10),TUSBF(10),NOFAIL(150,10)
      DO 12 I=1,NOTYPE
      NDISC(I)=0
      NOREQ(I)=0
      DO 11 J=1,NUNIT
      HUSW(J)=0.
      NOFAIL(I,J)=0
   11 DTH(I,J)=0.
   12 CONTINUE
      DO 13 I=1,10
      HSSW(I)=0.
   13 HCTW(I)=0.
      J=3+NUNIT
      DO 14 I=1,J
      QL(I)=0.
      WT(I)=0.
      IMAXQL(I)=0
      INENTR(I)=0
      NIER(I)=0
   14 HQE(I)=0.
      TRTS=0.
      RETURN
      END
```

6.9 SUBROUTINE SIE

Called By: Executive Routine

Abstract:

This subroutine performs three functions. The first is to generate initial fail events for all the items in the Landing Force. At the start of the mission (i.e., TIME=0.0) all the end items are assumed to be fully operational. For every end item, a failure is generated by storing a fail event on the event list. (See Section 7.1.) These items will therefore operate from TIME=0.0 until their generated time to failure.

The second function is to schedule the update of the variables LENTHQ and LENTHC at time TIMEINT by calling the function SNE(IQL,TIMEINT,WORD,FTIME).

The third function is to initialize various variables before the start of each simulated mission. Since all dedicated Contact Teams are initially at the seabase and are available for repair work, variable ICTS(i) is initialized to (NOTYPE+1) for i ranging from CT number 1 through CT numbers NCTS. To set up the initial float level of replacement items, variable INV(i) is initialized to the number of float items designated for type i (INV(i)=NFI(i) for i=1 through NOTYPE). Variables ISS(i), for i=1 through NSS, are initialized to zero to indicate that the required maintenance personnel and space number i are available for repair. If the maintenance personnel are removed from their space i, then the space is no longer available for a repair and ISS(i)≠0 indicates this condition. The other variables are initialized to zero. (Refer to program listing for the names of these variables.)

SUBROUTINE SIE

```
      SUBROUTINE SIE
      INTEGER TYPENO,WORD(5)
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10)
     1 ,PCTR(3),PF(5),CLASS
      COMMON/N2/NCTS,NSS,NUS
      COMMON/N3/INV(150),NEI(30,10),NFI(150),NLIST(10),NR,NTRQST(200),
     1 NURQST(200),TIRQST(200),TYPENO(30,10),TAMNO(150)
      COMMON/N5/ICTQ(200),ISQ(200),ISQA(200),ISS(10),IUQ(200,10),NICTQ,
     1  NICTS,NISQ,NISQA,NIUQ(10),NIUS(10),NPISQ(200),NPISQA(200),
     1  NUICTQ(200),TICTQ(200),TISQ(200),TISQA(200),TIUQ(200,10)
     1 ,NESQ(200),NESQA(200),NEUQ(200,10),NECTQ(200),ICTS(10)
      COMMON/N7/DTH(150,10),HQE(13),HWIQ(13),LENTHC(13),LENTHQ(13),
     1 MAXQL(13),NENTER(13),QL(13),TQBE(13),WT(13),NDISC(150),NOREQ(150)
     1 ,HCTW(10),TCTBF(10),HSSW(10),TSSBF(10),TRTS,NIER(13),IMAXQL(13)
     1 ,INENTR(13),TIMEINT,HUSW(10),TUSBF(10),NOFAIL(150,10)
      COMMON/SNTN/CLOCK(300),EVENT(300),IPTR,WORDS(6,300),FTIMES(300)
      DATA IQL,ICOMPS,IARRVL,IFAIL/1,2,4,6/
      IPTR=0
      DO 1 J=1,NUNIT
      II=NLIST(J)
      DO 2 I=1,II
      KK=NEI(I,J)
      DO 3 K=1,KK
      WORD(1)=TYPENO(I,J)
      WORD(2)=J
      CALL GENTTF(WORD,TTF)
      CALL SNE(IFAIL,TTF,WORD,FTIME)
    3 CONTINUE
    2 CONTINUE
    1 CONTINUE
      CALL SNE(IQL,TIMEINT,WORD,FTIME)
      DO 9 I=1,NCTS
    9 ICTS(I)=NOTYPE+1
      DO 4 I=1,NOTYPE
    4 INV(I)=NFI(I)
      NR=0
      DO 5 I=1,10
    5 ISS(I)=0
      NISQ=0
      NISQA=0
      NICTQ=0
      NICTS=0
      DO 6 I=1,NUNIT
      NIUQ(I)=0
    6 NIUS(I)=0
      J=3+NUNIT
      DO 7 I=1,J
      TQBE(I)=0.
      NENTER(I)=0
      HWIQ(I)=0.
      LENTHQ(I)=0
      LENTHC(I)=0
    7 MAXQL(I)=0
      RETURN
      END
```

6.10 SUBROUTINE SNE(IEV,TIME,WORD,FTIME)

Called By: Subroutine FAIL, Subroutine COMPS, Subroutine ARRVL, Subroutine REQUST, Subroutine SIE

Parameters Used:

IEV	Type of event
TIME	Time (clock time) event is scheduled to occur
WORD	Information about the event
FTIME	Time (clock time) item failed

Abstract:

Subroutine SNE stores an event just scheduled on the event list. When Subroutine SNE is called, IEV is represented by a hollerith constant. The value of IEV is converted into an integer constant by the statement, DATA IQL,ICOMPS,IARRVL,IFAIL/1,2,4,6/. In Subroutine SNE the integer value of IEV indicates the type of event to store as follows:

IQL	Schedule update of the variables LENTHQ and LENTHC
ICOMPS	Schedule a repair
IARRVL	Schedule an arrival
IFAIL	Schedule a failure

To indicate that an event is being added to the event list, the variable IPTR which records the number of events presently on the event list is updated (IPTR=IPTR+1). If this number exceeds the event list limit (IPTR > 300), the program stops. (To increase the event list limit from 300, the dimensions of the variables in COMMON statement /SNTN/ must be changed as well as the statement in Subroutine SNE: IF (IPTR.EQ.300) GO TO 8.) If IPTR ⩽ 300 the event just scheduled will be stored on the event list in a location which depends on the time the event is to occur (i.e., TIME) and the indicator of the event type (i.e., IEV). This location will be determined as follows:

If IPTR=1	Store in Location 1
If TIME < CLOCK(i), for any i=1,(IPTR-1)	Store in Location i
If TIME=CLOCK(i) and IEV < EVENT(i), for any i=1,(IPTR-1)	Store in Location i
If TIME=CLOCK(i) and IEV ⩾ EVENT(i), for any i=1,(IPTR-1)	Store in Location IPTR
If TIME > CLOCK(i), for all i=1,(IPTR-1)	Store in Location IPTR

For the case where the event is to be stored in Location i on the event list, since an event is already stored in that location, each event in locations i through (IPTR-1) will be moved back one location as follows, for m=i through (IPTR-1)

EVENT(m+1)=EVENT(m)
CLOCK(m+1)=CLOCK(m)
WORDS(k,m+1)=WORDS(k,m), for k=1,6
FTIMES(m+1)=FTIME(m)

The event just scheduled is placed into Location "x" of the event list by the following storage assignments:

EVENT(x)=IEV
CLOCK(x)=TIME
WORDS(j,x)=WORD(j), for j=1,6
FTIMES(x)=FTIME

SUBROUTINE SNE

```
      SUBROUTINE SNE(IEV,TIME,WORD,FTIME)
      INTEGER WORD(6),EVENT,WORDS
      COMMON/SNTN/CLOCK(300),EVENT(300),IPTR,WORDS(6,300),FTIMES(300)
      IF(IPTR.EQ.0)GOTO2
      IF(IPTR.EQ.300)GOTO8
      DO 1 I=1,IPTR
      IF(CLOCK(I).LT.TIME)GOTO1
      IF(CLOCK(I).EQ.TIME.AND.EVENT(I).LE.IEV)GOTO1
      GOTO7
    1 CONTINUE
    2 IPTR=IPTR+1
      EVENT(IPTR)=IEV
      CLOCK(IPTR)=TIME
      DO 3 I=1,6
    3 WORDS(I,IPTR)=WORD(I)
      FTIMES(IPTR)=FTIME
      RETURN
    7 IPTR=IPTR+1
      J=IPTR
    4 EVENT(J)=EVENT(J-1)
      CLOCK(J)=CLOCK(J-1)
      DO 5 K=1,6
    5 WORDS(K,J)=WORDS(K,J-1)
      FTIMES(J)=FTIMES(J-1)
      J=J-1
      IF(J.NE.I)GOTO4
      EVENT(I)=IEV
      CLOCK(I)=TIME
      DO 6 K=1,6
    6 WORDS(K,I)=WORD(K)
      FTIMES(I)=FTIME
      RETURN
    8 WRITE(6,9)
    9 FORMAT(39H DIMENSION OF EVENT LIST EXCEEDED LIMIT)
      STOP
      END
```

6.11 SUBROUTINE TNE

Called By: Executive Routine

Abstract:

This subroutine removes the event in Location 1 from the event list. If the time the first event on the event list is to occur is greater than the mission duration (CLOCK(1) $>$ GTIME), control of the program is returned to the Executive Routine. If CLOCK(1) $\leqslant$ GTIME, the event in Location 1 of the event list is removed by storing the following information into the variables as indicated here

TIME=CLOCK(1)	Time (clock time) event is scheduled to occur
IEV=EVENT(1)	Type of event
WORD(j)=WORDS(j,l), for j=1,6	Information about the event
FTIME=FTIMES(1)	Time (clock time) item failed

To indicate that an event is being removed from the event list, the variable IPTR which records the number of events presently stored on the event list is decremented (IPTR=IPTR-1). If any events are still on the event list (IPTR$\neq$0), each of them will be moved up one location as indicated here, for L=1 through IPTR

EVENT(m)=EVENT(m+1)
CLOCK(m)=CLOCK(m+1)
WORDS(j,m)=WORDS(j,m+1), for j=1,6
FTIMES(m)=FTIMES(m+1)

Control of the program is then transferred to a subroutine (depending on the value in IEV) as follows:

IEV=1	Subroutine QULENTH
IEV=2	Subroutine COMPS
IEV=4	Subroutine ARRVL
IEV=6	Subroutine FAIL

SUBROUTINE TNE

```
      SUBROUTINE TNE
      INTEGER WORD(6),EVENT,WORDS
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10)
     1 ,PCTR(3),PF(5),CLASS
      COMMON/SNTN/CLOCK(300),EVENT(300),IPTR,WORDS(6,300),FTIMES(300)
100   IF(CLOCK(1).GT.GTIME)RETURN
      IEV=EVENT(1)
      TIME=CLOCK(1)
      DO 9 I=1,6
9     WORD(I)=WORDS(I,1)
      FTIME=FTIMES(1)
      IPTR=IPTR-1
      IF(IPTR.EQ.0)GOTO3
      DO 8 I=1,IPTR
      EVENT(I)=EVENT(I+1)
      CLOCK(I)=CLOCK(I+1)
      DO 7 J=1,6
7     WORDS(J,I)=WORDS(J,I+1)
      FTIMES(I)=FTIMES(I+1)
8     CONTINUE
3     GOTO(1,2,595,4,595,6)IEV
1     CALL QULENTH(TIME,WORD,FTIME)
      GOTO100
2     CALL COMPS(TIME,WORD,FTIME)
      GOTO100
4     CALL ARRVL(TIME,WORD,FTIME)
      GOTO100
6     CALL FAIL(TIME,WORD,FTIME)
      GOTO100
595   WRITE(6,596)IEV
596   FORMAT(18H ILLEGAL EVENT NO=,I5,11H WAS CALLED)
      STOP
      END
```

6.12 SUBROUTINE FAIL(TIME,WORD,FTIME)

Called By: Subroutine TNE

Parameters Used:

TIME	Time (clock time) subroutine is entered
WORD(1)	Type of failed item
WORD(2)	Unit number of item

Abstract:

A failure has been simulated for the item whose type is represented by variable WORD(1) and whose unit is represented by variable WORD(2) at the present clock time, TIME. The variable NOFAIL(WORD(1), WORD(2)) which records the total number of times failures have been simulated for this item is incremented (NOFAIL(WORD(1),WORD(2))=NOFAIL(WORD(1),WORD(2))+1). The echelon level at which the item is to be repaired is computed from the variable PF(i) (percentage of items that fail requiring ith-echelon repair) and a generated random number, and is stored in the variable WORD(5).

When an item fails, it can undergo repair

- at the seabase
- ashore by CT
- at the unit

or be discarded, as determined by the following logic:

If the item requires either 2nd-echelon repair (WORD(5)=2) or 3rd-echelon repair (WORD(5)=3) and if this capability exists at the unit (IEAU(WORD(5),WORD(2))=1), the failed item will be repaired there. The item will be discarded if the required echelon of repair does not exist at either the unit (IEAU(WORD(5),WORD(2))=0) or the seabase (IECHAV(WORD(5))=0). If the seabase has the required echelon of repair (IECHAV(WORD(5))=1), the item will either be repaired at the seabase or ashore by a CT. If fourth-echelon repair is required (WORD(5)=4) or if repair by a CT is not specified (IDCT=2), then the item will be repaired at the seabase. If 2nd- or 3rd-echelon repair is required and repair by a CT is specified, the variable PCTR(i) (percentage of items repaired by CT's requiring ith-echelon repair) and a generated random number between zero and one, determine whether the item is to be repaired at the seabase or ashore by a CT.

Repair at the Seabase

Subroutine REQUST is called to determine if a replacement item of type WORD(1) is available from the float. The priority of the failed item will be assigned in Subroutine REQUST and stored as the variable WORD(2) (replacing the unit number of the failed item).

The failed item will be transported to the seabase for repair if the present length of the seabase queue afloat is less than the specified limit (NISQ < LIMIT). An arrival is scheduled by storing an arrival event on the event list (see Section 7.2.1). If a queue has formed at the seabase and if its present length is greater than or equal to the specified limit (NISQ $\geq$ LIMIT), the failed item will be transported to the seabase queue ashore. An arrival is scheduled by storing an arrival event on the event list (see Section 7.2.2). After the destination of the item is determined, control of the program is returned to Subroutine TNE.

Repair Ashore by a CT

When a failed item requires repair by a CT, the value of the input variable IDCT determines whether a dedicated or nondedicated CT is required as follows:

IDCT=0	Nondedicated CT required
IDCT=1	Dedicated CT required

By a Nondedicated CT

If the number of items being repaired (NICTS) by CT's equals the specified number of items allowed to be repaired simultaneously by CT's (NICTS=NCTS), the failed item is added to the CT queue (see Section 8.0). Control of the program is returned to Subroutine TNE. If the number of items being repaired by CT's is less than the specified number of items allowed to be repaired simultaneously by CT's, the failed item will be repaired by a CT. In some cases, when a nondedicated CT leaves the shop, the seabase repair capability will not be affected; in other cases it will, depending on the number of CT's already ashore. To simulate these conditions in the program, it was necessary to introduce two types of nondedicated CT's:

- Regular
- Phantom

Ashore they are indistinguishable in their repair capability; their use is strictly a programming device. A "regular" CT decreases the capability when removed from the seabase. A "phantom" CT will not. The array NDCS(i) (decrease in seabase repair capability as CT's depart) determines whether a regular or phantom CT is required ashore as indicated here.

If NICTS=0	A phantom CT is required
If NDCS(NICTS)=NDCS(NICTS+1)	A phantom CT is required
If NDCS(NICTS)≠NDCS(NICTS+1)	A regular CT is required

Once the type of CT required has been determined, its availability is determined.

A regular CT required ashore will be sent if maintenance personnel are available at the seabase (if ISS(i)=0, for any i=1 through NSS). The maintenance personnel are transported ashore as a CT with an identification number i to repair the failed item. The repair is scheduled by storing a complete service event on the event list (see Section 7.3.2). Control of the program is returned to Subroutine TNE. If a regular CT is required but one is not available (if ISS(i)=0, for all i≠1 through NSS), the failed item is added to the CT queue (see Section 8.0). Control of the program is then returned to Subroutine TNE.

Suppose a phantom CT is required ashore. An input to the program is the total number of phantom CT's specified, NPS. The phantom CT's are given identification numbers ranging from (NSS+1) through (NSS+NPS). Phantom CT number i is sent ashore to repair the failed item if ISS(i)=0, for any i= (NSS+1) through (NSS+NPS). Repair is scheduled by storing a complete service event on the event list (see Section 7.3.2). Control of the program is returned to subroutine TNE. If a phantom CT is required but one is not available (if ISS(i)≠0, for all i= (NSS+1) through (NSS+NPS)), the failed item is added to the CT queue (see Section 8.0). Control of the program is returned to Subroutine TNE.

By a Dedicated CT

A dedicated CT required ashore will be sent a) from a point ashore if ICTS(i)=0, for any i=1 through NCTS, or b) from the seabase if ICTS(i)=(NOTYPE+1) for any i=1 through NCTS. Repair by CT number i is scheduled by storing a complete service event on the event list (see Section 7.3.4). Control of the program is returned to Subroutine TNE. If a dedicated CT is required but one is not available, the failed item is added to the CT queue (see Section 8.0). Control of the program is then returned to Subroutine TNE.

Repair at the Unit

If the number of items being repaired at unit WORD(2) is less than a specified input value (NIUS(WORD(2)) <NUS), the failed item will be repaired. Repair is scheduled by storing a complete service event on the event list (see Section 7.3.3). Control of the program is then returned to Subroutine TNE.
If the number of items being repaired at unit WORD(2) equals a specified input value (NIUS(WORD(2))=NUS), the failed item is added to the unit queue (see Section 8.0). Control of the program is returned to Subroutine TNE.

Discard

If the failed end item cannot be repaired, the unit requires a replacement item of type WORD(1) from the float. Subroutine REQUST is called to determine if one is available. The variable NDISC(WORD(1)) which records the total number of times item type WORD(1) is discarded is incremented (NDISC(WORD(1)) =NDISC(WORD(1))+1). Control of the program is then returned to Subroutine TNE.

SUBROUTINE FAIL

```
          SUBROUTINE FAIL(TIME,WORD,FTIME)
          INTEGER WORD(6)
          COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10)
         1 ,PCTR(3),PF(5),CLASS
          COMMON/N2/NCTS,NSS,NUS
          COMMON/N5/ICTQ(200),ISQ(200),ISQA(200),ISS(10),IUQ(200,10),NICTQ,
         1  NICTS,NISQ,NISQA,NIUQ(10),NIUS(10),NPISQ(200),NPISQA(200),
         1  NUICTQ(200),TICTQ(200),TISQ(200),TISQA(200),TIUQ(200,10)
         1 ,NESQ(200),NESQA(200),NEUQ(200,10),NECTQ(200),ICTS(10)
          COMMON/N6/LIMDIM,LIMIT,T1,T2,IOPT1,IOPT2,IOPT3
          COMMON/N7/DTH(150,10),HQE(13),HWIQ(13),LENTHC(13),LENTHQ(13),
         1 MAXQL(13),NENTER(13),QL(13),TQBE(13),WT(13),NDISC(150),NOREQ(150)
         1 ,HCTW(10),TCTBF(10),HSSW(10),TSSBF(10),TRTS,NIER(13),IMAXQL(13)
         1 ,INENTR(13),TIMEINT,HUSW(10),TUSBF(10),NOFAIL(150,10)
          COMMON/N9/NDCS(5),NPS
          DATA ICOMPS,IARRVL,IFAIL/2,4,6/
C END ITEM TYPE WORD(1) FROM UNIT NO. WORD(2) FAILS AT TIME
          NOFAIL(WORD(1),WORD(2))=NOFAIL(WORD(1),WORD(2))+1
C GENERATE ECHELON OF REPAIR
          RN=RANF(DUM)
          B1=-0.
          B2=0.
          DO 500 I=2,5
          B2=PF(I)+B2
          IF(RN.GT.B1.AND.RN.LE.B2)WORD(5)=I
          B1=B2
500       CONTINUE
          IF(IOPT1.EQ.1)WRITE(6,200)WORD(1),WORD(2),TIME,WORD(5)
200       FORMAT(/,14H END ITEM TYPE,I2,13H FROM UNIT NO,I2, 9H FAILS AT,
         1 F6.1,28H HRS. MAINTENANCE AT ECHELON,I2,12H IS REQUIRED)
C DETERMINE LOCATION OF REPAIR
          IF((WORD(5).EQ.2.OR.WORD(5).EQ.3).AND.IEAU(WORD(5),WORD(2)).EQ.1)
         1 GOTO102
          IF(IECHAV(WORD(5)).EQ.0)GOTO103
          RN=RANF(DUM)
          IF(IDCT.NE.2.AND.(WORD(5).EQ.2.OR.WORD(5).EQ.3).AND.RN.LT.PCTR(WOR
         1D(5)))GOTO101

COMMENT   REPAIR END ITEM TYPE WORD(1) AT SEABASED MAINTENANCE SHOP
          CALL REQUST(TIME,WORD)
          IF(NISQ.GE.LIMIT)GOTO1
C TRANSPORT FAILED END ITEM TO SEABASED MAINTENANCE SHOP
          WORD(6)=1
          CALL SNE(IARRVL,TIME+T1,WORD,FTIME)
          IF(IOPT1.EQ.0)RETURN
          WRITE(6,201)
201       FORMAT(45H REPAIR END ITEM AT SEABASED MAINTENANCE SHOP)
          WRITE(6,211)WORD(2)
211       FORMAT(52H TRANSPORT END ITEM TO SB MAINT SHOP WITH A PRIOR OF,I2)
          RETURN
C TRANSPORT FAILED END ITEM TO SEABASED QUEUE ASHORE
1         WORD(6)=2
          CALL SNE(IARRVL,TIME+T2,WORD,FTIME)
          IF(IOPT1.EQ.0)RETURN
          WRITE(6,201)
```

```
            WRITE(6,204)WORD(2)
  204       FORMAT(63H TRANSPORT END ITEM TO SEABASED QUEUE ASHORE WITH A PRIO
           1RITY OF,I2)
            RETURN

      COMMENT   REPAIR END ITEM TYPE WORD(1) WITH CT
  101       CONTINUE
            IF(IDCT.EQ.1)GOTO7
      C NON-DEDICATED CT ARE SPECIFIED
            IF(NICTS.EQ.NCTS)GOTO2
            IF(NICTS.EQ.0)GOTO13
            IF(NDCS(NICTS).EQ.NDCS(NICTS+1))GOTO13
      C REGULAR C.T. IS REQUIRED
            DO 5 NSERVR=1,NSS
            IF(ISS(NSERVR).NE.0)GOTO5
      C TRANSPORT SHOP MAINT PERSONNEL ASHORE AS A CT, DECREASE SHOP REPAIR CAPABILIT
            NIER(3)=NIER(3)+1
            ISS(NSERVR)=NOTYPE+1
            NICTS=NICTS+1
            WORD(3)=NSERVR
            WORD(6)=2
            FTIME=TIME
            CALL GENTTR(WORD,TTR)
            CALL SNE(ICOMPS,TIME+TTR+T1,WORD,FTIME)
            TCTBF(WORD(3))=TIME+T1
            TRTS=T1+TRTS
            IF(IOPT1.EQ.0)RETURN
            WRITE(6,202)
  202       FORMAT(22H REPAIR END ITEM BY CT)
            RTIME=TIME+TTR+T1
            WRITE(6,206)NSERVR,RTIME
  206       FORMAT(31H SHOP MAINT PERS FROM SPACE NO.I2,87H ARE AVAIL IMMEDIAT
           1ELY TO REPAIR END ITEM, SO SEND HIM ASHORE. HE WILL FINISH REPAIR
           1AT,F6.1,5H HRS.)
            WRITE(6,219)
  219       FORMAT(37H NOTE-DECREASE SHOP REPAIR CAPABILITY)
            RETURN
  5         CONTINUE
      C ADD END ITEM TO CT QUEUE
  2         NICTQ=NICTQ+1
            IF(NICTQ.GT.LIMDIM)GOTO4
            ICTQ(NICTQ)=WORD(1)
            TICTQ(NICTQ)=TIME
            NUICTQ(NICTQ)=WORD(2)
            NECTQ(NICTQ)=WORD(5)
            IF(NICTQ.EQ.1)HQE(3)=TIME-TQBE(3)+HQE(3)
            NENTER(3)=NENTER(3)+1
            IF(MAXQL(3).LT.NICTQ)MAXQL(3)=NICTQ
            IF(IOPT1.EQ.0)RETURN
            WRITE(6,202)
            IF(IDCT.EQ.0)WRITE(6,207)
  207       FORMAT(59H NO SHOP MAINTENANCE PERSONNEL ARE AVAIL TO REPAIR END I
           1TEM)
            IF(IDCT.EQ.1)WRITE(6,213)
  213       FORMAT(46H NO DEDICATED C.T. IS AVAIL TO REPAIR END ITEM)
```

SUBROUTINE FAIL

```
      CALL RITCTQ
      RETURN
C PHANTOM C.T. IS REQUIRED
13    JJ=NSS+1
      KK=NSS+NPS
      DO 14 II=JJ,KK
      IF(ISS(II).NE.0)GOTO14
C TRANSPORT MAINT PERSONNEL ASHORE AS A CT, DO NOT DECREASE CAPACITY OF SHOP
      NIER(3)=NIER(3)+1
      ISS(II)=NOTYPE+1
      NICTS=NICTS+1
      WORD(3)=II
      WORD(6)=2
      FTIME=TIME
      CALL GENTTR(WORD,TTR)
      CALL SNE(ICOMPS,TIME+TTR+T1,WORD,FTIME)
      TCTBF(WORD(3))=TIME+T1
      TRTS=T1+TRTS
      IF(IOPT1.EQ.0)RETURN
      WRITE(6,202)
      RTIME=TIME+TTR+T1
      WRITE(6,206)II,RTIME
      WRITE(6,217)
217   FORMAT(44H NOTE-DO NOT DECREASE SHOP REPAIR CAPABILITY)
      RETURN
14    CONTINUE
      GOTO2
C DEDICATED CT ARE SPECIFIED
7     CONTINUE
      DO 8 I=1,NCTS
      IF(ICTS(I).EQ.0)GOTO9
8     CONTINUE
      DO 10 I=1,NCTS
      IF(ICTS(I).EQ.NOTYPE+1)GOTO11
10    CONTINUE
      GOTO2
C C.T. NO. II IS AVAILABLE FROM THE SEABASE
11    TRANSP=T1
      IF(IOPT1.EQ.0)GOTO12
      WRITE(6,202)
      WRITE(6,214)I
214   FORMAT(7H CT NO.,I2,65H IS AVAIL FROM THE SEABASE TO REPAIR END IT
     1EM, SO SEND HIM ASHORE)
      GOTO12
C CT NO. II IS AVAILABLE AT A POINT ASHORE
9     TRANSP=T2
      IF(IOPT1.EQ.0)GOTO12
      WRITE(6,202)
      WRITE(6,215)I
215   FORMAT(7H CT NO.,I2,67H IS AVAIL FROM POINT ASHORE TO REPAIR END I
     1TEM, SO SEND HIM TO ITEM)
12    ICTS(I)=WORD(1)
      NIER(3)=NIER(3)+1
      WORD(3)=I
      WORD(6)=4
```

```
      FTIME=TIME
      CALL GENTTR(WORD,TTR)
      CALL SNE(ICOMPS,TIME+TRANSP+TTR,WORD,FTIME)
      TCTBF(WORD(3))=TIME+TRANSP
      TRTS=TRTS+TRANSP
      RTIME=TIME+TRANSP+TTR
      IF(IOPT1.EQ.1)WRITE(6,216)RTIME
216   FORMAT(25H HE WILL FINISH REPAIR AT,F6.1,4H HRS)
      RETURN
4     WRITE(6,208)
208   FORMAT(49H NUMBER OF ITEMS IN CT QUEUE EXCEEDED UPPER LIMIT)
      STOP

COMMENT   REPAIR END ITEM TYPE WORD(1) AT UNIT WORD(2)
102   CONTINUE
      IF(NIUS(WORD(2)).EQ.NUS)GOTO3
C UNIT MAINT PERSONNEL IS AVAILABLE FOR REPAIR
      NIER(3+WORD(2))=NIER(3+WORD(2))+1
      NIUS(WORD(2))=NIUS(WORD(2))+1
      TUSBF(WORD(2))=TIME
      WORD(6)=3
      FTIME=TIME
      CALL GENTTR(WORD,TTR)
      CALL SNE(ICOMPS,TIME+TTR,WORD,FTIME)
      IF(IOPT1.EQ.0)RETURN
      WRITE(6,203)
203   FORMAT(28H REPAIR END ITEM AT ITS UNIT)
      RTIME=TIME+TTR
      WRITE(6,205)RTIME
205   FORMAT(95H END ITEM CAN BE REPAIRED IMMEDIATELY BY A UNIT MAINTENA
     1NCE PERSONNEL. HE WILL FINISH REPAIR AT,F6.1,5H HRS.)
      RETURN
C ADD END ITEM TO UNIT NO. WORD(2) QUEUE
3     NIUQ(WORD(2))=NIUQ(WORD(2))+1
      IF(NIUQ(WORD(2)).GT.LIMDIM)GOTO6
      IUQ(NIUQ(WORD(2)),WORD(2))=WORD(1)
      TIUQ(NIUQ(WORD(2)),WORD(2))=TIME
      NEUQ(NIUQ(WORD(2)),WORD(2))=WORD(5)
      IF(NIUQ(WORD(2)).EQ.1)HQE(3+WORD(2))=TIME-TQBE(3+WORD(2))+
     1  HQE(3+WORD(2))
      NENTER(3+WORD(2))=NENTER(3+WORD(2))+1
      IF(MAXQL(3+WORD(2)).LT.NIUQ(WORD(2)))
     1   MAXQL(3+WORD(2))=NIUQ(WORD(2))
      IF(IOPT1.EQ.0)RETURN
      WRITE(6,203)
      WRITE(6,209)
209   FORMAT(59H NO UNIT MAINTENANCE PERSONNEL ARE AVAIL TO REPAIR END I
     1TEM)
      CALL RITEUQ(WORD)
      RETURN
6     WRITE(6,212)
212   FORMAT(51H NUMBER OF ITEMS IN UNIT QUEUE EXCEEDED UPPER LIMIT)
      STOP

COMMENT   THE NUMBER ECHELON MAINTENANCE REQUIRED FOR THIS END ITEM IS NO
```

```
C           AVAILABLE IN THE ATF, SO DISCARD ITEM
103    CALL REQUST(TIME,WORD)
       NDISC(WORD(1))=NDISC(WORD(1))+1
       IF(IOPT1.EQ.1)WRITE(6,210)
210    FORMAT(60H THIS ECHELON MAINT IS NOT AVAIL IN THE ATF, SO DISCARD
      1ITEM)
       RETURN
       END
```

6.13 SUBROUTINE REQUST(TIME,WORD)

Called By: Subroutine FAIL.

Parameters Used:

TIME	Time (clock time) subroutine is entered
WORD(1)	Type of item
WORD(2)	Unit number of item (Input Usage)
WORD(2)	Priority of item (Output Usage)

Abstract:

This subroutine determines if a float item of type WORD(1) is available from the float for unit WORD(2) and then assigns the priority of the failed item and stores it as variable WORD(2) (replacing the unit number of the item).

If a float item of type WORD(1) is not available from the float for unit WORD(2); i.e., INV(WORD(1))=0, the unit registers a request for one. To indicate that a request for a float item is being made, the variable NR which records the present number of requests registered at units is updated (NR=NR+1). If this number exceeds the maximum number of requests allowed (NR > LIMDIM), the program stops; if not, the unit registers a request by storing the following information into the arrays as indicated here:

NTRQST(NR)=WORD(1)	Type of item requested by unit
NURQST(NR)=WORD(2)	Unit (number) requesting the float item
TIRQST(NR)=TIME	Time request is being made

The priority of the failed item is determined, and is stored in the variable WORD(2), as follows:

If NISQ=0 and NISQA=0	WORD(2)=2
If ISQ(i)≠WORD(1) or If ISQ(i)=WORD(1) and NPISQ(i)=2, for all i=1, NISQ; and if ISQA(i)≠WORD(1) or If ISQA(i)=WORD(1) and NPISQA(i)=2, for all i=1, NISQA	WORD(2)=2
If ISQ(i)=WORD(1) and NPISQ(i)≠2, for any i=1,NISQ	WORD(2)=0
If ISQA(i)=WORD(1) and NPISQA(i)≠2, for any i=1,NISQA	WORD(2)=0

In the last two cases, the priority of the item in Location i in the seabase queue afloat or in the seabase queue ashore is changed to two and the item is advanced in the queue according to its new priority. Control of the program is returned to Subroutine FAIL.

If a float item of type WORD(1) is available from the float for unit WORD(2), i.e., INV(WORD(1))≠0, it will be transported to unit WORD(2) ashore to begin operation. Its operation and subsequent failure are scheduled by storing a fail event on the event list (see Section 7.1). Variable INV(WORD(1)) which records the present number of float items available of type WORD(1) is decremented (INV(WORD(1))=INV(WORD(1))- The total amount of time all items of type WORD(1) from unit WORD(2) were non-operational

(DTH(WORD(1),WORD(2))) is updated by the time interval which extends from the time the item failed to the time the float item begins operation.

DTH(WORD(1),WORD(2))=(TIME+T1) - TIME + DTH(WORD(1),WORD(2))

The priority of the failed item is determined, and is stored in the variable (WORD(2) as follows:

If INV(WORD(1))≠0	WORD(2)=0
If NISQ=0 and NISQA=0	WORD(2)=1
If ISQ(i)≠WORD(1), for all i=1,NISQ and ISQA(i)≠WORD(1), for all i=1,NISQA	WORD(2)=1
If ISQ(i)=WORD(1) and NPISQ(i)=1, for any i=1,NISQ	WORD(2)=0
If ISQA(i)=WORD(1) and NPISQA(i)=1, for any i=1,NISQA	WORD(2)=0
If ISQ(i)=WORD(1) and NPISQ(i)=2, for any i=1,NISQ	WORD(2)=1
If ISQA(i)=WORD(1) and NPISQA(i)=2, for any i=1,NISQA	WORD(2)=1
If ISQ(i)=WORD(1) and NPISQ(i)=0, for any i=1,NISQ	WORD(2)=0
If ISQA(i)=WORD(1) and NPISQA(i)=0, for any i=1,NISQA	WORD(2)=0

In the last two cases, the priority of the item in Location i in the seabase queue afloat or in the seabase queue ashore is changed from zero to one and is advanced in the queue according to its new priority. Control of the program is returned to Subroutine FAIL.

SUBROUTINE REQUST

```
      SUBROUTINE REQUST(TIME,WORD)
      INTEGER WORD(6)
      COMMON/N2/NCTS,NSS,NUS
      COMMON/N3/INV(150),NEI(30,10),NFI(150),NLIST(10),NR,NTRQST(200),
     1 NURQST(200),TIRQST(200),TYPENO(30,10),TAMNO(150)
      COMMON/N5/ICTQ(200),ISQ(200),ISQA(200),ISS(10),IUQ(200,10),NICTQ,
     1  NICTS,NISQ,NISQA,NIUQ(10),NIUS(10),NPISQ(200),NPISQA(200),
     1  NUICTQ(200),TICTQ(200),TISQ(200),TISQA(200),TIUQ(200,10)
     1 ,NESQ(200),NESQA(200),NEUQ(200,10),NECTQ(200),ICTS(10)
      COMMON/N6/LIMDIM,LIMIT,T1,T2,IOPT1,IOPT2,IOPT3
      COMMON/N7/DTH(150,10),HQE(13),HWIQ(13),LENTHC(13),LENTHQ(13),
     1 MAXQL(13),NENTER(13),QL(13),TQBE(13),WT(13),NOISC(150),NOREQ(150)
     1 ,HCTW(10),TCTBF(10),HSSW(10),TSSBF(10),TRTS,NIER(13),IMAXQL(13)
     1 ,INENTR(13),TIMEINT,HUSW(10),TUSBF(10),NOFAIL(150,10)
      DATA ICOMPS,IARRVL,IFAIL/2,4,6/
      IF(INV(WORD(1)).EQ.0)GOTO1
C A FLOAT ITEM IS AVAILABLE
      INV(WORD(1))=INV(WORD(1))-1
      IF(IOPT1.EQ.1)WRITE(6,200)INV(WORD(1))
  200 FORMAT(32H A REPL IS AVAIL. NEW INV LEVEL=,I2)
      CALL GENTTF(WORD,TTF)
      CALL SNE(IFAIL,TIME+TTF+T1,WORD,FTIME)
      DTH(WORD(1),WORD(2))=T1+DTH(WORD(1),WORD(2))
      WORD(2)=0
      IF(INV(WORD(1)).NE.0)RETURN
      WORD(2)=1
      IF(NISQ.EQ.0)RETURN
      WORD(2)=0
      DO 9 I=1,NISQ
      IF(ISQ(I).EQ.WORD(1).AND.NPISQ(I).EQ.1)RETURN
    9 CONTINUE
      IF(NISQA.EQ.0)GOTO13
      DO 14 I=1,NISQA
      IF(ISQA(I).EQ.WORD(1).AND.NPISQA(I).EQ.1)RETURN
   14 CONTINUE
   13 DO 16 I=1,NISQ
      IF(ISQ(I).EQ.WORD(1).AND.NPISQ(I).EQ.0)GOTO10
   16 CONTINUE
      WORD(2)=1
      IF(NISQA.EQ.0)RETURN
      DO 17 I=1,NISQA
      IF(ISQA(I).EQ.WORD(1).AND.NPISQA(I).EQ.0)GOTO18
   17 CONTINUE
      RETURN
   10 NPISQ(I)=1
      IF(IOPT1.EQ.1)WRITE(6,201)I
  201 FORMAT(65H CHANGE PRIORITY OF THE ITEM IN SEABASED QUEUE AFLOAT IN
     1 LOCATION,I3,22H TO 1 AND UPDATE QUEUE)
      IF(I.EQ.1)RETURN
      K=I-1
      DO 5 J=1,K
      IF(NPISQ(J).EQ.2)GOTO5
      IF(NPISQ(J).EQ.1.AND.TISQ(J).LE.TISQ(I))GOTO5
      IISQ=ISQ(I)
      TTISQ=TISQ(I)
```

SUBROUTINE REQUST

```
               INESQ=NESQ(I)
         11    ISQ(I)=ISQ(I-1)
               TISQ(I)=TISQ(I-1)
               NPISQ(I)=NPISQ(I-1)
               NESQ(I)=NESQ(I-1)
               I=I-1
               IF(I.NE.J)GOTO11
               ISQ(J)=IISQ
               TISQ(J)=TTISQ
               NESQ(J)=INESQ
               NPISQ(J)=1
               IF(IOPT3.EQ.1)CALL RITESQ
               RETURN
         5     CONTINUE
               IF(IOPT3.EQ.1)CALL RITESQ
               RETURN
         18    NPISQA(I)=1
               WORD(2)=0
               IF(IOPT1.EQ.1)WRITE(6,205)I
         205   FORMAT(19H CHANGE PRIORITY OF,I3,52H ITEM IN SEABASED QUEUE ASHORE
              1 TO 1 AND UPDATE QUEUE)
               IF(I.EQ.1)RETURN
               K=I-1
               DO 19 J=1,K
               IF(NPISQA(J).EQ.2)GOTO19
               IF(NPISQA(J).EQ.1.AND.TISQA(J).LE.TISQA(I))GOTO19
               IISQA=ISQA(I)
               TTISQA=TISQA(I)
               INESQA=NESQA(I)
         12    ISQA(I)=ISQA(I-1)
               TISQA(I)=TISQA(I-1)
               NPISQA(I)=NPISQA(I-1)
               NESQA(I)=NESQA(I-1)
               I=I-1
               IF(I.NE.J)GOTO12
               ISQA(J)=IISQA
               TISQA(J)=TTISQA
               NESQA(J)=INESQA
               NPISQA(J)=1
               IF(IOPT3.EQ.1)CALL RITSQA
               RETURN
         19    CONTINUE
               IF(IOPT3.EQ.1)CALL RITSQA
               RETURN
         C A FLOAT ITEM IS NOT AVAILABLE
         1     NR=NR+1
               IF(NR.GT.LIMDIM)GOTO207
               IF(IOPT1.EQ.1)WRITE(6,203)
         203   FORMAT(17H NO REPL IS AVAIL)
               NTRQST(NR)=WORD(1)
               NURQST(NR)=WORD(2)
               TIRQST(NR)=TIME
               IF(IOPT1.EQ.1)CALL RITERQ
               WORD(2)=2
               IF(NISQ.EQ.0)RETURN
```

SUBROUTINE REQUST

```
            DO 3 I=1,NISQ
            IF(ISQ(I).EQ.WORD(1).AND.NPISQ(I).NE.2)GOTO4
      3     CONTINUE
            IF(NISQA.EQ.0)RETURN
            DO 21 I=1,NISQA
            IF(ISQA(I).EQ.WORD(1).AND.NPISQA(I).NE.2)GOTO20
     21     CONTINUE
            RETURN
      4     NPISQ(I)=2
            WORD(2)=0
            IF(IOPT1.EQ.1)WRITE(6,204)I
    204     FORMAT(58H A REPL WAS FOUND IN THE SEABASED QUEUE AFLOAT IN LOCATI
           1ON,I3,25H CHANGE ITS PRIORITY TO 2)
            IF(I.EQ.1)RETURN
            K=I-1
            DO 6 J=1,K
            IF(NPISQ(J).EQ.2.AND.TISQ(J).LE.TISQ(I))GOTO6
            IISQ=ISQ(I)
            TTISQ=TISQ(I)
            INESQ=NESQ(I)
      8     ISQ(I)=ISQ(I-1)
            TISQ(I)=TISQ(I-1)
            NPISQ(I)=NPISQ(I-1)
            NESQ(I)=NESQ(I-1)
            I=I-1
            IF(I.NE.J)GOTO8
            ISQ(J)=IISQ
            TISQ(J)=TTISQ
            NESQ(J)=INESQ
            NPISQ(J)=2
            IF(IOPT3.EQ.1)CALL RITESQ
            RETURN
      6     CONTINUE
            IF(IOPT3.EQ.1)CALL RITESQ
            RETURN
     20     NPISQA(I)=2
            WORD(2)=0
            IF(IOPT1.EQ.1)WRITE(6,206)I
    206     FORMAT(46H A REPL WAS FOUND IN THE SHOP QUE ASHORE SPACE,I3,25H CH
           1ANGE ITS PRIORITY TO 2)
            IF(I.EQ.1)RETURN
            K=I-1
            DO 22 J=1,K
            IF(NPISQA(J).EQ.2.AND.TISQA(J).LE.TISQA(I))GOTO22
            IISQA=ISQA(I)
            TTISQA=TISQA(I)
            INESQA=NESQA(I)
     23     ISQA(I)=ISQA(I-1)
            TISQA(I)=TISQA(I-1)
            NPISQA(I)=NPISQA(I-1)
            NESQA(I)=NESQA(I-1)
            I=I-1
            IF(I.NE.J)GOTO23
            ISQA(J)=IISQA
            TISQA(J)=TTISQA
```

SUBROUTINE REQUST

```
      NESQA(J)=INESQA
      NPISQA(J)=2
      IF(IOPT3.EQ.1)CALL RITSQA
      RETURN
   22 CONTINUE
      IF(IOPT3.EQ.1)CALL RITSQA
      RETURN
  207 WRITE(6,208)
  208 FORMAT(34H NUMBER OF REQUESTS EXCEEDED LIMIT)
      STOP
      END
```

6.14 SUBROUTINE ARRVL(TIME,WORD,FTIME)

Called By: Subroutine TNE

Parameters Used:

TIME	Time (clock time) subroutine is entered
WORD(1)	Type of item
WORD(2)	Priority of item
WORD(3)	CT identification number
WORD(5)	Echelon level of repair required

Abstract:

An arrival has been simulated at the present clock time, TIME. Parameter WORD(6) indicates which one of the following arrivals is simulated:

WORD(6)=1	Arrival of failed item at seabase
WORD(6)=2	Arrival of failed item at seabase queue ashore
WORD(6)=3	Arrival of nondedicated CT at seabase
WORD(6)=4	Arrival of dedicated CT at a unit ashore

Arrival of Failed Item at Seabase

Item type WORD(1) arrives at the seabase at time, TIME, with a priority of WORD(2) and requires repair at echelon level WORD(5).

If a maintenance space is available (ISS(i)=0, for any i=1 through NSS), the failed item will be repaired in space i. Repair is simulated by storing a complete service event on the event list (see Section 7.3.1). If maintenance space is not available (ISS(i)≠0, for all i=1 through NSS), the failed item is added to the seabase queue afloat (see Section 8.0). After the destination of the item is determined, control of the program is returned to Subroutine TNE.

Arrival of Failed Item at Seabase Queue Ashore

Item type WORD(1) arrives at the seabase queue ashore at time, TIME, with a priority of WORD(2) and requires repair at echelon level WORD(5).

The failed item will be transported to the seabase for repair if the present length of the seabase queue afloat is less than the specified limit (NISQ < LIMIT). An arrival is simulated by storing an arrival event on the event list (see Section 7.2.1). If the present length of the queue afloat is greater than or equal to the specified limit (NISQ ≥ LIMIT), the failed item is added to the seabase queue ashore (see Section 8.0). After the destination of the item is determined, control of the program is returned to Subroutine TNE.

Arrival of a Nondedicated CT at Seabase

A nondedicated CT identified by parameter WORD(3) arrives at the seabase at time, TIME. The number of items being repaired by CT's is decremented (NICTS=NICTS-1).

Variable ISS(WORD(3)) is equated to zero to indicate

- that space WORD(3) is now available to be used for a repair (if the returned CT is a regular CT; i.e., if WORD(3) ⩽NSS), or
- that phantom CT identified by parameter WORD(3) is now available for another repair ashore (if the returned CT is a phantom CT: i.e., if WORD(3) >NSS).

If a) items are in the CT queue ashore and b) the number of items being repaired by CT's is less than the specified number of items allowed to be repaired simultaneously by CT's, a CT is required ashore.

If a CT is not required ashore (NICTQ=0 or NICTS=NCTS), the returned CT will remain at the seabase. If there are no items in the seabase queue afloat (NISQ=0) or if the returned CT is a phantom CT (WORD(3) >NSS), the returned CT remains available at the seabase. Control of the program is returned to Subroutine TNE. If there are items in the seabase queue afloat and the returned CT is a regular CT, the item in Location 1 of the queue is removed for repair in space WORD(3). Repair is scheduled by storing a complete service event on the event list (see Section 7.3.1). The item in Location 1 of the seabase queue ashore can then be removed and transported to the seabase a) if the present length of the queue afloat is now less than the specified limit (NISQ <LIMIT) and b) if there are items in the seabase queue ashore (NISQA≠0). An arrival is scheduled by storing an arrival event on the event list (see Section 7.2.1). Control of the program is returned to Subroutine TNE.

If a CT is required ashore (NICTQ≠0 and NICTS≠NCTS), the kind of CT (regular or phantom) needed is determined; if the CT which just returned to the seabase is of this kind, it will be sent ashore. Four situations can exist as listed here:

	Kind of CT	
Situation	Returned to Seabase	Required Ashore
1	Regular	Regular
2	Phantom	Phantom
3	Phantom	Regular
4	Regular	Phantom

In either Situation 1 (i.e., WORD(3) ⩽NSS and NDCS(NICTS+1)≠NDCS(NICTS)) or Situation 2 (i.e., either WORD(3) >NSS and NDCS(NICTS+1)=NDCS(NICTS) or WORD(3)>NSS and NICTS=0), the returned CT is the correct kind to send ashore. The item in Location 1 of the CT queue is removed and the returned CT is sent ashore to repair it. Repair is scheduled by storing a complete service event on the event list (see Section 7.3.2). Control of the program is returned to Subroutine TNE.

In Situation 3 (i.e., WORD(3) >NSS and NDCS(NICTS+1)≠NDCS(NICTS)) the returned CT is not the correct kind to send ashore, so it will remain at the seabase for a repair which requires a phantom CT. It is then determined whether or not a regular CT is available from the seabase for the repair. If ISS(i)=0, for any i= 1 through NSS, the maintenance personnel are transported ashore as a CT with an identification number i to repair the item removed from Location 1 of the CT queue. Repair is scheduled by storing a complete service event on the event list (see Section 7.3.2). Control of the program is returned to Subroutine TNE.

In Situation 4 (i.e., either WORD(3) ⩽NSS and NICTS=0 or WORD(3) ⩽ NSS and NDCS(NICTS+1)=NDCS(NICTS)) the returned CT is not the correct kind to send ashore, so it is determined a) if a phantom CT is available for the repair ashore and b) if the returned CT is required for the repair of an item from the seabase queue afloat. If phantom CT number i is available for the repair ashore (ISS(i)=0, for any i= (NSS+1) through (NSS+NPS)), it is transported ashore to repair the item removed from Location 1 of the CT queue. Repair is scheduled by storing a complete service event on the event list (see Section 7.3.2). (If the returned CT is to repair an item from the seabase queue afloat, the identification number of the returned CT, WORD(3), is required. To retain this identification number while scheduling the complete service event for the phantom CT, WORD(3) is stored as variable IWORD3 (i.e., IWORD3=WORD(3)). After the complete service event is scheduled, the identification number of the returned CT can be taken out of storage (i.e., WORD(3)=IWORD3)). If there are no items in the seabase queue afloat (NISQ=0), the returned CT will remain at the seabase, and control of the program is returned to Subroutine TNE. If there are items in the seabase queue afloat, then since the returned CT increases the seabase repair capability, the item in Location 1 of the queue is removed for repair. Repair is scheduled by storing a complete service event on the event list (see Section 7.3.1). Control of the program is returned to Subroutine TNE.

Arrival of Dedicated CT at a Unit Ashore

The dedicated CT identified by parameter WORD(3) arrives at a unit ashore at time, TIME. To indicate that this CT is available ashore for repair, variable ICTS(WORD(3)) is equated to zero. If there are no items in the CT queue (NICTQ=0), the CT is not required for repair and control of the program is returned to Subroutine TNE. If there are items in the queue, the CT will repair the item removed from Location 1 of the queue. Repair is scheduled by storing a complete service event on the event list (see Section 7.3.4). Control of the program is then returned to Subroutine TNE.

SUBROUTINE ARRVL

```
      SUBROUTINE ARRVL(TIME,WORD,FTIME)
      INTEGER WORD(6)
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10)
     1 ,PCTR(3),PF(5),CLASS
      COMMON/N2/NCTS,NSS,NUS
      COMMON/N3/INV(150),NEI(30,10),NFI(150),NLIST(10),NR,NTRQST(200),
     1 NURQST(200),TIRQST(200),TYPENO(30,10),TAMNO(150)
      COMMON/N5/ICTQ(200),ISQ(200),ISQA(200),ISS(10),IUQ(200,10),NICTQ,
     1  NICTS,NISQ,NISQA,NIUQ(10),NIUS(10),NPISQ(200),NPISQA(200),
     1  NUICTQ(200),TICTQ(200),TISQ(200),TISQA(200),TIUQ(200,10)
     1 ,NESQ(200),NESQA(200),NEUQ(200,10),NECTQ(200),ICTS(10)
      COMMON/N6/LIMDIM,LIMIT,T1,T2,IOPT1,IOPT2,IOPT3
      COMMON/N7/DTH(150,10),HQE(13),HWIQ(13),LENTHC(13),LENTHQ(13),
     1 MAXQL(13),NENTER(13),QL(13),TQBE(13),WT(13),NDISC(150),NOREQ(150)
     1 ,HCTW(10),TCTBF(10),HSSW(10),TSSBF(10),TRTS,NIER(13),IMAXQL(13)
     1 ,INENTR(13),TIMEINT,HUSW(10),TUSBF(10),NOFAIL(150,10)
      COMMON/N9/NOCS(5),NPS
      DATA ICOMPS,IARRVL,IFAIL/2,4,6/
      GOTO(1,2,3,4)WORD(6)

COMMENT   FAILED END ITEM ARRIVES AT SEABASED MAINTENANCE SHOP
1     CONTINUE
      DO 13 NSERVR=1,NSS
      IF(ISS(NSERVR).NE.0)GOTO13
C SHOP SPACE NO. NSERVR IS AVAILABLE TO BE USED FOR REPAIR
      NIER(1)=NIER(1)+1
      ISS(NSERVR)=WORD(1)
      WORD(3)=NSERVR
      WORD(6)=1
      CALL GENTTR(WORD,TTR)
      CALL SNE(ICOMPS,TIME+TTR,WORD,FTIME)
      TSSBF(WORD(3))=TIME
      IF(IOPT1.EQ.0)RETURN
      WRITE(6,200)WORD(1),TIME
200   FORMAT(/,21H FAILED END ITEM TYPE,I2,41H ARRIVES AT SEABASED MAINT
     1ENANCE SHOP AT,F6.1,5H HRS.)
      RTIME=TIME+TTR
      WRITE(6,204)NSERVR,RTIME
204   FORMAT(15H SHOP SPACE NO.,I2,61H IS AVAIL TO BE USED FOR REPAIR. R
     1EPAIR WILL BE COMPLETED AT,F6.1,5H HRS.)
      RETURN
13    CONTINUE
C ADD END ITEM TO SEABASED QUEUE AFLOAT ACCORDING TO ITS PRIORITY
      IF(NISQ.EQ.0)GOTO10
      DO 5 I=1,NISQ
      IF(NPISQ(I).LT.WORD(2))GOTO6
      IF(NPISQ(I).EQ.WORD(2).AND.TISQ(I).GT.TIME)GOTO6
5     CONTINUE
10    NISQ=NISQ+1
      IF(NISQ.GT.LIMDIM)GOTO18
      ISQ(NISQ)=WORD(1)
      TISQ(NISQ)=TIME
      NPISQ(NISQ)=WORD(2)
      NESQ(NISQ)=WORD(5)
      IF(NISQ.EQ.1)HQE(1)=TIME-TQBE(1)+HQE(1)
```

SUBROUTINE ARRVL

```
                NENTER(1)=NENTER(1)+1
                IF(MAXQL(1).LT.NISQ)MAXQL(1)=NISQ
                IF(IOPT1.EQ.0)RETURN
                WRITE(6,200)WORD(1),TIME
                WRITE(6,205)
          205   FORMAT(45H NO SHOP SPACE IS AVAIL TO BE USED FOR REPAIR)
                CALL RITESQ
                RETURN
          6     NISQ=NISQ+1
                IF(NISQ.GT.LIMDIM)GOTO18
                J=NISQ
          7     ISQ(J)=ISQ(J-1)
                TISQ(J)=TISQ(J-1)
                NPISQ(J)=NPISQ(J-1)
                NESQ(J)=NESQ(J-1)
                J=J-1
                IF(J.NE.I)GOTO7
                ISQ(I)=WORD(1)
                TISQ(I)=TIME
                NPISQ(I)=WORD(2)
                NESQ(I)=WORD(5)
                IF(NISQ.EQ.1)HQE(1)=TIME-TQBE(1)+HQE(1)
                NENTER(1)=NENTER(1)+1
                IF(MAXQL(1).LT.NISQ)MAXQL(1)=NISQ
                IF(IOPT1.EQ.0)RETURN
                WRITE(6,200)WORD(1),TIME
                WRITE(6,205)
                IF(IOPT2.EQ.0)WRITE(6,209)ISQ(I),I,TISQ(I),NPISQ(I),NESQ(I)
          209   FORMAT(5X,14H END ITEM TYPE,I2,26H ADD TO SB QUEUE AFL SPACE,I2,
               1 3H AT,F6.1,20H HRS WITH A PRIOR OF,I2,14H. MAINT AT ECH,I2,
               1 12H IS REQUIRED)
                IF(IOPT2.EQ.1)CALL RITESQ
                RETURN
          18    WRITE(6,207)
          207   FORMAT(51H NO. OF END ITEMS IN SB QUEUE AFLOAT EXCEEDED LIMIT)
                STOP

          COMMENT   FAILED END ITEM ARRIVES AT SEABASED QUEUE ASHORE
          2     CONTINUE
                IF(NISQ.GE.LIMIT)GOTO21
          C TRANSPORT FAILED END ITEM TO SEABASED MAINTENANCE SHOP
                WORD(6)=1
                CALL SNE(IARRVL,TIME+T1,WORD,FTIME)
                IF(IOPT1.EQ.0)RETURN
                WRITE(6,206)WORD(1),TIME
                WRITE(6,202)WORD(1)
                RETURN
          C ADD FAILED END ITEM TO SEABASED QUEUE ASHORE ACCORDING TO ITS PRIORITY
          21    IF(NISQA.EQ.0)GOTO14
                DO 15 I=1,NISQA
                IF(NPISQA(I).LT.WORD(2))GOTO16
                IF(NPISQA(I).EQ.WORD(2).AND.TISQA(I).GT.TIME)GOTO16
          15    CONTINUE
          14    NISQA=NISQA+1
                IF(NISQA.GT.LIMDIM)GOTO19
```

```
            ISQA(NISQA)=WORD(1)
            TISQA(NISQA)=TIME
            NPISQA(NISQA)=WORD(2)
            NESQA(NISQA)=WORD(5)
            IF(NISQA.EQ.1)HQE(2)=TIME-TQBE(2)+HQE(2)
            NENTER(2)=NENTER(2)+1
            IF(MAXQL(2).LT.NISQA)MAXQL(2)=NISQA
            IF(IOPT1.EQ.0)RETURN
            WRITE(6,206)WORD(1),TIME
      206   FORMAT(/,21H FAILED END ITEM TYPE,I2,36H ARRIVES AT SEABASED QUEUE
           1 ASHORE AT,F6.1,5H HRS.)
            CALL RITSQA
            RETURN
      16    NISQA=NISQA+1
            IF(NISQA.GT.LIMDIM)GOTO19
            J=NISQA
      17    ISQA(J)=ISQA(J-1)
            TISQA(J)=TISQA(J-1)
            NPISQA(J)=NPISQA(J-1)
            NESQA(J)=NESQA(J-1)
            J=J-1
            IF(J.NE.I)GOTO17
            ISQA(I)=WORD(1)
            TISQA(I)=TIME
            NPISQA(I)=WORD(2)
            NESQA(I)=WORD(5)
            IF(NISQA.EQ.1)HQE(2)=TIME-TQBE(2)+HQE(2)
            NENTER(2)=NENTER(2)+1
            IF(MAXQL(2).LT.NISQA)MAXQL(2)=NISQA
            IF(IOPT1.EQ.0)RETURN
            WRITE(6,206)WORD(1),TIME
            IF(IOPT2.EQ.0)WRITE(6,214)ISQA(I),I,TISQA(I),NPISQA(I),NESQA(I)
      214   FORMAT(5X,14H END ITEM TYPE,I2,34H ADDED TO SB QUEUE ASHORE IN SPA
           1CE,I2,3H AT,F6.1,20H HRS WITH A PRIOR OF,I2,13H MAINT AT ECH,I2,
           1 12H IS REQUIRED)
            IF(IOPT2.EQ.1)CALL RITSQA
            RETURN
      19    WRITE(6,208)
      208   FORMAT(51H NO. OF END ITEMS IN SB QUEUE ASHORE EXCEEDED LIMIT)
            STOP

      COMMENT   NON-DEDICATED CT ARRIVES AT SEABASED MAINTENANCE SHOP
      3     CONTINUE
            IF(IOPT1.EQ.1)WRITE(6,201)WORD(3),TIME
      201   FORMAT(/,7H CT NO.,I2,33H ARRIVES AT SEABASE MAINT SHOP AT,F6.1,5H
           1 HRS.)
            ISS(WORD(3))=0
            NICTS=NICTS-1
            IF(NICTQ.EQ.0.OR.NICTS.EQ.NCTS)GOTO9
      C A CT IS NEEDED ASHORE, CHECK TO SEE IF RETURNED CT CAN BE SENT BACK ASHORE
            IF(NICTS.EQ.0.AND.WORD(3).LE.NSS)GOTO26
            IF(NICTS.EQ.0.AND.WORD(3).GT.NSS)GOTO25
            IF(NDCS(NICTS+1).EQ.NDCS(NICTS).AND.WORD(3).LE.NSS)GOTO26
            IF(NDCS(NICTS+1).NE.NDCS(NICTS).AND.WORD(3).GT.NSS)GOTO27
      C TRANSPORT RETURNED CT BACK ASHORE
```

```
   25   NIER(3)=NIER(3)+1
        NICTS=NICTS+1
        WORD(1)=ICTQ(1)
        WORD(2)=NUICTQ(1)
        ISS(WORD(3))=NOTYPE+1
        WORD(6)=2
        WORD(5)=NECTQ(1)
        FTIME=TICTQ(1)
        CALL GENTTR(WORD,TTR)
        CALL SNE(ICOMPS,TIME+TTR+T1,WORD,FTIME)
        TCTBF(WORD(3))=TIME+T1
        TRTS=TRTS+T1
        HWIQ(3)=TIME+T1-TICTQ(1)+HWIQ(3)
        NICTQ=NICTQ-1
        IF(NICTQ.EQ.0)TQBE(3)=TIME+T1
        IF(NICTQ.EQ.0)GOTO20
        DO 11 I=1,NICTQ
        ICTQ(I)=ICTQ(I+1)
        NUICTQ(I)=NUICTQ(I+1)
        NECTQ(I)=NECTQ(I+1)
   11   TICTQ(I)=TICTQ(I+1)
   20   CONTINUE
        IF(IOPT1.EQ.0)RETURN
        RTIME=TIME+TTR+T1
        WRITE(6,203)WORD(3),WORD(1),RTIME
  203   FORMAT(25H PERS FROM SHOP SPACE NO.,I2,33H IS AVAIL TO REPAIR END
       1ITEM TYPE,I2,59H FROM CT QUEUE. SEND ASHORE AS CT. ITEM WILL BE RE
       1PAIRED AT,F6.1,4H HRS)
        IF(WORD(3).GT.NSS)WRITE(6,213)
        IF(WORD(3).LE.NSS)WRITE(6,215)
  213   FORMAT(38H NOTE-DO NOT DECREASE CAPACITY OF SHOP)
  215   FORMAT(31H NOTE-DECREASE CAPACITY OF SHOP)
        IF(IOPT3.EQ.1.AND.NICTQ.NE.0)CALL RITCTQ
        RETURN
C CT WHICH JUST ARRIVED CAN NOT GO BACK ASHORE (BECAUSE WILL DECREASE CAPACI1
C OF SHOP) BUT CHECK TO SEE IF CT IS AVAIL WHO WILL NOT DECREASE SHOP CAPACI1
   26   JJ=NSS+1
        KK=NSS+NPS
        DO 28 II=JJ,KK
        IF(ISS(II).EQ.0)GOTO29
   28   CONTINUE
        GOTO9
C CT WHICH JUST ARRIVED CAN NOT GO BACK ASHORE (BECAUSE IT WILL NOT DECREASE
C CAPACITY OF SHOP) BUT CHECK TO SEE IF CT IS AVAIL WHO WILL DECR SHOP CAPACI
   27   DO 30 II=1,NSS
        IF(ISS(II).EQ.0)GOTO29
   30   CONTINUE
        GOTO9
C CT NO II IS AVAIL AND IS THE CORRECT TYPE TO SEND ASHORE
   29   IWORD3=WORD(3)
        WORD(3)=II
        NIER(3)=NIER(3)+1
        NICTS=NICTS+1
        WORD(1)=ICTQ(1)
        WORD(2)=NUICTQ(1)
```

```
      ISS(WORD(3))=NOTYPE+1
      WORD(6)=2
      WORD(5)=NECTQ(1)
      FTIME=TICTQ(1)
      CALL GENTTR(WORD,TTR)
      CALL SNE(ICOMPS,TIME+TTR+T1,WORD,FTIME)
      TCTBF(WORD(3))=TIME+T1
      TRTS=TRTS+T1
      HWIQ(3)=TIME+T1-TICTQ(1)+HWIQ(3)
      NICTQ=NICTQ-1
      IF(NICTQ.EQ.0)TQBE(3)=TIME+T1
      IF(NICTQ.EQ.0)GOTO31
      DO 32 I=1,NICTQ
      ICTQ(I)=ICTQ(I+1)
      NUICTQ(I)=NUICTQ(I+1)
      NECTQ(I)=NECTQ(I+1)
32    TICTQ(I)=TICTQ(I+1)
31    CONTINUE
      IF(IOPT1.EQ.0)WORD(3)=IWORD3
      IF(IOPT1.EQ.0)GOTO9
      RTIME=TIME+TTR+T1
      WRITE(6,216)WORD(3),WORD(1),RTIME
216   FORMAT(73H RETURNED C.T. CAN NOT GO BACK ASHORE, BUT MAINT PERS FR
     1OM SHOP SPACE NO.,I2,24H SENT ASHORE TO REP TYPE,I2,15H FROM CT QU
     1EUE.,/,25H ITEM WILL BE REPAIRED AT,F6.1,5H HRS.)
      IF(WORD(3).GT.NSS)WRITE(6,213)
      IF(WORD(3).LE.NSS)WRITE(6,215)
      IF(IOPT3.EQ.1.AND.NICTQ.NE.0)CALL RITCTQ
      WORD(3)=IWORD3
C RETURNED CT REMAINS AFLOAT
9     IF(NISQ.EQ.0.OR.WORD(3).GT.NSS)RETURN
C ITEM FROM SEABASED QUEUE AFLOAT WILL BE REPAIRED IN SHOP SPACE NO. WORD(3)
      NIER(1)=NIER(1)+1
      WORD(1)=ISQ(1)
      ISS(WORD(3))=WORD(1)
      WORD(6)=1
      WORD(5)=NESQ(1)
      CALL GENTTR(WORD,TTR)
      CALL SNE(ICOMPS,TIME+TTR,WORD,FTIME)
      RTIME=TIME+TTR
      IF(IOPT1.EQ.1)WRITE(6,211)WORD(3),WORD(1),RTIME
211   FORMAT(15H SHOP SPACE NO.,I2,48H IS AVAIL TO BE USED FOR REPAIR OF
     1 END ITEM TYPE,I2,50H FROM SB QUEUE AFLOAT. REPAIR WILL BE COMPLET
     1ED AT,F6.1,5H HRS.)
      TSSBF(WORD(3))=TIME
      HWIQ(1)=TIME-TISQ(1)+HWIQ(1)
      NISQ=NISQ-1
      IF(NISQ.EQ.0)TQBE(1)=TIME
      IF(NISQ.EQ.0)GOTO22
      DO 8 I=1,NISQ
      ISQ(I)=ISQ(I+1)
      NPISQ(I)=NPISQ(I+1)
      NESQ(I)=NESQ(I+1)
8     TISQ(I)=TISQ(I+1)
      IF(IOPT3.EQ.1)CALL RITESQ
```

SUBROUTINE ARRVL

```
22    IF(NISQ.GE.LIMIT.OR.NISQA.EQ.0)RETURN
C TRANSPORT ITEM IN LOCATION 1  OF SEABASED QUEUE ASHORE TO SEABASED MAINT SH
      WORD(1)=ISQA(1)
      WORD(2)=NPISQA(1)
      WORD(5)=NESQA(1)
      WORD(6)=1
      CALL SNE(IARRVL,TIME+T1,WORD,FTIME)
      IF(IOPT1.EQ.1)WRITE(6,202)WORD(1)
202   FORMAT(31H TRANSPORT FAILED END ITEM TYPE,I2,50H FROM SEABASED QUE
     1UE ASHORE TO SEABASED MAINT SHOP)
      HWIQ(2)=TIME-TISQA(1)+HWIQ(2)
      NISQA=NISQA-1
      IF(NISQA.EQ.0)TQBE(2)=TIME
      IF(NISQA.EQ.0)RETURN
      DO 12 I=1,NISQA
      ISQA(I)=ISQA(I+1)
      NPISQA(I)=NPISQA(I+1)
      NESQA(I)=NESQA(I+1)
12    TISQA(I)=TISQA(I+1)
      IF(IOPT3.EQ.1)CALL RITSQA
      RETURN

COMMENT   DEDICATED CT ARRIVES AT A NEARBY UNIT ASHORE
4     CONTINUE
      IF(IOPT1.EQ.1)WRITE(6,210)WORD(3),TIME
210   FORMAT(/,7H CT NO.,I2,35H ARRIVES AT A NEARBY UNIT ASHORE AT,F6.1,
     1 5H HRS.)
      ICTS(WORD(3))=0
      IF(NICTQ.EQ.0)RETURN
C TRANSPORT CT TO END ITEM IN LOCATION 1 OF CT QUEUE
      NIER(3)=NIER(3)+1
      WORD(1)=ICTQ(1)
      WORD(2)=NUICTQ(1)
      ICTS(WORD(3))=WORD(1)
      WORD(6)=4
      FTIME=TICTQ(1)
      WORD(5)=NECTQ(1)
      CALL GENTTR(WORD,TTR)
      CALL SNE(ICOMPS,TIME+T2+TTR,WORD,FTIME)
      TCTBF(WORD(3))=TIME+T2
      TRTS=TRTS+T2
      HWIQ(3)=TIME+T2-TICTQ(1)+HWIQ(3)
      NICTQ=NICTQ-1
      IF(NICTQ.EQ.0)TQBE(3)=TIME+T2
      IF(NICTQ.EQ.0)GOTO23
      DO 24 I=1,NICTQ
      ICTQ(I)=ICTQ(I+1)
      NECTQ(I)=NECTQ(I+1)
      NUICTQ(I)=NUICTQ(I+1)
24    TICTQ(I)=TICTQ(I+1)
23    CONTINUE
      IF(IOPT1.EQ.0)RETURN
      RTIME=TIME+TTR+T2
      WRITE(6,212)WORD(3),WORD(1),RTIME
212   FORMAT(6H CT NO,I2,33H IS AVAIL TO REPAIR END ITEM TYPE,I2,54H FRO
```

6.15 SUBROUTINE COMPS(TIME,WORD,FTIME)

Called By: Subroutine TNE

Parameters Used:

TIME	Time (clock time) subroutine is entered
WORD(1)	Type of item
WORD(2)	Number of unit where item is located
WORD(3)	Space number of CT identification number
WORD(6)	Location of repair
FTIME	Time of failure of item

Abstract:

The completion of the repair of an item is simulated at the present clock time, TIME. Parameter WORD(6) indicates the location of repair as follows:

WORD(6)=1	Complete service at the seabase
WORD(6)=2	Complete service ashore by nondedicated CT
WORD(6)=3	Complete service ashore at unit
WORD(6)=4	Complete service ashore by dedicated CT

Complete Service at the Seabase

The repair of item WORD(1) in space WORD(3) at the seabase is complete as of the time, TIME. To indicate that space WORD(3) is now free, the variable ISS(WORD(3)) is set equal to zero. The total amount of time spent in the repair of items in space WORD(3) at the seabase (HSSW(WORD(3))) is updated to include the time spent repairing item WORD(1):

HSSW(WORD(3))=TIME-TSSBF(WORD(3))+HSSW(WORD(3)).

TSSBF(WORD(3)) represents the time that item WORD(1) entered space WORD(3) for repair. Disposition of the repaired item and of the maintenance personnel from space WORD(3) must now be determined.

If there are no unfilled unit requests for an item of type WORD(1) (NTRQST(i)≠WORD(1), for all i= 1 through NR), the repaired item is sent to the float, and the total number of WORD(1)-type items in the float is updated (INV(WORD(1))=INV(WORD(1))+1). If there is an unfilled unit request for type WORD(1) (for the first i such that NTRQST(i)=WORD(1)), the repaired item is sent to unit NURQST(i). Its operation and subsequent failure is generated by storing a fail event on the event list (see Section 7.1). The total amount of time items of type WORD(1) from unit WORD(2) (WORD(2)=NURQST(i)) are out of operation (DTH(WORD(1),WORD(2))) is updated by the amount of time item WORD(1) was out of operation, figured from the time the unit registered the request for a WORD(1)-type item until the time item WORD(1) resumed operation:

DTH(WORD(1),WORD(2))=(TIME+T1) - TIRQST(i) + DTH(WORD(1),WORD(2)).

TIRQST(i) represents the time that item WORD(1) failed. The number of requests currently contained on the unit replacement request arrays is decremented (NR=NR-1). All of those items remaining in the request arrays in locations (i+1) through (NR+1) (i.e., the arrays TIRQST, NTRQST, NURQST), are advanced one location so that Location i is once again filled.

Disposition of maintenance space WORD(3) personnel is decided in the following way. If a) items are present in the CT queue (NICTQ≠0), and b) the present number of items undergoing repair by CT's is under the allowable limit (NICTS <NCTS), and c) repair by a nondedicated CT is specified as input (IDCT=0), and d) a regular CT is required ashore (NICTS≠0 and NDCS(NICTS)≠NDCS(NICTS+1)), then, if all these conditions are met, the maintenance personnel from space WORD(3) are transported ashore as a CT, with an identification number equal to WORD(3), to repair the item removed from Location 1 of the CT queue (see Section 9.0). Repair is scheduled by storing a complete service event on the event list (see Section 7.3.2). Control of the program is then returned to Subroutine TNE. If any of these four conditions described has not been satisfied (NICTQ=0, or NICTS=NCTS, or IDCT≠0, or NICTS=0, or NDCS(NICTS+1)=NDCS(NICTS)), and if there are no items in the seabase queue afloat (NISQ=0), the maintenance personnel from space WORD(3) will remain available for maintenance, and control of the program is returned to Subroutine TNE. If items are waiting in the seabase queue afloat (NISQ≠0), the item in Location 1 is removed from the queue (see Section 9.0) to space WORD(3) for repair. Repair is scheduled by storing a complete service event on the event list (see Section 7.3.1). If the queue afloat is not full (NISQ <LIMIT) and the queue ashore still has items in it (NISQA≠0), the item in Location 1 of the queue ashore is removed (see Section 9.0) and transported to the seabase. Its arrival is scheduled by storing an arrival event on the event list (see Section 7.2.1). Control of the program is returned to Subroutine TNE.

Complete Service Ashore by Nondedicated CT

The repair of item WORD(1) ashore at unit WORD(2) by the nondedicated CT number WORD(3) is complete as of time, TIME. The item failed at time, FTIME. When an item is repaired by CT, it must be returned to the unit following its repair, since no replacement item is furnished. The Item's operation and subsequent failure is generated by storing a fail event on the event list (see Section 7.1). The total amount of time items of type WORD(1) from unit WORD(2) are out of operation (DTH(WORD(1),WORD(2))) is updated by the amount of time item WORD(1) was out of operation, figured from the time the item failed until the time the item resumed operation:

DTH(WORD(1),WORD(2)) = TIME - FTIME +DTH(WORD(1),WORD(2)).

The total amount of time spent in the repair of items by CT number WORD(3) (HCTW(WORD(3))) is updated to include the time spent repairing item WORD(1):

HCTW(WORD(3)) = TIME - TCTBF(WORD(3)) + HCTW(WORD(3)).

TCTBF(WORD(3)) represents the time that CT number WORD(3) initiated repair on item WORD(1). Dispositon of CT number WORD(3) is decided in the following way.

If there are no items in the CT queue (NICTQ=0), a nondedicated CT is transported back to the seabase. Its arrival is scheduled by storing a complete service event on the event list (see Section 7.3.2). Control of the program is then returned to Subroutine TNE. If items are present in the CT queue (NICTQ≠0), the item in Location 1 is removed (see Section 9.0) for repair. Repair is scheduled by storing a complete service event on the event list (see Section 7.3.2). Control of the program is then returned to Subroutine TNE.

Complete Service Ashore at Unit

The repair of item WORD(1) ashore at unit WORD(2) is complete as of time, TIME. The item failed at time, FTIME. When an item is repaired at a unit, it must be restored to operation at the unit following its repair, since no replacement item is furnished. The item's operation and subsequent failure are generated by storing a fail event on the event list (see Section 7.1). The total amount of time items of type WORD(1) from unit WORD(2) are out of operation (DTH(WORD(1),WORD(2))) is updated by the amount of time item WORD(1) was out of operation, figured from the time the item failed until the time the item resumed operation:

DTH(WORD(1),WORD(2)) = TIME - FTIME + DTH(WORD(1),WORD(2)).

The total amount of time spent in the repair of items at unit WORD(2) (HUSW(WORD(2))) is updated to include the time spent repairing item WORD(1):

HUSW(WORD(2)) = TIME - TUSBF(WORD(2)) + HUSW(WORD(2)).

TUSBF(WORD(2)) represents the time that unit WORD(2) initiated repair on item WORD(1). Disposition of the available maintenance resources at unit WORD(2) is decided in the following way.

If there are no items in the unit queue (NIUQ(WORD(2))=0), control of the program is returned to Subroutine TNE. If items are present in the queue (NIUQ(WORD(2))≠0), the item in Location 1 is removed (see Section 9.0) for repair. Repair is scheduled by storing a complete service event on the event list (see Section 7.3.3). Control of the program is returned to Subroutine TNE.

Complete Service Ashore by a Dedicated CT

All aspects of service ashore by a dedicated CT are identical to those of service ashore by a non-dedicated CT except for disposition of the CT. Disposition of a dedicated CT number WORD(3) is decided in the following way.

If there are no items in the CT queue (NICTQ=0), the dedicated CT is transported to a nearby unit. Its arrival is scheduled by storing an arrival event on the event list (see Section 7.2.4). Control of the program is returned to Subroutine TNE. If items are present in the CT queue (NICTQ≠0), the item in Location 1 is removed (see Section 9.0) for repair by CT number WORD(3). Repair is scheduled by storing a complete service event on the event list (see Section 7.3.4). Control of the program is then returned to Subroutine TNE.

SUBROUTINE COMPS

```
      SUBROUTINE COMPS(TIME,WORD,FTIME)
      INTEGER WORD(6)
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10)
     1 ,PCTR(3),PF(5),CLASS
      COMMON/N2/NCTS,NSS,NUS
      COMMON/N3/INV(150),NEI(30,10),NFI(150),NLIST(10),NR,NTRQST(200),
     1 NURQST(200),TIRQST(200),TYPENO(30,10),TAMNO(150)
      COMMON/N5/ICTQ(200),ISQ(200),ISQA(200),ISS(10),IUQ(200,10),NICTQ,
     1  NICTS,NISQ,NISQA,NIUQ(10),NIUS(10),NPISQ(200),NPISQA(200),
     1  NUICTQ(200),TICTQ(200),TISQ(200),TISQA(200),TIUQ(200,10)
     1 ,NESQ(200),NESQA(200),NEUQ(200,10),NECTQ(200),ICTS(10)
      COMMON/N6/LIMDIM,LIMIT,T1,T2,IOPT1,IOPT2,IOPT3
      COMMON/N7/DTH(150,10),HQE(13),HWIQ(13),LENTHC(13),LENTHQ(13),
     1 MAXQL(13),NENTER(13),QL(13),TQBE(13),WT(13),NDISC(150),NOREQ(150)
     1 ,HCTW(10),TCTBF(10),HSSW(10),TSSBF(10),TRTS,NIER(13),IMAXQL(13)
     1 ,INENTR(13),TIMEINT,HUSW(10),TUSBF(10),NOFAIL(150,10)
      COMMON/N9/NDCS(5),NPS
      DATA ICOMPS,IARRVL,IFAIL/2,4,6/
      GOTO(1,2,3,4)WORD(6)

COMMENT   COMPLETE SERVICE AT THE SEABASED MAINTENANCE SHOP
1     ISS(WORD(3))=0
      IF(IOPT1.EQ.1)WRITE(6,200)WORD(1),TIME,WORD(3)
200   FORMAT(/,14H END ITEM TYPE,I2,15H IS REPAIRED AT,F6.1,33H HRS. IN
     1 SEABASED SHOP SPACE NO.,I2)
      HSSW(WORD(3))=TIME-TSSBF(WORD(3))+HSSW(WORD(3))
      IF(NR.EQ.0)GOTO7
      DO 5 I=1,NR
      IF(NTRQST(I).EQ.WORD(1))GOTO14
5     CONTINUE
C NO REQUEST FOR END ITEM-SEND BACK TO INVENTORY
7     INV(WORD(1))=INV(WORD(1))+1
      IF(IOPT1.EQ.1)WRITE(6,202)INV(WORD(1))
202   FORMAT(63H NO REQUEST FOR END ITEM-SEND BACK TO INVENTORY. NEW INV
     1 LEVEL=,I2)
      GOTO8
C END ITEM IS REQUESTED BY A UNIT, SO SEND IT ASHORE
14    WORD(2)=NURQST(I)
      ARR=TIME+T1
      IF(IOPT1.EQ.1)WRITE(6,201)WORD(2),ARR
201   FORMAT(27H IT IS REQUESTED BY UNIT NO,I2,22H SO IT IS SENT ASHORE.
     1 25H IT WILL ARRIVE ASHORE AT,F6.1,5H HRS.)
      DTH(WORD(1),WORD(2))=TIME+T1-TIRQST(I)+DTH(WORD(1),WORD(2))
      CALL GENTTF(WORD,TTF)
      CALL SNE(IFAIL,TIME+TTF+T1,WORD,FTIME)
      NR=NR-1
      IF(I.EQ.(NR+1).AND.NR.NE.0.AND.IOPT3.EQ.1)CALL RITERQ
      IF(I.EQ.(NR+1))GOTO8
      DO 6 J=I,NR
      TIRQST(J)=TIRQST(J+1)
      NTRQST(J)=NTRQST(J+1)
6     NURQST(J)=NURQST(J+1)
      IF(IOPT3.EQ.1)CALL RITERQ
8     IF(NICTQ.EQ.0.OR.NICTS.EQ.NCTS.OR.IDCT.NE.0.OR.NICTS.EQ.0)GOTO9
      IF(NDCS(NICTS+1).EQ.NDCS(NICTS))GOTO9
```

```
C TRANSPORT SHOP MAINT PERSONNEL ASHORE AS A CT
      NICTS=NICTS+1
      TRANSP=T1
      IF(IOPT1.EQ.0)GOTO10
      WRITE(6,203)
203   FORMAT(53H SEND AVAIL SHOP MAINTENANCE PERSONNEL ASHORE AS A CT)
      WRITE(6,209)
209   FORMAT(31H NOTE-DECREASE CAPACITY OF SHOP)
      GOTO10
C SHOP MAINT PERSONNEL REMAINS AT SEABASED MAINTENANCE SHOP
9     IF(NISQ.EQ.0)RETURN
C REPAIR END ITEM FROM LOCATION 1 OF SEABASED QUEUE AFLOAT
      NIER(1)=NIER(1)+1
      WORD(1)=ISQ(1)
      ISS(WORD(3))=WORD(1)
      WORD(6)=1
      WORD(5)=NESQ(1)
      CALL GENTTR(WORD,TTR)
      CALL SNE(ICOMPS,TIME+TTR,WORD,FTIME)
      RTIME=TIME+TTR
      IF(IOPT1.EQ.1)WRITE(6,210)WORD(3),WORD(1),RTIME
210   FORMAT(31H MAINT PERS FROM SHOP SPACE NO.,I2,33H IS AVAIL TO REPAI
     1R END ITEM TYPE,I2,46H FROM SEABASED QUEUE AFLOAT. WILL COMP SERV
     1AT,F6.1,5H HRS.)
      TSSBF(WORD(3))=TIME
      HWIQ(1)=TIME-TISQ(1)+HWIQ(1)
      NISQ=NISQ-1
      IF(NISQ.EQ.0)TQBE(1)=TIME
      IF(NISQ.EQ.0)GOTO17
      DO 21 I=1,NISQ
      ISQ(I)=ISQ(I+1)
      NPISQ(I)=NPISQ(I+1)
      NESQ(I)=NESQ(I+1)
21    TISQ(I)=TISQ(I+1)
      IF(IOPT3.EQ.1)CALL RITESQ
17    IF(NISQ.GE.LIMIT.OR.NISQA.EQ.0)RETURN
C TRANSPORT FIRST END ITEM IN SEABASED QUEUE ASHORE TO SEABASED MAINTENANCE SHOP
      WORD(1)=ISQA(1)
      WORD(2)=NPISQA(1)
      WORD(6)=1
      WORD(5)=NESQA(1)
      CALL SNE(IARRVL,TIME+T1,WORD,FTIME)
      IF(IOPT1.EQ.1)WRITE(6,213)WORD(1)
213   FORMAT(31H TRANSPORT FAILED END ITEM TYPE,I2,
     1 56H FROM SEABASED QUEUE ASHORE TO SEABASED MAINTENANCE SHOP)
      HWIQ(2)=TIME-TISQA(1)+HWIQ(2)
      NISQA=NISQA-1
      IF(NISQA.EQ.0)TQBE(2)=TIME
      IF(NISQA.EQ.0)RETURN
      DO 16 I=1,NISQA
      ISQA(I)=ISQA(I+1)
      NPISQA(I)=NPISQA(I+1)
      NESQA(I)=NESQA(I+1)
16    TISQA(I)=TISQA(I+1)
      IF(IOPT3.EQ.1)CALL RITSQA
```

```
              RETURN

        COMMENT   COMPLETE SERVICE BY NON-DEDICATED CT
        2     CONTINUE
              IF(IOPT1.EQ.1)WRITE(6,205)WORD(1),WORD(2),TIME,WORD(3)
        205   FORMAT(/,14H END ITEM TYPE,I2,13H FROM UNIT NO,I2,15H IS REPAIRED
             1AT,F6.1,10H BY CT NO.,I2)
              HCTW(WORD(3))=TIME-TCTBF(WORD(3))+HCTW(WORD(3))
              DTH(WORD(1),WORD(2))=TIME-FTIME+DTH(WORD(1),WORD(2))
              CALL GENTTF(WORD,TTF)
              CALL SNE(IFAIL,TIME+TTF,WORD,FTIME)
              TRANSP=T2
              IF(NICTQ.NE.0)GOTO10
        C TRANSPORT CT BACK TO SEABASED MAINTENANCE SHOP
              WORD(6)=3
              IF(IOPT1.EQ.1)WRITE(6,206)
        206   FORMAT(59H NO OTHER END ITEMS IN CT QUEUE, SO SEND CT BACK TO SEAB
             1ASE)
              CALL SNE(IARRVL,TIME+T1,WORD,FTIME)
              TRTS=TRTS+T1
              RETURN
        C CT REMAINS ASHORE, REPAIR END ITEM IN LOCATION 1 OF CT QUEUE
        10    WORD(1)=ICTQ(1)
              NIER(3)=NIER(3)+1
              WORD(2)=NUICTQ(1)
              ISS(WORD(3))=NOTYPE+1
              WORD(6)=2
              WORD(5)=NECTQ(1)
              FTIME=TICTQ(1)
              CALL GENTTR(WORD,TTR)
              CALL SNE(ICOMPS,TIME+TTR+TRANSP,WORD,FTIME)
              RTIME=TIME+TTR+TRANSP
              IF(IOPT1.EQ.1)WRITE(6,211)WORD(3),WORD(1),RTIME
        211   FORMAT(7H CT NO.,I2,30H WILL REPAIR END ITEM TYPE NO.,I2,14H FROM
             1CT QUEUE,26H. HE WILL FINISH REPAIR AT,F6.1,5H HRS.)
              TCTBF(WORD(3))=TIME+TRANSP
              TRTS=TRTS+TRANSP
              HWIQ(3)=TIME+TRANSP-TICTQ(1)+HWIQ(3)
              NICTQ=NICTQ-1
              IF(NICTQ.EQ.0)TQBE(3)=TIME+TRANSP
              IF(NICTQ.EQ.0)RETURN
              DO 11 I=1,NICTQ
              ICTQ(I)=ICTQ(I+1)
              NUICTQ(I)=NUICTQ(I+1)
              NECTQ(I)=NECTQ(I+1)
        11    TICTQ(I)=TICTQ(I+1)
              IF(IOPT3.EQ.1)CALL RITCTQ
              RETURN

        COMMENT   COMPLETE SERVICE BY DEDICATED CT
        4     CONTINUE
              IF(IOPT1.EQ.1)WRITE(6,205)WORD(1),WORD(2),TIME,WORD(3)
              HCTW(WORD(3))=TIME-TCTBF(WORD(3))+HCTW(WORD(3))
              DTH(WORD(1),WORD(2))=TIME-FTIME+DTH(WORD(1),WORD(2))
              CALL GENTTF(WORD,TTF)
```

SUBROUTINE COMPS

```
      CALL SNE(IFAIL,TIME+TTF,WORD,FTIME)
      IF(NICTQ.NE.0)GOTO22
C TRANSPORT CT TO A NEARBY UNIT ASHORE
      WORD(6)=4
      IF(IOPT1.EQ.1)WRITE(6,204)
204   FORMAT(72H NO OTHER END ITEMS IN CT QUEUE, SO SEND CT BACK TO A NE
     1ARBY UNIT ASHORE)
      CALL SNE(IARRVL,TIME+T2,WORD,FTIME)
      TRTS=TRTS+T2
      RETURN
C CT REPAIR END ITEM IN LOCATION 1 OF CT QUEUE
22    WORD(1)=ICTQ(1)
      NIER(3)=NIER(3)+1
      WORD(2)=NUICTQ(1)
      ICTS(WORD(3))=WORD(1)
      WORD(6)=4
      WORD(5)=NECTQ(1)
      FTIME=TICTQ(1)
      CALL GENTTR(WORD,TTR)
      CALL SNE(ICOMPS,TIME+TTR+T2,WORD,FTIME)
      RTIME=TIME+TTR+T2
      IF(IOPT1.EQ.1)WRITE(6,211)WORD(3),WORD(1),RTIME
      TCTBF(WORD(3))=TIME+T2
      TRTS=TRTS+T2
      HWIQ(3)=TIME+T2-TICTQ(1)+HWIQ(3)
      NICTQ=NICTQ-1
      IF(NICTQ.EQ.0)TQBE(3)=TIME+T2
      IF(NICTQ.EQ.0)RETURN
      DO 24 I=1,NICTQ
      ICTQ(I)=ICTQ(I+1)
      NUICTQ(I)=NUICTQ(I+1)
      NECTQ(I)=NECTQ(I+1)
24    TICTQ(I)=TICTQ(I+1)
      IF(IOPT3.EQ.1)CALL RITCTQ
      RETURN

COMMENT   COMPLETE SERVICE AT UNIT
3     CALL GENTTF(WORD,TTF)
      DTH(WORD(1),WORD(2))=TIME-FTIME+DTH(WORD(1),WORD(2))
      HUSW(WORD(2))=TIME-TUSBF(WORD(2))+HUSW(WORD(2))
      IF(IOPT1.EQ.1)WRITE(6,208)WORD(1),WORD(2),TIME
208   FORMAT(/,14H END ITEM TYPE,I2,13H FROM UNIT NO,I2,15H IS REPAIRED
     1AT,F6.1,5H HRS.)
      CALL SNE(IFAIL,TIME+TTF,WORD,FTIME)
      IF(NIUQ(WORD(2)).NE.0)GOTO12
      NIUS(WORD(2))=NIUS(WORD(2))-1
      RETURN
C UNIT MAINT PERSONNEL REPAIR END ITEM IN LOCATION 1 OF UNIT WORD(2) QUEUE
12    WORD(1)=IUQ(1,WORD(2))
      NIER(3+WORD(2))=NIER(3+WORD(2))+1
      TUSBF(WORD(2))=TIME
      WORD(5)=NEUQ(1,WORD(2))
      FTIME=TIUQ(1,WORD(2))
      CALL GENTTR(WORD,TTR)
      CALL SNE(ICOMPS,TIME+TTR,WORD,FTIME)
```

SUBROUTINE COMPS

```
      RTIME=TIME+TTR
      IF(IOPT1.EQ.1)WRITE(6,212)WORD(1),RTIME
  212 FORMAT(57H UNIT MAINTENANCE PERSONNEL WILL REPAIR END ITEM TYPE NO
     1.I2,16H FROM UNIT QUEUE,25H HE WILL FINISH REPAIR AT,F6.1,5H HRS.)
      HWIQ(3+WORD(2))=TIME-TIUQ(1,WORD(2))+HWIQ(3+WORD(2))
      NIUQ(WORD(2))=NIUQ(WORD(2))-1
      IF(NIUQ(WORD(2)).EQ.0)TQBE(3+WORD(2))=TIME
      IF(NIUQ(WORD(2)).EQ.0)RETURN
      K=NIUQ(WORD(2))
      DO 13 I=1,K
      IUQ(I,WORD(2))=IUQ(I+1,WORD(2))
      NEUQ(I,WORD(2))=NEUQ(I+1,WORD(2))
   13 TIUQ(I,WORD(2))=TIUQ(I+1,WORD(2))
      IF(IOPT3.EQ.1)CALL RITEUQ(WORD)
      RETURN
      END
```

6.16 SUBROUTINE QULENTH(TIME,WORD,FTIME)

Called By: Subroutine TNE

Parameter Used:

TIME	Time (clock time) subroutine is entered

Abstract:

The variables which record the cumulative queue length LENTHQ(i), for I= 1 through (3+NUNIT) (i refers to the location of the queue), are updated by the present queue lengths as indicated here:

If i=1	Seabase queue afloat	LENTHQ(1)=NISQ+LENTHQ(1)
If i=2	Seabase queue ashore	LENTHQ(2)=NISQA+LENTHQ(2)
If i=3	CT queue	LENTHQ(3)=NICTQ+LENTHQ(3)
If i=3+j, j=1,NUNIT	Queue at unit j	LENTHQ(3+j)=NIUQ(j)+LENTHQ(3+j)

The variables LENTHC(i) which record the number of times the variables LENTHQ(i) are updated at each location i, are incremented (LENTHC(i)=LENTHC(i)+1, for i= 1 through (3+NUNIT)).

The updating of the variables LENTHQ and LENTHC is scheduled next for time TIME+TIMEINT by calling the function SNE(IQL,TIMEINT+TIME,WORD,FTIME). Control of the problem is returned to Subroutine TNE.

SUBROUTINE QULENTH

```
      SUBROUTINE QULENTH(TIME,WORD,FTIME)
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10)
     1 ,PCTR(3),PF(5),CLASS
      COMMON/N5/ICTQ(200),ISQ(200),ISQA(200),ISS(10),IUQ(200,10),NICTQ,
     1  NICTS,NISQ,NISQA,NIUQ(10),NIUS(10),NPISQ(200),NPISQA(200),
     1  NUICTQ(200),TICTQ(200),TISQ(200),TISQA(200),TIUQ(200,10)
     1 ,NESQ(200),NESQA(200),NEUQ(200,10),NECTQ(200),ICTS(10)
      COMMON/N7/DTH(150,10),HQE(13),HWIQ(13),LENTHC(13),LENTHQ(13),
     1 MAXQL(13),NENTER(13),QL(13),TQBE(13),WT(13),NDISC(150),NOREQ(150)
     1 ,HCTW(10),TCTBF(10),HSSW(10),TSSBF(10),TRTS,NIER(13),IMAXQL(13)
     1 ,INENTR(13),TIMEINT,HUSW(10),TUSBF(10),NOFAIL(150,10)
      DATA IQL/1/
      LENTHQ(1)=LENTHQ(1)+NISQ
      LENTHQ(2)=LENTHQ(2)+NISQA
      LENTHQ(3)=LENTHQ(3)+NICTQ
      DO 1 I=1,NUNIT
    1 LENTHQ(3+I)=LENTHQ(3+I)+NIUQ(I)
      J=3+NUNIT
      DO 2 I=1,J
    2 LENTHC(I)=LENTHC(I)+1
      CALL SNE(IQL,TIMEINT+TIME,WORD,FTIME)
      RETURN
      END
```

6.17 SUBROUTINE GENMT(WORD,TEMP)

ENTRY GENTTF(WORD,TEMP) ---

Called By: Subroutine SIE, Subroutine REQUST, Subroutine COMPS

Parameters Used:

WORD(1)	Type of item
TEMP	Operating time, in hours, prior to failure

Abstract:

This entry computes the interval of time (TEMP) that item WORD(1) is to operate. This interval is a function of the Mean Time Between Failures (MTBF) and utilization factor (UF) of WORD(1) and a generated random number. Control of the program is returned to the calling subroutine.

ENTRY GENTTR(WORD,TEMP) ---

Called By: Subroutine FAIL, Subroutine COMPS, Subroutine ARRVL

Parameters Used:

WORD(5)	Echelon level required for repair
WORD(6)	Location of repair
TEMP	Interval of time, in hours, required for repair

Abstract:

This entry computes the interval of time (TEMP) needed for the repair of item WORD(1). This interval is a function of the echelon level required for repair, the location of the repair and a generated random number. Control of the program is returned to the calling subroutine.

SUBROUTINE GENMT

```
      SUBROUTINE GENMT(WORD,TEMP)
      INTEGER WORD(6)
      REAL MTBF,MTTR2,MTTR3AU,MTTR3CT,MTTR4
      COMMON/N4/MTBF(150),UF(150),MTTR2,MTTR3AU,MTTR3CT,MTTR4
      ENTRY GENTTF
      RN=RANF(DUM)
      TEMP=((-MTBF(WORD(1))*24.0)/UF(WORD(1)))*ALOG(RN)
      RETURN
      ENTRY GENTTR
      RN=RANF(DUM)
      IF(WORD(5).EQ.2)TEMP=-MTTR2*ALOG(RN)
      IF(WORD(5).EQ.3.AND.(WORD(6).EQ.2.OR.WORD(6).EQ.4))
     1 TEMP=-MTTR3CT*ALOG(RN)
      IF(WORD(5).EQ.3.AND.(WORD(6).EQ.1.OR.WORD(6).EQ.3))
     1 TEMP=-MTTR3AU*ALOG(RN)
      IF(WORD(5).EQ.4)TEMP=-MTTR4*ALOG(RN)
      RETURN
      END
```

6.18 SUBROUTINE ENDMIS

Called By: Executive Routine

Abstract:

Subroutine ENDMIS updates various output variables, as indicated below, when a mission (KMI) is complete (KMI ranges from 1 through NMI):

- Total amount of time items are non-operational
- Total amount of time items are in the individual queues prior to repair
- Total amount of time queues are empty
- Total amount of time spent in repair by maintenance personnel
- Total number of unfilled requests
- Maximum queue length recorded for this mission
- Number of items added to the individual queues
- Average queue length recorded for this mission
- Average amount of time items are in the individual queues prior to repair

The downtime of individual failed items still not repaired at the end of a mission must be added to the downtime totals. At the end of the mission, the items that are still out of operation will include:

- Those requested by the units as float items
- Those undergoing repair by a CT or at the units
- Those still in the CT or the unit queues

If the repair request was submitted by a unit; i.e., for every i= 1 through NR, the downtime at unit NURQST(i) requesting float item type NTRQST(i) at the end of the mission is

$$DTH(NTRQST(i),NURQST(i)) = GTIME - TIRQST(i) + DTH(NTRQST(i),NURQST(i)).$$

If the item was undergoing repair by a CT or at one of the units, the event list must be examined to isolate the complete service events; i.e., for every i= 1 through IPTR such that EVENT(i)=2 and WORDS(6,i)$\neq$1. The downtime for item WORDS(1,i) from unit WORDS(2,i) undergoing repair by CT at the end of the mission or by a unit at the end of the mission is

$$DTH(WORDS(1,i),WORDS(2,i)) = GTIME - FTIMES(i) + DTH(WORDS(1,i),WORDS(2,i)).$$

If the item was awaiting repair in the CT queue; i.e., for every i= 1 through NICTQ, the downtime for item ICTQ(i) from unit NUICTQ(i) in the CT queue at the end of the mission is

$$DTH(ICTQ(i),NUICTQ(i)) = GTIME - TICTQ(i) + DTH(ICTQ(i),NUICTQ(i)).$$

If the item was awaiting repair in a unit queue; i.e., for every i= 1 through NUNIT, and for every j= 1 through NIUQ(i), the downtime for item IUQ(j,i) at unit i at the end of the mission is

$$DTH(IUQ(j,i),i) = GTIME - TIUQ(j,i) + DTH(IUQ(j,i),i).$$

The amount of time individual items still in the queues at the end of a mission have spent in these queues must be added to the total amount of time items are in the individual queues. The following four expressions represent updating of the total amounts of time that items wait in the seabase queue, the seabase queue ashore, the CT queue, and the unit queue by the waiting times of those items still in the queues at the end of the mission. For example, the time that items wait in the seabase queue is updated by the interval

GTIME-TISQ(i) which represents the time that the ith item spends in the queue until the end of the mission. TISQA(i), TICTQ(i), and TIUQ(j,i) represent the times that items entered the other three queues. If the item was in the seabase queue afloat; i.e., for every i= 1 through NISQ:

$$HWIQ(1) = GTIME - TISQ(i) + HWIQ(1).$$

If the item was in the seabase queue ashore; i.e., for every i= 1 through NISQA:

$$HWIQ(2) = GTIME - TISQA(i) + HWIQ(2).$$

If the item was in the CT queue; i.e., for every i= 1 through NICTQ:

$$HWIQ(3) = GTIME - TICTQ(i) + HWIQ(3).$$

If the item was in a unit queue; i.e., for every i= 1 through NUNIT, and for every j= 1 through NIUQ(i):

$$HWIQ(3+i) = GTIME - TIUQ(j,i) + HWIQ(3+i).$$

The amount of time individual queues which are empty at the end of a mission have been empty must be added to the total amount of time queues are empty. TQBE(1), TQBE(2), TQBE(3), and TQBE(3+i) represent times that the last item was removed from the queue. If there are no items in the seabase queue afloat; i.e., if NISQ=0:

$$HQE(1) = GTIME - TQBE(1) + HQE(1).$$

If there are no items in the seabase queue ashore, i.e., NISQA=0.

$$HQE(2) = GTIME - TQBE(2) + HQE(2).$$

If there are no items in the CT queue; i.e., NICTQ=0:

$$HQE(3) = GTIME - TQBE(3) + HQE(3).$$

If there are no items in a unit queue; i.e., for every i= 1 through NUNIT, if NIUQ(i)=0:

$$HQE(3+i) = GTIME - TQBE(3+i) + HQE(3+i).$$

The amount of time spent in repair by maintenance personnel still repairing items at the end of a mission must be added to the total amount of time spent in repair. The following three expressions represent updating of the toal time spent in repair at the seabase, by CT, and at the unit by the repair times of those items still under repair at the end of the mission. For example, the total repair time at the seabase HSSW(WORDS(3,i)) is updated by the interval GTIME-TSSBF(WORDS(3,i)) representing the time that repair space WORDS(3,i) is occupied until the end of the mission. TSSBF(WORDS(3,i) represents the time that repair began at space WORDS(3,i). TCTBF(WORDS(3,i)) and TUSBF(WORDS(2,i)) represent the times, respectively that CT WORDS(3,i) and unit WORD(2,i) began repair on an item still under repair at the end of the mission. If a maintenance man at the seabase was involved in a repair at the close of a mission the event list must be examined to isolate the complete service events; i.e., for every i= 1 through IPTR such that EVENT(i)=2 and WORDS(6,i)=1:

$$HSSW(WORDS(3,i)) = GTIME - TSSBF(WORDS(3,i)) + HSSW(WORDS(3,i)).$$

If a CT ashore was involved in a repair at the close of a mission the event list must be examined to isolate the complete service events; i.e., for every i= 1 through IPTR such that EVENT(i)=2 and WORDS(6,i)=3:

$$HUSW(WORDS(2,i)) = GTIME - TUSBF(WORDS(2,i)) + HUSW(WORDS(2,i)).$$

The number of requests for float items still unfilled at the end of a mission must be added to the cumulative total number of requests unfilled from previous mission; i.e., for every i= 1 through NR:

NOREQ(NTRQST(i)) = NOREQ(NTRQST(i)) + 1.

In the following four paragraphs, the variable i refers to the location of the queue as indicated here:

If i=1	Seabase queue afloat
If i=2	Seabase queue ashore
If i=3	CT queue
If i=3+j, j=1,NUNIT	Queue at unit j

The maximum queue length, IMAXQL(i), recorded for this mission at each queue location i must be added to the cumulative total of maximum queue lengths from the previous missions, IMAXQL(i), recorded for each location i; i.e., for every i= 1 through (3+NUNIT):

IMAXQL(i) = MAXQL(i) + IMAXQL(i).

The number of items added to the queue at each location i, NENTER(i), during this mission must be added to the cumulative total from the previous missions, INENTR(i), of the number of items added to the queue at each location i, for every i= 1 through (3+NUNIT):

INENTR(i) = NENTER(i) + INENTR(i).

The average queue length recorded at each queue location i, LENTHQ(i)/LENTHC(i), for this mission must be added to the cumulative total from the previous missions, QL(i), of average queue lengths recorded at each queue location i, for every i= 1 through (3+NUNIT):

QL(i) = LENTHQ(i)/LENTHC(i) + QL(i).

The average amount of time an item waits in the queue at location i, HWIQ(i)/NENTER(i), during this mission must be added to the cumulative total from the previous missions, WT(i), of the average waiting times at each queue location i, for every i= 1 through (3+NUNIT):

WT(i) = HWIQ(i)/NENTER(i) + WT(i).

SUBROUTINE ENDMIS

```
      SUBROUTINE ENDMIS
      INTEGER EVENT,WORDS,TYPENO
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IOCT,NMI,KMI,IEAU(3,10)
     1 ,PCTR(3),PF(5),CLASS
      COMMON/N2/NCTS,NSS,NUS
      COMMON/N3/INV(150),NEI(30,10),NFI(150),NLIST(10),NR,NTRQST(200),
     1 NURQST(200),TIRQST(200),TYPENO(30,10),TAMNO(150)
      COMMON/N5/ICTQ(200),ISQ(200),ISQA(200),ISS(10),IUQ(200,10),NICTQ,
     1  NICTS,NISQ,NISQA,NIUQ(10),NIUS(10),NPISQ(200),NPISQA(200),
     1  NUICTQ(200),TICTQ(200),TISQ(200),TISQA(200),TIUQ(200,10)
     1 ,NESQ(200),NESQA(200),NEUQ(200,10),NECTQ(200),ICTS(10)
      COMMON/N7/DTH(150,10),HQE(13),HWIQ(13),LENTHC(13),LENTHQ(13),
     1 MAXQL(13),NENTER(13),QL(13),TQBE(13),WT(13),NDISC(150),NOREQ(150
     1 ,HCTW(10),TCTBF(10),HSSW(10),TSSBF(10),TRTS,NIER(13),IMAXQL(13)
     1 ,INENTR(13),TIMEINT,HUSW(10),TUSBF(10),NOFAIL(150,10)
      COMMON/SNTN/CLOCK(300),EVENT(300),IPTR,WORDS(6,300),FTIMES(300)
      IF(NR.EQ.0)GOTO11
      DO 10 I=1,NR
   10 DTH(NTRQST(I),NURQST(I))=GTIME-TIRQST(I)+DTH(NTRQST(I),NURQST(I))
   11 DO 13 I=1,IPTR
      IF(EVENT(I).EQ.2.AND.WORDS(6,I).NE.1)DTH(WORDS(1,I),WORDS(2,I))=
     1 GTIME-FTIMES(I)+DTH(WORDS(1,I),WORDS(2,I))
   13 CONTINUE
      IF(NICTQ.EQ.0)GOTO14
      DO 15 I=1,NICTQ
   15 DTH(ICTQ(I),NUICTQ(I))=GTIME-TICTQ(I)+DTH(ICTQ(I),NUICTQ(I))
   14 DO 16 I=1,NUNIT
      IF(NIUQ(I).EQ.0)GOTO16
      K=NIUQ(I)
      DO 17 J=1,K
   17 DTH(IUQ(J,I),I)=GTIME-TIUQ(J,I)+DTH(IUQ(J,I),I)
   16 CONTINUE
      IF(NISQ.EQ.0)GOTO1
      DO 6 I=1,NISQ
    6 HWIQ(1)=GTIME-TISQ(I)+HWIQ(1)
    1 IF(NISQA.EQ.0)GOTO5
      DO 18 I=1,NISQA
   18 HWIQ(2)=GTIME-TISQA(I)+HWIQ(2)
    5 IF(NICTQ.EQ.0)GOTO7
      DO 4 I=1,NICTQ
    4 HWIQ(3)=GTIME-TICTQ(I)+HWIQ(3)
    7 DO 8 I=1,NUNIT
      IF(NIUQ(I).EQ.0)GOTO8
      K=NIUQ(I)
      DO 9 J=1,K
    9 HWIQ(3+I)=GTIME-TIUQ(J,I)+HWIQ(3+I)
    8 CONTINUE
      IF(NISQ.EQ.0)HQE(1)=GTIME-TQBE(1)+HQE(1)
      IF(NISQA.EQ.0)HQE(2)=GTIME-TQBE(2)+HQE(2)
      IF(NICTQ.EQ.0)HQE(3)=GTIME-TQBE(3)+HQE(3)
      DO 19 I=1,NUNIT
      IF(NIUQ(I).EQ.0)HQE(3+I)=GTIME-TQBE(3+I)+HQE(3+I)
   19 CONTINUE
      J=3+NUNIT
      DO 2 I=1,J
```

SUBROUTINE ENDMIS

```
      IMAXQL(I)=MAXQL(I)+IMAXQL(I)
      INENTR(I)=NENTER(I)+INENTR(I)
      A=LENTHQ(I)
      B=LENTHC(I)
      D=NENTER(I)
      IF(B.NE.0.)QL(I)=A/B+QL(I)
      IF(D.NE.0.)WT(I)=HWIQ(I)/D+WT(I)
    2 CONTINUE
      DO 24 I=1,IPTR
      IF(EVENT(I).EQ.2.AND.WORDS(6,I).EQ.1)HSSW(WORDS(3,I))=GTIME-
     1   TSSBF(WORDS(3,I))+HSSW(WORDS(3,I))
      IF(EVENT(I).EQ.2.AND.(WORDS(6,I).EQ.2.OR.WORDS(5,I).EQ.4))HCTW(WOR
     1DS(3,I))=GTIME-TCTBF(WORDS(3,I))+HCTW(WORDS(3,I))
      IF(EVENT(I).EQ.2.AND.WORDS(6,I).EQ.3)HUSW(WORDS(2,I))=GTIME-
     1 TUSBF(WORDS(2,I))+HUSW(WORDS(2,I))
   24 CONTINUE
      IF(NP.EQ.0)GOTO27
      DO 26 I=1,NR
   26 NOREQ(NTRQST(I))=NOREQ(NTRQST(I))+1
   27 CONTINUE
      RETURN
      END
```

6.19 SUBROUTINE OUTPUT

Called By: Executive Routine

Abstract:

This subroutine averages the information in the output variables by dividing the running sums by NMI. It then prints out these averages for the commodity class under consideration.

SUBROUTINE OUTPUT

```
      SUBROUTINE OUTPUT
      INTEGER TYPENO,CLASS
      COMMON/N1/GTIME,IECHAV(5),NOTYPE,NUNIT,IDCT,NMI,KMI,IEAU(3,10)
     1 ,PCTR(3),PF(5),CLASS
      COMMON/N2/NCTS,NSS,NUS
      COMMON/N3/INV(150),NEI(30,10),NFI(150),NLIST(10),NR,NTRQST(200),
     1 NURQST(200),TIRQST(200),TYPENO(30,10),TAMNO(150)
      COMMON/N7/DTH(150,10),HQE(13),HWIQ(13),LENTHC(13),LENTHQ(13),
     1 MAXQL(13),NENTER(13),QL(13),TQBE(13),WT(13),NDISC(150),NOREQ(150)
     1 ,HCTW(10),TCTBF(10),HSSW(10),TSSBF(10),TRTS,NIER(13),IMAXQL(13)
     1 ,INENTR(13),TIMEINT,HUSW(10),TUSBF(10),NOFAIL(150,10)
      COMMON/N10/NPRR2(4),NPRR3(4),NPRR4(4)
      DIMENSION DTHPI(150,10),UAVAIL(150,10),IHQE(13),IQL(13),IWT(13)
     1 ,TMHU(10),NPRU(10),UUTIL(10)
      WRITE(6,1)
    1 FORMAT(1H1,53X,14HOPERATING DATA)
      ANMI=NMI
      TOTAL=0.
      TOTAL3=0.
      IT=0
      TNOFAIL=0.
      DO 2 J=1,NUNIT
      SUB=0.
      SUB2=0.
      SUB3=0.
      T1=0.
      WRITE(6,3)J
    3 FORMAT(//,53X,8H*** UNIT,I3,4H ***)
      WRITE(6,18)
   18 FORMAT(/,          8X,7HTAM NO.,3X,21HNO. END ITEMS IN UNIT,3X,
     1 14HDOWNTIME HOURS,3X,28HAVERAGE DT HOURS PER FAILURE,3X,
     1 12HAVAILABILITY)
      K=NLIST(J)
      DO 4 I=1,K
      IT=NEI(I,J)+IT
      T1=NEI(I,J)+T1
      DTH(TYPENO(I,J),J)=DTH(TYPENO(I,J),J)/ANMI
      ANF=NOFAIL(TYPENO(I,J),J)/ANMI
      TNOFAIL=ANF+TNOFAIL
      IANF=ANF
      ANF1=ANF-IANF
      IF(ANF1.GE..5)IANF=IANF+1
      IF(IANF.NE.0)DTHPI(TYPENO(I,J),J)=DTH(TYPENO(I,J),J)/IANF
      IF(IANF.EQ.0)DTHPI(TYPENO(I,J),J)=0.
      UAVAIL(TYPENO(I,J),J)=(GTIME-DTH(TYPENO(I,J),J)/NEI(I,J))/GTIME
      WRITE(6,5)TAMNO(TYPENO(I,J)),NEI(I,J),DTH(TYPENO(I,J),J),
     1 DTHPI(TYPENO(I,J),J),UAVAIL(TYPENO(I,J),J)
    5 FORMAT(9X,A5,13X,I3,12X,F10.1,16X,F6.1,19X,F6.4)
      SUB=DTH(TYPENO(I,J),J)+SUB
    4 SUB2=DTHPI(TYPENO(I,J),J)+SUB2
      SUB2=SUB2/NLIST(J)
      SUB3=(T1*GTIME-SUB)/(T1*GTIME)
      WRITE(6,6)J,SUB,SUB2,SUB3
    6 FORMAT(//,16X,4HUNIT,I2,17H CHARACTERISTICS-,3X,F10.1,16X,F6.1,19X
     1,F6.4)
```

SUBROUTINE OUTPUT

```
            TOTAL=SUB+TOTAL
      2     CONTINUE
            TOTAL2=TOTAL/TNOFAIL
            TOTAL3=(IT*GTIME-TOTAL)/(IT*GTIME)
            WRITE(6,7)TOTAL,TOTAL2,TOTAL3
      7     FORMAT(//,105H         *******************************************
           1*****************************************************,//,50X,19HMA
           1U CHARACTERISTICS,//,40X,21HCUMMULATIVE DT HOURS=,F20.4,//,40X,
           1 29HAVERAGE DT HOURS PER FAILURE=,F12.4,//,40X,21HAVERAGE AVAILABI
           1LITY=,F20.4)
            WRITE(6,8)
      8     FORMAT(1H1,50X,19HDISCARD INFORMATION,//,18X,10HTAM NUMBER,2X,15HI
           1TEMS DISCARDED,2X,22HITEM REQUESTS UNFILLED,2X,30HORIGINAL NUMBER
           1OF FLOAT ITEMS)
            ITOTAL=0
            DO 9 I=1,NOTYPE
            DISC=NDISC(I)/ANMI
            NDISC(I)=DISC
            DISC1=DISC-NDISC(I)
            IF(DISC1.GE..5)NDISC(I)=NDISC(I)+1
            REQ=NOREQ(I)/ANMI
            NOREQ(I)=REQ
            REQ1=REQ-NOREQ(I)
            IF(REQ1.GE..5)NOREQ(I)=NOREQ(I)+1
            ITOTAL=ITOTAL+NDISC(I)
      9     WRITE (6,10)TAMNO(I),NDISC(I),NOREQ(I),NFI(I)
      10    FORMAT(20X,A5,11X,I3,17X,I3,25X,I3)
            TOTAL=ITOTAL
            TOTAL=TOTAL/IT
            WRITE(6,19)ITOTAL,TOTAL
      19    FORMAT(//,42X,22HTOTAL ITEMS DISCARDED=,I15,//,42X,27HPERCENT OF I
           1TEMS DISCARDED=,F10.4)
            WRITE(6,25)
      25    FORMAT(/,55X,10H**********,/)
            WRITE(6,11)(I,I=1,NUNIT)
      11    FORMAT(    47X,25HCHARACTERISTICS OF QUEUES,/,100X,8HAT UNITS,/,
           139X,10HAT SEABASE,2X,18HASHORE FOR SEABASE,2X,13HASHORE FOR CT9I5)
            J=3+NUNIT
            DO 57 I=1,J
            HQE(I)=GTIME-HQE(I)/ANMI
            HQE(I)=HQE(I)/GTIME
            QL(I)=QL(I)/NMI
            IQL(I)=QL(I)
            QL1=QL(I)-IQL(I)
            IF(QL1.GE..5)IQL(I)=IQL(I)+1
            AMAXQL=IMAXQL(I)/ANMI
            IMAXQL(I)=AMAXQL
            AMAXQL1=AMAXQL-IMAXQL(I)
            IF(AMAXQL1.GE..5)IMAXQL(I)=IMAXQL(I)+1
            ANIER=NIER(I)/ANMI
            NIER(I)=ANIER
            ANIER1=ANIER-NIER(I)
            IF(ANIER1.GE..5)NIER(I)=NIER(I)+1
            ANENTR=INENTR(I)/ANMI
            INENTR(I)=ANENTR
```

```
      ANENTR1=ANENTR-INENTR(I)
      IF(ANENTR1.GE..5)INENTR(I)=INENTR(I)+1
      WT(I)=WT(I)/NMI
      IWT(I)=WT(I)
      WT1=WT(I)-IWT(I)
57    IF(WT1.GE..5)IWT(I)=IWT(I)+1
      WRITE(6,32)NIER(1),(NIER(I),I=3,J)
32    FORMAT(/,29H NO. OF ITEMS ENTERING REPAIRI16,13X,3HN/AI18,5X,9I5)
      WRITE(6,13)(INENTR(I),I=1,J)
13    FORMAT(/,28H NO. OF ITEMS ENTERING QUEUE,I17,I16,I18,5X,9I5)
      WRITE(6,14)(IQL(I),I=1,J)
14    FORMAT(/,26H AV. NO. OF ITEMS IN QUEUE,I19,I16,I18,5X,9I5)
      WRITE(6,15)(IMAXQL(I),I=1,J)
15    FORMAT(/,27H MAX. NO. OF ITEMS IN QUEUE,I18,I16,I18,5X,9I5)
      WRITE(6,17)(HQE(I),I=1,J)
17    FORMAT(/,29H PERC. OF TIME QUEUE OCCUPIED,F16.2,F16.2,F18.2,5X,
     1 9F5.2)
      WRITE(6,16)(IWT(I),I=1,J)
16    FORMAT(/,38H AV. TIME, IN HRS, ITEMS WAIT IN QUEUE,I7,I16,I18,5X,
     1 9I5)
      THSSW=0.
      THCTW=0.
      TRTS=TRTS/NMI
      DO 53 I=1,10
53    THSSW=HSSW(I)+THSSW
      THSSW=THSSW/NMI
      DO 54 I=1,10
54    THCTW=HCTW(I)+THCTW
      THCTW=THCTW/NMI
      SUTIL=THSSW/NSS/GTIME
      WRITE(6,22)
22    FORMAT(1H1,45X,29HSHOP AND PERSONNEL STATISTICS)
      WRITE(6,25)
      WRITE(6,51)THSSW
51    FORMAT(55X,10HAT SEABASE,//,36X,32HTOTAL SHOP HOURS SPENT IN REPAI
     1R,F15.4,/)
      WRITE(6,48)SUTIL
48    FORMAT(36X,30HPERC. OF TIME SHOP IS UTILIZED,F17.4,/)
      TMH=0.
      IF(IDCT.EQ.1)GOTO23
      IF(IECHAV(4).EQ.1)TMH=THSSW*NPRR4(CLASS)+THCTW+TRTS
      IF(IECHAV(4).NE.1.AND.IECHAV(3).EQ.1)TMH=THSSW*NPRR3(CLASS)+THCTW+
     1 TRTS
      IF(IECHAV(4).NE.1.AND.IECHAV(3).NE.1)TMH=THSSW*NPRR2(CLASS)+THCTW+
     1 TRTS
      GOTO24
23    IF(IECHAV(4).EQ.1)TMH=THSSW*NPRR4(CLASS)
      IF(IECHAV(4).NE.1.AND.IECHAV(3).EQ.1)TMH=THSSW*NPRR3(CLASS)
      IF(IECHAV(4).NE.1.AND.IECHAV(3).NE.1)TMH=THSSW*NPRR2(CLASS)
24    WRITE(6,39)TMH
39    FORMAT(36X,15HTOTAL MAN HOURS,F32.4,/)
      FNPR=TMH/(GTIME/24.*8.)
      NPR=FNPR
      FNPR1=FNPR-NPR
      IF(FNPR1.NE.0.)NPR=NPR+1
```

SUBROUTINE OUTPUT

```
      WRITE(6,40)NPR
   40 FORMAT(36X,22HTOTAL PERSONS REQUIRED,I25,/,36X,26H(BASED ON TOTAL
     1MAN HOURS))
      IF(SUTIL.GT..6667)WRITE(6,36)
   36 FORMAT(/,36X,36HNOTE-ADDITIONAL PERSONNEL ARE NEEDED,/)
      IF(IDCT.EQ.2)GOTO38
      WRITE(6,25)
      WRITE(6,41)THCTW
   41 FORMAT(49X,22HASHORE FOR C.T. REPAIR,//,39X,27HTOTAL HOURS SPENT I
     1N REPAIR,F16.4,/)
      AHCTW=THCTW/NCTS
      IF(IDCT.EQ.1)WRITE(6,42)AHCTW
   42 FORMAT(39X,29HAVERAGE HOURS SPENT IN REPAIR,F14.4,/)
      WRITE(6,43)TRTS
   43 FORMAT(39X,30HTOTAL HOURS SPENT IN TRANSPORT,F13.4,/)
      ATRTS=TRTS/NCTS
      PERC=ATRTS/GTIME
      IF(IDCT.EQ.1)WRITE(6,44)ATRTS,PERC
   44 FORMAT(39X,32HAVERAGE HOURS SPENT IN TRANSPORT,F11.4,//,39X,37HPER
     1CENTAGE OF TIME SPENT IN TRANSPORT,F6.4,/)
      CTUTIL=(AHCTW+ATRTS)/GTIME
      IF(IDCT.EQ.1)WRITE(6,34)CTUTIL
   34 FORMAT(39X,33HPERCENTAGE OF TIME CT IS UTILIZED,F10.4,/)
   38 WRITE(6,25)
      DO 33 I=1,NUNIT
      HUSW(I)=HUSW(I)/NMI
   33 UUTIL(I)=HUSW(I)/GTIME
      WRITE(6,49)(I,I=1,NUNIT)
   49 FORMAT(38X,45HAT UNITS (VALID IF UNIT REPAIR CAPACITY IS 1),/,33X,
     1 10I10)
      WRITE(6,26)(HUSW(I),I=1,NUNIT)
   26 FORMAT( /,33H TOTAL SHOP HOURS SPENT IN REPAIR,10F10.1)
      WRITE(6,56)(UUTIL(I),I=1,NUNIT)
   56 FORMAT(/,28H PERC. OF TIME SHOP IS UTIL.,5X,10F10.1)
      DO 20 I=1,NUNIT
      TMHU(I)=0.
      IF(IEAU(3,I).EQ.1)TMHU(I)=HUSW(I)*NPRR3(CLASS)
   20 IF(IEAU(3,I).NE.1.AND.IEAU(2,I).EQ.1)TMHU(I)=HUSW(I)*NPRR2(CLASS)
      WRITE(6,55)(TMHU(I),I=1,NUNIT)
   55 FORMAT(/,16H TOTAL MAN HOURS,17X,10F10.1)
      DO 21 I=1,NUNIT
      FNPR=TMHU(I)/(GTIME/24.*8.)
      NPRU(I)=FNPR
      FNPR1=FNPR-NPRU(I)
      IF(FNPR1.NE.0.)NPRU(I)=NPRU(I)+1
   21 CONTINUE
      WRITE(6,12)(NPRU(I),I=1,NUNIT)
   12 FORMAT(/,23H TOTAL PERSONS REQUIRED,10X,10I10)
      WRITE(6,37)
   37 FORMAT(   27H (BASED ON TOTAL MAN HOURS),/)
      DO 58 I=1,NUNIT
   58 IF(UUTIL(I).GT..6667)WRITE(6,59)I
   59 FORMAT(51H NOTE-ADDITIONAL PERSONNEL ARE REQUIRED AT UNIT NO.,I3)
      RETURN
      END
```

6.20 SUBROUTINE RITE

ENTRY RITERQ ---

Abstract:

This entry prints out the contents of the arrays which contain information about requests for replacement items (NTRQST, NURQST, TIRQST).

ENTRY RITESQ ---

Abstract:

This entry prints out the contents of the arrays which contain information about the seabase queue afloat (ISQ, TISQ, NPISQ, NESQ).

ENTRY RITSQA ---

Abstract:

This entry prints out the contents of the arrays which contain information about the seabase queue ashore (ISQA, TISQA, NPISQA, NESQA).

ENTRY RITCTQ ---

Abstract:

This entry prints out the contents of the arrays which contain information about the CT queue (ICTQ, NUICTQ, TICTQ, NECTQ).

SUBROUTINE RITE

```
      SUBROUTINE RITE
      COMMON/N3/INV(150),NEI(30,10),NFI(150),NLIST(10),NR,NTRQST(200),
     1 NURQST(200),TIRQST(200),TYPENO(30,10),TAMNO(150)
      COMMON/N5/ICTQ(200),ISQ(200),ISQA(200),ISS(10),IUQ(200,10),NICTQ,
     1  NICTS,NISQ,NISQA,NIUQ(10),NIUS(10),NPISQ(200),NPISQA(200),
     1  NUICTQ(200),TICTQ(200),TISQ(200),TISQA(200),TIUQ(200,10)
     1 ,NESQ(200),NESQA(200),NEUQ(200,10),NECTQ(200),ICTS(10)
      COMMON/N6/LIMDIM,LIMIT,T1,T2,IOPT1,IOPT2,IOPT3
      ENTRY RITERQ
      IF(IOPT2.EQ.0)GOTO10
      DO 1 I=1,NR
    1 WRITE(6,2)I,NTRQST(I),NURQST(I),TIRQST(I)
    2 FORMAT(10X,17H UNIT REQUEST NO.,I3,19H--END ITEM TYPE NO.,I2,
     1 21H IS REQUESTED BY UNIT,I2,3H AT,F6.1,5H HRS.)
      RETURN
   10 WRITE(6,2)NR,NTRQST(NR),NURQST(NR),TIRQST(NR)
      RETURN
      ENTRY RITESQ
      IF(IOPT2.EQ.0)GOTO11
      DO 3 I=1,NISQ
    3 WRITE(6,4)ISQ(I),I,TISQ(I),NPISQ(I),NESQ(I)
    4 FORMAT(5X,14H END ITEM TYPE,I2,43H ADDED TO SEABASED QUEUE AFLOAT
     1IN LOCATION,I3,3H AT,F6.1,20H HRS WITH A PRIOR OF,I2,14H. MAINT AT
     1 ECH,I2,12H IS REQUIRED)
      RETURN
   11 I=NISQ
      WRITE(6,4)ISQ(I),I,TISQ(I),NPISQ(I),NESQ(I)
      RETURN
      ENTRY RITSQA
      IF(IOPT2.EQ.0)GOTO12
      DO 7 I=1,NISQA
    7 WRITE(6,9)ISQA(I),I,TISQA(I),NPISQA(I),NESQA(I)
    9 FORMAT(5X,14H END ITEM TYPE,I2,43H ADDED TO SEABASED QUEUE ASHORE
     1IN LOCATION,I3,3H AT,F6.1,20H HRS WITH A PRIOR OF,I2,14H. MAINT AT
     1 ECH,I2,12H IS REQUIRED)
      RETURN
   12 I=NISQA
      WRITE(6,9)ISQA(I),I,TISQA(I),NPISQA(I),NESQA(I)
      RETURN
      ENTRY RITCTQ
      IF(IOPT2.EQ.0)GOTO8
      DO 5 I=1,NICTQ
    5 WRITE(6,6)ICTQ(I),NUICTQ(I),I,TICTQ(I),NECTQ(I)
    6 FORMAT(5X,17H END ITEM TYPE NO,I2,13H FROM UNIT NO,I2,29H ENTERED
     1CT QUEUE IN LOCATION,I3,3H AT,F6.1,28H HRS. MAINTENANCE AT ECHELON
     1,I2,12H IS REQUIRED)
      RETURN
    8 I=NICTQ
      WRITE(6,6)ICTQ(I),NUICTQ(I),I,TICTQ(I),NECTQ(I)
      RETURN
      END
```

6.21 SUBROUTINE RITEUQ(WORD)

Parameter Used:

WORD(2) Unit number where item is located

Abstract:

This subroutine prints out the contents of the arrays (IUQ, TIUQ, and NEUQ), which contain information about the queue at unit WORD(2).

SUBROUTINE RITEUQ

```
      SUBROUTINE RITEUQ(WORD)
      INTEGER WORD(6)
      COMMON/N5/ICTQ(200),ISQ(200),ISQA(200),ISS(10),IUQ(200,10),NICTQ,
     1  NICTS,NISQ,NISQA,NIUQ(10),NIUS(10),NPISQ(200),NPISQA(200),
     1  NUICTQ(200),TICTQ(200),TISQ(200),TISQA(200),TIUQ(200,10)
     1 ,NESQ(200),NESQA(200),NEUQ(200,10),NECTQ(200),ICTS(10)
      COMMON/N6/LIMDIM,LIMIT,T1,T2,IOPT1,IOPT2,IOPT3
      IF(IOPT2.EQ.0)GOTO3
      J=NIUQ(WORD(2))
      DO 1 I=1,J
    1 WRITE(6,2)IUQ(I,WORD(2)),WORD(2),I,TIUQ(I,WORD(2)),NEUQ(I,WORD(2))
    2 FORMAT(5X,17H END ITEM TYPE NO,I2,16H ENTERED UNIT NOI3,18H QUEUE
     1IN LOCATION,I2,3H AT,F6.1,28H HRS. MAINTENANCE AT ECHELON,I2,12H I
     1S REQUIRED)
      RETURN
    3 I=NIUQ(WORD(2))
      WRITE(6,2)IUQ(I,WORD(2)),WORD(2),I,TIUQ(I,WORD(2)),NEUQ(I,WORD(2))
      RETURN
      END
```

7.0 DETAILS OF THE SCHEDULING PROCESS

The following pages describe the steps taken to schedule the failure (Fail Event) or repair (Complete Service Event) of an item, or the arrival (Arrival Event) of an item or CT

7.1 Fail Event

The time (clock time) at which an item is to fail is scheduled by storing a Fail Event on the event list. This failure time is computed by adding the following two intervals of time to the current clock time:

- TRANSP, the interval of time required for transportation:
  TRANSP=T1 The item is being transported from the seabase to a unit ashore
  TRANSP=0.0 The item is already at a unit ashore
- TTF, the interval of time the item is to continue operating before failing (TTF is computed by Subroutine GENTTF).

The information required at the time of failure is stored in the following variables:

WORD(1) Type of item to fail
WORD(2) Unit number where item to fail is located

The Fail Event is stored on the event list by the calling function

CALL SNE(IFAIL,TIME+TRANSP+TTF,WORD,FTIME).

7.2 Arrival Event

The time (clock time) at which an item or CT is to arrive at its destination is scheduled by storing an Arrival Event on the event list. This arrival time depends on which one of the following arrivals is scheduled:

- Arrival of failed item at seabase
- Arrival of failed item at seabase queue ashore
- Arrival of nondedicated CT at seabase
- Arrival of dedicated CT at a unit ashore

7.2.1 Arrival of Failed Item at Seabase

The time (clock time) a failed item is to arrive at a seabase is computed by adding T1 (the interval of time required to transport the failed item from a point ashore to the seabase) to the current clock time. The information required at the time of arrival is stored in the following variables:

WORD(1) Type of item to arrive
WORD(2) Priority of item to arrive
WORD(5) Echelon level required for repair
WORD(6) Seabase arrival indicated (value will be set to 1)

The Arrival Event is stored on the event list by the calling function

CALL SNE(IARRVL,TIME+T1,WORD,FTIME).

7.2.2 Arrival of Failed Item at Seabase Queue Ashore

The time (clock time) a failed item is to arrive at the seabase queue ashore is computed by adding T2 (the interval of time required to transport the failed item from a point ashore to the queue) to the current clock time. The information required at the time of arrival is stored in the following variables:

WORD(1)	Type of item to arrive
WORD(2)	Priority of item to arrive
WORD(5)	Echelon level required for repair
WORD(6)	Queue ashore arrival indicated (value will be set to 2)

The Arrival Event is stored on the event list by the calling function

CALL SNE(IARRVL,TIME+T2,WORD,FTIME).

7.2.3 Arrival of a Nondedicated CT at Seabase

The time (clock time) at which a nondedicated CT is to arrive at the seabase is computed by adding T1 (the interval of time required to transport the CT from the shore to the seabase) to the current clock time. The information required at the time of arrival is stored in the following variables:

WORD(3)	Identification of the CT
WORD(6)	Seabase arrival of CT indicated (value will be set to 3)

The Arrival Event is stored on the event list by the calling function

CALL SNE(IARRVL,TIME+T1,WORD,FTIME).

The variable which records the total amount of time spent in transporting CT's is updated to include the time used in returning the CT to the seabase (TRTS=TRTS+T1).

7.2.4 Arrival of a Dedicated CT at a Unit Ashore

The time (clock time) at which a dedicated CT is to arrive at a unit ashore is computed by adding T2 (the interval of time required to transport the CT from a point ashore to the unit ashore) to the current clock time. The information required at the time of arrival is stored in the following variables:

WORD(3)	Identification of the CT
WORD(6)	Arrival of CT at the indicated unit (value will be set to 4)

The Arrival Event is stored on the event list by the calling function

CALL SNE(IARRVL,TIME+T2,WORD,FTIME).

The variable which records the total amount of time spent in transporting CT's is updated to include the time used in returning the CT to a unit (TRTS=TRTS+T2).

7.3 Complete Service Event

The time (clock time) at which repair of an item is to be completed is scheduled by storing a Complete Service Event on the event list. This complete service time depends on the location of the scheduled repair:

- Complete service at the seabase
- Complete service ashore by a nondedicated CT
- Complete service ashore at a unit
- Complete service ashore by a dedicated CT

7.3.1 Complete Service at the Seabase

The time (clock time) at which repair of an item is to be completed at the seabase is computed by adding TTR (the interval of time required for repair, which is computed by Subroutine GENTTR) to the current clock time. The information required at the time repair is completed is stored in the following variables:

WORD(1)	Type of item to be repaired
WORD(3)	Space item will occupy during repair
WORD(6)	Location of repair indicated (value will be set to 1)

The Complete Service Event is stored on the event list by the calling function

CALL SNE(ICOMPS,TIME+TTR,WORD,FTIME).

Variable ISS(WORD(3)) is equated to variable WORD(1) to indicate that space WORD(3) is temporarily in use. The variable which records the cumulative total of items repaired at the seabase (NIER(1)) is updated (NIER(1)=NIER(1)+1). To record the time when the repair began, the variable TSSBF(WORD(3)) is equated to the current clock time.

7.3.2 Complete Service Ashore by a Nondedicated CT

The time (clock time) at which repair of an item is to be completed ashore by a nondedicated CT is computed by adding the following two intervals of time to the current clock time:

- TRANSP, the interval of time required to transport the CT to the item:
  TRANSP=T1 The CT is being transported fiom the seabase
  TRANSP=T2 The CT is being transported from a shore point
- TTR, the interval of time required for the repair of the item (that time is computed by Subroutine GENTTR).

The information required at the time repair is completed is stored in the following variables:

WORD(1)	Type of item to be repaired
WORD(2)	Unit number of item to be repaired
WORD(3)	Identification of the CT
WORD(6)	Location of repair indicated (value will be set to 2)
FTIME	Time at which item failed

The Complete Service Event is stored on the event list by the calling function

CALL SNE(ICOMPS,TIME+TRANSP+TTR,WORD,FTIME).

Variable ISS(WORD(3)) is equated to variable (NOTYPE+1) to indicate

- that space WORD(3) is no longer available for use since the maintenance personnel were removed as a regular CT (if WORD(3) $\leqslant$NSS);
- that a phantom CT identified by parameter WORD(3) is presently occupied repairing item WORD(1) (if WORD(3) $>$NSS).

If the CT is being transported from the seabase, the present number of items being repaired by CT's is updated (NICTS=NICTS+1). The variable which records the cumulative total of items repaired by CT's (NIER(3)) is updated (NIER(3)=NIER(3)+1). To record the time when the repair began, the variable TCTBF(WORD(3)) is equated to (TIME+TRANSP). The variable which records the total amount of time spent in transporting CT's is updated to include the time required to transport the CT to the failed item (TRTS=TRTS+TRANSP).

7.3.3 Complete Service Ashore at a Unit

The time (clock time) at which repair of an item is to be completed ashore at a unit is computed by adding TTR (the interval of time required for repair, which is computed by Subroutine GENTTR) to the current clock time. The information required at the time repair is completed is stored in the following variables:

WORD(1)	Type of item to be repaired
WORD(2)	Unit number of item to be repaired
WORD(6)	Location of repair indicated (value will be set to 3)
FTIME	Time at which item failed

The Complete Service Event is stored on the event list by the calling function

CALL SNE(ICOMPS,TIME+TTR,WORD,FTIME).

If the scheduled repair is for an item which has just failed (one not yet in a queue), the total number of items currently in repair at unit WORD(2), (NIUS(3+WORD(2))) is updated (NIUS(3+WORD(2))=NIUS(3+WORD(2))+1). The cumulative total of items repaired at unit WORD(2) (NIER(3+WORD(2))) is updated (NIER(3+WORD(2))= NIER(3+WORD(2))+1). To indicate the time when repair began, the variable TUSBF(WORD(2)) is equated to the current clock time. (If unit WORD(2) can repair more than one end item at any time, this variable is invalid).

7.3.4 Complete Service Ashore by a Dedicated CT

The time (clock time) at which repair of an item is to be completed ashore by a dedicated CT is computed by adding the following two intervals of time to the current clock time:

- TRANSP, the interval of time required to transport the CT to the item:
  TRANSP=T1 The CT is being transported from the seabase
  TRANSP=T2 The CT is being transported from a shore point
- TTR, the interval of time required for the repair of the item (TTR is computed by Subroutine GENTTR).

The information required at the time repair is completed is stored in the following variables:

WORD(1)	Type of item to be repaired
WORD(2)	Unit number of item to be repaired
WORD(3)	Identification of the CT
WORD(6)	Location of repair indicated (value will be set to 4)
FTIME	Time at which item failed

The Complete Service Event is stored on the event list by the calling function

CALL SNE(ICOMPS,TIME+TRANSP+TTR,WORD,FTIME).

Variable ICTS(WORD(3)) is equated to variable WORD(1) to indicate that the CT identified by parameter WORD(3) is presently occupied repairing item WORD(1). The cumulative total of items repaired by CT's (NIER(3)) is updated (NIER(3)=NIER(3)+1). To indicate the time when repair began, the variable TCTBF(WORD(3)) is equated to (TIME+TRANSP). The variable which records the total amount of time spent in transporting CT's is updated to include this latest transportation (TRTS=TRTS+TRANSP).

8.0 ADDING ITEMS TO QUEUES

This section describes the various steps required to add items to the appropriate queues.

- **To the Seabase Queue Afloat**

To indicate that a failed item is being added to the seabase queue afloat, the variable NISQ which records the number of items presently in the queue is updated (NISQ=NISQ+1). If this number exceeds the queue limit (NISQ > LIMDIM), the program stops; if not, two comparisons are made to determine where in the queue the failed item should be placed. The priority of the failed item (WORD(2)) is compared with the priorities of the other queue entries (i.e., the array NPISQ(i), for i= 1 through NISQ-1) and the time at which the failed item is added to the repair queue (TIME) is compared with the times when the other items were placed in the queue (i.e., the array TISQ(i), for i=1 through NISQ-1). The failed item is placed in the queue at the first Location i where $1 \leqslant i \leqslant (NISQ-1)$ which satisfies either the condition that WORD(2) > NPISQ(i) or the condition that WORD(2)=NPISQ(i) and TIME < TISQ(i). If neither of these two conditions is satisfied, the failed item is placed in Location NISQ.

The failed item is placed in the designated "x" location in the seabase queue afloat by storing the data into the arrays as follows:

ISQ(x)=WORD(1)	Type of item that failed
TISQ(x)=TIME	Time at which item enters queue
NPISQ(x)=WORD(2)	Priority of item that failed
NESQ(x)=WORD(5)	Echelon level required for repair

If the failed item is added to an empty queue, the total amount of time that the queue has been empty during the mission (HQE(1)) is updated by that amount of time which extends from the time the queue was last emptied to the present (HQE(1)=TIME-TQBE(1)+HQE(1)). When an item is added to a queue, the cumulative sum of the items added to the queue during the mission (NENTER(1)) is updated (NENTER(1)=NENTER(1)+1). If the number of items in the current queue (NISQ) is greater than the number recorded in MAXQL(1) (MAXQL(1) records the longest individual queue length for the mission thus far), the two variables are equated.

- **To the Seabase Queue Ashore**

To indicate that a failed item is being added to the seabase queue ashore, the variable NISQA which records the number of items presently in the queue is updated (NISQA=NISQA+1). If this number exceeds the queue limit (NISQA > LIMDIM), the program stops; if not, two comparisons are made to determine where in the queue the failed item should be placed. The priority of the failed item (WORD(2)) is compared with the priorities of the other queue entries (i.e., the array NPISQA(i), for i=1 through NISQA-1) and the time at which the failed item is added to the repair queue (TIME) is compared with the times when the other items were placed in the queue (i.e., the array TISQA(i), for i=1 through NISQA-1). The failed item is placed in the queue at the first Location i where $1 \leqslant i \leqslant (NISQA-1)$ which satisfies either the condition that WORD(2) > NPISQA(i) or the condition that WORD(2)=NPISQA(i) and TIME < TISQA(i). If neither of these two conditions is satisfied, the failed item is placed in Location NISQA.

The failed item is placed in the designated "x" location in the seabase queue ashore by storing the data into the arrays as follows:

ISQA(x)=WORD(1)	Type of item that failed
TISQA(x)=TIME	Time at which item enters queue
NPISQA(x)=WORD(2)	Priority of item that failed
NESQA(x)=WORD(5)	Echelon level required for repair

If the failed item is added to an empty queue, the total amount of time that the queue has been empty during the mission (HQE(2)) is updated by that amount of time which extends from the time the queue was last emptied to the present (HQE(2)=TIME-TQBE(2)+HQE(2)). When an item is added to a queue, the cumulative sum of items queued during the mission (NENTER(2)) is updated (NENTER(2)=NENTER(2)+1). If the number of items in the current queue (NISQA) is greater than the number recorded in MAXQL(2) (MAXQL(2) records the longest individual queue length for the mission thus far), the two variables are equated.

- **To the CT Queue**

To indicate that a failed item is being added to the CT queue, the variable NICTQ which records the number of items presently in the queue is updated (NICTQ=NICTQ+1). If the number exceeds the queue limit (NICTQ > LIMDIM), the program stops; if not, the failed item is placed in Location NICTQ of the CT queue by storing the data into the arrays as follows:

ICTQ(NICTQ)=WORD(1)	Type of item that failed
TICTQ(NICTQ)=TIME	Time at which item enters queue
NUICTQ(NICTQ)=WORD(2)	Unit number of item that failed
NECTQ(NICTQ)=WORD(5)	Echelon level required for repair

If the failed item is added to an empty queue, the total amount of time that the queue has been empty during the mission (HQE(3)) is updated by that amount of time which extends from the time the queue was last emptied to the present (HQE(3)=TIME-TQBE(3)+HQE(3)). When an item is added to a queue, the cumulative sum of items queued during the mission (NENTER(3)) is updated (NENTER(3)=NENTER(3)+1). If the number of items in the current queue (NICTQ) is greater than the number recorded in MAXQL(3) (MAXQL(3) records the longest individual queue length for the mission thus far), the two variables are equated.

- **To the Unit Queue**

To indicate that a failed item is being added to the queue at the ith unit, the variable NIUQ(i) which records the number of items presently in the queue is updated (NIUQ(i)=NIUQ(i)+1). If the number exceeds the queue limit (NIUQ(i) > LIMDIM), the program stops; if not, the failed item is placed in Location NIUQ(i) of the queue by storing the data into the arrays as follows:

IUQ(NIUQ(i),i)=WORD(1)	Type of item that failed
TIUQ(NIUQ(i),i)=TIME	Time at which item enters queue
NEUQ(NIUQ(i),i)=WORD(5)	Echelon level required for repair

If the failed item is added to an empty queue, the total amount of time that the queue has been empty during the mission (HQE(3+i)) is updated by that amount of time which extends from the time the queue was last emptied to the present (HQE(3+i)=TIME-TQBE(3+i)+HQE(3+i)). When an item is added to a queue, the cumulative sum of items queued during the mission (NENTER(3+i)) is updated (NENTER(3+i)=NENTER(3+i)+1). If the number of items in the current queue (NIUQ(3+i)) is greater than the number recorded in MAXQL(3+i) (MAXQL(3+i) records the longest individual queue length for the mission thus far), the two variables are equated.

9.0 REMOVING ITEMS FROM QUEUES

This Section describes the various steps required to remove items from the different queues.

- **From the Seabase Queue Afloat**

When a maintenance space is available at the seabase, the item in Location 1 of the seabase queue afloat is removed and a complete service event is scheduled. The characteristics of this item (presently stored in the queue arrays) will be stored in the variables WORD(1) and WORD(5) so that the complete service event may be stored on the event list.

The item in Location 1 of the queue is removed by storing the following information into the variables indicated:

WORD(1)=ISQ(1)	Type of item in queue
WORD(5)=NESQ(1)	Echelon level required for repair

(The characteristics of the item stored in variables TISQ(1) and NPISQ(1) are not required for the complete service event.)

To indicate that a failed item is being removed from the seabase queue afloat, the variable NISQ which records the number of items presently in the queue is decremented (NISQ=NISQ-1). The variable which records the total amount of time that items wait in the queue (HWIQ(1)) is updated by the interval which extends from the time the item just removed was placed in the queue to the present (HWIQ(1)=TIME-TISQ(1)+HWIQ(1)). If the queue is now empty (NISQ=0) the variable which records the time the last item was removed from the queue (TQBE(1)) is equated to the present (TQBE(1)=TIME).

If there are still items in the queue (NISQ≠0), the contents of the queue arrays (i.e., arrays ISQ, NESQ, NPISQ, TISQ) in locations 2 through (NISQ+1) are advanced one location.

- **From the Seabase Queue Ashore**

When space is available in the seabase queue afloat, the item in Location 1 of the seabase queue ashore is removed. An arrival event is scheduled and the item is transported to the seabase. The characteristics of this item (presently stored in the queue arrays) will be stored in the variables (WORD(1), WORD(2), and WORD(5) so that the arrival event may be stored on the event list.

The item in Location 1 of the queue is removed by storing the following information into the variables indicated:

WORD(1)=ISQA(1)	Type of item in queue
WORD(2)=NPISQA(1)	Priority of item in queue
WORD(5)=NESQA(1)	Echelon level required for repair

(The characteristic of the item stored in variable TISQA(1) is not required for the arrival event.)

To indicate that a failed item is being removed from the seabase queue ashore, the variable NISQA which records the number of items presently in the queue is decremented (NISQA=NISQA-1). The variable which records the total amount of time that items wait in the queue (HWIQ(2)) is updated by the interval which extends from the time the item just removed was placed in the queue to the present (HWIQ(2)=TIME-TISQA(1)+HWIQ(2)). If the queue is now empty (NISQA=0) the variable which records the time the last item was removed from the queue (TQBE(2)) is equated to the present (TQBE(2)=TIME).

If there are still items in the queue (NISQA≠0), the contents of the queue arrays (i.e., arrays ISQA, NESQA, NPISQA, TISQA) in locations 2 through (NISQA+1) are advanced one location.

- **From the CT Queue**

When a CT is available, the item in Location 1 of the CT queue is removed and a complete service event is scheduled. The characteristics of this item (presently stored in the queue arrays) will be stored in the variables WORD(1), WORD(2), WORD(5), and FTIME so that the complete service event may be stored on the event list.

The item in Location 1 of the queue is removed by storing the following information into the variables indicated:

WORD(1)=ICTQ(1)	Type of item in queue
WORD(2)=NUICTQ(1)	Unit of item in queue
WORD(5)=NECTQ(1)	Echelon level required for repair
FTIME=TICTQ(1)	Time at which item failed

To indicate that a failed item is being removed from the CT queue, the variable NICTQ which records the number of items presently in the queue is decremented (NICTQ=NICTQ-1). The variable which records the total amount of time that items wait in the queue (HWIQ(3)) is updated by the interval which extends from the time the item just removed was placed in the queue to the present (HWIQ(3)=TIME-TICTQ(1)+HWIQ(3)). If the queue is now empty (NICTQ=0), the variable which records the time the last item was removed from the queue (TQBE(3)) is equated to the present (TQBE(3)=TIME).

If there are still items in the queue (NICTQ≠0), the contents of the queue arrays (i.e., ICTQ, NUICTQ, NECTQ, TICTQ) in locations 2 through (NICTQ+1) are advanced one location.

- **From the Unit Queue**

When a maintenance resource is available at a unit, the item in Location 1 of the unit queue is removed and a complete service event is scheduled. The characteristics of this item (presently stored in the queue arrays) will be stored in the variables WORD(1), WORD(5), and FTIME so that the complete service event may be stored on the event list.

The item in Location 1 of the queue at the ith unit is removed by storing the following information into the variables indicated:

WORD(1)=IUQ(1,i)	Type of item in queue
WORD(5)=NEUQ(1,i)	Echelon level required for repair
FTIME=TIUQ(1,i)	Time at which item failed

To indicate that an item is being removed from the queue at the ith unit, the variable NIUQ(i) which records the number of items presently in the queue is decremented (NIUQ(i)=NIUQ(i)-1). The variable which records the total amount of time that items wait in the queue (HWIQ(3+i)) is updated by the interval which extends from the time the item just removed was placed in the queue to the present (HWIQ(3+i)=TIME-TIUQ(1,i)+HWIQ(3+i)). If the queue is now empty (NIUQ(i)=0) the variable which records the time the last item was removed from the queue (TQBE(3+i)) is equated to the present (TQBE(3+i)=TIME).

If there are still items in the queue (NIUQ(i)≠0), the contents of the queue arrays (i.e., IUQ, NEUQ, TIUQ) in locations 2 through (NIUQ(i)+1) are advanced one location.

10.0 EXAMPLE OF PROGRAM OUTPUT

An example of the program output for a given set of data is detailed here; the listing of the program output is included following this discussion.

In this example, we dealt with items in the Motor Transport class; the output presented is appropriate to that class. When other classes are involved, the output will vary accordingly. Information of a general nature is found on pages 112 through 114 of the program output listing; information strictly concerned with the individual classes follows.

The information of a general nature is organized in the following tables:

- Total Number of Persons Required to Repair Item
- Decrease in Seabase Repair Capability as CT's Depart (For Nondedicated CT's only)
- Mission Characteristics
- Repair Intervals (Mean Time to Repair) in Hours
- Percentage of Items that Fail Requiring the Various Echelons of Repair
- Percentage of Items Repaired by CT's Requiring the Various Echelons of Repair
- Transportation Times

The information for these tables is read in and printed out in table form by Subroutine TITLE.

The information following on the next pages 115 through 116 of the program output listing is strictly concerned with the Motor Transport class. The information on the input data for the Motor Transport class is organized under the following tables:

- Personnel and Seabase Shop Characteristics
- Repair Capability of Units Ashore
- MAU Configuration

The information for the first two tables and part of the third table is read in by Subroutine INPUT (part of the information for the third table is read in by Subroutine RETRIEV). The information for these tables is printed out in table form by Subroutine INPUT before simulation begins. The table "Personnel and Seabase Shop Characteristics" (page 115) includes the following information:

- Total Number of Contact Teams Available (NCTS)
- Seabase Repair Capacity (NSS) – the number of repair spaces in the maintenance shop available for the repair of items
- Number of Items Allowed in Seabase Queue Afloat (LIMIT) – the maximum number of items allowed in the seabase queue afloat simultaneously
- Total number of Repair Personnel Required at Seabase – computed as a function of the information from the table "Total Number of Persons Required to Repair Item," the highest echelon level of repair available at the seabase, and the seabase repair capacity. To determine how many repair personnel are needed for two 8-hour shifts, the number indicated in the table was multiplied by two; if dedicated CT's are specified, the number indicated is incremented by NCTS
- Total Number of Repair Personnel Required at Units – computed as a function of the information from the table "Total Number of Persons Required to Repair Item," the highest echelon level of repair available at each unit, and the unit repair capacity; and summed for all the units in the Landing Force. To determine how many repair personnel are needed for two 8-hour shifts, the number indicated in the table was multiplied by two
- Total Number of Personnel Required for MAU Repair – includes both seabase and unit repair personnel required

The table "Repair Capability of Units Ashore" (page 115) includes the units by their identification numbers and by their names, and gives the unit repair capacity and the repair echelon level available at each unit. In this example, the Landing Force consists of nine units. If the ith unit does not have a 2nd- or a 3rd-echelon maintenance capability (if IEAU(2,i)=0 and IEAU(3,i)=0), the unit repair capacity is zero. If the ith unit has a 2nd-echelon maintenance capability but not 3rd (if IEAU(2,i)=1 and IEAU(3,i)=0), the unit repair capacity equals NUS, and 2ND is entered under the column heading "Echelon Available." If the ith unit has both a 2nd- and a 3rd-echelon maintenance capability (IEAU(2,i)=1) and IEAU(3,i)=1), the unit repair capacity equals NUS and 2ND and 3RD are entered under the column heading "Echelon Available."

The information for the table "MAU Configuration" (page 115) defines the items in the Landing Force by listing the items by their TAM numbers (these TAM numbers are listed in alphanumeric order, the first listed is type 1, the ith is type i), and gives the following information for each item in the Landing Force:

- Nomenclature
- Total number of items at the units ashore (end items) and total number of float items
- Mean Time Between Failure (MTBF)
- Utilization Factor
- Square
- Cube
- Unit Packaging
- Embark Information

The information in the output data for the Motor Transport class is organized under the following tables:

- Tool Sets, Kits, and Special Equipment Required
- Operating Data
- Discard Information
- Characteristics of Queues
- Shop and Personnel Statistics

The information for the table "Tool Sets, Kits, and Special Equipment Required" (page 116) is computed and printed out in table form by Subroutines TSEQ3 and TESTEQ.

The information for the table "Operating Data" indicates how the items are distributed at the units and provides statistics concerning the Downtime Hours, Average Downtime (DT) Hours Per Failure, and the Availability for each of the items in the units. These statistics are calculated during the simulation and are printed out in table form by Subroutine OUTPUT pages 117 and 118. The Downtime Hours indicate how long the item is non-operational at the unit. The average downtime hours per failure is a function of the total downtime hours and the number of times the item fails during the simulation. The Availability is a function of the downtime hours, the number of items in the unit, and the mission duration; it is defined as the fraction of the mission duration that a given item is in operation.

The information for the table "Discard Information" (page 119) provides statistics concerning how many items were discarded during the simulation and how many requests for float items were still unfilled at the completion of the mission. These statistics are calculated during the simulation and are printed out in table form by Subroutine OUTPUT.

The information for the table "Characteristics of Queues" (page 119) includes the following for items in the seabase queue afloat, the seabase queue ashore, the CT queue, and the queue at each of the units:

- Number of Items Entering Repair
- Number of Items Entering Queue
- Average Number of Items in Queue
- Maximum Number of Items in Queue
- Percentage of Time Queue is Occupied
- Average Time, in hours, Items Wait in Queue

This information is calculated during the simulation and printed out in table form by Subroutine OUTPUT.

The tables located under the heading "Shop and Personnel Statistics" (page 120) provide information for the repair locations at the seabase, ashore for CT repair, and at the units. The following information is provided for seabase repair:

- Total Shop Hours Spent in Repair
- Percentage of Time Shop is Utilized
- Total Man Hours – computed as a function of the total shop hours spent in repair, and the information from the table "Total Number of Persons Required to Repair Item." If nondedicated CT's are specified, then the number indicated in the table also includes the total hours spent in repair by CT's and total hours spent in transport
- Total Personnel Required – Based on Total Man Hours

The following information is provided for repair ashore by CT's:

- Total Hours Spent in Repair
- Average Hours Spent in Repair
- Total Hours Spent in Transport

- Average Hours Spent in Transport
- Percentage of Time Spent in Transport
- Percentage of Time CT is Utilized

The following information is provided for repair at the units:

- Total Shop Hours Spent in Repair
- Percentage of Time Shop is Utilized
- Total Man Hours: computed as a function of the total shop hours spent in repair, and the information from the table "Total Number of Persons Required to Repair Item"
- Total Personnel Required: Based on Total Man Hours

The statistics for these tables are calculated during the simulation and are printed out in table form by Subroutine OUTPUT.

NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

BETHESDA, MARYLAND 20034

SMLS MAINTENANCE OPTIMIZATION MODEL

DEVELOPED FOR MARINE CORPS DEVELOPMENT AND EDUCATION COMMAND

SMLS PROJECT OFFICE

COMPUTATIONS AND MATHEMATICS DEPARTMENT

JANUARY 18, 1973

THE MODEL SIMULATES OPERATION AT THE MARINE AMPHIBIOUS UNIT (MAU) LEVEL

THE END ITEM CONFIGURATION IS REPRESENTATIVE OF 34TH MAU

****

MAINTENANCE SPECIALIST PERSONNEL DATA

TOTAL NUMBER OF PERSONS REQUIRED TO REPAIR ITEM

ECHELON	2	3	4
COMM/ELEC	1	1	1
ENGINEER	1	2	2
MOTOR TRANSPORT	1	2	2
ORDNANCE	1	1	2

DECREASE IN SEABASE REPAIR CAPABILITY AS C.T.'S DEPART (FOR NON-DEDICATED C.T. ONLY)
NOTE - CAPABILITY=NUMBER OF ITEMS CAN REPAIR AT ONE TIME

TOTAL C.T.'S ABSENT FROM SEABASE	1	2	3	4	5
COMM/ELEC	0	0	1	2	2
ENGINEER	0	1	1	2	3
MOTOR TRANSPORT	0	0	1	2	3
ORDNANCE	0	1	1	2	3

MISSION CHARACTERISTICS

NUMBER OF SIMULATED MISSION RUNS 50
MISSION DURATION IN HOURS 240.

****

REPAIR INTERVALS (MEAN TIME TO REPAIR) IN HOURS

AT SEABASE OR ASHORE AT UNIT ECH	INTERVAL	ASHORE BY C.T. ECH	INTERVAL
2ND	.5	2ND	.5
3RD	4.0	3RD	2.0
4TH	24.0		

****

	2ND ECH	3RD ECH	4TH ECH	DISCARD
PERCENTAGE OF ITEMS THAT FAIL REQUIRING THE VARIOUS ECHELON	.64	.24	.10	.02
PERCENTAGE OF ITEMS REPAIRED BY CT REQUIRING THE VARIOUS ECHELON	.90	.64	0.00	0.00
IS ECHELON AVAILABLE AT SEABASE	YES	YES	YES	

****

TRANSPORTATION TIMES

SHIP TO SHORE= 2.00 HRS
SHORE TO SHORE= .50 HRS

****

INPUT DATA FOR THE

MOTOR TRANSPORT CLASS

****

PERSONNEL AND SEABASE SHOP CHARACTERISTICS

TOTAL NUMBER OF CONTACT TEAMS AVAILABLE	2	
SEABASE REPAIR CAPACITY	1	
NUMBER OF ITEMS ALLOWED IN SEABASE QUEUE AFLOAT	2	
TOTAL NUMBER OF REPAIR PERSONS REQUIRED AT SEABASE	6	(TWO 8-HR SHIFTS)
TOTAL NUMBER OF REPAIR PERSONS REQUIRED AT UNITS	8	(TWO 8-HR SHIFTS)
TOTAL NUMBER OF PERSONS REQUIRED FOR MAU REPAIR	14	

****

REPAIR CAPABILITY OF UNITS ASHORE

UNIT NUMBER	UNIT NAME	UNIT REPAIR CAPACITY	ECHELON AVAILABLE
1	RIFLE COMPANY A	0	
2	RIFLE COMPANY B	0	
3	RIFLE COMPANY C	0	
4	RIFLE COMPANY D	0	
5	HEADQUARTERS SERVICE	0	
6	ARTILLERY BATTERY	0	
7	TANK PLATOON	1	2ND, 3RD
8	LVT PLATOON	1	2ND, 3RD
9	MOTOR TRANSPRT GROUP	0	

****

MAU CONFIGURATION

TAM NUMBER	NOMENCLATURE	TOTAL NUMBER OF ITEMS END ITEMS	FLOAT ITEMS	MTBF	UTIL. FACT.	SQUARE	CUBE	UNIT PACK.	EMB. INFO.
D0840	TRAILER,AMPHIB CARGO,1/4T,2-WHL,M416B	13	2	1800.0	3.	46.00	162.00	1	-0
D0860	TRAILER, CARGO,1-1/2T,2-WHL,M105A2	5	1	1800.0	6.	96.00	781.00	1	SS
D0880	TRAILER, TANK, WATER, 400GAL,M149	6	1	1800.0	9.	91.00	608.00	-0	SS
D0890	TRUCK,AMBULANCE,1/4T,4X4,M718	1	0	57.0	9.	65.00	280.00	1	SS
D1010	TRUCK,CARGO,3/4T,4X4,M37B1,W/W	7	0	84.0	6.	98.00	732.00	1	SS
D1030	TRUCK,CARGO,DROPSIDE,2 1/2T,6X6,M35A2C,W/OW, WPTO	16	1	84.0	6.	176.00	1687.00	1	SS
D1100	TRUCK,PLATFORM,UTIL,1/2T	26	2	57.0	3.	42.00	173.00	1	SS
D1110	TRUCK,TANK,FUEL SERVICING,1200 GAL,2-1/2T,6X6,M49A	2	0	84.0	6.	185.00	1493.00	1	SS
D1160	TRUCK,UTLITY,1/4T,4X4,M151A1	12	2	57.0	3.	59.00	354.00	1	SS
E0830	LANDING VEHICLE TRACKED,LVTP5A1,W/E W/RADIO SYS AN	10	0	32.0	10.	349.00	3341.00	1	SS
E1850	TANK COMBAT,FULL-TRACKED,90MM GUN,M48A3,W/E,W/RADI	7	1	48.0	10.	292.00	2993.00	1	SS

NOTE-SS DENOTES ITEMS REQUIRING SQUARE STOWAGE

****

OUTPUT DATA FOR THE

MOTOR TRANSPORT CLASS

****

TOOL SETS, KITS, AND SPECIAL EQUIPMENT REQUIRED

NOMENCLATURE	TEST TAM NO.	QUANTITY OF REPAIR ITEMS REQUIRED AT UNITS 1	2	3	4	5	6	7	8	9	AT SEABASE	TOTAL
CHARGER,BATTERY,ALLEN,12-3 CELL	D0070	0	0	0	0	0	0	1	1	0	3	5
CLEANER,STEAM PRESSURE JET,TRLR MTD,-JOM-1-	D0090	0	0	0	0	0	0	2	2	0	5	9
DEGREASER,PORTABLE TYPE, 20-GAL	D0100	0	0	0	0	0	0	2	2	0	5	9
GENERATOR SET,GASOLINE ENGINE, BATTERY CHARGER	D0160	0	0	0	0	0	0	1	1	0	3	5
LUBRICATING +SERVICING UNIT PWR OPERATED,2-1/2T,TRLR MTD	D0190	0	0	0	0	0	0	1	1	0	1	3
SHOP SET,FM,AUTOMOTIVE BASIC CONSISTS OF-	D0310	0	0	0	0	0	0	1	1	0	2	4
SHOP SET, AUTO,FUEL +ELECTRICAL SYSTEMS CONSISTS OF	D0320	0	0	0	0	0	0	1	1	0	2	4
SHOP SET,FM,AUTO,FUEL+ELECT SYS,SUPPLEMENTAL NO2 CONSISTSOF	D0330	0	0	0	0	0	0	1	1	0	2	4
SHOP SET,FM,AUTO,FUEL+ELECT SYS,SUPPLEMENTAL NO2 SET, B	D0340	0	0	0	0	0	0	0	0	0	1	1
SHOP SET,FM,AUTO,SUPPLEMENTAL NO1 CONSISTS OF	D0350	0	0	0	0	0	0	0	0	0	1	1
SHOP SET,FM,AUTO,SUPPLEMENTAL NO2 CONSISTS OF	D0360	0	0	0	0	0	0	0	0	0	1	1
TEST SET, BATTERY STARTER,6-12-24V	D0380	0	0	0	0	0	0	2	2	0	5	9
TEST SET, ENGINE DISTRIBUTOR + RPM	D0390	0	0	0	0	0	0	2	2	0	5	9
TEST SET,GENERATOR + VOLTAGE REGULATOR, AUTO	D0400	0	0	0	0	0	0	2	2	0	5	9
TESTER,COIL + CONDENSER	D0410	0	0	0	0	0	0	2	2	0	5	9
TESTER,DIESEL FUEL INJECTOR NOZZLE	D0420	0	0	0	0	0	0	2	2	0	4	8
TOOL KIT,FIELD + DEPOT MAINTENANCE TRLR	D0470	0	0	0	0	0	0	0	0	0	2	2
TOOL KIT,FM,3D ECH,F/TRK,PLATFORM,1/2T,M274 SERIES	D0510	0	0	0	0	0	0	0	0	0	1	1
TOOL KIT,FM,4TH ECH,F/TRK PLATFORM,1/2T,M274 SERIES	D0520	0	0	0	0	0	0	0	0	0	1	1
TOOL KIT,OM,BASIC SET B,F/TRK PLATFORM,1/2T,M274 SERIES	D0530	0	0	0	0	0	0	0	0	0	1	1
TOOL KIT,3D ECH,FM,SPECIAL BASIC F/M151A1	D0680	0	0	0	0	0	0	0	0	0	1	1
TOOL KIT,4TH ECH,FM,SPECIAL BASIC F/M151A1	D0690	0	0	0	0	0	0	0	0	0	1	1
TOOL KIT,OM,COMMON NO 1	D0725	0	0	0	0	0	0	1	1	0	2	4
TOOL KIT,OM,SPEC,BASIC SET B F/M151A1	D0770	0	0	0	0	0	0	0	0	0	1	1
WRENCH,WHL BEARING ADJ NUT,F/M295,M105A2,M107A2,M295A1,M200	D1250	0	0	0	0	0	0	0	0	0	3	3

OPERATING DATA

*** UNIT 1 ***

TAM NO.	NO. END ITEMS IN UNIT	DOWNTIME HOURS	AVERAGE DT HOURS PER FAILURE	AVAILABILITY
00840	1	.0	0.0	.9998
01100	2	4.4	4.4	.9908
	UNIT 1 CHARACTERISTICS-	4.5	2.2	.9938

*** UNIT 2 ***

TAM NO.	NO. END ITEMS IN UNIT	DOWNTIME HOURS	AVERAGE DT HOURS PER FAILURE	AVAILABILITY
00840	1	.0	0.0	.9999
01100	2	6.0	6.0	.9874
	UNIT 2 CHARACTERISTICS-	6.1	3.0	.9916

*** UNIT 3 ***

TAM NO.	NO. END ITEMS IN UNIT	DOWNTIME HOURS	AVERAGE DT HOURS PER FAILURE	AVAILABILITY
00840	1	0.0	0.0	1.0000
01100	2	5.2	5.2	.9891
	UNIT 3 CHARACTERISTICS-	5.2	2.6	.9927

*** UNIT 4 ***

TAM NO.	NO. END ITEMS IN UNIT	DOWNTIME HOURS	AVERAGE DT HOURS PER FAILURE	AVAILABILITY
00840	1	0.0	0.0	1.0000
01100	2	1.5	1.5	.9969
	UNIT 4 CHARACTERISTICS-	1.5	.8	.9979

*** UNIT 5 ***

TAM NO.	NO. END ITEMS IN UNIT	DOWNTIME HOURS	AVERAGE DT HOURS PER FAILURE	AVAILABILITY
00840	4	.0	0.0	1.0000
01100	18	29.2	2.9	.9932
01160	4	4.8	2.4	.9950
	UNIT 5 CHARACTERISTICS-	34.0	1.8	.9945

*** UNIT 6 ***

TAM NO.	NO. END ITEMS IN UNIT	DOWNTIME HOURS	AVERAGE DT HOURS PER FAILURE	AVAILABILITY
00840	1	0.0	0.0	1.0000
01030	6	19.7	4.9	.9863
01160	1	1.8	1.8	.9923
UNIT 6 CHARACTERISTICS-		21.5	2.3	.9888

*** UNIT 7 ***

TAM NO.	NO. END ITEMS IN UNIT	DOWNTIME HOURS	AVERAGE DT HOURS PER FAILURE	AVAILABILITY
E1850	7	36.0	2.6	.9786
UNIT 7 CHARACTERISTICS-		36.0	2.6	.9786

*** UNIT 8 ***

TAM NO.	NO. END ITEMS IN UNIT	DOWNTIME HOURS	AVERAGE DT HOURS PER FAILURE	AVAILABILITY
E0830	10	214.9	7.7	.9105
UNIT 8 CHARACTERISTICS-		214.9	7.7	.9105

*** UNIT 9 ***

TAM NO.	NO. END ITEMS IN UNIT	DOWNTIME HOURS	AVERAGE DT HOURS PER FAILURE	AVAILABILITY
00840	4	.0	0.0	1.0000
00860	5	.5	0.0	.9996
00880	6	.3	0.0	.9998
00890	1	20.2	10.1	.9159
01010	7	46.3	11.6	.9725
01030	10	32.1	4.0	.9866
01110	2	8.2	8.2	.9828
01160	7	7.1	1.8	.9958
UNIT 9 CHARACTERISTICS-		114.7	4.5	.9886

****

MAU CHARACTERISTICS

CUMMULATIVE DT HOURS= 438.5003

AVERAGE DT HOURS PER FAILURE= 5.3242

AVERAGE AVAILABILITY= .9826

DISCARD INFORMATION

TAM NUMBER	ITEMS DISCARDED	ITEM REQUESTS UNFILLED	ORIGINAL NUMBER OF FLOAT ITEMS
D0840	0	0	2
D0860	0	0	1
D0880	0	0	1
D0890	0	0	0
D1010	0	0	0
D1030	0	0	1
D1100	0	0	2
D1110	0	0	0
D1160	0	0	2
E0830	0	1	0
E1850	0	0	1

TOTAL ITEMS DISCARDED= 0

PERCENT OF ITEMS DISCARDED= 0.0000

****

CHARACTERISTICS OF QUEUES

	AT SEABASE	ASHORE FOR SEABASE	ASHORE FOR CT	AT UNITS 1	2	3	4	5	6	7	8	9
NO. OF ITEMS ENTERING REPAIR	12	N/A	29	0	0	0	0	0	0	13	25	0
NO. OF ITEMS ENTERING QUEUE	7	4	1	0	0	0	0	0	0	1	3	0
AV. NO. OF ITEMS IN QUEUE	1	1	0	0	0	0	0	0	0	0	0	0
MAX. NO. OF ITEMS IN QUEUE	2	3	1	0	0	0	0	0	0	1	2	0
PERC. OF TIME QUEUE OCCUPIED	.40	.21	.00	0.00	0.00	0.00	0.00	0.00	0.00	.01	.04	0.00
AV. TIME, IN HRS, ITEMS WAIT IN QUEUE	23	21	0	0	0	0	0	0	0	1	3	0

SHOP AND PERSONNEL STATISTICS

****

AT SEABASE

TOTAL SHOP HOURS SPENT IN REPAIR	147.1386
PERC. OF TIME SHOP IS UTILIZED	.6131
TOTAL MAN HOURS	294.2772
TOTAL PERSONS REQUIRED (BASED ON TOTAL MAN HOURS)	4

****

ASHORE FOR C.T. REPAIR

TOTAL HOURS SPENT IN REPAIR	24.9778
AVERAGE HOURS SPENT IN REPAIR	12.4889
TOTAL HOURS SPENT IN TRANSPORT	32.0600
AVERAGE HOURS SPENT IN TRANSPORT	16.0300
PERCENTAGE OF TIME SPENT IN TRANSPORT	.0668
PERCENTAGE OF TIME CT IS UTILIZED	.1188

****

AT UNITS (VALID IF UNIT REPAIR CAPACITY IS 1)

	1	2	3	4	5	6	7	8	9
TOTAL SHOP HOURS SPENT IN REPAIR	0.0	0.0	0.0	0.0	0.0	0.0	17.3	35.4	0.0
PERC. OF TIME SHOP IS UTIL.	0.0	0.0	0.0	0.0	0.0	0.0	.1	.1	0.0
TOTAL MAN HOURS	0.0	0.0	0.0	0.0	0.0	0.0	34.6	70.9	0.0
TOTAL PERSONS REQUIRED (BASED ON TOTAL MAN HOURS)	0	0	0	0	0	0	1	1	0

APPENDIX A
ITEM IDENTIFICATION

Unique all-integer type numbers are assigned to the various items in the MAU according to the particular TAM number (which consists of five alphanumeric characters - one letter followed by four integers). There are a total of NOTYPE different item types in a Landing Force; each different item type has a different TAM number. The parameter TAMNO(i) is defined as the ith TAM number in the Landing Force, or as the TAM number for item type i.

Items are identified by their type numbers during a simulated mission; items are identified by their TAM numbers on the input cards and on the program output.

Arrays NLIST, TYPENO and NEI are designated within the program to identify the item types at each unit. NLIST(j) is the total number of different item types at unit j, where j= 1 through NUNIT. TYPENO(k,j) is defined as the kth different item type at unit j, where k= 1 through NLIST(j) and j= 1 through NUNIT. (For example, TYPENO(1,2) represents the first item type at Unit 2.) NEI(k,j) represents the total number of items at unit j for the kth different item type; where k= 1 through NLIST(j) and j= 1 through NUNIT.

The arrays NLIST, TYPENO, and NEI are set up by Subroutine INPUT. Each time a different TAM number in the Landing Force and its associated parameters are read in (see Section 4.0), arrays NLIST, TYPENO, and NEI are updated to include this new item type.

For example, suppose the ith TAM number is read in. The parameters associated with this item type are:

TAMNO(i)	TAM number
NUTNAI	Number of Units which contain items of this type
UNITNO(k); k=1,NUTNAI	List of units, by identification number, which contain items of this type
UNITDEN(k)	Total number of items of this type at unit UNITNO(k); k= 1 through NUTNAI

For every unit which contains type i items, the following actions will occur; i.e., for every unit j, where j=UNITNO(L) and L= 1 through NUTNAI:

NLIST(j) = NLIST(j) + 1
TYPENO(NLIST(j),j) = i
NEI(NLIST(j),j) = UNITDEN(j)

As an illustration of the above process, suppose there are three units in a Landing Force and three different item types. The following information will be read in by Subroutine INPUT.

The TAM number of the first item type is A1111. At Unit 1 there are 2 items of this type; at Unit 3 there are 5.

The TAM number of the second item type is A1311. At Unit 1 there are 7 items of this type; at Unit 2 there are 11.

The TAM number of the third item type is B0000. At Unit 1 there are 4 items of this type, at Unit 2 there are 3; at Unit 3 there is 1.

The following variables will then be set up by Subroutine INPUT. Since Unit 1 contains all three item types, the variable NLIST(1)=3; Unit 2 contains two items types and the variable NLIST(2)=2; Unit 3 contains two item types and the variable NLIST(3)=2. The following variables apply to Unit 1:

TYPENO(1,1)=1	NEI(1,1)=2
TYPENO(2,1)=2	NEI(2,1)=7
TYPENO(3,1)=3	NEI(3,1)=4

The following variables apply to Unit 2;

TYPENO(1,2)=2	NEI(1,2)=11
TYPENO(2,2)=3	NEI(2,2)=3

The following variables apply to Unit 3:

TYPENO(1,3)=1	NEI(1,3)=5
TYPENO(2,3)=3	NEI(2,3)=1

APPENDIX B
CONTROL CARDS

The control cards (see Figure 6) located at the beginning of the program direct the computer to:

- Copy the File for Item Characteristics on to a scratch tape
- Load the Maintenance Equipment File on to a tape drive
- Read in and execute the program

The File for Item Characteristics is mounted on a tape drive and its contents are then transferred to TAPE 2 by the commands:

```
LABEL,LMAUEI,L=CACY,R,D=HY.        (CJ0236/NORING)
COPYCF,LMAUEI,TAPE2.
```

The Maintenance Equipment File is mounted on a tape drive by the command:

```
LABEL,TSEQ,L=CACY,R,D=HY.          (CJ0234/NORING)
```

Its contents are transferred to TAPE1 by the program card in the Executive Routine. After these commands the program is read in and execution begins.

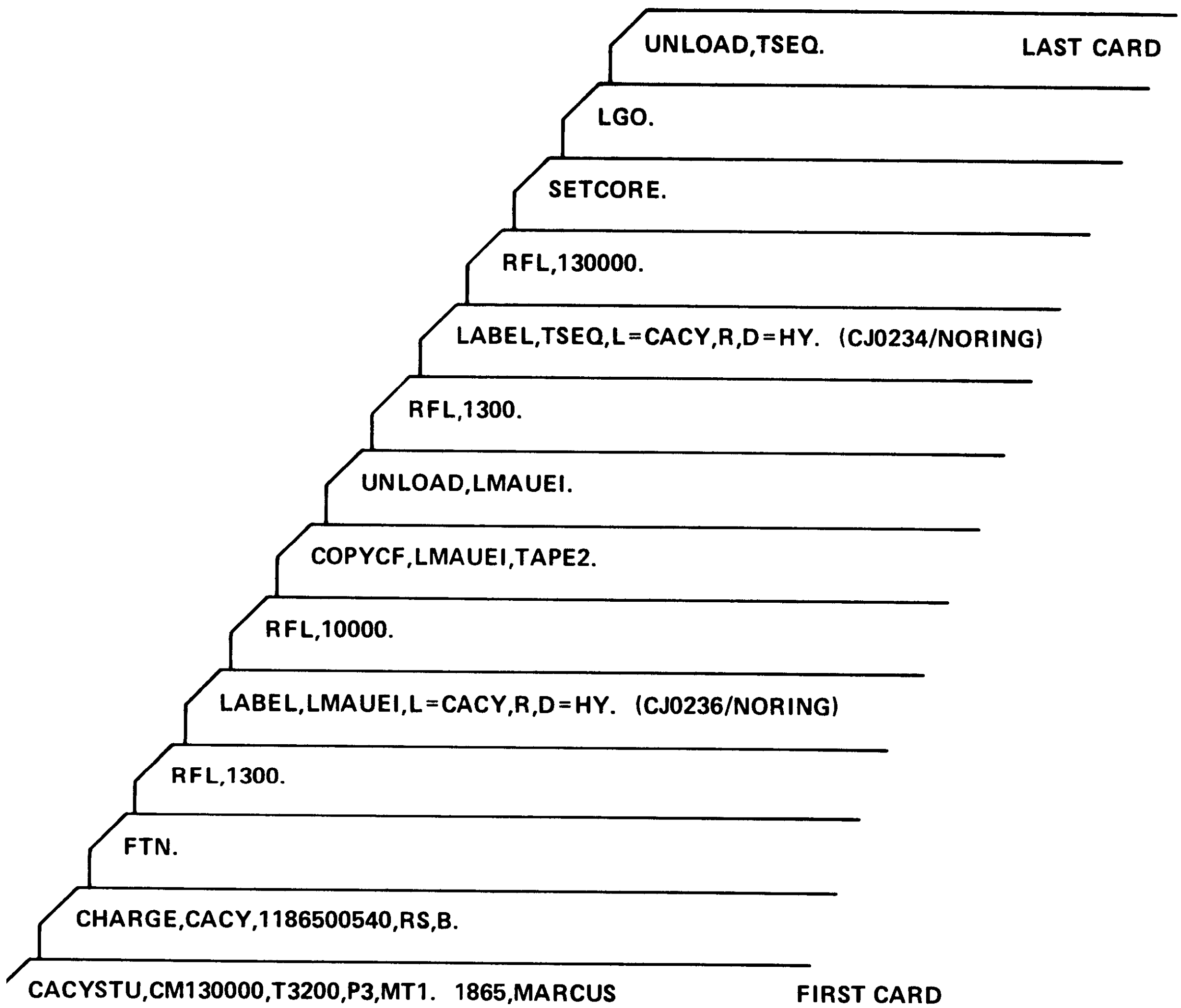

Figure 6. Control Cards

APPENDIX C
MAINTENANCE EQUIPMENT FILE

The tool sets, kits, and special equipment required by the maintenance shops are listed on the permanent file identified as follows:

Logical File Name = TSEQ
File Label = CACY
Tape Density = HY (800 BPI 7 TRACK)
Visual Reel Number = CJ0234

The characteristics of each tool set, kit, and special equipment are stored on the file as a "record." Each record consists of 160 characters (two card images). The records are grouped according to the class to which the maintenance equipment belongs (i.e., Communications/Electronics, Engineer, Motor Transport, or Ordnance). Within each group, the records are ordered alphanumerically according to the TAM number of the maintenance equipment (as stated on the first card of the record). To set off the different groups, identifying header cards (80 characters each with an integer number in the first 2 card columns) are used as indicated here:

10 Communications/Electronics Class
20 Engineer Class
30 Motor Transport Class
40 Ordnance Class

Figure 7 indicates the arrangement of this file.

The contents of this file are transferred to a scratch file (TAPE 1) by a command from the program card in the Executive Routine. Any reference in this report and in the program listing to TAPE 1 indicates a requirement for the Maintenance Equipment File.

Table 3 describes the variables on a record for the ith maintenance equipment and gives the required format and card column, where the information is entered.

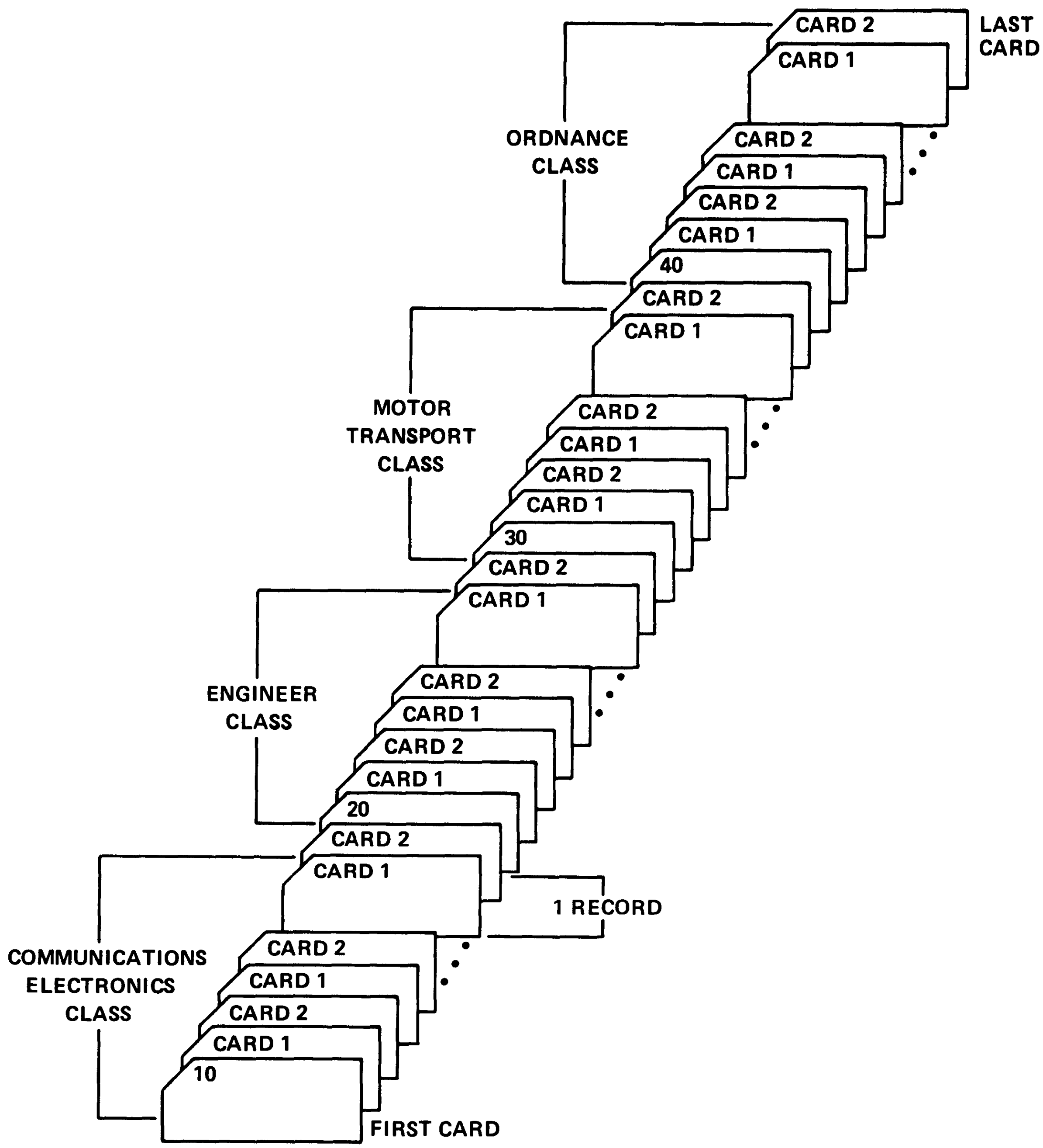

Figure 7. Arrangement of Maintenance Equipment File

TABLE 3 – DESCRIPTION OF THE VARIABLES IN THE MAINTENANCE EQUIPMENT FILE

Variable Name	Card Column	Format	Description
First Card of Record:			
ICLASS	1	I1	Indicates class to which maintenance equipment belongs ICLASS=1 Communication/Electronics ICLASS=2 Engineer ICLASS=3 Motor Transport ICLASS=4 Ordnance
IFLAG	2	I1	Indicates either that the maintenance equipment is a function of the total number of items in the Landing Force (IFLAG=1), or that the maintenance equipment is a function of the total number of maintenance personnel and their military occupational specialty MOS (IFLAG=2)
TTAMNO(i)	3–7	A5	TAM number of the ith type of maintenance equipment
*	8	I1	Number of separate items associated with the maintenance equipment indicated; i.e., the component parts of a shop set
CONT	9	A1	Indicates that the maintenance equipment is part of a shop set; i.e., a combination of two or more items
*	10–15	A6	ID number, taken from TAM, USMC
*	16–26	I11	Federal Stock Number
*	27–32	F6.2	Area in square feet occupied by maintenance equipment (square)
*	33–39	F7.2	Volume in cubic feet occupied by maintenance equipment (cube)
*	40–45	I6	Weight in pounds of maintenance equipment
*	55–57	I3	Length in feet of maintenance equipment
*	58–60	I3	Width in feet of maintenance equipment
*	61–63	I3	Height in feet of maintenance equipment
N2E	64	I1	Total number of this maintenance equipment required for a 2nd-echelon level repair
N3E	66	I1	Total number of this maintenance equipment required for a 3rd-echelon level repair
N4E	68	I1	Total number of this maintenance equipment required for a 4th-echelon level repair
MODE	70	I1	Category to which maintenance equipment belongs (only valid for the Motor Transport class) MODE=1 Gas Powered MODE=2 Diesel Powered MODE=3 Trailers

TABLE 3 – DESCRIPTION OF THE VARIABLES IN THE MAINTENANCE EQUIPMENT FILE (continued)

Variable Name	Card Column	Format	Description
First Card of Record (continued):			
NVS2E	71–72	I2	Total number of items in the Landing Force of category MODE which can be supported by this maintenance equipment
ISC	73–76	I4	Integer portion of the TAM number of the item repaired by this maintenance equipment
*	77–80	I3	Military Occupational Specialty
Second Card of Record:			
ICLASS	1	I1	(Same as on First Card)
IFLAG	2	I1	(Same as on First Card)
TTAMNO(i)	3–7	A5	(Same as on First Card)
*	8	I1	(Same as on First Card)
CONT	9	A1	(Same as on First Card)
*	10–15	A15	(Same as on First Card)
NOMEN(i,1)	16–25	A10	Descriptive name of the maintenance equipment
NOMEN(i,2)	26–35	A10	Descriptive name of the maintenance equipment
NOMEN(i,3)	36–45	A10	Descriptive name of the maintenance equipment
NOMEN(i,4)	46–55	A10	Descriptive name of the maintenance equipment
NOMEN(i,5)	56–65	A10	Descriptive name of the maintenance equipment
NOMEN(i,6)	66–74	A9	Descriptive name of the maintenance equipment

*Column not used at present

APPENDIX D
FILE FOR ITEM CHARACTERISTICS

The characteristics of items in a Landing Force used in a 10-day or 90-day mission are listed on the permanent file identified as follows:

Logical File Name = LMAUEI
File Label = CACY
Tape Density = HY (800 BPI 7 TRACK)
Visual Reel Number = CJ0236

The characteristics of each item are stored on the file as a "record." Each record consists of 160 characters (two card images). The records are grouped according to the mission length to which the item belongs. Within each group, the records are ordered alphanumerically according to the TAM number of the item (as stated on the first card of the record). To set off the records of the items used in the 10-day mission from those in the 90-day mission, identifying header cards (160 characters each with alphanumeric characters in the first 6 card columns) are used as indicated here:

10 DAY   Items used in a 10-day mission
90 DAY   Items used in a 90-day mission

Figure 8 indicates the arrangement of this file.

The contents of this file are transferred to a scratch file (TAPE 2) by commands from the control cards. Any reference in this report and in the program listing to TAPE 2 indicates a requirement for the File For Item Characteristics.

Table 4 describes the variables on a record for the ith item in the landing force and gives the required format and card column where the information is entered.

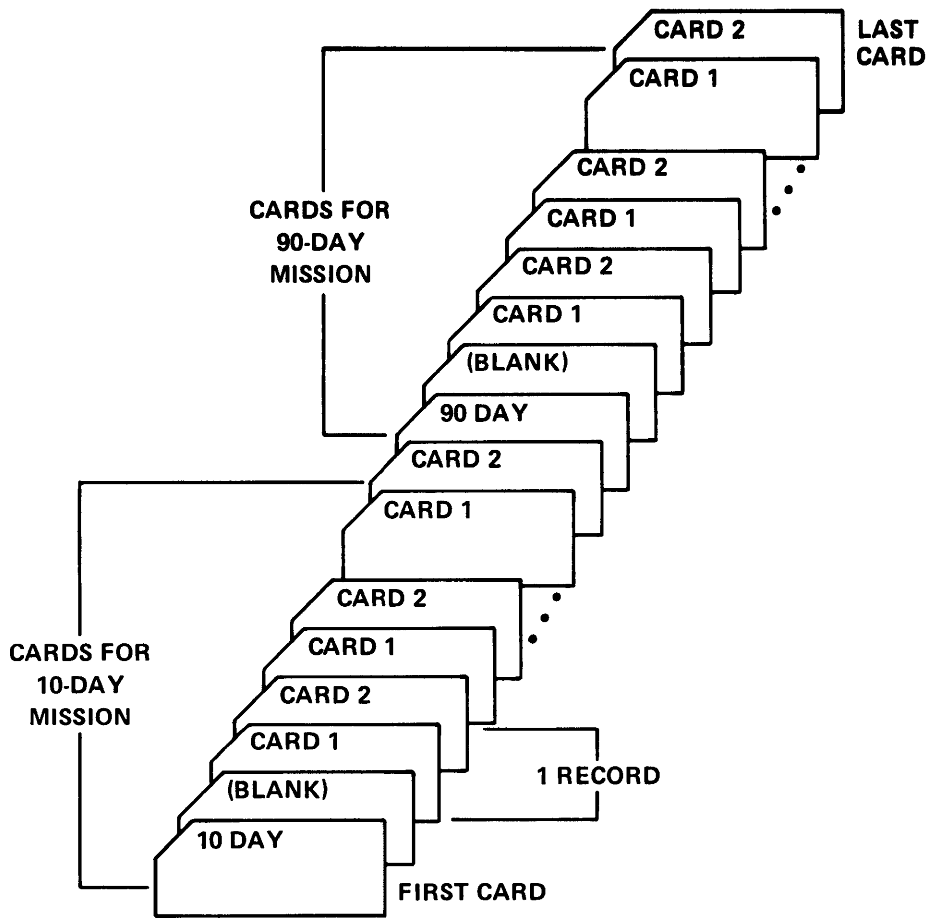

Figure 8. Arrangement of File for Item Characteristics

TABLE 4 – DESCRIPTION OF THE VARIABLES IN THE FILE FOR ITEM CHARACTERISTICS

Variable Name	Card Column	Format	Description
First Card of Record:			
TAMN	1–5	A5	TAM number of the ith item in the landing force
SQ(i)	6–11	F6.2	Square of item
CUBE(i)	12–18	F7.2	Cube of item
MTBF(i)	19–24	F6.0	Mean time between failure of item
UF(i)	25–27	F3.0	Utilization Factor of item
ISUP(i)	28–30	I3	Standard of Unit packaging of item
EMB(i)	31–32	A2	Embark information for item
Second Card of Record:			
NOMEN(i,1)	1–10	A10	Nomenclature of item
NOMEN(i,2)	11–20	A10	Nomenclature of item
NOMEN(i,3)	21–30	A10	Nomenclature of item
NOMEN(i,4)	31–40	A10	Nomenclature of item
NOMEN(i,5)	41–50	A10	Nomenclature of item
NOMEN(i,6)	51–60	A10	Nomenclature of item
NOMEN(i,7)	61–65	A5	Nomenclature of item

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2. Hubai, P., Humfeld, G.R., and Fuller, S., "Computer Simulation Model for Seaborne Mobile Logistic System (SMLS) at the Amphibious Task Unit/Marine Amphibious Unit (ATU/MAU) Level, Part 1 Model Description," NSRDC Report 4114, In publication.

3. Marine Corps Order No. 3120.3A, Hr. A03H14-CC, 18 August 1970.

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13 ABSTRACT

The Maintenance Optimization Model is a computer simulation program designed to help determine optimal maintenance configurations and resource requirements for the maintenance subsystem of the Seaborne Mobile Logistic System (SMLS).

In the model, failure/repair cycles for each end item in the Landing Force are simulated over the period of a specified mission, using event generations, queuing, and Monte Carlo techniques. Measures of effectiveness such as utilization statistics for the maintenance system configuration and availability of the end item in the Landing Force are computed. In addition, the effect of the maintenance configuration on the availability of end items in the Landing Force and on requirements for resources such as operational readiness floats (ORF), maintenance personnel, and tool sets, kits, and special equipment can be examined.

This report contains a description of the computer program for the Maintenance Optimization Model, a user's guide for the program, a listing of the program, and sample output.

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