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GENERALIZED ELECTRONICS MAINTENANCE
MODEL (GEMM)

Robert Dale White, et al

Army Electronics Command
Fort Monmouth, New Jersey

November 1971

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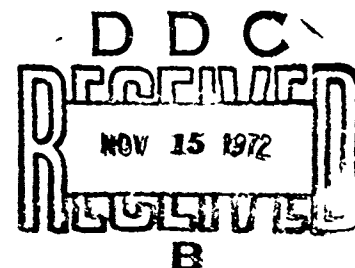


GENERALIZED ELECTRONICS MAINTENANCE MODEL (GEMM)

R. Dale White
David A. Tyburski

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13. ABSTRACT The rapid advances in technology and the ever-changing mission requirements of today's Army create a multitude of problems in the logistics support area. With support costs over the life cycle averaging from 10-100 times greater than procurement costs for electronic equipments, it becomes obvious that the area of logistics support requires a great deal of detailed scrutiny and analysis. What is not so obvious is that this analysis cannot be restricted to logistics support per se. The effect that design parameters have on logistics support must be determined. This interaction between design and logistics support permits trade-off analysis for the express purpose of optimizing the logistics profile with respect to effectiveness constraints. In order to accomplish trade-off analyses in a timely manner, it is necessary to employ the technique of mathematical support modeling. A support model is a mathematical representation of an actual support system that permits detailed support requirements analysis and design trade-offs. The Generalized Electronics Maintenance Model (GEMM) is such a model, designed in-house by ECOM personnel for the study of ECOM equipments. GEMM is a management tool designed to assist the manager in the decision-making process during the development of prime equipment and its supporting logistics system. Implementation of GEMM will provide management with the capability to study the interaction of the many elements of equipment design and logistics support and the effect that each element has on life cycle support costs and operational availability. The effect that changes in spare policies, manpower, test equipment and transportation will have on the life cycle support costs and operational availability can be shown over a wide range of values.			

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this document may be better
studied on microfiche

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FORT MONMOUTH, NEW JERSEY

ABSTRACT

The rapid advances in technology and the everchanging mission requirements of today's Army create a multitude of problems in the logistics support area. With support costs over the life cycle averaging from 10-100 times greater than procurement costs for electronic equipments, it becomes obvious that the area of logistics support requires a great deal of detailed scrutiny and analysis. What is not so obvious is that this analysis cannot be restricted to logistics support per se.

The effect that design parameters have on logistics support must be determined. This interaction between design and logistics support permits trade-off analysis for the express purpose of optimizing the logistics profile with respect to effectiveness constraints.

In order to accomplish trade-off analyses in a timely manner, it is necessary to employ the technique of mathematical support modeling. A support model is a mathematical representation of an actual support system that permits detailed support requirements analysis and design trade-offs. The Generalized Electronics Maintenance Model (GEMM) is such a model, designed in-house by ECOM personnel for the study of ECOM equipments.

GEMM is a management tool designed to assist the manager in the decision-making process during the development of prime equipment and its supporting logistics system. Implementation of GEMM will provide management with the capability to study the interaction of the many elements of equipment design and logistics support and the effect that each element has on life cycle support costs and operational availability. The effect that changes in spare policies, manpower, test equipment and transportation will have on the life cycle support costs and operational availability can be shown over a wide-range of values. Likewise, the effect of design changes in reliability and maintainability can be assessed and reliability versus maintainability trade-offs can be performed.

Utilization of support models, such as GEMM during the early stages of an equipment design and continuing throughout its life cycle, is the only method by which accurate and timely decisions can be rendered concerning the support of modern Army equipments.

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CHAPTER I

INTRODUCTION

This document is the final report on the Generalized Electronics Maintenance Model (GEMM). GEMM is an integrated design and logistics support model written in FORTRAN IV computer language. This report contains information of the purpose of GEMM, the model inputs and outputs, logic flow, derivation of equations, sensitivity analysis, and two sample problems utilizing GEMM. In addition, the appendices contains the computer flow chart, a program listing, a description of input data requirements, and an identification list of variable names.

BACKGROUND

A study program for this model was developed by the Systems Analysis Division of the Systems/Cost Analysis Office and first presented to the ECOM Special Studies and Review Board in November of 1969. This proposal was approved in December and the importance of the project was recognized and emphasized by the Deputy Commanding General, ECOM. In March of 1970, a meeting was held between Systems Analysis Division and Maintenance Engineering Directorate to discuss support modeling relative to Integrated Logistics Support. This meeting resulted in a joint venture to develop GEMM with both activities supplying the necessary resources. The GEMM development was initiated in April of 1970 and two man-years of effort has been required for this development.

SUPPORT MODELING

The GEMM model belongs to that class of mathematical models normally referred to as a "Support" model. A "Support" model is a representation of an actual support system. This representation may be accomplished in a number of ways but the most common means is by simulation or mathematical equations or a combination of both. Some support models can be exercised by hand but in most cases support models are computerized.

The definition of simulation is "to have the external characteristics of or to look or act like." This is analogous to building a scale model of an airplane to test its air flow characteristics. Applied to simulation support modeling, this means that a computer model is built that has the characteristics of and acts like an actual support system.

The type of model utilizing mathematical equations is called an analytical model. This type of model utilizes mathematical equations to calculate the elements of the actual support system in question. Mathematical relationships are derived that enable the determination of spare requirements, maintenance manpower requirements, and other support elements.

By utilizing a computer model of an actual support system, it is possible to obtain much information about a system at a substantial savings compared to study of the actual physical system.

The steps that are taken during the development of a support model are extremely beneficial. The first step that must be undertaken in the development of a support model is the determination of all the key elements of support. This is a big job in itself and one which imparts a great deal of useful knowledge to the model developer. An abundance of insight into various phases of support is a side product of this activity.

An in-depth evaluation of maintenance and logistic flow must be completed before a simulation or an analytical support model can be developed. Once again, the desirable side effect of this task is a better understanding of the maintenance and logistics system and its problem areas.

The determination of the possible support policies for various equipments requires a great deal of investigation into equipment repair and maintenance procedures and a thorough understanding of transportation problems, stockage procedures, repair shop operation and other phases of maintenance support. The support model must be developed in such a manner that it can be readily applied to a wide-range of support problems. The detailed investigation of maintenance and logistics discussed above enables the development of a support model with the necessary ingredients of versatility and applicability.

GEMM APPROACH

For the GEMM program the decision was made to develop an analytical support model rather than a simulation model. This decision was based on several factors. A support model was needed that could be exercised several times during the life cycle of an equipment with rapid turn around so that timely decisions could be reached through application of the model. Also a great deal of sensitivity analysis will be required to facilitate the evaluation of alternate design and logistics plans from the standpoint of life cycle support costs and operational availability. The amount of analysis that would be required is substantial. This type of analysis takes time and costs money. The computer time required and the huge amounts of input data required for simulation makes the simulation approach prohibitive. The type and quantities of data required for large simulation simply is not available and the validity of this type of data is highly questionable.

To be realistic, GEMM is capable of evaluating thirty-five different possibilities of maintenance allocation. These maintenance allocations cover the realm of possibilities which could actually occur within the Army structure.

For the most part, GEMM utilizes mean value for input data. This type of data is available or may generally be obtained within the Army structure. GEMM does, however, consider confidence limits for stockage based on the Poisson Distribution, via TM 38-715-1.

Again, to be realistic, GEMM is compatible with the force structure approach. GEMM can consider almost any type of force structure from a battalion deployment to a field Army. Force structure data such as number of equipment in the force structure, the number of organizational, direct, general and depot support shops, distances between shops, etc., are required by GEMM. Decisions made by the model are based on life cycle support costs. Additionally, the operational availability of the end item will be calculated for the optimum policy. Operational availability is the availability of the end item to the user in the field taking into consideration both the design and logistics system.

This computerized model is not a compilation of sophisticated mathematical manipulations. It makes use of standard Army methods of determining logistics support requirements. The attribute of GEMM is not its utilization of complex computer-oriented operations research techniques but the speed with which it performs previously manual calculations and the integration of design and logistics variables to provide a total-picture approach to design and logistics decision-making.

GEMM APPLICATIONS

GEMM is a management tool designed to assist the manager in the decision-making process during the development of prime equipment and its supporting logistics system. Implementation of GEMM will provide management with the capability to study the interaction of the many elements of logistics support and the effect that each element has on the support system life cycle costs.

The effect that changes in spares policy, manpower, test equipment, etc., will have on the support system life cycle cost and the equipment operational availability can be shown over a wide range of values. Likewise, the effect of design changes in reliability and maintainability can be assessed and Reliability versus Maintainability Trade-Offs can be performed. These investigations can be accomplished using estimated and predicted values to assist in the decision-making in the early design stages before equipment design and logistics policy have been firmly definitized.

The speed with which GEMM can be exercised on the computer permits sensitivity analysis yielding instantaneous evaluation of alternative solutions, thereby creating a direct man-machine interface. Many iterations of the input data such as different MTBF's, MTTR's, stockage confidence levels, and many other input variables. This sensitivity analysis will permit detailed analysis of the effect of design and logistic parameters on

life cycle support costs and operational availability. Sensitivity analysis can be used to pin-point system parameters that will have a significant impact on life cycle support costs and operational availability in order to "zero-in" on these critical factors.

Furthermore, the model can be exercised with updated information as performance data becomes available to verify earlier decisions. The maintenance philosophy of fielded equipment can be analyzed to determine if certain changes might yield a more cost effective support system. The advantages of the model are varied and as experience is gained in its use, applications in areas other than those discussed herein will no doubt be discovered.

CHAPTER II

MAINTENANCE OPERATIONS

There are four categories or echelons of maintenance in an Army theater of operations. These categories are: Organizational Support (O), Direct Support (DS), General Support (GS) and Depot Support (D). Figure 1 briefly describes the type of work normally accomplished at each echelon, the location where the work is done, the person or group doing the work, the equipment that is maintained, and the basis of the repair action. This figure describes maintenance operations as they are normally performed within the Army. There are certain equipments that do not lend themselves to this type of organization of maintenance. And other equipment, while lending themselves to this type maintenance structure, might be repaired more efficiently with a resulting lower cost if allowed to follow some other maintenance policy.

The GEMM model is not constrained to the general maintenance organization shown in this figure. It has the flexibility to investigate various structures. To accomplish this variation of structure, it was necessary to identify several maintenance actions without restricting the echelon at which they could occur (except in one instance).

These maintenance actions are: Check-Out Equipment (COE), Fault Isolate to Component (FIC), Fault Isolate to Module (FIM), Fault Isolate to Part (FIP), Throwaway Module (TAM), Throwaway Component (TAC), and Throwaway Equipment (TAE). COE is the only restricted action and it must be accomplished at organizational support. COE is the action required to determine that the equipment has failed. FIC is the maintenance action that is required to fault isolate the failed equipment down to the component level, i.e., to locate the failed component and it can occur at any one of the four echelons.

Correspondingly, FIM is the action required to locate the failed module and FIP is the action required to locate the failed part. It is assumed that the actions must be performed in sequence, i.e., before FIP can be performed it is necessary to perform COE, FIC and FIM respectively. Figure 2 denotes the equipment breakdown and the order of performance of these maintenance actions.

To make GEMM general purpose it was necessary to consider a wide range of maintenance philosophies. These philosophies are made up of the functions described above and the different philosophies exhibit differences due to the echelon at which the maintenance functions take place. After extensive analysis, it was determined that thirty-five maintenance philosophies defined the universe of possibilities for Army electronic equipment. Other possibilities were removed from consideration as being infeasible.

Category	Organizational Maintenance		Direct Support Maintenance	General Support Maintenance	Depot Maintenance
Former Echelon	First	Second	Third	Fourth	Fifth
Done Where	Wherever the Equipment is	In Unit	In Mobile and/or Semi-Fixed Shops		In Base Depot Shop
Done by Whom	Operator	Using Unit	Division/Corps/Army		Theater Communication Zone and/or Z/I (USA)
On Whose Equipment	Own Equipment		Other People's Equipment		
Basis	Repair and Keep it		Repair and Return to User		Repair for Stock
Type of Work Done	Inspection Servicing Adjustment Minor Repairs and Modification	Inspection Complicated Adjustment Major Repairs and Modification Major Replacement Overload from Lower Echelons		Inspection Most Complicated Adjustments Repairs and Replacement Including Complete Overhaul and Rebuild Overload from Lower Echelons	

FIGURE 1 CATEGORIES OF MAINTENANCE IN A THEATER OF OPERATIONS

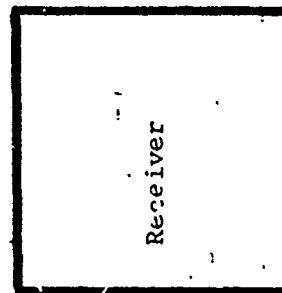
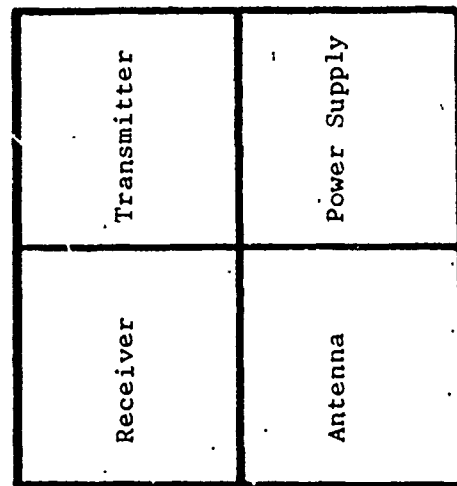
Equipment (i.e., end item)

Component

Module

Part

AN/XYZ-99



COE
(Check Out Equipment)
Maintenance action that verifies failed equipment.

FIC
(Fault Isolation to Component)
Maintenance action that locates failed component.

FIM
(Fault Isolate to Module)
Maintenance action that locates failed module.

FIP
(Fault Isolate to Part)
Maintenance action that locates failed part.

Figure 2. Equipment and Repair Terminology

These thirty-five possibilities will cover any situation of equipment type, operational environment, maintenance structure, etc.. Figure 3 is a list of these possibilities. Similarly, Figure 4 is a graphical tree representation of these same thirty-five possibilities.

It is important to understand that for one and the same equipment, it may be possible, and desirable, that several of these philosophies describe the maintenance actions required to maintain the equipment in an optimal manner. For example, a particular radar equipment might exhibit one throw-away component, while another component might require FIM at the DS level and still another might require FIM at GS. Likewise, some modules might be thrown-away rather than repaired while others might be repaired at different maintenance echelons. This is a real situation and one that places a definite requirement on the evaluation capability of GEMM. Other models were investigated and found to be excellent in many respects. However, too many models could not consider the repair of modules at different echelons nor could they evaluate component repair at different levels. This is a "must" as far as realism and versatility is concerned in a support model.

POLICY	COE	FIC	FIM	FIP	TAE	TAC	TAM
1	0	0	0	0			
2	0	0	0	DS			
3	0	0	0	GS			
4	0	0	0	D			
5	0	0	0				0
6	0	0	DS	DS			
7	0	0	DS	GS			
8	0	0	DS	D			
9	0	0	DS				DS
10	0	0	GS	GS			
11	0	0	GS	D			
12	0	0	GS				GS
13	0	0	D	D			
14	0	0	D				D
15	0	0				0	
16	0	DS	DS	DS			
17	0	DS	DS	GS			
18	0	DS	DS	D			
19	0	DS	DS				DS
20	0	DS	GS	GS			
21	0	DS	GS	D			
22	0	DS	GS				GS
23	0	DS	D	D			
24	0	DS	D				D
25	0	DS				DS	

Figure 3. Maintenance Policies (Sheet 1 of 2 sheets)

<u>POLICY</u>	<u>COE</u>	<u>FIC</u>	<u>FIM</u>	<u>FIP</u>	<u>TAE</u>	<u>TAC</u>	<u>TAM</u>
26	0	GS	GS	GS			
27	0	GS	GS	D			
28	0	GS	GS				GS
29	0	GS	D	D			
30	0	GS	D				D
31	0	GS				GS	
32	0	D	D	D			
33	0	D	D				D
34	0	D				D	
35	0				0		

Figure 3. Maintenance Policies (Sheet 2 of 2 sheets)

CHAPTER III

CALCULATION PROCESS LOGIC

This chapter attempts to familiarize the reader with the manner in which calculations are performed by the model. In order to accomplish this a figure is included that illustrates the various maintenance policies that are capable of evaluation by GEMM (Figure 4). Figure 4 exhibits four maintenance actions: COE (checkout of equipment), FIC (fault isolate to component), FIM (fault isolate to module) and FIP (fault isolate to part). All Checkout of Equipment (COE), is assumed to be performed at the organizational repair level (O). The other three repair actions can be performed at any one of four levels: Organizational (O), Direct Support (DS), General Support (GS), and the Depot (D). Also included in the figure are the throwaway maintenance functions: Throwaway Equipment (TAE), Throwaway Component (TAC), and Throwaway Module (TAM).

In addition to this figure a logic flow diagram of the calculation process is presented in Figure 5. The flow chart is essentially self-explanatory, therefore, detailed discussion of the flow chart will not be presented herein. However, a summary of the calculation process will be presented below to provide a general understanding of the calculation logic prior to study of the flow diagram.

The Principle of Optimality states "An optimal policy has the property that whatever the initial decision, the remaining decisions must constitute an optimal policy with respect to the results of the first decision." This is to say that in a problem constituted of a number of discrete parts, an optimum answer for the totality can be built up if an optimum answer is obtained for each separate part. Applying this principle to Figure 4 forms the basis for GEMM's calculation process. A determination is made of the optimum repair level for each module under a particular FIM. This constitutes the first decision and it is an optimal decision.

The optimal FIM level is then determined for all components under a particular FIC using the information calculated previously for the optimal repair of the module. This procedure is repeated under each FIC. Finally the optimal location for the FIC function is determined utilizing all of the information that has now been determined (information on the optimal FIM level for components and the optimal FIP levels for the modules). The requirements for performing COE are then determined and combined with all previous results. An optimal maintenance philosophy has now been determined. This optimal philosophy will specify the level at which all modules and components should be repaired or thrown away.

MAINTENANCE PHI

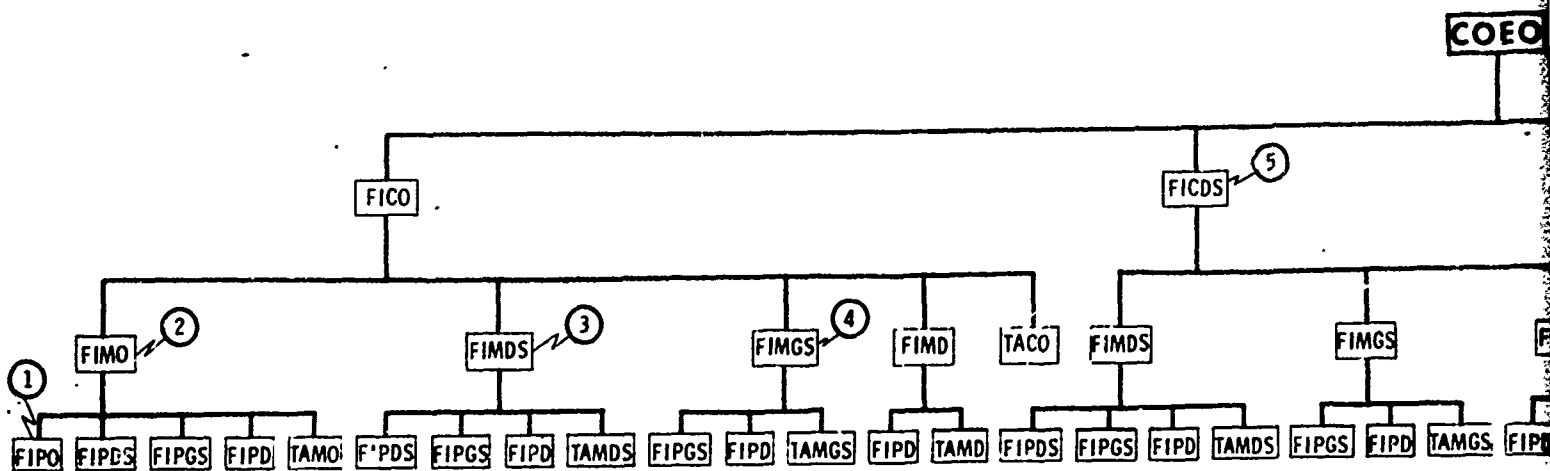


FIGURE 4

MAINTENANCE PHILOSOPHY TREE

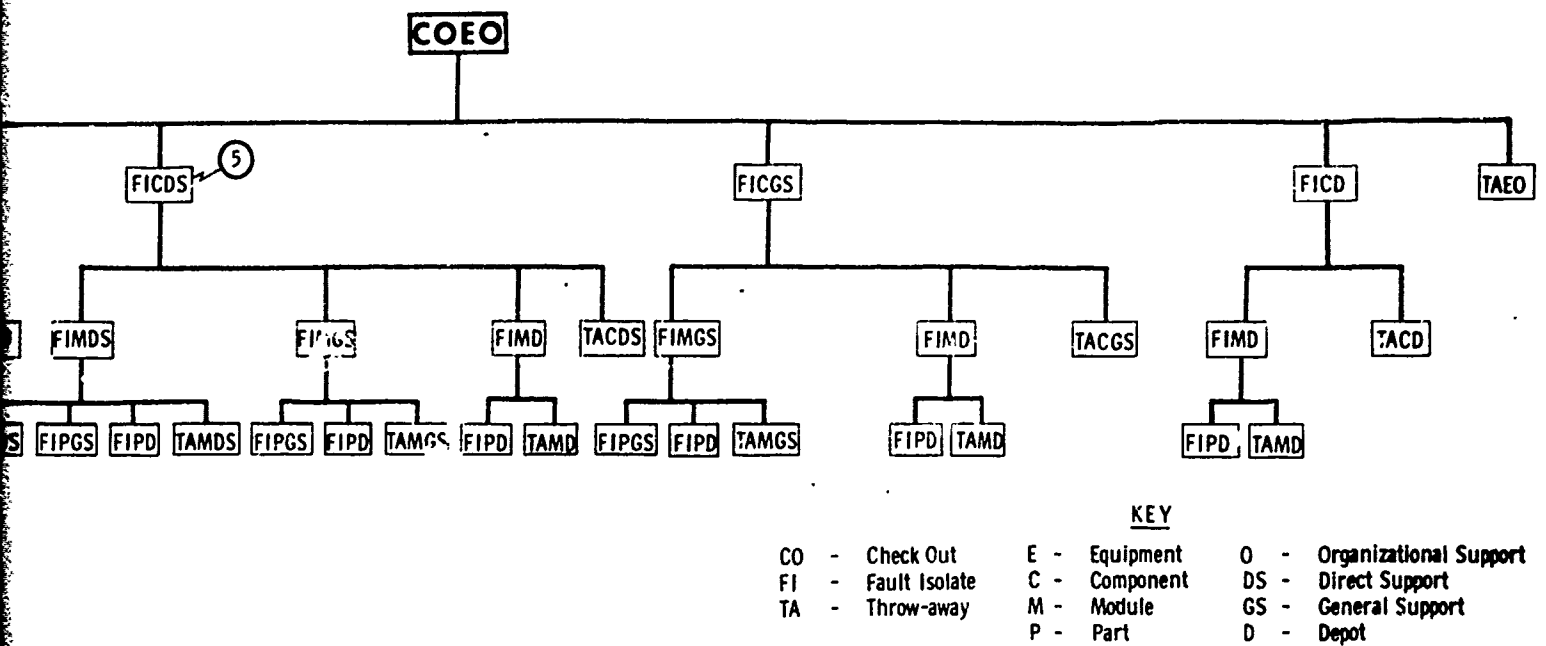


FIGURE 4

12

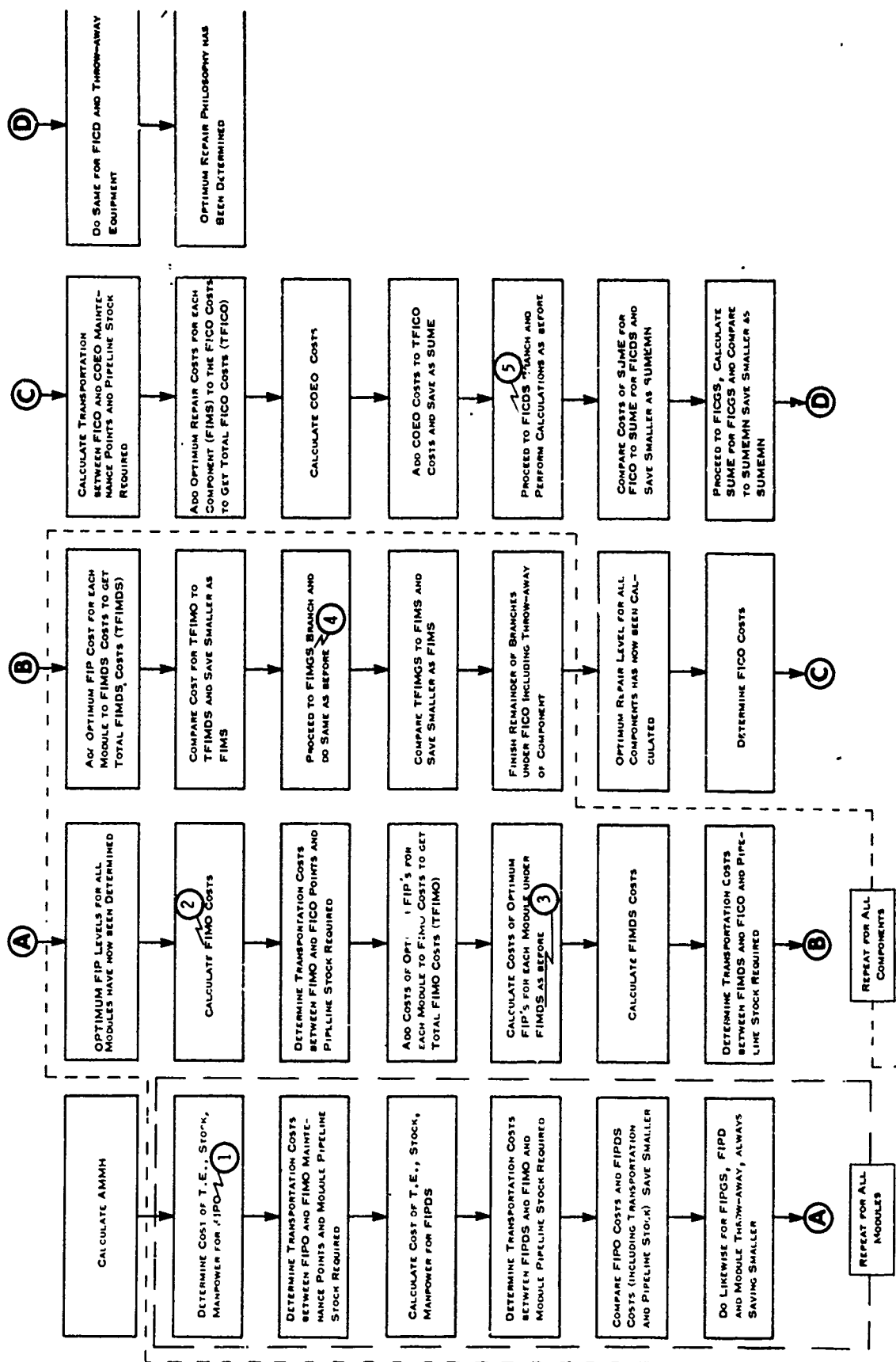


FIGURE 5 GEMM CALCULATION FLOW LOGIC

In addition, test equipment, manpower and stockage requirements will be determined for the optimal maintenance philosophy for the equipment under study. These are three general categories of information calculated by GEMM. However, more detailed breakdowns of cost information such as training, inventory management, etc., is also an output of GEMM and will be discussed in the output chapter of this report. To follow the flow logic, Figure 5, it is necessary to refer back to Figure 4. The flow logic refers to Figure 4 from left to right and from bottom to top and also makes reference to specific functions by the use of numbered "flag identifiers".

CHAPTER IV

INPUT & OUTPUT

This chapter discusses the input requirements of GEMM and the output that will be obtained from a computer run. The discussion in this chapter concerning inputs and outputs is general in nature. A more detailed list of input data requirements can be found in Appendix A.

Input

The GEMM model utilizes mean values for inputs in order to reduce the magnitude of the data collection effort. Also, to further minimize data gathering, the number of data inputs is held to the absolute minimum commensurate with the level of detail provided by the GEMM program. Figure 6 indicates the general data requirements for GEMM.

Reliability and Maintainability information is required for the end item and for each component, module and part class within the end item. In order to avoid data collection for individual pieceparts it is necessary to structure the pieceparts into what will be called part classes.

A part class is a means of structuring pieceparts according to some applicable characteristic such as failure rate, cost, weight, etc.. The selection of the particular pieceparts that should make up the parts classes should be done by a research and development engineer. For example, all passive elements might be assigned to a particular part class, say Class 1. There might be twenty-five different pieceparts within this parts class. Each piecepart might be assigned a failure rate and a cost equal to the average of the twenty-five elements of the class. Thus, whenever a piecepart of Class 1 is encountered, the failure rate and cost of Class 1 is used rather than that of the individual piecepart. This will reduce the quantity of input variables required for GEMM. If care and consideration is taken in the structuring of the parts into parts classes, it is felt that the errors introduced will not be significant and the benefits derived, i.e., the substantial reduction in this averaging method does not give sufficient detail for a particular problem then each piecepart can be considered as being a part class itself. If only part failure rates can be determined, then one of the subroutines of GEMM will apportion the reliability parameters to the modules, components and the end item.

The mission profile for the equipment under consideration must be entered into the model. The mission profile includes such information as: hours of operation per day of the equipment, number of days per year of operation, and restrictions on maintenance shops such as number of shifts, hours per shift, etc..

Research and development costs are read into the model as a total cost and may be used to reflect higher research and development costs incurred when higher mean-time-between-failure figures are desired.

- * RELIABILITY AND MAINTAINABILITY INFORMATION
- * RESEARCH AND DEVELOPMENT COSTS
- * MISSION PROFILE
- * FORCE STRUCTURE
- * TEST EQUIPMENT
- * PERSONNEL
- * ATTRITION FACTORS
- * TRANSPORTATION
- * PUBLICATIONS
- * STOCKAGE INFORMATION
- * ECONOMIC LIFE

Figure 6. Inputs

Force structure information is required such as the number of organizational shops supported by one direct support shop, the number of direct support shops per general support shop, etc. Also distances between shops, and number of equipments supported per shop are other examples of force structure data requirements.

Test equipment and maintenance personnel requirements are needed as input to the model. Test equipment information is input by type and cost and maintenance personnel are described by MOS type and pay allowance per year.

Attrition factors are input to the model to reflect geographical location and peace time or war time conditions. Transportation information includes distances between shops, as mentioned previously, the cost per pound per mile for transportation, and the weights of the modules, components and the end item.

Stockage information includes the array of confidence levels to be investigated, the turnaround times, order-ship times and the length of the replenishment periods.

Also included is the cost of the spares. And, a final input is the economic life to be considered for the equipment under study.

These inputs have been discussed in general categories. Appendix A gives a more detailed listing of input data requirements.

Outputs

One of the most important outputs of GEMM is the operational availability for the equipment being analyzed. This is calculated for the maintenance policy that is determined to be the optimum policy. However, it may be calculated for any of the thirty-five policies.

The Life Cycle Support Costs form an important category of output information. The support costs are divided into the following factors:

- | | |
|--------------------------------|----------------------------------|
| (a) Test Equipment Cost | (g) Publications Cost |
| (b) Spares & Repair Parts Cost | (h) Research & Development Costs |
| (c) Personnel Costs | (i) Production Cost |
| (d) Transportation Cost | |
| (e) Training Costs | |
| (f) Inventory Management Costs | |

The maintenance allocation for repair of all modules, components, and the end item is an output of GEMM. Any module or component that should receive throwaway maintenance is indicated along with the level at which throwaway should take place.

The requirements for stock, test equipment and maintenance personnel is presented in the output. The stockage requirements are shown as the quantity required for each level of maintenance. The test equipment requirements at each level are presented by type of test equipment and quantity required. The MOS designation for the maintenance personnel and the quantity that is required at each level of maintenance is indicated. The outputs for test equipment and personnel are presented on a per shop basis. In addition, the total force structure requirements are also computed.

GEMM also makes use of graphical outputs. Graphs are plotted by the computer to show the inter-relationships of key variables. The relationships that are plotted are listed below:

- (a) Availability versus Sensitivity Run (SR)
- (b) Support Costs versus Sensitivity Run (SR)
- (c) Cost Effectiveness versus Sensitivity Run (SR)

Each sensitivity run may represent the change of one variable or a combination of several variables. Since some variables are not independent, a change in one variable may demand a change in some other variable. For example, if it is desired to determine the effect of a change in the equipment MTBF, this change must be reflected in the component and module MTBFs, the MTTRs, and also in the costs of the equipment.

CHAPTER V

DERIVATION OF KEY EQUATIONS

The following discussion concerns the derivation of key relationships that are utilized internally within the calculation portion of GEMM. The key equations will be presented in the following order: Annual Maintenance Manhour, Test Equipment Requirements, Manpower Requirements, Transportation and Stockage Requirements, Availability, Inventory Management and Training.

Annual Maintenance Manhour Calculations

The Annual Maintenance Manhour computer subroutine is exercised for each module and component and for the equipment to determine the Annual Maintenance Manhour (AMMH) requirements for maintenance. The AMMH is defined as the number of failures per year multiplied by the mean time to repair (MTTR) per failure or,

$$\text{AMMH} = (\text{Number of Failures/year}) (\text{MTTR/Failure}).$$

In more detail this equation becomes,

$$\text{AMMH} = \frac{(\text{Operating Hours/day} \times \text{Operating Days/Year}) (\text{MTTR/Failure})}{\text{Mean-Time-Between Failure (MTBF)}}$$

Test Equipment Calculations

The routine that calculates test equipment requirements makes use of the AMMH information to calculate the test equipment required for each module, component and the equipment. The test equipment required for the Unit Under Test, UUT, whether it be module, component or equipment is defined as the AMMH for the UUT divided by the number of shop hours available per year. In equation form this becomes,

$$\text{Test Equipment of Type I per shop} = \frac{(\text{AMMH of UUT}) \times N}{\text{Shop Hrs Available/year}},$$

where N = total number of UUT's per shop.

In more detail,

$$\text{TE (I) per shop} = \frac{(\text{AMMH of UUT}) (\text{UUT's/Shop})}{(\text{Operating Hour/Shop} \times \text{Operating Days/Year})}$$

and the total test equipment requirement for Type I in the force structure is

Total Test Equipment I = TE (I)/Shop X Number of Shops/Force Structure.

These calculations are performed for the checkout and repair of the equipment being studied and for the repair of each module and component within the equipment. The test equipment requirements are summed over all the UUT's (modules, components and the equipment) to get the total test equipment required for full equipment repair capability.

Maintenance Manpower Calculations

The equations for the calculation of maintenance manpower requirements are derived in a similar manner using the AMMH values for the UUT. In equation form,

$$\text{MOS (I)} = \frac{(\text{AMMH of UUT})}{(\text{MOS Hours Available})}$$

or

$$\text{MOS (I) per shop} = \frac{(\text{AMMH of UUT}) \cdot (\text{UUT's/Shop})}{(\text{Operating Hrs/Shop} \times \text{Operating Days/Year} \times \text{PF})}$$

where PF = Productivity Factor

The productivity factor indicates the percentage of the time the repairman is productive when he is available.

And for the total force structure this becomes,

$$\text{Total MOS (I)} = \text{MOS (I)/Shop} \times \text{Number of Shops/Force Structure.}$$

Stockage Calculations

Stockage calculations are based on the Initial Provisioning Manual, TM 38-715-1 for the Initial Provisioning Stock, and on the Consumption rate for Reorder Stock. The model calculates stockage requirements in a similar manner to the way it is now done manually.

There are two types of Initial Provisioning Stockage: Non-repairable stock and repairable stock. Non-repairable stock is stockage for items that are not repaired such as parts and "throwaway" items, i.e., throwaway modules, throwaway components and throwaway equipments. Repairable stock is stockage for items that are repaired such as repairable modules, components and/or end items.

For non-repairable stockage, three classes are calculated for initial provisioning:

- (1) Initial Issue Quantity
- (2) Order-Ship Quantity
- (3) Replacement Quantity

Initial Issue Quantity is the issue of stock that is placed in the field concurrently with the initial deployment of an equipment. Order-Ship Stockage is the stock that is necessary to fill the stockage pipelines and is based on the turnaround time. Finally, the Replacement Quantity is the non-repairable stock located at the depot that is utilized as back-up or replacement stock for the field stockage as it is used up.

For repairable stock there is no need for initial issue stockage or replacement stockage. Since the item in question is repairable, it is not lost to the system when a failure occurs. The only stockage that is required is pipeline stock which is used to replace the failed item while it is being repaired (turned around). This stockage is analogous to Order-Ship Stockage for non-repairables.

The first step in the derivation of the equation to calculate initial issue stock is to determine the number of failures within a 15 day period.

$$\begin{aligned} \text{Failures/15 days} &= \text{Operating Hours/Day} \times \text{Number of Days/Year} \\ &\quad \times 0.04 \text{ Mean-Time-Between-Failure (MTBF)} \end{aligned}$$

This mean demand per shop for the stockage objective (B) is calculated as follows:

$$\begin{aligned} \text{Mean Demand} &= \text{Failures/15 days} \times \text{Number of Uses/Equipment} \\ &\quad \times \text{Number of Equipments/Shop} \times B, \end{aligned}$$

where B = Number of 15 day periods in stockage objective which is defined as the amount of time for which a maintenance level is allowed to stock.

Thus, the stock required for a given protection level (K) at a particular support shop becomes,

$$\text{Initial Issue Stock} = \text{Mean Demand} + K (\text{Mean Demand})^{\frac{1}{2}}$$

The total stock required for the entire force structure is therefore,

$$\begin{aligned} \text{Initial Issue Stock/Force Structure} &= \text{Initial Issue/Shop} \times \text{Number of} \\ &\quad \text{Shops in Force Structure.} \end{aligned}$$

Combining these three types of stockage, the Initial Provisioning Quantity for non-repairables becomes,

$$\begin{aligned} \text{Total Initial Provisioning/Force Structure} = & \text{Initial Issue Stock/} \\ & \text{Force Structure.} \\ & + \text{Order-Ship/Stock} \\ & \text{Force Structure.} \\ & + \text{Replacement Stock/} \\ & \text{Force Structure.} \end{aligned}$$

As mentioned previously, only pipeline stockage is required for repairables as compensation for the turnaround time necessary to affect a repair on a failed item. The equation for calculating the Mean Demand for pipeline stockage per shop is

$$\text{Mean Demand} = \frac{\text{Failures/15 days} \times \text{Turnaround Time} \times \text{Number of uses/}}{\text{Equipment} \times \text{Number Equipment/Shop.}}$$

For a given protection level K, the Pipeline Stockage is

$$\begin{aligned} \text{Pipeline Stockage} = & \text{Mean Demand} + K (\text{Mean Demand})^{\frac{1}{2}} \\ \text{Per Shop} \end{aligned}$$

The total stock required for the entire force structure is

$$\text{Pipeline Stockage/Force Structure} = \frac{\text{Pipeline Stock/Shop} \times \text{Shops/}}{\text{Force Structure.}}$$

Reorder Stockage is calculated for both repairables and non-repairables, and is based on the consumption rate. For non-repairables the Reorder Stockage is equal to the number of failures expected in the force structure and the life cycle plus those failures which will be caused by attrition. Reorder Stockage for repairables is simply the number of failures caused by attrition as all other failures are corrected by repair rather than replacement action.

Availability

GEMM calculates the operational availability of the equipment under consideration at the organizational level. This operational availability is the actual availability of the equipment to the equipment user. The general formula for operational availability, Ao, is:

$$A_o = \frac{\text{Mean Time Between Equipment Failure}}{\text{Mean Time Between Equipment Failure} + \text{Mean Equipment Down Time.}}$$

Mean Time Between Equipment Failure is an input to the model while the Mean Down Time of the equipment must be calculated within the model. Mean Down Time (MDT) for the equipment can be stated as:

$$MDT = (\text{Probability of Equipment Spare on Hand}) (\text{Mean Check-out Time of Equipment}) + (1 - \text{Probability of Equipment Spare on Hand}) (\text{Mean Check-Out Time of Equipment} + \text{Turn Around Time for Equipment}).$$

This formula assumes that if an equipment spare is available, it can be obtained in time, t , where $t = 0$. The Turn Around Time for equipment is the time required to transport the equipment to a maintenance shop for whatever maintenance is required to repair it to its previous operational condition. The only unknown in this equation is the equipment Turn-Around Time (TTE). This variable can be calculated as follows:

$$TTE = \text{Transportation Time} + \text{Waiting Time for Service} + (\text{Probability of Component Spare on Hand}) (\text{Mean Time To Repair Equipment}) + (1 - \text{Probability of Component Spare on Hand}) (\text{Mean Time To Repair Equipment} + \text{Turn-Around Time for Component}).$$

Once again, the unknown variable is the Turn-Around Time, in this case, the Turn-Around Time for the Component (TTC). This variable is determined in the same manner as TTE. Therefore,

$$TTC = \text{Transportation Time} + \text{Waiting Time for Service} + (\text{Probability of Module Spare on Hand}) (\text{Mean Time To Repair Component}) + (1 - \text{Probability of Module Spare on Hand}) (\text{Mean Time To Repair Component} + \text{Turn Around Time for Module}).$$

The equation to calculate the Turn-Around Time for the Module (TIM) is

$$TIM = \text{Transportation} + \text{Waiting Time for Service} + (\text{Probability of Parts Stock on Hand}) (\text{Mean Time To Repair Module}) + (1 - \text{Probability of Parts Stock on Hand}) (\text{Mean Time To Repair Module} + \text{Requisition Time for Part}).$$

In this equation there are no unknowns as the Requisition Time for Parts is an input to the model. The complete equation for A_0 is given in Figure 7.

The transportation and waiting time depend on the levels of the respective repair actions and the repair times depend on the module, component, etc., respectively. The Turn-Around Time for parts is a function of the level of parts stockage as would be expected. The GEMM Model considers the variations internally and will yield the operational availability of the equipment to the equipment user.

$$A_0 = \frac{MTBF}{MTBF + MDT}$$

and

$$MDT = P_{es} (MCOTE) + (1 - P_{es}) \left\{ MCOTE + TRANSTE + WTSERE + P_{cs} (MTTRE) + (1 - P_{cs}) [MTTRE + TRANSTC + WTSERC + P_{ms} (MTTRC) + (1 - P_{ms}) (MTTRC + TRANSTM + WTSERM + P_{ps} (MTTRM) + (1 - P_{ps}) (MTTRM + REQP))] \right\}$$

where,

A_0 = Operational Availability of Equipment to User

$MTBF$ = Mean Time Between Equipment Failure

MDT = Mean Down Time for Equipment

P_{es} = Probability of Equipment Spare

P_{cs} = Probability of Component Spare

P_{ms} = Probability of Module Spare

P_{ps} = Probability of Part Spare

$MCOTE$ = Mean Check Out Time for Equipment

$MTTRE$ = Mean Equipment Repair Time

$MTTRC$ = Mean Component Repair Time

$MTTRM$ = Mean Module Repair Time

$TRANSTE$ = Transportation Time of Equipment during maintenance

$TRANSTC$ = Transportation of Component during maintenance

$TRANSTM$ = Transportation Time of Module during maintenance

$WTSERE$ = Waiting Time for Repair Service for Equipment

$WTSERC$ = Waiting Time for Repair Service for Component

$WTSERM$ = Waiting Time for Repair Service for Module

$REQP$ = Requisition Time for Part

FIGURE 7. Operational Availability Equation

In the case of a throwaway end item, component, or module, the turn-around time of that item would be the time consumed in obtaining a replacement for that item if one were not available at the level where maintenance was being performed.

Inventory Management Calculations

Inventory Management costs for stockage inventories are calculated by the use of an inventory factor. This inventory factor is a percentage of the total stockage costs over the life cycle being considered.

The initial provisioning quantity minus the amount consumed during the initial provisioning period is maintained throughout the life cycle and reorder stock is requisitioned for each year after the initial provisioning period as stock is consumed. An average reorder stockage is considered since the stock is not on hand for the entire period. This average is approximated by one-half of the total reorder stock since theoretically, at the beginning of each year there will be a large quantity of reorder stock on hand and at the end of the year there will be none. Thus, the reorder stock divided by two is the average reorder quantity on hand during the year. The formula yielding the inventory management cost is

$$\begin{aligned} \text{Inventory Management Cost for Life Cycle} &= (\text{Initial Provisioning Quantity} - \text{Stock Consumed During Initial Provisioning Period})/2 \\ &+ \text{Initial Provisioning Stock remaining} \times \text{the remaining Life Cycle} + \text{Reorder Stock}/2 \times \text{Cost of Stock} \times \text{Inventory Factor.} \end{aligned}$$

Maintenance Training Calculations

Training costs reflect the number of maintenance personnel required, the type of MOS and the turnover rate of maintenance types. The formula for maintenance training is:

$$\text{Training Costs} = \text{Number of MOS type} \times \text{Cost of Training per MOS type} \times \text{Life Cycle (years)}/\text{Turnover Rate}$$

Publications Cost Calculation

Publications cost are calculated for the check-out equipment, fault-isolate-to-component, fault-isolate-to-module and fault-isolate-to-part maintenance functions. In general,

$$\text{Publications Cost} = \text{Cost per page} \times \text{Number of pages required for specific maintenance action}$$

Research and Development Cost

This is the total cost of research and development and is an input into the model. It is useful for sensitivity analysis to reflect changes in research and development costs when equipment design and failure rates are changed.

Production Cost

This is simply an estimate of the total production costs including the cost of prime equipment.

Overhaul Costs

Overhaul costs are considered using a time-between-overhaul (TBO) and a cost per overhaul as input information. Overhaul costs may be considered for modules, components and the end-item. The equation for overhaul cost is:

Cost of Overhaul = Equipment Life Cycle/TBO x Cost per Overhaul.

CHAPTER VI

SENSITIVITY ANALYSIS

Purpose

Aside from the maintenance allocation optimization process contained in GEMM, the sensitivity analysis capability of GEMM is its most powerful attribute. Sensitivity analysis has two major uses. The first is to determine the effect of changes in different key variables on support life cycle costs and operational availability. Not only may the effect of one variable be measured, but the effect and interaction of several variables may be studied at one time. This is necessary because the physical variables which are simulated in a support model do not act independently. Though the change of one variable by itself may seem advantageous, it may not be. It is possible that the perturbation of one variable may cause a change in another or several other variables which is detrimental to the system considered as a whole.

Cost Effectiveness

It is for this reason that a sensitivity analysis is performed on reliability and maintainability factors to see what effect different combinations of these factors will have on system costs and effectiveness. This is a tool which allows the system designer or manager to evaluate the effect his decisions will have on costs and effectiveness before they are initiated. Therefore, errors that are made will effect paper exercises and not actual hardware.

Sensitivity of Variables

The second major use for sensitivity analysis is to test the sensitivity of different variables. Unfortunately, design predictions and field data are not one hundred percent reliable. Therefore, it is necessary to know how sensitive a variable is, or how far off an estimate of a variable can be without affecting the solution received by using an estimate of that variable. In other words the risk associated with using a certain value of a variable may be investigated by using sensitivity analysis to determine the changes to system values when a given variable is varied over a range of values. This option allows the system planner to evaluate his decisions armed with the probable outcomes of his decisions if variables do not take on the values his predictions suggest.

Support Parameters

The following support parameters can be varied over a range of values during sensitivity analysis, either separately or in combination with each other:

- (a) MTBF's
- (b) MTTR's
- (c) Cost of Equipment
- (d) Test Equipment Information
- (e) Manpower Information
- (f) Weight of Equipment
- (g) Force Structure
- (h) Transportation Information
- (i) Requisition Times
- (j) Operating Hours Per Shop
- (k) Stockage Confidence Limits
- (l) Attrition Rate
- (m) Stockage Objectives & Order-Shipping Time
- (n) Economic Life
- (o) Training Factors
- (p) Inventory Management Factor
- (q) Maintenance Policies
- (r) Research and Development Cost
- (s) Round up Option
- (t) Maintenance Publications
- (u) Overhaul Considerations

Optimization Under Constraints

The Sensitivity Analysis function of the GEMM Model provides a vehicle for optimization of system parameters under constraints. The GEMM Model itself minimizes support life cycle costs with no constraints.

Using sensitivity analysis it is possible to obtain different combinations of life cycle costs and operational availability for different values

of key system parameters. From these combinations of output it is possible to eliminate combinations of parameters which do not meet operational constraints and to choose that combination of parameters which minimizes or maximizes an objective function subject to the constraints of the problem.

Figure 8 is an example of how this type of optimization may be accomplished using GEMM as a vehicle. By using the sensitivity analysis option of GEMM on stockage confidence levels, a table such as the one in Figure 8 may be obtained. Looking at the values in the table, suppose we are constrained to have a confidence level on stockage of at least 80 percent and a constraint of 93 percent on operational availability. We would like to determine the combination of parameters that would yield the minimum support life cycle costs. In this case, it is policy 3 with life cycle costs equal 4.6 million dollars, confidence limit equal 85 percent, and availability equal to 93 percent. It is possible under another application that policy 4, 5, 6 or 7 might have been least cost and still met the constraints of the problem.

The example given is a simple one but illustrates how GEMM may be used to optimize under constraints. The number of constraints that may be applied is limited only by the amount of sensitivity analysis which is performed by the model. The number of constraints may range from 0 to a maximum of 54 different types.

The process of optimization under more than one constraint is accomplished in the same manner as one with 1 or 2 constraints, as combinations are eliminated from consideration as soon as any of the constraints are violated. If several combinations meet all constraints, then the least cost combination is chosen as optimum.

POLICY	LIFE CYCLE COST	AVAILABILITY	CONFIDENCE LIMIT
1	1.2	.75	.75
2	3.4	.83	.80
3	4.6	.93	.85
4	7.9	.95	.90
5	8.3	.96	.95
6	9.2	.99	.975
7	10.2	.999	.99

Figure 8. Optimization Under Constraints

CHAPTER VII

CONTROL AND DATA CARD ARRANGEMENTS

General

This chapter discusses the card-deck arrangement and input card formats required for operation of the GEMM Model. The deck arrangement discussed herein is for processing on the Borroughs 5500 computer using card input. A detailed step by step input procedure is included which requires no prior data processing knowledge for its use. The process control cards required specifically for the Borroughs machine are not listed but may be obtained from the Computation Agency.

GEMM Card Deck Arrangement

Figure 9 shows the overall card deck arrangement to be used when the GEMM program is run. The GEMM Program Deck is loaded and behind it is placed the Data and Program Control Deck and then the Sensitivity Analysis Deck.

Figure 10 shows the arrangement for the Data and Program Control Deck. The cards are specified by card types and the shaped cards indicate cards which may not necessarily be used depending on the specific use of the GEMM Program.

- (1) Card type 1-4 are required.
- (2) Card type 5 is a control card.
- (3) Card types 6-8 are used if the value of card type 5 is 1, otherwise they are omitted.
- (4) Card type 9-42 are required.
- (5) Card type 43 is a control card.
- (6) Card types 44-46 are used if the value of card type 43 is 1, otherwise they are omitted.
- (7) Card type 47 is used if the value of card type 43 is 0.
- (8) Card types 48-53 are required.

Figure 11 illustrates the sensitivity variable groups that may be used to perform sensitivity analysis. Any one of these groups or any combination of these groups may make up a sensitivity run. All this means is that after the initial model run, one or several variable values are changed automatically

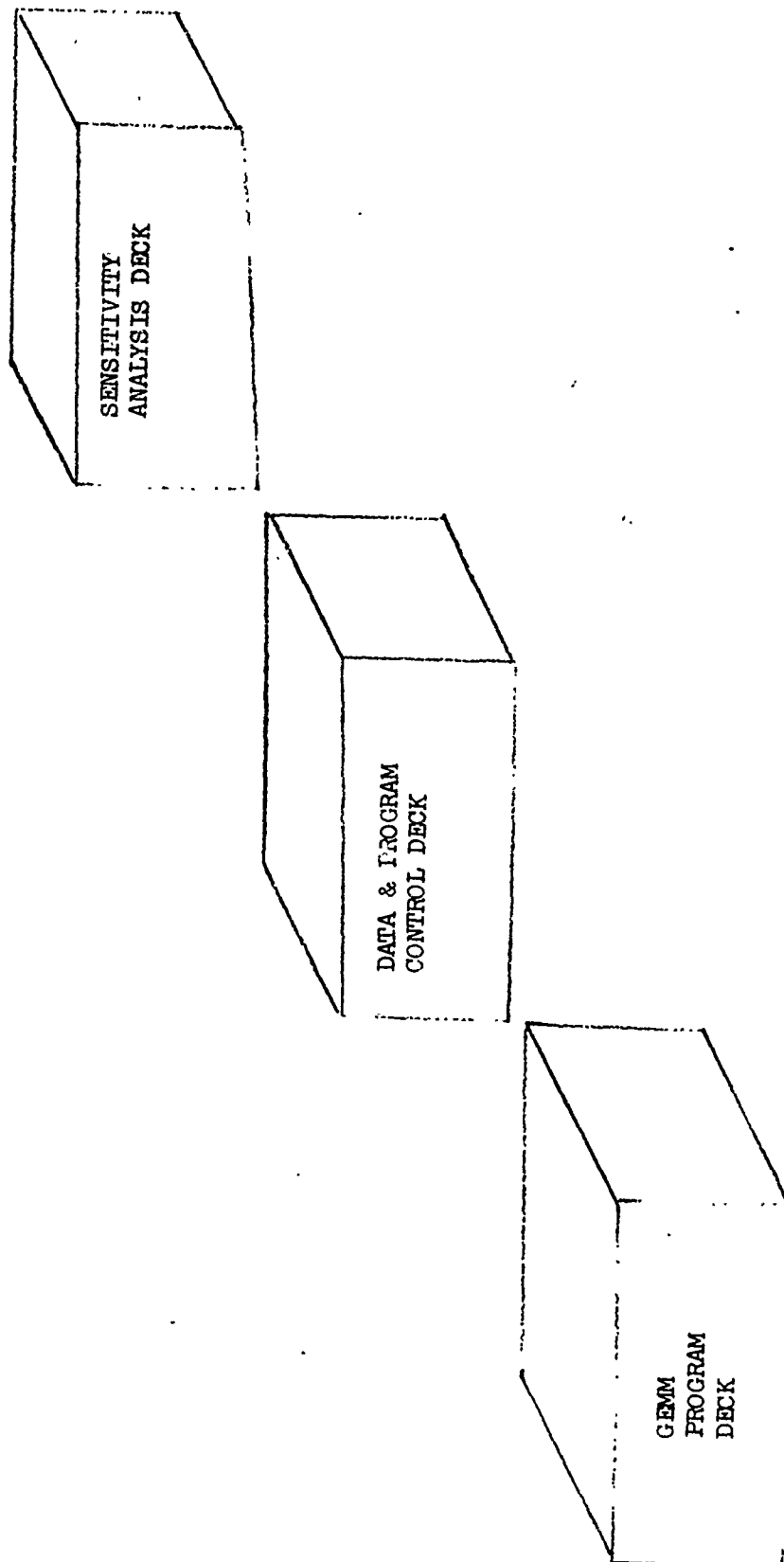


Figure 9. GEMM Card Deck Arrangement

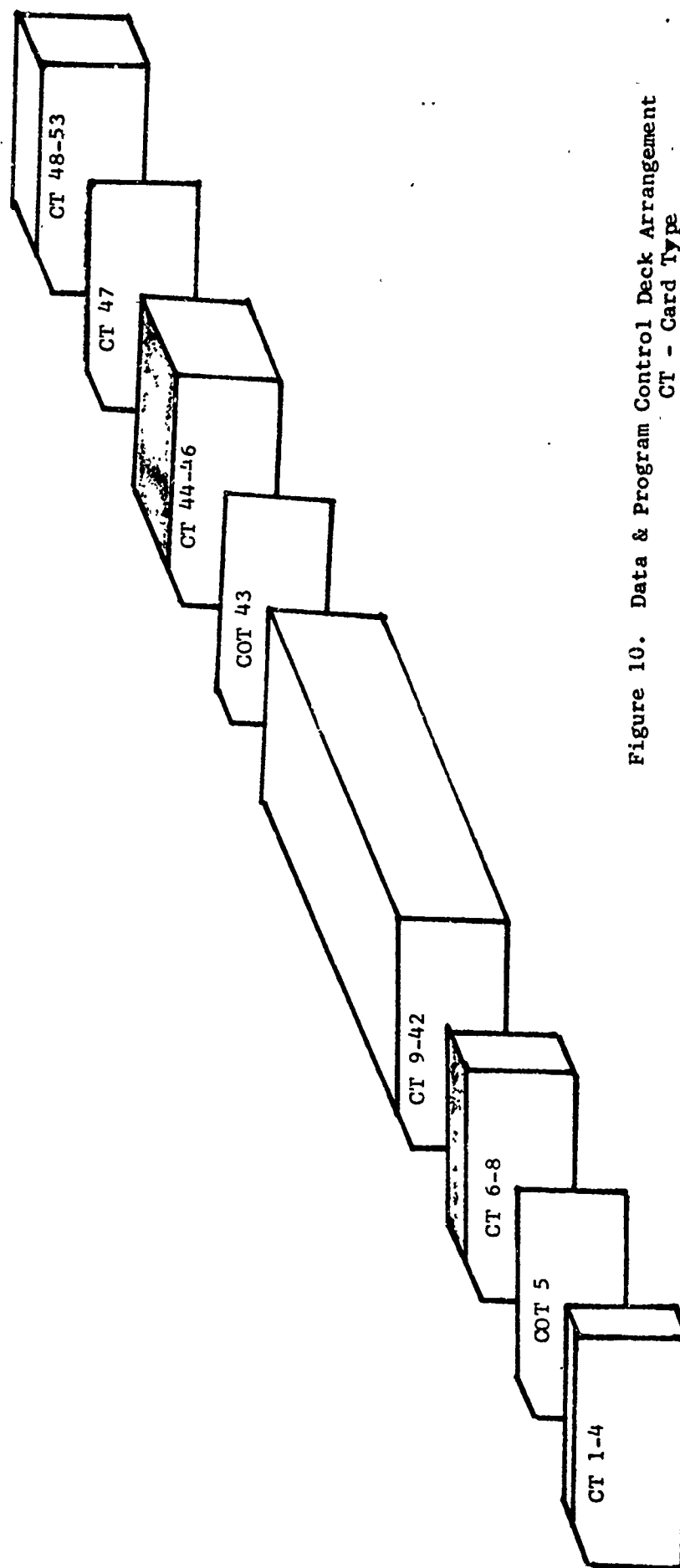


Figure 10. Data & Program Control Deck Arrangement
 CT - Card Type
 COT - Control Card Type

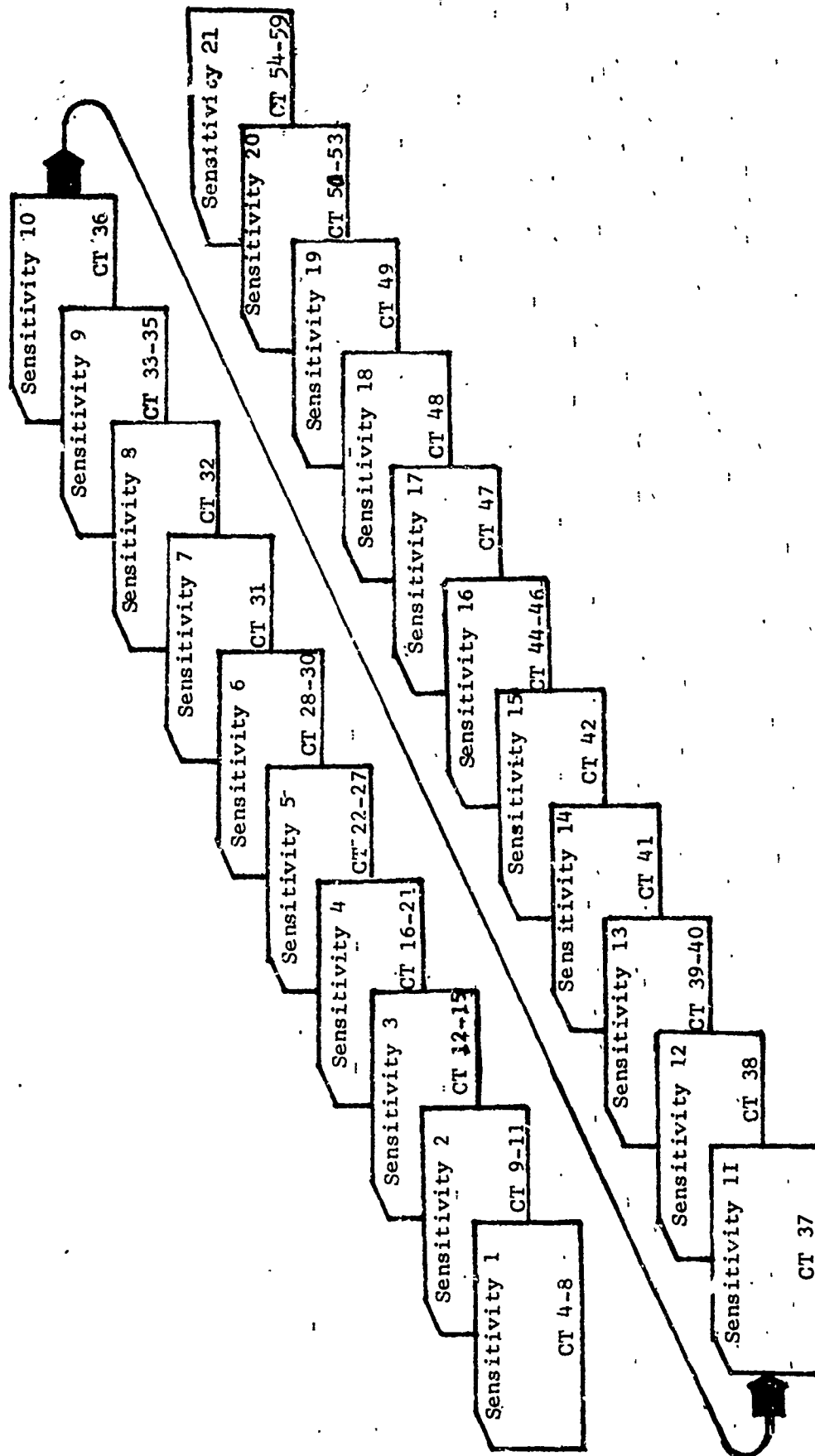


Figure 11. Sensitivity Variable Groups

to determine its effect on life-cycle support costs or operational availability.

If any of the information for any of the sensitivity group is used all the information for that group must be re-read.

Figure 12 shows the deck arrangement for sensitivity analysis. The first card is a control card type 54 containing the number of sensitivity group. The next group of cards are the card types which make up that sensitivity group. If other sensitivity groups are to be changed a type 54 card is required for each followed by the card types to be changed. The next card is a control card type 48 containing a 0 to indicate the end of the sensitivity group cards. These groups of cards (control, sensitivity and control) are repeated for each sensitivity variation desired. The last card of the deck is another control card type 54 containing a 100 to indicate the end of sensitivity variations. If no sensitivity analysis is run the only card in the sensitivity analysis deck is a type 54 card containing the number 100. The sensitivity groups are as follows:

- Sensitivity 1 - Mean-Time-Between-Failure Information
- Sensitivity 2 - Mean-Time-To-Repair Information
- Sensitivity 3 - Acquisition Cost Information
- Sensitivity 4 - Test Equipment Information
- Sensitivity 5 - Manpower Information
- Sensitivity 6 - Weight Information
- Sensitivity 7 - Force Structure Information
- Sensitivity 8 - Transportation Information
- Sensitivity 9 - Requisition Times and Waiting Times
- Sensitivity 10- Operating Hours Per Shop
- Sensitivity 11- Confidence Levels, False-No-Gos, Attrition
- Sensitivity 12- Stockage Objectives, Order-Ship Times turnaround times and Reorder Period
- Sensitivity 13- Economic Life
Number of Days of Operation of the Equipment and Maintenance Shops, Operating Hours Per Day of Equipment.
- Sensitivity 14- Training Cost for Manpower
- Sensitivity 15- Inventory and Training Factor
- Sensitivity 16- Known Maintenance Allocation Policy
- Sensitivity 17- Maintenance Policies
- Sensitivity 18- Research and Development Cost
- Sensitivity 19- Round Up on Test Equipment and Manpower
- Sensitivity 20- Publications Cost
- Sensitivity 21- Overhaul Considerations

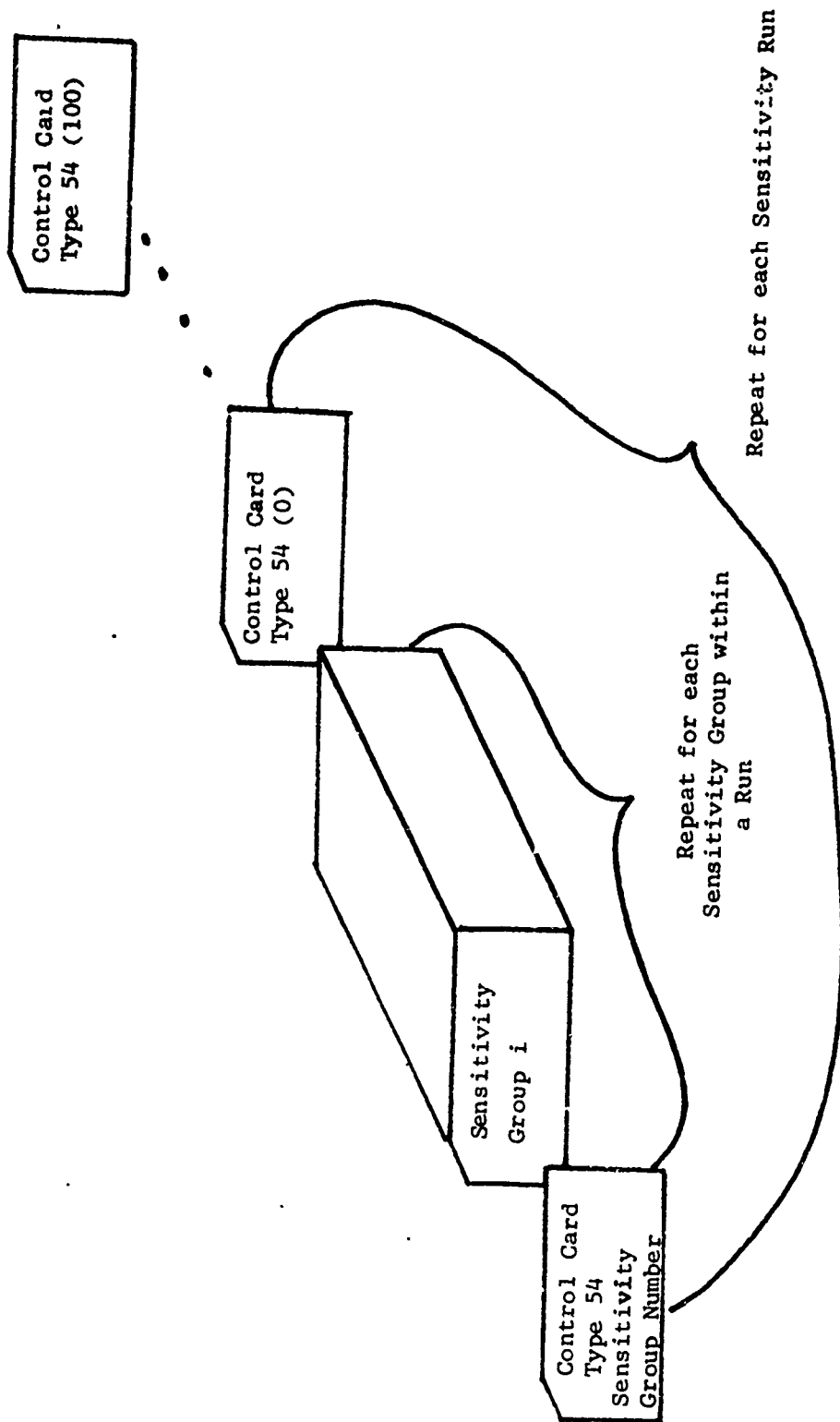


Figure 12. Sensitivity Analysis Deck Arrangement

Data for GEMM Card Types

Distances given are in miles, weight is in pounds and time is in hours unless specified otherwise. The data is as follows in the format indicated:

Type One Card -

- Column 1-3 - Number of Components (right justified)
- Column 4-6 - Number of Classes of Parts (right justified)

Type Two Card -

- Column 1-3 - Number of Modules in Component 1
- Column 4-6 - Number of Modules in Component 2

.
.
.

(3 columns for each number, right justified, 10 numbers per card)

Type Three Card -

- Column 1-3 - Number of Class 1 parts in Module 1 of Component 1
- Column 4-6 - Number of Class 2 parts in Module 1 of Component 1

.
.
.

(Continue for all classes on same card. One card for each of the modules of Component 1, then all modules of all other components). (Right justified, 20 numbers per card).

Type Four Card -

- Column 1-8 - Mean-Time-Between-Failure for Part Class 1.
- Column 9-16 - Mean-Time-Between-Failure for Part Class 2.

.
.
.

(Continue for each Part Class, right justified with two decimal places, 10 numbers per card).

Type Five Card -

- Column 1 - Reliability Assessment Indicator a 1 in column 1 indicates you will read the Type 6, 7, 8 cards. A zero in Column 1 indicates that GEMM will apportion the module, component, and end item mean-time-between-failure numbers. If so skip to card type 9.

Type Six Card -

Column 1-8 - Mean-Time-Between-Failure for Module 1 of Component 1
Column 9-16- Mean-Time-Between-Failure for Module 2 of Component 1

.
.
.
(Continue for each module of component, one card for each component, 10 numbers per card, two decimals).

Type Seven Card -

Column 1-8 - Mean-Time-Between-Failure for Component 1
Column 9-16- Mean-Time-Between-Failure for Component 2

.
.
.
(Continue for all Components) (Right Justified, two decimals 10 numbers per card).

Type Eight Card -

Column 1-10- Mean-Time-Between-Failure of the Equipment (Right Justified, five decimal places.)

Type Nine Card -

Column 1-6 - Mean-Time-To-Check-Out the Equipment
Column 7-12- Mean-Time-To-Repair the Equipment (Right Justified, two decimal places).

Type Ten Card -

Column 1-6 - Mean-Time-To-Repair Component 1
Column 7-12- Mean-Time-To-Repair Component 2

.
.
.
(Continue for all Components, Right Justified, two decimals)

Type Eleven Card -

Column 1-6 - Mean-Time-To-Repair Module 1 of Component 1
Column 7-12- Mean-Time-To-Repair Module 2 of Component 1

.
.
.
(Continue for all Modules of a Component, one card per Component, right justified, two decimals, maximum 10 numbers per card).

Type Twelve Card -

Column 1-8 - Purchase Price of an End Item (Right Justified two decimals)

Type Thirteen Card -

Column 1-8 - Cost of Component 1

Column 9-16- Cost of Component 2

.
.
.
(Continue for all components, ten per card, right justified, two decimals).

Type Fourteen Card -

Column 1-8 - Cost of Module 1 of Component 1

Column 9-16- Cost of Module 2 of Component 1

.
.
.
(Continue for all Modules of Component 1. Repeat with new card for each component, 10 modules per card, right justified, two decimals).

Type Fifteen Card -

Column 1-8 - Cost of Part Class 1

Column 9-16- Cost of Part Class 2

.
.
.
(Continue for all part types 10 per card, right justified, two decimals).

Type Sixteen Card -

Column 1-3 - Number of Different Types of Test Equipment (Right Justified)

Type Seventeen Card -

Column 1 - Punch a 1 if test equipment (TE) type 1 is used to check-out the equipment. Punch a 0 if test equipment type 1 is not used to check-out the equipment.

Column 2 - 1 If TE type 2 is used to check-out the equipment.
0 If TE type 1 is not used to check-out the equipment.

.
.
.
(Continue for all types of TE, with a (1) or (0) for each type,
forty numbers per card, maximum)

Type Eighteen Card -

Column 1 - 1 If TE Type 1 used to perform equipment repair.
0 If TE Type 1 not used to perform equipment repair.

Column 2 - 1 If TE Type 2 used to perform equipment repair.
0 If TE Type 2 used to perform equipment repair.

.
.
.
(Continue for all test equipment types 40 per card).

Type Nineteen Card -

Column 1 - 1 If TE Type 1 used to repair Component 1.
0 If TE Type 1 not used to repair Component 1.

.
.
.
(Continue for each type of TE, one card for each component
forty numbers per card, maximum).

Type Twenty Card -

Column 1 - 1 If TE Type 1 used to repair Module 1 of Component 1.
0 If TE Type 1 used to repair Module 1 of Component 1.

.
.
.
(Continue for each type of TE one card for each Module of
Component 1, then repeat for all components, forty numbers per
card, maximum).

Type Twenty-One Card -

Column 1-8 - Cost of Test Equipment Type 1.
Column 9-16- Cost of Test Equipment Type 2.

.
.
.
(Continue for all Test Equipment Types, right justified, two
decimals, maximum ten numbers per card).

Type Twenty-Two Card -

Column 1-3 - Number of different types of maintenance personnel (MOS).

Type Twenty-Three Card -

Column 1 - 1 If MOS Type 1 used to Check-Out the Equipment.

0 If MOS Type 1 not used to Check-Out the Equipment.

Column 2 - 1 If MOS Type 2 used to Check-Out the Equipment.

0 If MOS Type 2 not used to Check-Out the Equipment.

(Continue for each Type of MOS, maximum 10 per card).

Type Twenty-Four Card -

Column 1 - 1 If MOS Type 1 used to perform Equipment Repair.

0 If MOS Type 1 not used to perform Equipment Repair.

Column 2 - 1 If MOS Type 2 used to perform Equipment Repair.

0 If MOS Type 2 not used to perform Equipment Repair.

(Continue for all MOS Types, maximum 10 per card).

Type Twenty-Five Card -

Column 1 - 1 If MOS Type 1 used to perform repair on Component 1.

0 If MOS Type 1 not used to perform repair on Component 1.

Column 2 - 1 If MOS Type 2 used to perform repair on Component 1.

0 If MOS Type 2 not used to perform repair on Component 1.

(Continue for each type of MOS Type, one card per component,
10 numbers maximum per card).

Type Twenty-Six Card -

Column 1 - 1 If MOS Type 1 used to repair Module 1 of Component 1.

0 If MOS Type 1 not used to repair Module 1 of Component 1.

Column 2 - 1 If MOS Type 2 used to repair Module 1 of Component 1.

0 If MOS Type 2 not used to repair Module 1 of Component 1.

(Continue for each MOS Type one card for each Module of Component
1, then repeat for all components, right justified, maximum 10
numbers per card).

Type Twenty-Seven Card -

Column 1-8 - Salary for MOS Type 1 at level 1.

Column 9-16- Salary for MOS Type 2 at level 1.

.

.

.

(Continue for each MOS type, right justified, two decimals, maximum 10 numbers per card, repeat with one card for each level 2, 3 and 4).

Type Twenty-Eight Card -

Column 1-7 - Weight of the end item. (Right justified, two decimals).

Type Twenty-Nine Card -

Column 1-7 - Weight of Component 1.

Column 8-14- Weight of Component 2.

.

.

.

(Continue for all components, right justified, two decimals, Maximum 10 numbers per card).

Type Thirty Card -

Column 1-7 - Weight of Module 1 of Component 1.

Column 8-14- Weight of Module 2 of Component 1.

.

.

.

(Continue for all modules of Component 1, one card for each component, right justified, two decimals, maximum 10 numbers per card).

Type Thirty-One Card -

Column 1-4 - Number of Equipment supported by one shop at maintenance level 1.

Column 5-6 - Blank.

Column 7-8 - Number of maintenance shops at Level 1.

.

.

.

(Repeat fields 1-8 starting in column 9 for level 2 thru 4, right justified, all one card).

Type Thirty-Two Card -

- Column 1-6 - Average transportation distance between level (L) = 1 and next level (NL) = 1. (Right justified)
Column 7-13- Cost per pound per mile for transportation between level (L) 1 and next level (NL) = 1. (Right justified, four decimals)

(Continue for L equal 2 to 4 with NL equal to 1. Then repeat with NL=2, L=2, 3, 4; then NL=3, L=3, 4; then NL=4, L=4 all on one card).

Type Thirty-Two A Card -

- Column 1-7 - Transportation time between level L=(1) and level NL=(1). (Right justified, two decimals).
Column 8-14- Transportation time between L=(1) and NL=(2).
Column 15-21-Transportation time between L=1 and NL=(3).
Column 32-28-Transportation time between L=1 and NL=(4).

(Continue on the same card for L=2, NL=2,3,4; L=3, NL=3,4; L=4, NL=4.)

Type Thirty-Three Card -

- Column 1-4 - Requisition time of a part from level (L)=1 to level 4.
Column 5-8 - Requisition time of a module from level (L) = 1 to level 4.
Column 9-12- Requisition time of a component from level (L) = 1 to level 4.

(Repeat with one card for (L) equal to 2, 3, and 4, right justified).

Type Thirty-Four Card -

- Column 1-8 - Requisition time of an equipment from level 4, throwaway equipment case (right justified, two decimals).

Type Thirty-Four A Card -

Column 1-8 - Requisition time for an equipment float at organizational level.

Type Thirty-Five Card -

Column 1-4 - Waiting time at level 1 for maintenance.

Column 5-6 - Blank.

Column 7-10- Waiting time at level 2 for maintenance.

Column 11-12-Blank.

(Continue for level 3 and 4, right justified).

Type Thirty-Six Card -

Column 1-5 - Operating Hours per Day of Maintenance Shop at level 1.

Column 6-10- Operating Hours per Day of Maintenance Shop at level 2.

(Continue for level 3 and 4, right justified, two decimals).

Type Thirty-Six A Card -

Column 1-8 - Manpower Productivity Factor, (four decimals, right justified.)

Type Thirty-Seven Card -

Column 1-4 - Number of standard deviations that yields confidence limit desired for part stockage. (Z value, normal distribution).

Column 5-8 - Z value for module stockage.

Column 9-12- Z value for equipment stockage.

Column 13-16-Z value for equipment stockage.

Column 17-20-Confidence limit or safety level (SL) for part stockage.

Column 21-24-(SL) for module stockage.

Column 25-28-(SL) for component stock.

Column 29-32-(SL) for equipment stock.

Column 33-36-Probability of false-no-go at equipment level.

Column 37-40-Attrition factor. (All previous fields right justified, three decimals).

Column 41-43-Requisition objective period in months (right justified, no decimals).

Type Thirty-Eight Card - Number of 15 day periods

Column 1-5 - Stockage objective at level (L) = 1.
Column 6-10 - Order ship time at level (L) = 1.
Column 11-15 - Turnaround time for modules at level (L) = 1.
Column 16-20 - Turnaround time for component at level (L) = 1.

(Repeat with one card for each level (L), right justified, two decimals).

Type Thirty-Nine Card -

Column 1-5 - Economic life of the equipment. (right justified, two decimals, in years).

Type Forty Card -

Column 1-3 - Number of days per year of operation of the equipment (Right justified).
Column 4-6 - Operating hours per day of the equipment. (Right justified no decimals).
Column 7-9 - Numbers of days per year of operation of the maintenance shops (right justified).

Type Forty-One Card -

Column 1-2 - Blank.
Column 3-7 - Cost of training MOS Type 1 (Right justified).
Column 8-9 - Blank.
Column 10-14 - Cost of training MOS Type 2.

(Continue for all MOS types, maximum ten numbers per card).

Type Forty-Two Card -

Column 1-5 - Inventory management factor. (Right justified, three decimals).
Column 6-9 - Time between retraining periods for MOS types at level 1. (Right justified, 2 decimals).
Column 10-13 - Time between retraining periods at level 2.
Column 14-17 - Time between retraining at level 3.
Column 18-21 - Time between retraining at level 4.
Column 22-25 - Depot maintenance factor.

Type Forty-Three Card -

Column 1 - 1 If you are reading in maintenance allocation.
0 If allocation not read in, skip to type 47.

Type Forty-Four Card -

Column 1 - Level at which fault isolation of components occurs.

Type Forty-Five Card -

Column 1 - Level at which fault isolation for modules of component 1.
Column 2 - Level at which fault isolation for modules of component 2
takes place.

.
.
.
(Continue for all components).

Type Forty-Six Card -

Column 1 - Level at which fault isolation of parts (FIP) of module 1
of component 1 takes place.

Column 2 - Level at which FIP of Module 2 of component 1 takes place.

.
.
.
(Continue for all modules of component 1, repeat with one card
for each component).

Type Forty-Seven Card -

Column 1-2 - Number of policies to be analyzed.
Column 3-4 - Number from Figure 3 of a policy to be evaluated.
Column 5-6 - Number from Figure 3 of a policy to be evaluated.

.
.
.
(Continue for all policies to be evaluated, list in ascending
order, right justified)

Type Forty-Eight Card -

Column 1-12- Cost of Research & Development, two decimals, right justified

Type Forty-Eight A Card -

Column 1-12- Cost of Production including prime equipment, two decimals,
right justified.

Type Forty-Nine Card -

Column 1 - 1 If round up on manpower and test equipment desired.
0 If round up not desired.

Type Fifty Card -

Column 1 - 7 - Cost per page for publications (two decimals, right justified).

Type Fifty-One Card -

Column 1-5 - Number of pages of publications for check-out equipment.
Column 6-10- Number of pages of publications for repair equipment
(right justified, no decimals).

Type Fifty-Two Card -

Column 1-5 - Number of pages for repair component 1.
Column 6-10- Number of pages for repair of component 2.

.
.
.

(Continue for all components, maximum 10 to a card, right justified, no decimals).

Type Fifty-Three Card -

Column 1-5 - Number of pages required for repair of module 1, of component 1.
Column 6-10- Number of pages required for repair of module 2, of component 1.

.
.
.

(Repeat for all modules of component 1. Maximum 10 numbers per card, then a new card for each component).

Type Fifty-Four Card -

Column 1-8 - Cost of overhaul for end item (right justified, two decimals).

Type Fifty-Five Card

Column 1-8 - Cost of overhaul for component 1.
Column 9-16- Cost of overhaul for component 2.

(Continue for each component, maximum 10 per card, right justified, two decimals).

Type Fifty-Six Card -

Column 1-8 - Cost of overhaul for module 1 of component 1.

Column 9-16 - Cost of overhaul for module 2 of component 1.

(Continue for all modules of component 1, maximum 10 numbers per card, right justified, two decimals. Then repeat for modules of each component).

Type Fifty-Seven Card -

Column 1-3 - Time-between-overhaul of the end item in years (right justified).

Type Fifty-Eight Card -

Column 1-3 - Time between overhaul for component 1.

Column 4-6 - Time between overhaul for component 2.

(Continue for all components (right justified)).

Type Fifty-Nine Card -

Column 1-3 - Time between overhaul for module 1 of component 1.

Column 4-6 - Time between overhaul for module 2 of component 1.

(Continue for all modules of component 1. Then repeat for modules of each component.)

Type Sixty Card -

Column 1-3 - 1-20 If sensitivity variable to be exercised. Number indicates which sensitivity variable to be exercised.
0 indicates the last sensitivity variable has been exercised for a run.
100 Indicates end of all use program.

CHAPTER VIII

SAMPLE PROBLEMS

The sample problems included in this report are designed to give the model user an idea of type of model outputs which may be expected, their form, and possible uses for these outputs as an aid to decision making. These examples may also be used to test the program itself if this is desired.

Example I. Maintenance Allocation

This example illustrates the inputs required by GEMM and the results obtained when GEMM is used to optimize the maintenance allocation of an equipment/system based on fixed inputs. The equipment being analyzed is hypothetical and all of the data herein is for illustration purposes only.

The inputs required are listed below.

- Type 1. Number of components = 2
Number of classes of parts = 2
- Type 2. Number of modules in component (1) = 2
Number of modules in component (2) = 2
- Type 3. Number of part type (1) in module (1, 1) = 2
Number of part type (2) in module (1, 1) = 2
Number of part type (1) in module (1, 2) = 0
Number of part type (2) in module (1, 2) = 10
Number of part type (1) in module (2, 1) = 5
Number of part type (2) in module (2, 1) = 0
Number of part type (1) in module (2, 2) = 10
Number of part type (2) in module (2, 2) = 10
- Type 4. MTBF for part class (1) = 200,000 hours
(2) = 300,000 hours
- Type 5. MTBF Identifier = 0 (MTBF's apportioned)
- Type 6, 7, 8 not used.
- Type 9. MTRR Equipment = 1.32 hours
Meantime to Check-Out Equipment = 2 hours.

Example I (Contd)

- Type 10. MTTR of component (1) = 1.33 hours
MTTR of component (2) = 1 hour
- Type 11. MTTR of module (1, 1) = 1 hour
MTTR of module (1, 2) = 2 hours
MTTR of module (2, 1) = 4 hours
MTTR of module (2, 2) = 3 hours
- Type 12. Cost of Equipment = \$5000
- Type 13. Cost of component (1) = \$2000
(2) = \$3000
- Type 14. Cost of module (1, 1) = \$1000
(1, 2) = \$1000
(2, 1) = \$1000
(2, 2) = \$1000
- Type 15. Cost of part type (1) = \$5
Cost of part type (2) = \$10
- Type 15. Number of test equipment = 3
- Type 17. Test equipment types for checkout = 1 and 3
- Type 18. Test equipment types for repair of equipment = 1
- Type 19. Test equipment types for repair of component (1) = 1 and 3
Test equipment types for repair of component (2) = 1 and 2
- Type 20. Test equipment types for repair of module (1, 1) = 3
Test equipment types for repair of module (1, 2) = 1
Test equipment types for repair of module (2, 1) = 1
Test equipment types for repair of module (2, 2) = 2
- Type 21. Cost of Test Equipment type (1) = \$1000
(2) = \$700
(3) = \$200
- Type 22. Number of Manpower types = 3
- Type 23. Manpower types for check-out equipment = 1
- Type 24. Manpower types for repair of equipment = 2
- Type 25. Manpower types for repair of component (1) = 1 and 2
Manpower types for repair of component (2) = 3
- Type 26. Manpower types for repair of module (1, 1) = 1 and 2
Manpower types for repair of module (1, 2) = 1
Manpower types for repair of module (2, 1) = 3
Manpower types for repair of module (2, 2) = 3
- Type 27. Salary of manpower type (1) = \$8000
Salary of manpower type (2) = \$10000
Salary of manpower type (3) = \$8000
These remain the same for all four levels.
- Type 28. Weight of equipment = 1000 lbs.
- Type 29. Weight of component (1) = 500 lbs.
Weight of component (2) = 500 lbs.
- Type 30. Weight of module (1, 1) = 200 lbs.
Weight of module (1, 2) = 300 lbs.
Weight of module (2, 1) = 300 lbs.
Weight of module (2, 2) = 200 lbs.

Example I. (Contd)

- Type 31. Number of equipment supported at level (1) = 125
Number of maintenance shops at level (1) = 8
Number of equipment supported at level (2) = 250
Number of maintenance shops at level (2) = 4
Number of equipment supported at level (3) = 500
Number of maintenance shops at level (3) = 2
Number of equipment supported at level (4) = 1000
Number of maintenance shops supported at level (4) = 1
- Type 32. Transportation distance (1, 1) = 0 miles
Transportation distance (1, 2) = 20 miles
Transportation distance (2, 1) = 100 miles
Transportation distance (2, 2) = 400 miles
Transportation distance (2, 3) = 80 miles
Transportation distance (2, 4) = 350 miles
Transportation distance (3, 3) = 0 miles
Transportation distance (3, 4) = 300 miles
Transportation distance (4, 4) = 0 miles
Cost-per-pound-mile (1, 1) = \$.000
Cost-per-pound-mile (1, 2) = \$.0001
Cost-per-pound-mile (1, 3) = \$.0001
Cost-per-pound-mile (1, 4) = \$.0001
Cost-per-pound-mile (2, 2) = \$.000
Cost-per-pound-mile (2, 3) = \$.0001
Cost-per-pound-mile (2, 4) = \$.0001
Cost-per-pound-mile (3, 3) = \$.000
Cost-per-pound-mile (3, 4) = \$.0001
Cost-per-pound-mile (4, 4) = \$.000
- Type 32A. Transportation Time (1, 1) = 0 hours
Transportation Time (1, 2) = 5 hours
Transportation Time (1, 3) = 10 hours
Transportation Time (1, 4) = 240 hours
Transportation Time (2, 2) = 0 hours
Transportation Time (2, 3) = 10 hours
Transportation Time (2, 4) = 240 hours
Transportation Time (3, 3) = 0 hours
Transportation Time (3, 4) = 240 hours
Transportation Time (4, 4) = 0 hours
- Type 33. Requisition time for parts from level (4) to level (1) = 720 hrs
Requisition time for parts from level (4) to level (2) = 480 hrs
Requisition time for parts from level (4) to level (3) = 240 hrs
Requisition time for parts from level (4) to level (4) = 48 hrs
Requisition time for modules from level (4) to level (1)
= 720 hours
Requisition time for modules from level (4) to level (2)
= 480 hours
Requisition time for modules from level (4) to level (3)
= 240 hours
Requisition time for modules from level (4) to level (4) = 48 hrs

Example 1. Contd

- Requisition time for components from level (4) to level (1) = 720 hours
Requisition time for components from level (4) to level (2) = 480 hours
Requisition time for components from level (4) to level (3) = 240 hours
Requisition time for components from level (4) to level (4) = 48 hours
- Type 34. Requisition time for equipment from level (4) to level (1) = 720 hours
- Type 34A. Requisition time of an equipment float = 2 hours
- Type 35. Waiting time for maintenance at level (1) = 2 hours
Waiting time for maintenance at level (2) = 4 hours
Waiting time for maintenance at level (3) = 6 hours
Waiting time for maintenance at level (4) = 8 hours
- Type 36. Operating hours per shop, level (1) = 5 hours
Operating hours per shop, level (2) = 5 hours
Operating hours per shop, level (3) = 10 hours
Operating hours per shop, level (4) = 10 hours
- Type 36A. Productivity factor = .75
- Type 37. Confidence limits = 95% value = 1.65
Probability of false no-gos = 5%
Attrition factor = 5%
Requirements Objective Period = 12 months
- Type 38. Stockage objective period at level (1) = 1
Stockage objective period at level (2) = 2
Stockage objective period at level (3) = 2
Stockage objective period at level (4) = 3
Order shipping time at level (1) = 1
Order shipping time at level (2) = 2
Order shipping time at level (3) = 2
Order shipping time at level (4) = 3
Turnaround time for modules at level (1) = .5
Turnaround time for modules at level (2) = .5
Turnaround time for modules at level (3) = 1
Turnaround time for modules at level (4) = 1
Turnaround time for components and equipment at level (1) = .5
Turnaround time for components and equipment at level (2) = .5
Turnaround time for components and equipment at level (3) = 1
Turnaround time for components and equipment at level (4) = 1
- Type 39. Economic life = 10 years
- Type 40. Number of days per year of operation of maintenance shops = 365 days
Number of operating hours per day of the equipment = 8 hours
Number of days per year of operation of the equipment = 365 days

Example 1. Contd

- Type 41. Cost to train manpower type (1) = \$1000
Cost to train manpower type (2) = \$1000
Cost to train manpower type (3) = \$1000
- Type 42. Training factor = 2.5 years for levels 1 - 3 and 5 years for level 4
Inventory factor = .01
Depot maintenance factor = .30
- Type 43. Known allocation identifier = 0
- Type 44. Not required.
- Type 45. Not required.
- Type 46. Not required.
- Type 47. MMAX = 4
Policies 8, 9, 21, 25
- Type 48. Research and Development Cost = \$1,000,000
- Type 49. Round up equals 0.
- Type 50. Cost per page for publications = \$150.
- Type 51. Number of pages for check-outs = 15 pages.
Number of pages for FIC = 20 pages.
- Type 52. Number of pages for FIM for each component = 15 pages.
- Type 53. Number of pages for FIP of each module = 15 pages.
- Type 54. Cost of overhaul of equipment = \$400.
- Type 55. Cost of overhaul of component 1 = \$0
Cost of overhaul of component 2 = \$0
- Type 56. Cost of overhaul of module 1 of component 1 = \$0
Cost of overhaul of module 2 of component 1 = \$0
Cost of overhaul of module 1 of component 2 = \$0
Cost of overhaul of module 2 of component 2 = \$0
- Type 57. Time between overhaul for equipment = 4 years
- Type 58. Time between overhaul for component 1 = 50 years
Time between overhaul for component 2 = 50 years
- Type 59. Time between overhaul for module 1 of component 1 = 50 years
Time between overhaul for module 2 of component 1 = 50 years
Time between overhaul for module 1 of component 2 = 50 years
Time between overhaul for module 2 of component 2 = 50 years
- The fifty year figure is used to assure no overhaul will take place.
- Type 60. Sensitivity variable = 100 (no sensitivity)

NOTE: For this example MTBF's are apportioned by the model and are not read in. Also, since type 60 input is 100, there is no sensitivity analysis required.

Using these inputs we are manipulating the GEMM Model to simulate the operation of this equipment for its entire life cycle. In this case, we are using the GEMM Model to determine the best maintenance policy for the equipment to follow from the set of possible maintenance policies listed in the inputs based on life cycle support costs. The equipment may follow any

one of these policies or a combination of any of these policies.

In this example, we are looking at a policy which reflects maintenance support positive, a throw-away module philosophy, a four-level philosophy and a throw-away component philosophy. It is very possible that the best equipment philosophy may be one in which some modules may be repaired in the field, some in the depot and others may be thrown away.

The first output from the GEMM Model is the input information. This allows the user to check his input data and provides a record of the input parameters for this run. The data is listed by its variable name in the program. See Table I.

The next output is the reliability apportionment (Table II). Only part failure rates were input in this example and the program apportioned the failure rates, in a series manner, to the modules, components, and the end item.

The next output is the maintenance allocation for the equipment, its components and modules (Table III). Here, fault isolation to components is carried out at level (1). Component 1 and 2 are fault isolated to the module at level (2). In this case, all modules are fault isolated to the part level at level (4). For this example, level (1) is the organizational level of support, level (2) is direct support, level (3) is general support, and level (4) is the depot level of support. This is the least cost maintenance allocation based on the input data.

The next output is a break-out or the life cycle support costs for the best maintenance allocation and the Operational Availability of the equipment (Table IV). Research and development and production costs were read into the model. Test equipment costs, manpower cost and training cost are based only on that percentage of resource which is used for the equipment under consideration. It may be possible that a resource is not used fully at some given level. If so, only a percentage of the cost of that resource is charged to the equipment under study. Stockage and inventory costs are for the entire life-cycle. The operational availability figure is the expected availability of the equipment to the user in the field.

The next output is stockage information. Table V shows the different types of stockage required for the maintenance allocation chosen by GEMM. It is broken-out into four types, parts, modules, components, and end-item stock. Under each type, it is further divided to indicate the type, cost and level at which each repairables or non-repairables will be stocked. The quantities listed are for the entire force structure based on the force structure information input to the model. These are the initial provisioning quantities. Reorder stock is simply based on demand.

Table I. INPUT INFORMATION

NC=	2	NCCLASP=	2
NMK(COMPONENT)=	2	2	
NUMRR(COMP,MODULE,CLASS)=	70	50	
NUMRR(COMP,MODULE,CLASS)=	70	50	
NUMRR(COMP,MODULE,CLASS)=	70	50	
NUMRR(COMP,MODULE,CLASS)=	140	100	
MTBFP(CLASS)=	200000.00	300000.00	
MTBFD=	0		
MTTRCE=	2.00	MTIME=	1.32
MTTRC(COMP)=	1.33	1.00	
MTTRM(COMP,MODULE)=	1.00	2.00	
MTTRM(COMP,MODULE)=	4.00	3.00	
CSET=	5000.00		
CCC(COMP)=	2000.00	3000.00	
CC(COMP,MODULE)=	1000.00	1000.00	
CC(COMP,MODULE)=	1000.00	2000.00	
C(CLASS)=	5.00	10.00	
NTE=	3		
TECF(TYPE)=	101		
TEET(TYPE)=	100		
TECI(COMP,TYPE)=	101		
TECI(COMP,TYPE)=	110		
TEMT(COMP,MODULE,TYPE)=	001		
TEMT(COMP,MODULE,TYPE)=	100		
TEMT(COMP,MODULE,TYPE)=	100		
TEMT(COMP,MODULE,TYPE)=	010		
TECOST(TYPE)=	1000.00	700.00	200.00
NMOS=	3		
MOSCE(TYPE)=	100		
MOSF(TYPE)=	010		
MOSC(COMP,TYPE)=	110		
MOSC(COMP,TYPE)=	001		

TABLE I. INPUT INFORMATION (Contd)

MOSM(COMP,MODULE,TYPE)=110
MOSM(COMP,MODULE,TYPE)=100
MOSM(COMP,MODULE,TYPE)=001
MOSM(COMP,MODULE,TYPE)=001
MCOST(TYPE)= 8000.0010000.00 8000.00
MCOST(TYPE)= 8000.0010000.00 8000.00
MCOST(TYPE)= 8000.0010000.00 8000.00
MCOST(TYPE)= 8000.0010000.00 8000.00
WTE= 1000.00
WTC(COMP)= 500.00 500.00
WTM(COMP,MODULE)= 200.00 300.00
WTM(COMP,MODULE)= 300.00 200.00
NSHOP(LEVEL)= 125. 250. 500.1000.
NUMFS(LEVEL)= 8 4 2 1
TRANST(LEVEL,NEXT LEVEL)= 0. 20. 100. 400.
0. 80. 350. 0. 300. 0.
TRANS(LEVEL,NEXT LEVEL)= 0.00 5.00 10.00 240.00 0.00
10.00 240.00 0.00 240.00 0.00
COSLB(LEVEL,NEXT LEVEL)=0.0001000.0001000.0001000.000100
0.0001000.0001000.0001000.0001000.000100
REQPT(LEVEL,4)720.REQMT(LEVEL(4)720.REQCT (LEVEL,4)720.
REQPT(LEVEL,4)480.REQMT(LEVEL(4)480.REQCT (LEVEL,4)480.
REQPT(LEVEL,4)240.REQMT(LEVEL(4)240.REQCT (LEVEL,4)2
REQPT(LEVEL,4) 48.REQMT(LEVEL(4) 48.REQCT (LEVEL,4) 48.
REQET= 720.
REQ= 2.00
WAIT(LEVEL)= 2.
WAIT(LEVEL)= 4.
WAIT(LEVEL)= 6.

TABLE I. INPUT INFORMATION (Contd)

WAIT(LEVEL)= 8.
 UPHRSH(LEVEL)= 5.00 5.00 10.00 10.00
 PRODUCTIVE FACTOR= 0.7500
 K1= 1.65 K2= 1.65 K3= 1.65 K4= 1.65 TK1= 0.95 TK2= 0.05 TK3= 0.95
 TK4= 0.95 PFNGN= 0.05 ATRF= 0.05 ROP= 12.
 B(LEVEL)= 1.00 G(LEVEL)= 1.00 TURN1(LEVEL)= 0.50 TURN2(LEVEL)= 0.50
 H(LEVEL)= 2.00 G(LEVEL)= 2.00 TURN1(LEVEL)= 0.50 TURN2(LEVEL)= 0.50
 B(LEVEL)= 2.00 G(LEVEL)= 2.00 TURN1(LEVEL)= 1.00 TURN2(LEVEL)= 1.00
 H(LEVEL)= 3.00 G(LEVEL)= 3.00 TURN1(LEVEL)= 1.00 TURN2(LEVEL)= 1.00
 LLIFE= 10.00
 NDAY= 365 OPHRDY= 8, NDAE= 365
 XMAN(MOS)= 1000. 1000. 1000.
 FACTIN= 0.1700 THAIN(LEVEL)= 2.50 2.50 2.50 5.00 DMF= 0.30
 KNOWN= 0
 POLICIES 8 92125
 RESEARCH AND DEVELOPMENT COST 1000000.00
 PRODUCTION COST= 5000000.00
 ROUND UP EQUAL 0
 PPC= 150.00
 PGC= 15.00 PGL= 20.00
 PGM(COMP)= 15.00 15.00
 PGP(COMP,MODULE)= 15.00 15.00
 PGP(COMP,MODULE)= 15.00 15.00
 CTOE= 400.00
 CTUC(COMP)= 0.00 0.00
 CTUM8(COMP,MOD)= 0.00 0.00
 CTUM8(COMP,MOD)= 0.00 0.00
 TBOE= 4.00
 TBQC(COMP)= 50.00 50.00
 TBQM(COMP,MOD)= 50.00 50.00
 TBQM(COMP,MOD)= 50.00 50.00

TABLE II. RELIABILITY INFORMATION

ITEM		MEAN TIME BETWEEN FAILURE
END ITEM		287,097
COMPONENT	1	967,742
COMPONENT	2	645,161
MODULE	1, 1	1935,484
MODULE	1, 2	1935,484
MODULE	2, 1	1935,484
MODULE	2, 2	967,742
PART TYPE	1	200000.
PART TYPE	2	300000.

TABLE III. MAINTENANCE ALLOCATION

COMP	MOD	FIC	FIM	FIP
		1	2	
1				4
1	1			4
1	2			
2			2	
2	1			4
2	2			4

TABLE IV. LIFE CYCLE COSTS

R AND D COST	1000000.00
PRODUCTION COST	5000000.00
TEST EQUIPMENT	25239.79
STOCKAGE	
INITIAL PROVISIONING	1008888.00
REORDER STOCK	13492590.00
TOTAL STOCK	14501478.00
MANPOWER	2731361.78
TRAINING	117970.84
INVENTORY	355053.95
TRANSPORTATION	710280.00
PUBLICATION	18750.00
OVERHAUL COST*	800000.00
TOTAL LIFE CYCLE COST	25260134.36
OPERATIONAL AVAILABILITY	0.9910

TABLE V. STOCKAGES

PARTS STOCKAGE

LEVEL	CLASS	QUANTITY	COST
1	1	0.	0.00
1	2	0.	0.00
2	1	0.	0.00
2	2	0.	0.00
3	1	0.	0.00
3	2	0.	0.00
4	1	6214.	31078.00
4	2	2981.	29810.00

MODULE STOCKAGE

COMPONENT	MODULE	LEVEL	STOCK	COST
1	1	1	0.	0.00
1	2	1	0.	0.00
2	1	1	0.	0.00
2	2	1	0.	0.00
1	1	2	52.	52000.00
1	2	2	52.	52000.00
2	1	2	52.	52000.00
2	2	2	38.	176000.00
1	1	3	0.	0.00
1	2	3	0.	0.00
2	1	3	0.	0.00
2	2	3	0.	0.00
1	1	4	0.	0.00
1	2	4	0.	0.00
2	1	4	0.	0.00
2	2	4	0.	0.00

TABLE V. STOCKAGES (Contd)

COMPONENT STOCKAGE

COMPONENT	LEVEL	STOCK	COST
1	1	104.	209000.00
2	1	136.	408000.00
1	2	0.	0.00
2	2	0.	0.00
1	3	0.	0.00
2	3	0.	0.00
1	4	0.	0.00
2	4	0.	0.00

END ITEM STOCKAGE

LEVEL	STOCK	COST
1	0.	0.00

In this example, initial issue and order-ship part stock is required at level 4 where FIP is performed. Replacement stock is also required at level (4). Module stock is required at level (2) where FIM maintenance is performed. Since COE and FIC are accomplished at the same level no end item float is required.

The next output is Test Equipment. Table VI lists the type, quantity and cost of test equipment required at each level of maintenance. Also listed are the requirements for test equipment in the whole force structure.

Note that no test equipment is required at the general support level since no maintenance performed at this level. Also the values listed under "quantity" are the percentages of the test equipment which is used by the equipment being evaluated. If this equipment is the only equipment using the test equipment, these numbers must be rounded up to the nearest whole number. A type 49 card with a value of 1 would cause both test equipment and manpower requirements to be rounded up. The information listed under "Total Test Equipment Requirements" is for the entire force structure. Again, if the equipment is the only one to use these test equipment, the quantity values on a per shop basis must be rounded up and multiplied times the number of each shop in the force structure.

The last output for this example is maintenance personnel. Table VII shows type quantity and cost of the different manpower categories. The costs here is on a per year basis. Again the quantity and cost information are based on use chargeable directly to the equipment under consideration. Also, as with the test equipment, "Total Maintenance Personnel Requirements" are based requirements for the total force structure.

The last two outputs, one graphical and one table of cost, availability and cost-effectiveness are not used for this example since there is no sensitivity analysis performed.

TABLE VI. TEST EQUIPMENT PER SHOP

ORGANIZATIONAL SUPPORT"

TYPE	QUANTITY	COST
1	1.715	1715.33
2	0.000	0.00
3	1.033	206.67

DIRECT SUPPORT"

TYPE	QUANTITY	COST
1	1.170	1169.73
2	0.620	434.00
3	0.550	109.95

GENERAL SUPPORT"

TYPE	QUANTITY	COST
1	0.000	0.00
2	0.000	0.00
3	0.000	0.00

DEPOT SUPPORT"

TYPE	QUANTITY	COST
1	1.736	1736.00
2	1.736	1215.20
3	0.289	57.87

TOTAL TEST EQUIPMENT REQUIREMENTS

TYPE	QUANTITY
1	20.138
2	4.216
3	10.755

TABLE VII. MAINTENANCE PERSONNEL PER SHOP

ORGANIZATIONAL SUPPORT			
MDS	QUANTITY	COST	
1	1.378	11022.22	
2	0.909	9093.33	
3	0.000	0.00	
DIRECT SUPPORT			
MDS	QUANTITY	COST	
1	0.733	5863.82	
2	0.733	7329.78	
3	0.827	6613.33	
GENERAL SUPPORT			
MDS	QUANTITY	COST	
1	0.000	0.00	
2	0.000	0.00	
3	0.000	0.00	
DEPOT SUPPORT			
MDS	QUANTITY	COST	
1	0.868	6944.00	
2	0.289	2893.33	
3	2.893	23146.67	
TOTAL MAINTENANCE PERSONNEL REQUIREMENTS			
MDS,	QUANTITY		
1		14.822	
2		10.496	
3		6.200	

Example 2, Maintainability vs. Reliability Tradeoff

The input data for our hypothetical equipment is identical to that used in Example 1. In this example we are interested in knowing the effect changes in Reliability and Maintainability have on support life cycle costs and operational availability.

To accomplish this we employ the sensitivity analysis option of GEMM. In this case, we will make four sensitivity runs perturbing each time: the mean-time-between-failure (MTBF) of parts, the mean-time-to-repair (MTTR) of the equipment, components and modules, and also the acquisition cost of the equipment, components, modules and parts.

Table VIII shows the values over which these parameters are varied. For each sensitivity run there is a set of parameter values. These sets of values may be thought of as the parameter values given by four different contractors vying for a development contract.

TABLE VIII. SENSITIVITY VALUES

<u>PARAMETER</u>	<u>SENSITIVITY 1</u>	<u>SENSITIVITY 2</u>	<u>SENSITIVITY 3</u>	<u>SENSITIVITY 4</u>
MTBF Type 1 Parts	50000 hrs	100000 hrs	200000 hrs	300000 hrs
MTBF Type 2 Parts	75000 hrs	150000 hrs	300000 hrs	400000 hrs
MTTR Checkout Eqpm	.5 hrs	1.5 hrs	2 hrs	4 hrs
MTTR Equipment	.5 hrs	.75 hrs	1.32 hrs	2.0 hrs
MTTR Component 1	.5 hrs	1.0 hrs	1.33 hrs	3. hrs
MTTR Component 2	.5 hrs	.75 hrs	1.0 hrs	5.0 hrs
MTTR Module (1,1)	.5 hrs	.75 hrs	1.0 hr	2.0 hrs
MTTR Module (1,2)	.5 hrs	1.0 hrs	2.0 hrs	6.0 hrs
MTTR Module (2,1)	2 hrs	3 hrs	4 hrs	8 hrs
MTTR Module (2,2)	1 hrs	2 hrs	3 hrs	4 hrs
Part Cost Type 1	\$1.00	\$80.00	\$5.00	\$10.00
Part Cost Type 2	\$5.00	\$14.00	\$10.00	\$20.00
Equipment Cost	\$2500.00	\$3000.00	\$5000.00	\$15000.00
Component 1 Cost	\$1500.00	\$1500.00	\$2000.00	\$5000.00
Component 2 Cost	\$1000.00	\$1500.00	\$3000.00	\$10000.00
Module (1,1) Cost	\$ 500.00	\$5.00	\$1000.00	\$2000.00
Module(1,2) Cost	\$ 500.00	\$ 750.00	\$1000.00	\$2000.00
Module (2,1) Cost	\$ 500.00	\$ 500.00	\$1000.00	\$2000.00
Module (2,2) Cost	\$1000.00	\$1250.00	\$2000.00	\$4000.00

In this example, we are optimizing over the same four policies that we evaluated in Example 1, but this time the optimization is accomplished with the original data and the four groups of sensitivity data. For each set of data the same output is obtained as in Example 1.

Table IX depicts the maintenance allocation for the second sensitivity run. Module one of component one is thrown away at level 2 while all the other modules are repaired at depot level (4). This table illustrates that thru optimization repair of modules of the same component can be allocated to different levels. This versatility in a model is required since one module may be mostly electronic and may be repaired in the field, and another module may be optical in nature and may have to be sent to the depot for repair.

Table X is a summary table which shows for each sensitivity run the life cycle cost, the operational availability and the cost-effectiveness. Cost-effectiveness is defined as availability divided by life cycle cost. This table is useful if a constrained optimum solution is required. In this example policy 1 is the original data, policy 2 is the first sensitivity run and so on for policies 3, 4 and 5.

Suppose there is a constraint on operational availability that it must be greater than 99 percent. This constraint would eliminate policies 2 and 3 from consideration. Of the policies remaining, policy 4 is the least cost while meeting the operational availability constraint. The life-cycle cost is \$25.26 million and the operational availability is .9909. Policy 4 is also the most cost-effective system. That is, you receive the most availability per unit dollar with policy 4.

The last three outputs, Figure 13, 14 and 15 are graphical outputs. Figure 13 provides a graph of life-cycle cost vs. different sensitivity runs. The first bar is for the original data and the remaining bars are for the sensitivity runs. Cost is in millions of dollars and each dot is one million dollar. Figure 14 is a graph of availability vs. sensitivity run and the last graph is cost-effectiveness where each dot is a unit of cost-effectiveness.

These graphs are designed to give the user a graphical representation of decision factors and to aid the user in any trend analysis.

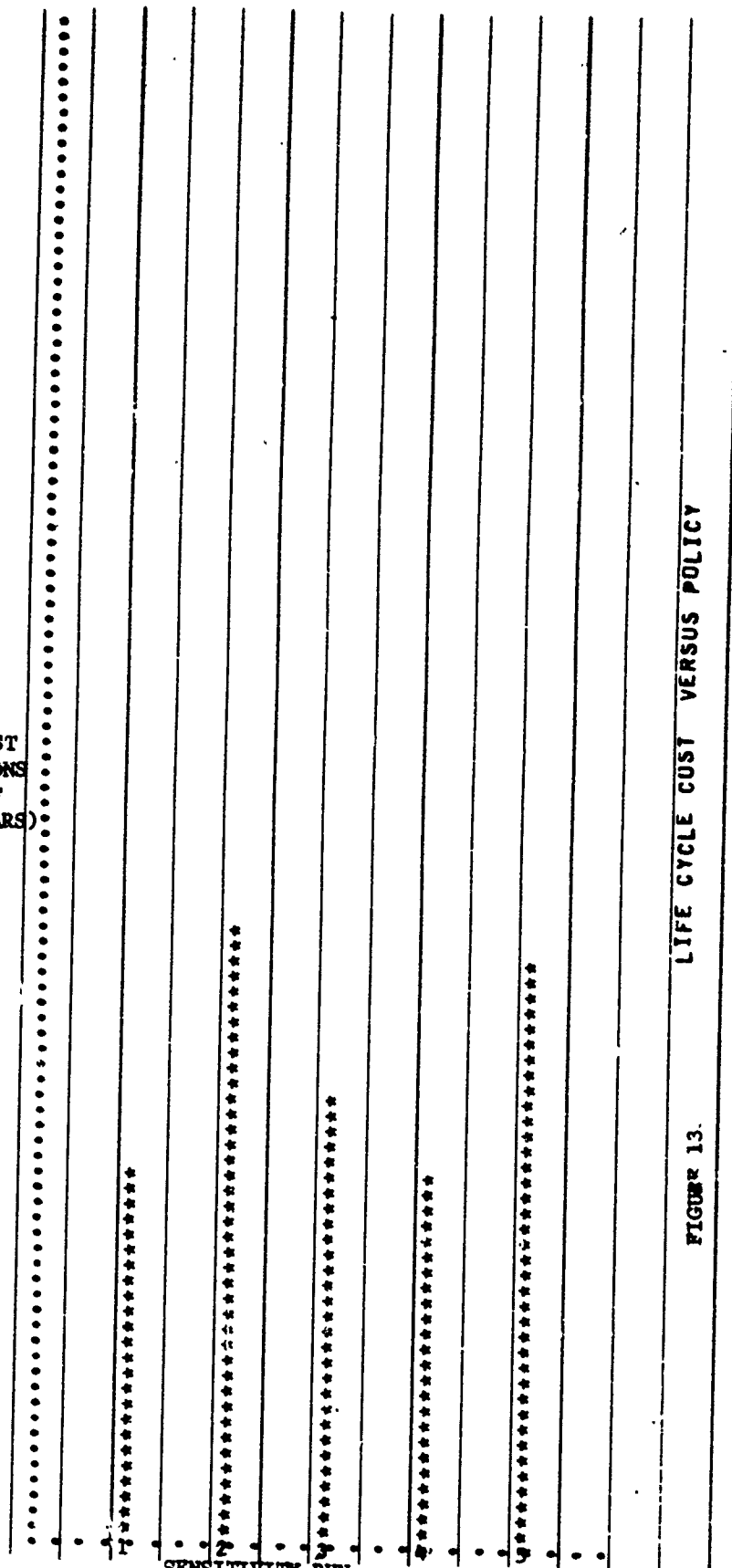
TABLE IX. MAINTENANCE ALLOCATION FOR SENSITIVITY 2

COMP	MUD	FIC	FIM	FIP
1		1	2	
1	1			0
1	2			4
2			2	
2	1			4
2	2			4

TABLE X. SUMMARY TABLE

POLICY	COST	AVAIL	COST-EFF
1	25.26013	99.099	3.9231
2	41.20918	97.352	2.3624
3	30.40519	98.510	3.2399
4	25.26013	99.099	3.9231
5	39.68797	99.214	2.4999

COST
(MILLIONS
OF
DOLLARS)

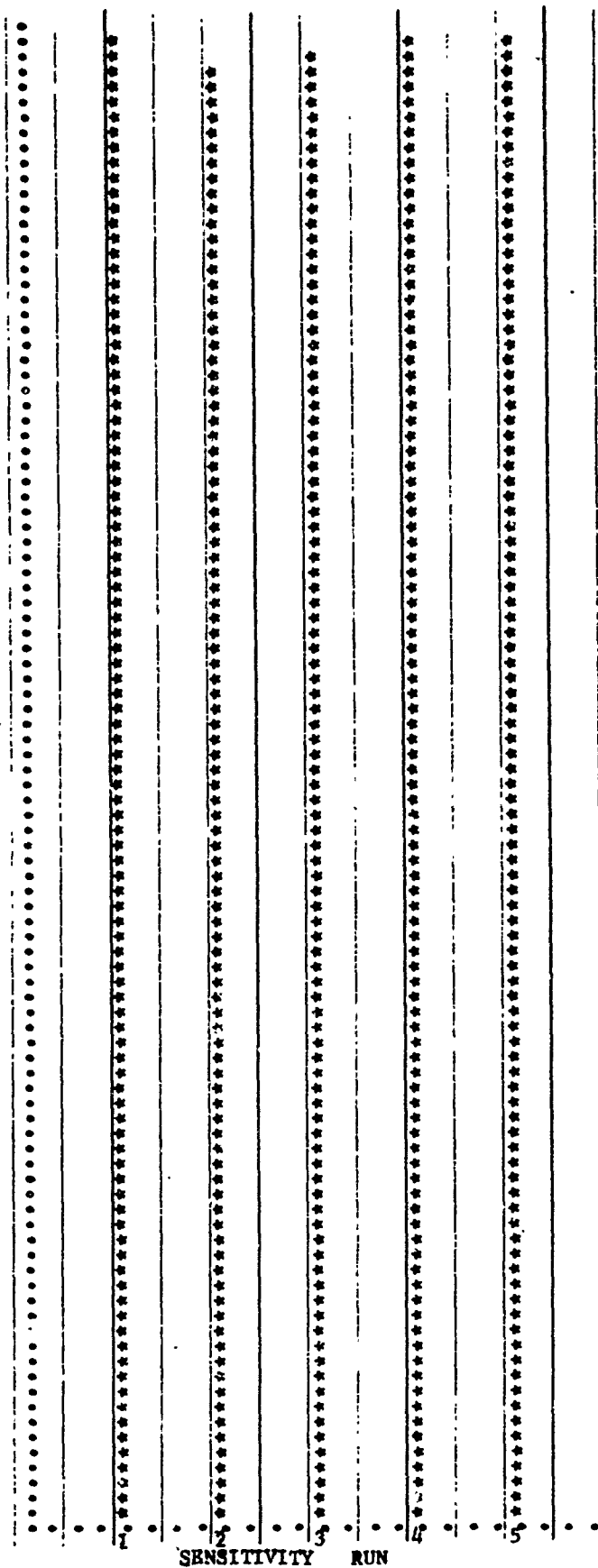


SENSITIVITY RUN

LIFE CYCLE COST VERSUS POLICY

FIGURE 13.

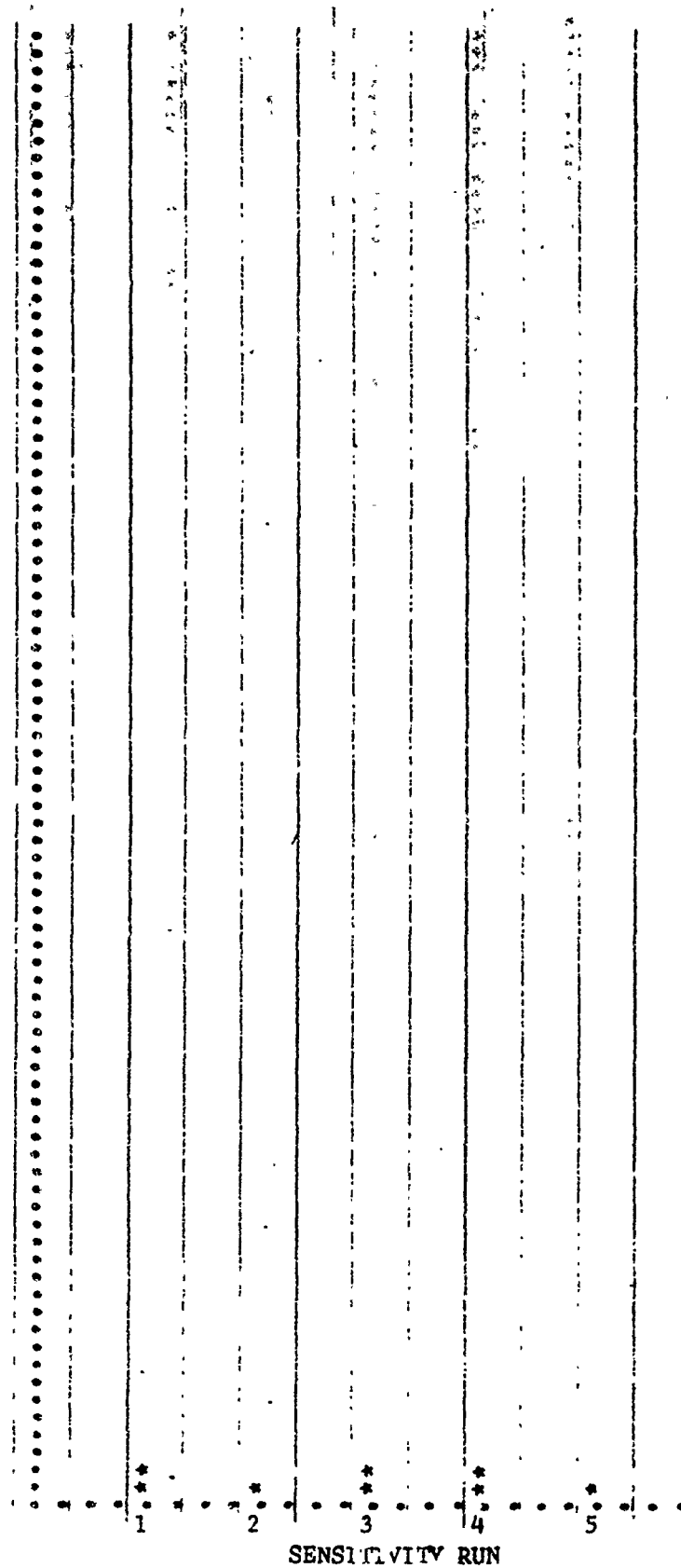
AVAILABILITY
(PERCENT)



SENSITIVITY RUN

FIGURE 14 AVAILABILITY VERSUS POLICY

COST
(MILLIONS
OF
DOLLARS)



SENSITIVITY RUN

FIGURE 15 COST EFFECTIVENESS VERSUS POLICY

CHAPTER IX

CONCLUSION

The GEMM development program has been completed. The GEMM Model is now operating on the Burroughs 5500 and IBM 360/65 computers. The equations in GEMM have been reviewed for accuracy and the logic flow of the program has been tested for errors. A sample problem was constructed of fictitious data to test the logic flow and computer subroutines. Manual calculation were performed on a small desk-top computer and compared to the GEMM outputs. The results of the comparison proved the accuracy of the logic flow and computer subroutines.

GEMM exhibits a degree of versatility not commonly found in support models. It is capable of optimization in an automatic mode and it can also be used to analyze a variety of maintenance situations in a manual mode. In the automatic mode, a specified number of maintenance policies can be evaluated and maintenance requirements will be output for the optimum policy. If it is necessary to review the maintenance requirements of each policy independently, then the manual mode can be used to obtain output for each policy.

Sensitivity analysis is another very important attribute of GEMM that yields a high degree of versatility and flexibility. GEMM is capable of sensitivity analysis on numerous different inputs variables. This is an invaluable tool for identifying variables that have a large impact on life cycle support costs and operational availability.

A common fault with many support models is the severe structuring of the model that allows little or no activity at the man-model interface. This type of model is completely automatic and the user merely inputs the data and interprets the results. This restricts the user from becoming involved with the analysis and denies him the privilege of applying his first-hand knowledge to the problem. GEMM provides the user with a powerful tool to which he can apply his first-hand knowledge for a more detailed and beneficial analysis. The automatic mode of GEMM can be used to determine the optimum policy and sensitivity analysis can be performed at the investigator's discretion. GEMM enlarges the man-model interface to permit more personalized analysis of design and logistics problems. Decisions on design and logistics of modern, sophisticated systems are much too complicated to be made by one man or group of men without a detailed analysis of many correlated factors. GEMM enables this detailed analysis at a tremendous savings in terms of time and money. This model is, however, only one step in the design of an automatic decision-making process that must be evolved in order to provide timely and cost-effective decisions in this rapidly moving age of technology.

APPENDIX A. GEMM Input Requirements

1. Number of components in equipment
2. Number of classes of parts in equipment
3. Number of modules in each component
4. Number of each part class in each module
5. Reliability information based on equipment operating hours:
 - a. Mean-Time-Between Failure for each part class
 - b. Mean-Time-Between Failure for each module
 - c. Mean-Time-Between Failure for each component
 - d. Mean-Time-Between Failure of the equipment
6. Mean-Time to check-out the equipment
7. Mean-Time-To-Repair Information based on active repair time (Fault Diagnosis + Replacement Time + Retest and Re-Calibrate Time):
 - a. Mean-Time-To-Repair the equipment
 - b. Mean-Time-To-Repair each component
 - c. Mean-Time-To-Repair each module
8. Cost of the equipment
9. Cost of the components
10. Cost of the modules
11. Average cost of each part class
12. Number of different types of test equipment required to perform all maintenance functions.
13. Test equipment required to check-out equipment.
14. Test equipment required to fault isolate to the component.
15. Test equipment required to fault isolate to the module.
16. Test equipment required to fault isolate to the part.

17. Cost for each type of test equipment.
18. Number of different types of manpower classifications (MOS).
19. MOS required for check-out-equipment.
20. MOS required for fault isolation to component.
21. MOS required for fault isolation to module.
22. MOS required for fault isolation to part.
23. Cost for each type of MOS (Per Year)
24. Weight of the equipment
25. Weight of each component
26. Weight of each module
27. Number of equipment serviced per shop at each maintenance level
28. Number of maintenance shops of each maintenance level in the force structure
29. Distance in miles between each maintenance level (Between Org and DS, DS and GS, GS and Depot, also Org and GS, Org and Depot, DS and Depot).
30. Cost per pound per mile for transportation (Between the different shops)
31. Requisition time for a part from the depot if part out of stock at level (L) where L can be DS, GS, and the Depot.
32. Requisition time for throwaway module from Depot if module out of stock at level (L) where L can be Org, DS and GS and Depot.
33. Requisition time for throwaway component from Depot if component out of stock at level (L) where L can be Org, DS, GS, and Depot.
34. Requisition time for spare equipment from the Depot.



35. Number of days per year that maintenance shops at each level operate.
36. Number of days per year of operation of the equipment.
37. Operating hours per day of the equipment.
38. Confidence limits for stockage of parts, modules, components, and the equipment.
39. Probability of false-no-go.
40. Attrition factor.
41. Requirements objective period.
42. Stockage objective periods between levels.
43. Order and shipping times between levels.
44. Turnaround times for modules between levels.
45. Turnaround times for components between levels.
46. Economic Life.
47. Cost to train each MOS type.
48. Turnover time for manpower.
49. Percentage factor of total stockage cost for Inventory Management.
50. Fraction mean-time-to-repair reduced if maintenance is accomplished at the depot level.
51. Total cost of research & development.
52. Publication information.

* Parts must be classified into different classes. Could be classified according to failure rate, cost, etc.. This classification should probably be done by the R&D engineer.

APPENDIX B. FORTRAN Names and Descriptions

This appendix is divided into three major sections: Input Variables, Program Variables and Subroutines. For each variable the FORTRAN name is given along with a brief description of that variable. This listing may be used along with the flow diagrams in Appendix C to follow the logic of the GEMM Program given in Appendix D.

INPUT VARIABLES

<u>SYMBOL</u>	<u>DESCRIPTION</u>
NC	Number of components
NCLASP	Number of classes of parts
NMK (I)	Number of modules in a component
NUMBR (I,J,KS)	Number of part type (KS) in module (IJ)
MTBFP (K)	Mean-time-between failure for part class (K)
MTBFM (I,J)	Mean-time-between failure for module (I,J)
MTBFC (I)	Mean-time-between-failure for component (I)
MTBFE	Mean-time-between-failure of the equipment
MITRCE	Mean-time to check-out the equipment
MITRE	Mean-time-to-repair the equipment
MITRC (I)	Mean-time-to-repair the component (I)
MITRM (I,J)	Mean-time-to-repair the module (I,J)
CSEI	Cost of the equipment
CCC (I)	Cost of the Component (I)
CC (I,J)	Cost of module (I,J)
C (K)	Cost of part type (K)
NTE	Number of different types of test equipment required.
TECF (K) 2 or 0 for all K	Test equipment use identifier for check-out equipment
TEEI (K) 1 or 0 for all K	Test equipment use identifier for fault isolate to component
TECI (I,K) 1 or 0 for all K	Test Equipment use identifier for fault isolate to module
TEMI (I,J,K) 2 or 0 for all K	Test Equipment use identifier for fault isolate to part

<u>SYMBOL</u>	<u>DESCRIPTION</u>
TECOST (K)	Test Equipment Cost for type (K)
NMOS	Number of different types of manpower classifications
MOSCE (KM) 1 or 0 for all KM	Manpower use identifier for check out equipment
MOSE (KM) 1 or 0 for all KM	Manpower use identifier for fault isolation to component
MOSC (I, KM) 1 or 0 for all KM	Manpower use identifier for fault isolation to module
MOSM (I,J,KM) 1 or 0 for all KM	Manpower use identifier for fault isolation to part
MCOST (KM)	Manpower cost for type (KM)
WTE	Weight of the equipment
WTC (I)	Weight of component (I)
WTM (I,J)	Weight of module (I,J)
NSHOP (L)	Number of equipment serviced at maintenance level (L)
NUMFS (L)	Number of maintenance shops type (L) in the force structure
TRANST (L, NL)	Distance in miles between maintenance level (L) and (NL)
COSLB (L, NL)	Cost per pound per mile for transportation from level (L) to (NL)
REQPT (L,4)	Requisition time for a part from level (4) if part out of stock at level (L)
REQMT (L,4)	Requisition time for throwaway module from level (4) if module out of stock at level (L)
REQCT (L,4)	Requisition time for throwaway component from level (4) if component out of stock at level (L)
REQET	Requisition time for spare equipment
WAIT (L)	Waiting time for maintenance at level (L)
OPHRSH (L)	Operating hours per day of maintenance shop at level (L)

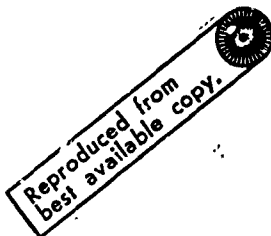
<u>SYMBOL</u>	<u>DESCRIPTION</u>
NDAY	Number of days per year of operation of maintenance shops
NDAE	Number of days per year of operation of the equipment
OPHRDY	Operating hours per day of the equipment
K1,K2,K3,K4	Confidence limits for stockage of parts, modules, components, and the equipment
PFNGO	Probability of false-no-go
ATRF	Attrition factor
ROP	Requirements objective period
B(L)	Stockage objective periods between levels
G(L)	Order and shipping times between levels
TURN1(L)	Turnaround times for modules between levels
TURN2(L)	Turnaround times for components between levels
ELIFE	Economic life
XMAN (KM)	Cost to train manpower type (KM)
TRAIN	Turnover time for manpower
FACTIN	Percentage factor of total stockage cost for Inventory Management
TRANS (L, NL)	Distance in time between maintenance level (L) and (NL).
PROD	Productive factor of manpower.
CTOE	Cost to overhaul equipment.
CTOC (I)	Cost to overhaul component type (I).
CTOM (I, J)	Cost to overhaul module type (I, J).
TBOE	Time between overhauls of equipment.
TBOC (I)	Time between overhauls of component type (I).

TBOM (I, J)

Time between overhauls of module type
(I, J)

REQ

Requisition time of an equipment float.



PROGRAM VARIABLES

AMMHC(I) - AMMH for repair of component.

AMMHCE - Annual Maintenance Manhours (AMMH) for check-out equipment.

AMMHM (I, J) - Annual Maintenance Manhours for a module.

AMMHM (I, J) - AMMH for repair of module.

AMMHE - AMMH for repair of equipment.

AVAILA - Operational Availability

COE (I) - Level for Checkout of Equipment.

CSTK (L, K) - Cost of part stock for printout.

CSTLC (L, I) - Cost of Component Stock for Printout.

CSTKM (NL, I, J) - Cost of Module Stock for Printout.

CSTRNC (I) - Cost of Transportation for Components.

CSTRNE - Cost of Transportation for Equipment.

CTINVI - Adds up inventory costs for printout.

CTRM - Adds up training cost for printout

FIC (I) - Level for Fault Isolation to Component.

FICT - Tradeoff value for FIC level.

FIM (I) - Level for fault isolation to module.

FIMS (I) - Cost for Optimum level for FIM.

FIMT (I) - Tradeoff value for FIM level.

FIP (I) - Level for fault isolation to part.

FIPS (I, J) - Cost for optimum FIP level.

FIPT (I, T) - Tradeoff cost for FIP level.

GAVAL (I) - Values for availability for different sensitivity runs.

GCOST (I) - Values for cost for different sensitivity runs.

GCSTE (I) - Value for cost-effectiveness for different sensitivity runs.

I - Component Indicator

II - X Value in graph routine represents input policy run.
 IR - Sets poli / equal to next policy.
 J - Module Indicator
 K - Part type indicator
 L - Maintenance level where FIP accomplished.
 LEMIN - Optimum repair level for the equipment.
 LMMIN (I) - Optimum repair level for components.
 LMS (I) - Optimum level for FIM.
 LPMIN (I, J) - Optimum repair level for modules.
 LPP (I, J) - Optimum FIP level for given FIM level.
 LPS (I, J) - Optimum FIP level.
 LX³ - Indicates next policy to be evaluated.
 M - Specifies policy to be investigated.
 MMLEV (L, KM) - Adds up manpower requirements for printout.
 MMNUM (KM) - Force structure requirement for printout.
 MOSCC - Total manpower cost for FIC for a given policy.
 MOSCM (I) - Total test equipment cost for FIM of a component.
 MOSCP (I, J) - Total cost for manpower for a module.
 MOSEC - Manpower cost for COE
 MPT - Mean down time for equipment
 NL - Maintenance level where FIM accomplished.
 >NNL - Maintenance level where FIC accomplished.
 >NNLEV (L, KK) - Adds up test equipment requirements for printout.
 NOFAIC (I) - Number of components which fail during a year.
 NOFAIE - Number of equipment which fail during a year
 NOFAIL (I, J) - Number of module which fail during a year.
 REST - Total reorder stock cost for printout.

ROPART - Adds up reorder stock cost for printout.
 ST1 (K) - Initial provisioning replacement part stock.
 ST3 (K) - Initial provisioning initial issue parts stock.
 STCM (I) - Cost of the stock of modules for a component.
 STCP (I, J) - Cost of initial provisioning part cost for a module.
 STKC (NNL, I) - Requirements for component stockage.
 STKCR (I) - Requirements for reorder component stock.
 STKE - Number of end item stock required manpower.
 STKEC - Cost of end item stock for printout.
 STKM (NL, I, J) - Initial provisioning stock for modules.
 STKMR (I, J) - Reorder stock for modules.
 STKTC (NNL, I) - Number of throwaway components required for initial provisioning.
 STKTC (NNL, I) - Requirements for throwaway components.
 STKTCR (I) - Number of throwaway components required for reorder.
 STKTCR (I) - Requirements for reorder stock for throwaway components.
 STKTM (NL, I, J) - Number of throwaway modules required for initial provisioning.
 STKTM (I, J) - Requirements for throwaway modules.
 STKTMR (I, J) - Number of throwaway modules required for reorder.
 STKTMR (I, J) - Requirements for reorder stock for throwaway modules.
 STL (K) - Initial provisioning order-ship part stock
 STR (K) - Reorder stock for parts.
 SUMC - Total of optimum FIMS's for the equipment.
 SUME - Total cost for repair for modules, components, and the end item.
 SUMEMN - Optimum total cost for the whole equipment.
 SUMM - Total cost for modules of a component and component itself.
 SUMP - Total of optimum FIPS's for given component.

SUN - Cost for reorder stock for a module.

SUNN - Cost of reorder stock.

SUNNN - Total cost of reorder stock.

T (I) - Indicator for throwaway components.

T (I, J) - Indicator for throwaway modules.

TECC - Total test equipment cost for a given policy.

TECM (I) - Total manpower cost for FIM of a component.

TECP (I, J) - Total cost of test equipment for a module.

TEEC - Test Equipment Cost for COE.

TINVIN - Inventory Costs.

TOMOS - Total MOS cost for printout.

TOMOSS - Total manpower cost for printout for life.

TOSTK - Total stock cost for initial provisioning for printout.

TOTCSC - Total cost for repair of components

TOTCSM (I) - Total cost of modules for a component.

TOTCSP (I, J, L) - Total cost for repair of a module at a given level of maintenance.

TOTE - Total test equipment cost for printout.

TOTEND - Total cost for check out of equipment including end item stock.

TOTRNS - Total transportation cost for one year.

TOTRSS - Total transportation cost for printout.

TRM - Training Cost

TSTOCK - Total stockage cost for printout.

TTC - Turnaround time of a component.

TTE - Turnaround time of equipment.

TTM - Turnaround time of a module.

TTT - Indicator for throwaway end item

VALUE (II) - Y value in graph routine represents cost, availability or cost effectiveness.

ZZ - Resets policy indicator.

SUBROUTINES

<u>SYMBOL</u>	<u>DESCRIPTION</u>
MTBFMD	Calculates mean time between failure of modules
MTBFCM	Calculates mean time between failure of components
MTBFEQ	Calculates mean time between failure of equipment
ANMH	Calculates Annual Maintenance Manhours (AMMH) for modules, components and the end item.
XFIM	Calculates repair or maintenance requirements for components except for stockage. Those requirements include manpower, test equipment and training.
XFIC	Calculates maintenance requirements for the repair of the end item itself except for stockage. These requirements include manpower, test equipment and training.
XCOE	Calculates maintenance and stockage requirements for the check-out of the end item. Requirements include manpower, test equipment, training and end item float or throwaway end items.
TRANSM	Calculates transportation costs for modules between levels of maintenance
TRANSC	Calculates transportation costs for components between levels of maintenance.
TRANSE	Calculates transportation costs for the end item between levels of maintenance.
THRMOD	Calculates stockage requirements for modules to receive throwaway maintenance.
THRCOM	Calculates stockage requirements for components to receive throwaway maintenance.
NRFPE	Calculates stockage requirements for the end item to receive throwaway maintenance.
NONREP	Calculates stockage requirements for non-repairable parts for all levels.
REPMOD	Calculates stockage requirements for repairable modules.
REPCOM	Calculates stockage requirements for repairable components.
REPEND	Calculates stockage requirements for repairable end items.

SYMBOL

DESCRIPTION

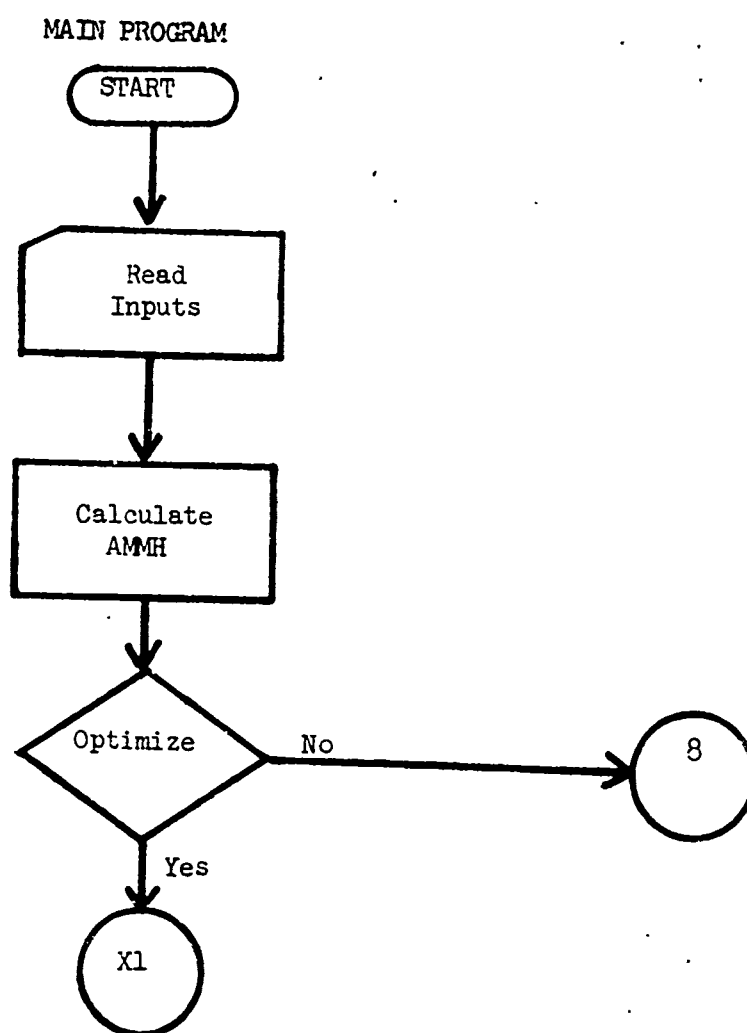
AVAIL

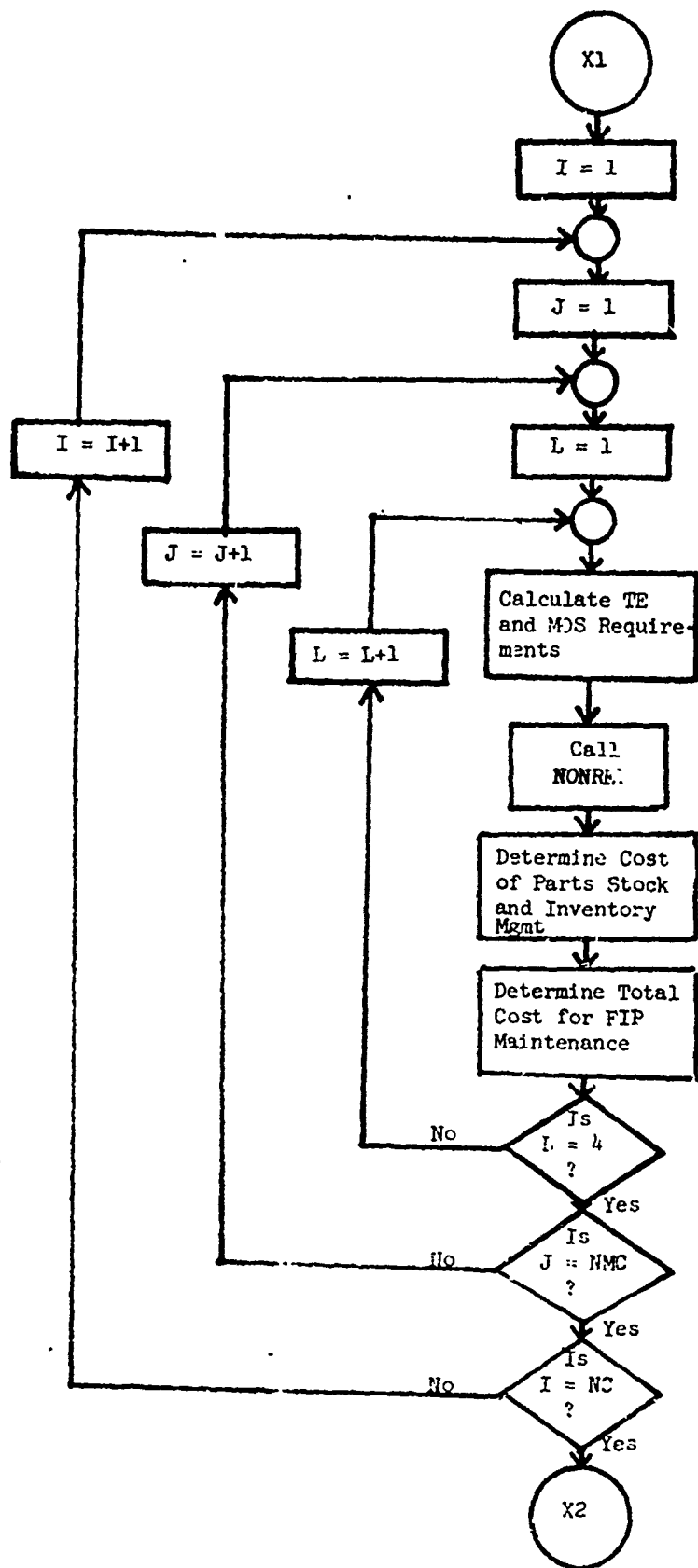
Calculates operational availability for the equipment under study.

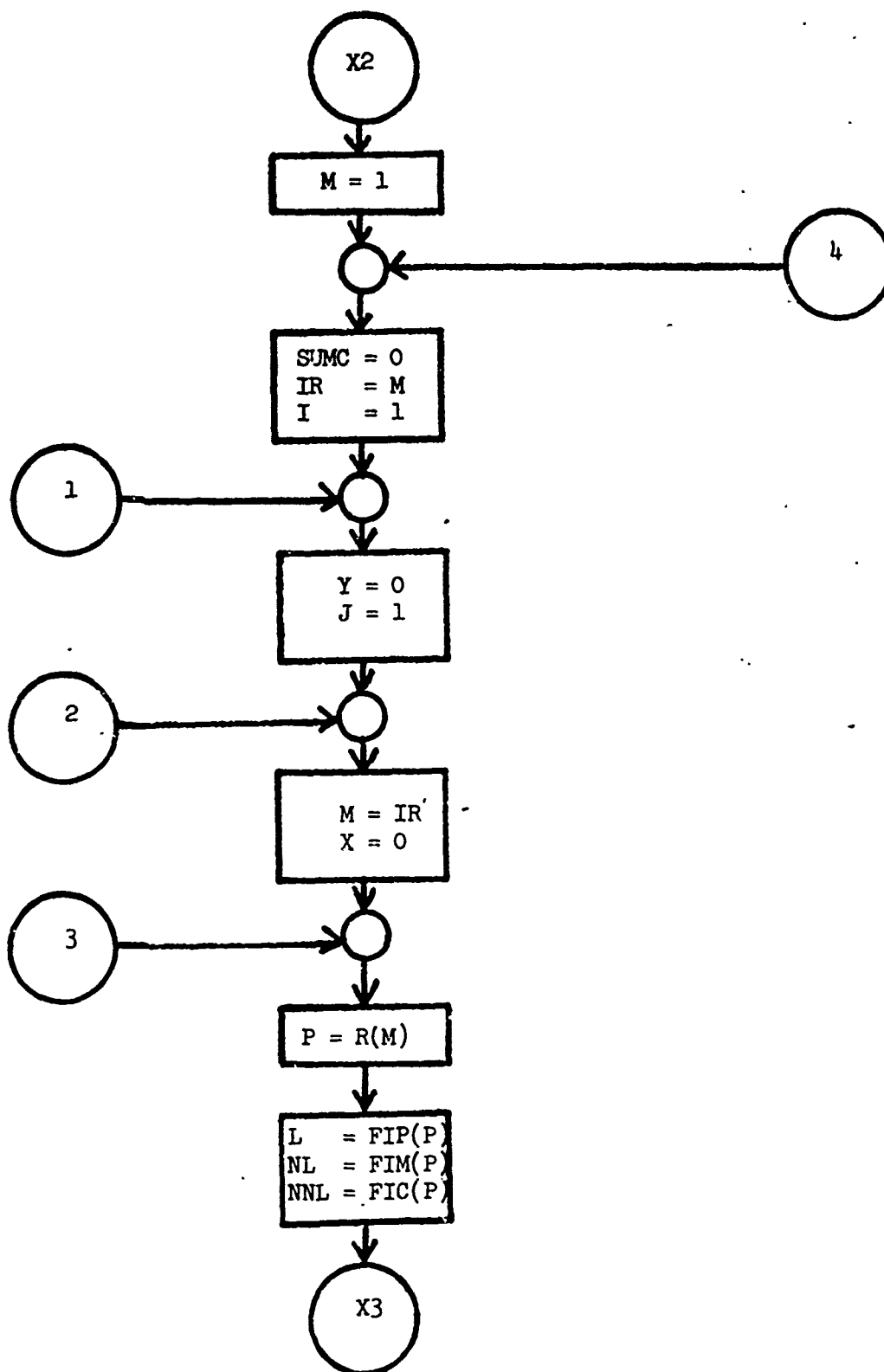
GRAPH

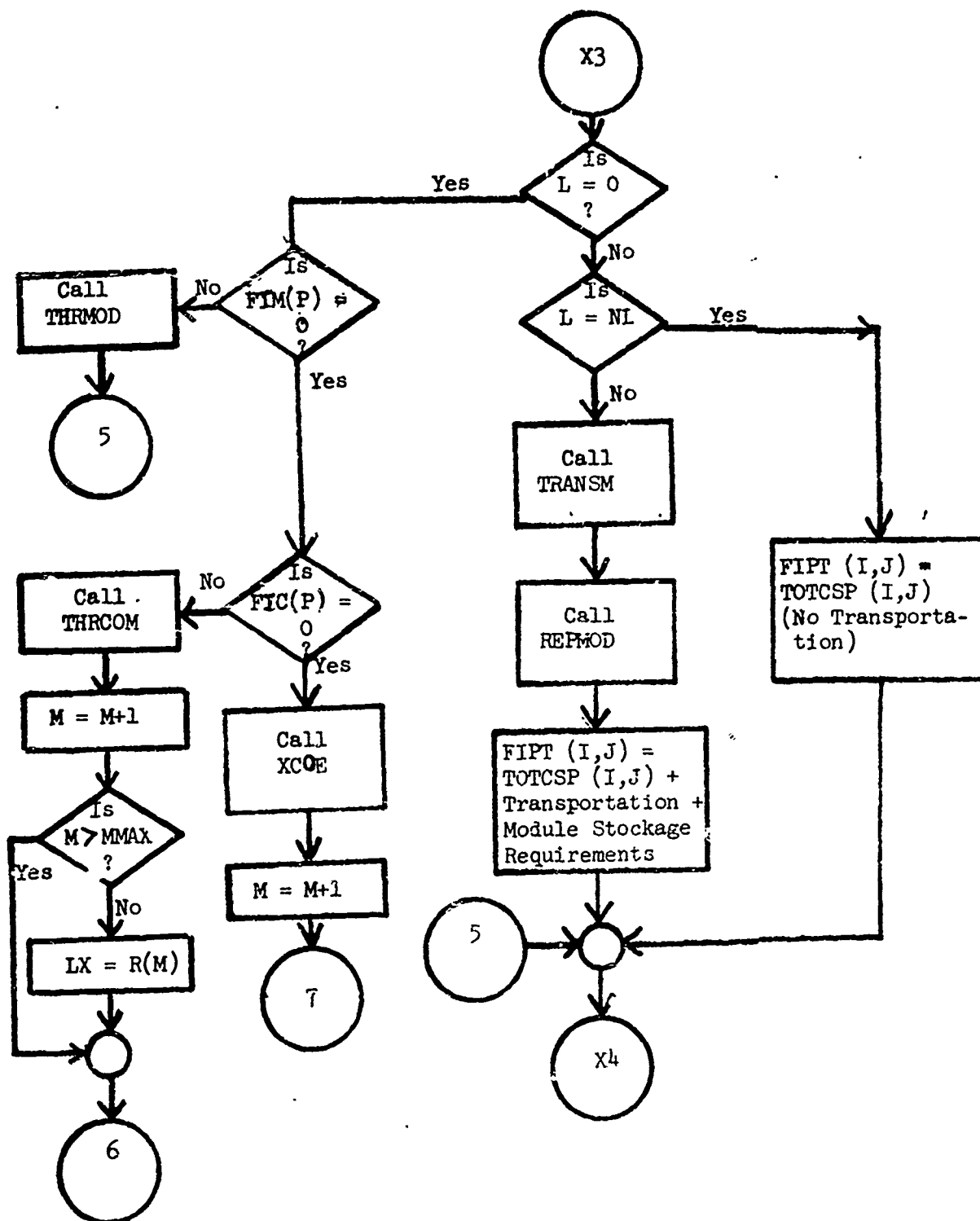
Output routine for graphical representation of cost, availability and cost-effectiveness.

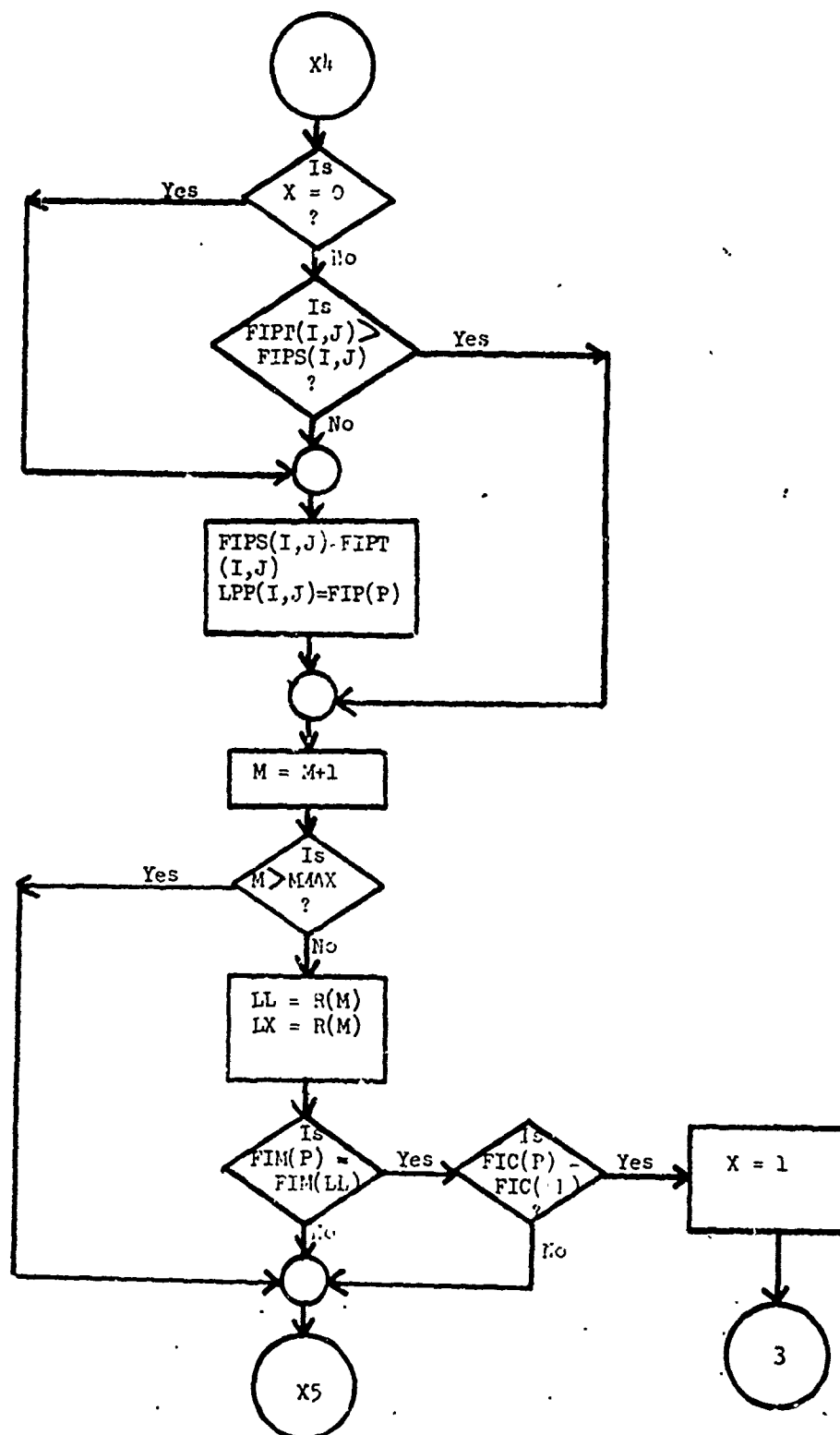
APPENDIX C. FLOW DIAGRAMS

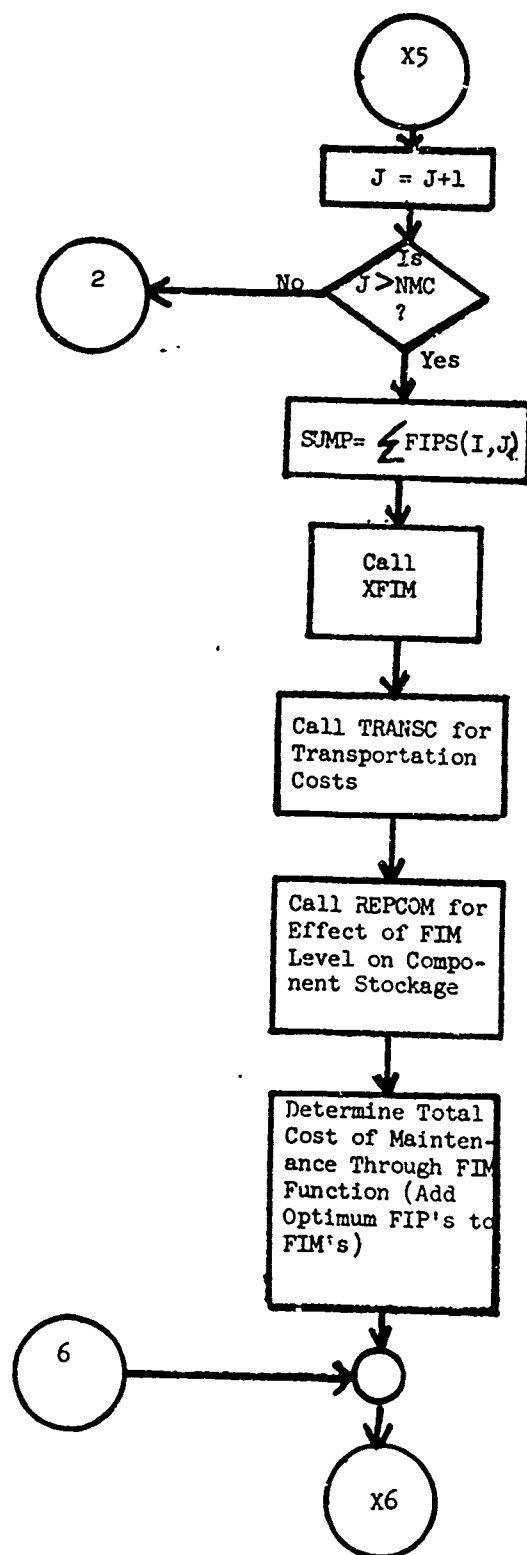


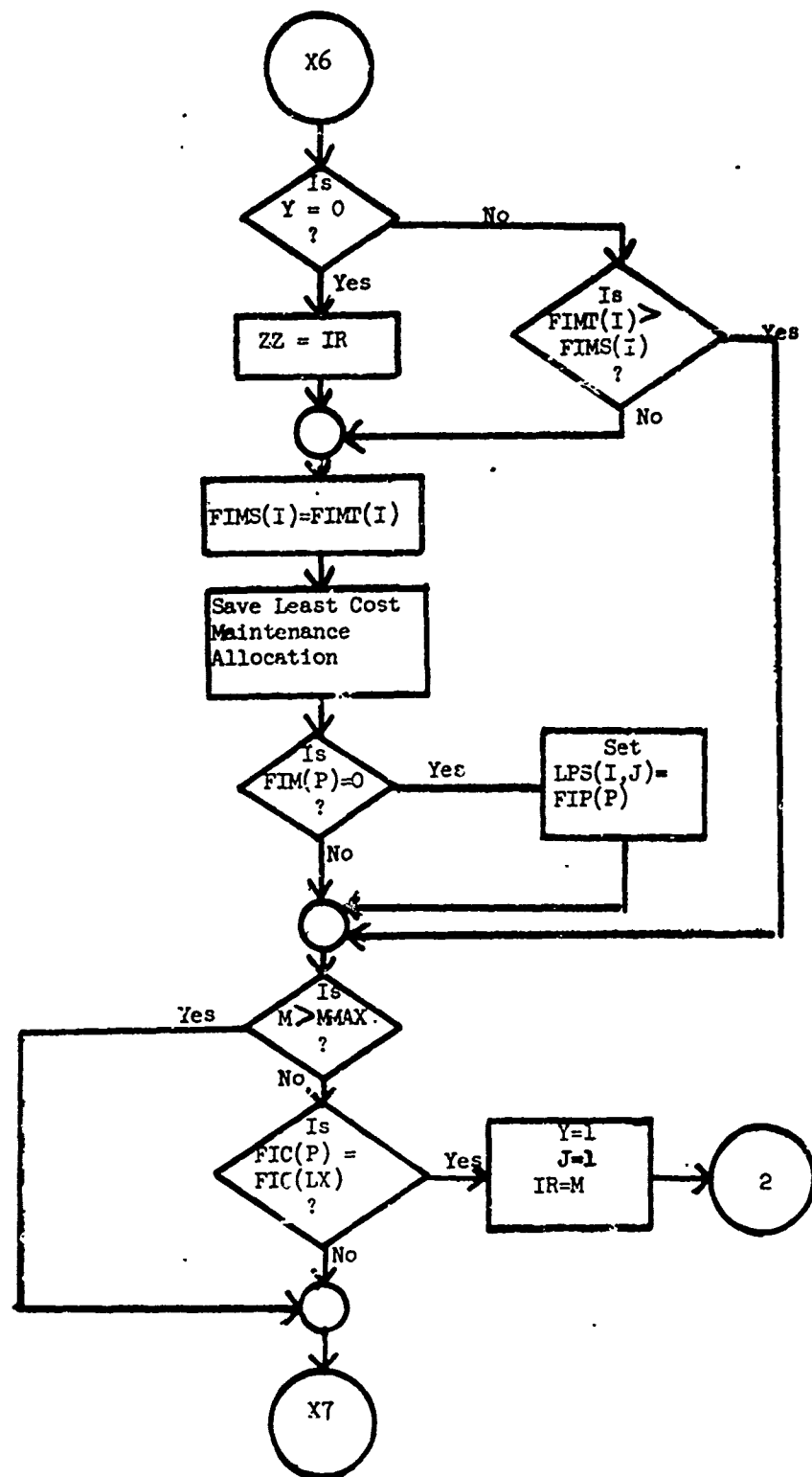


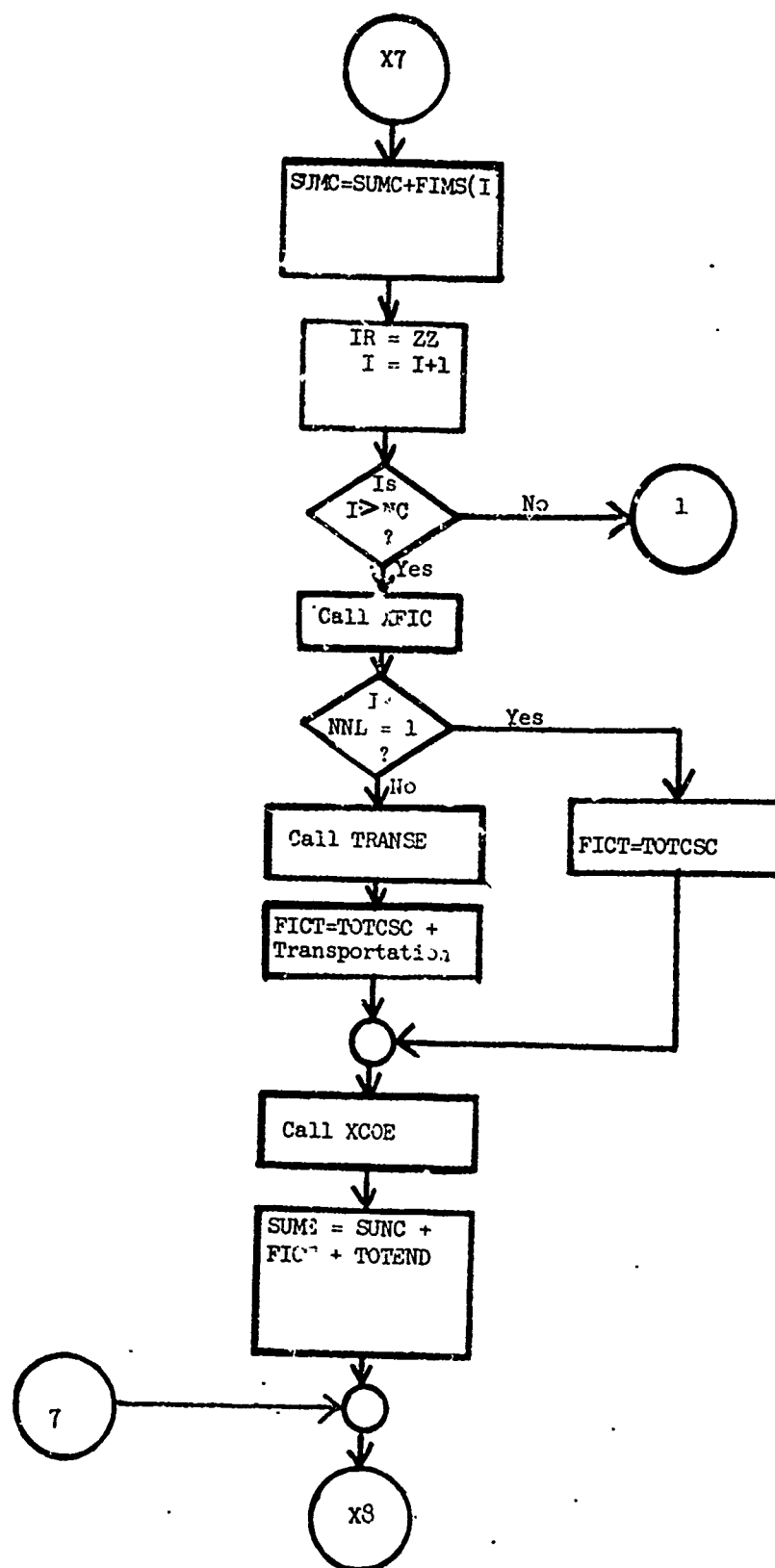


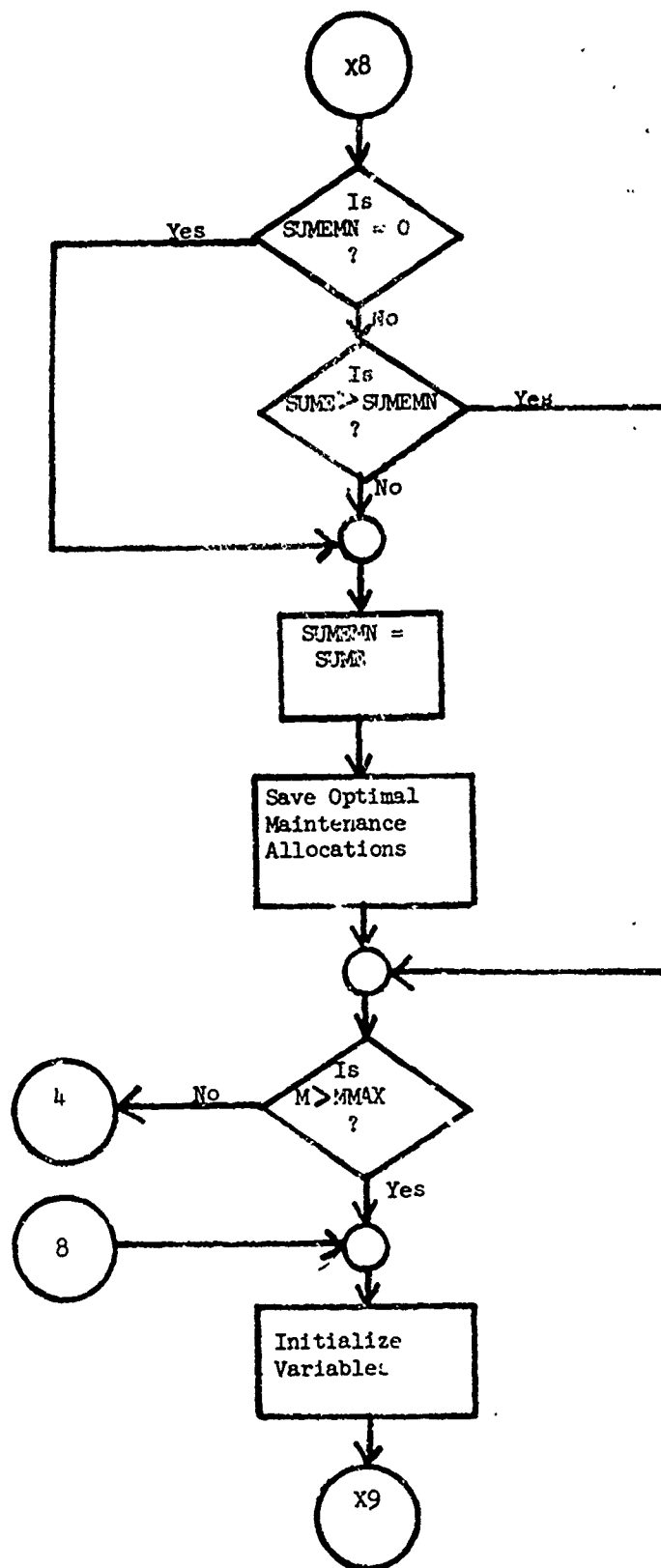


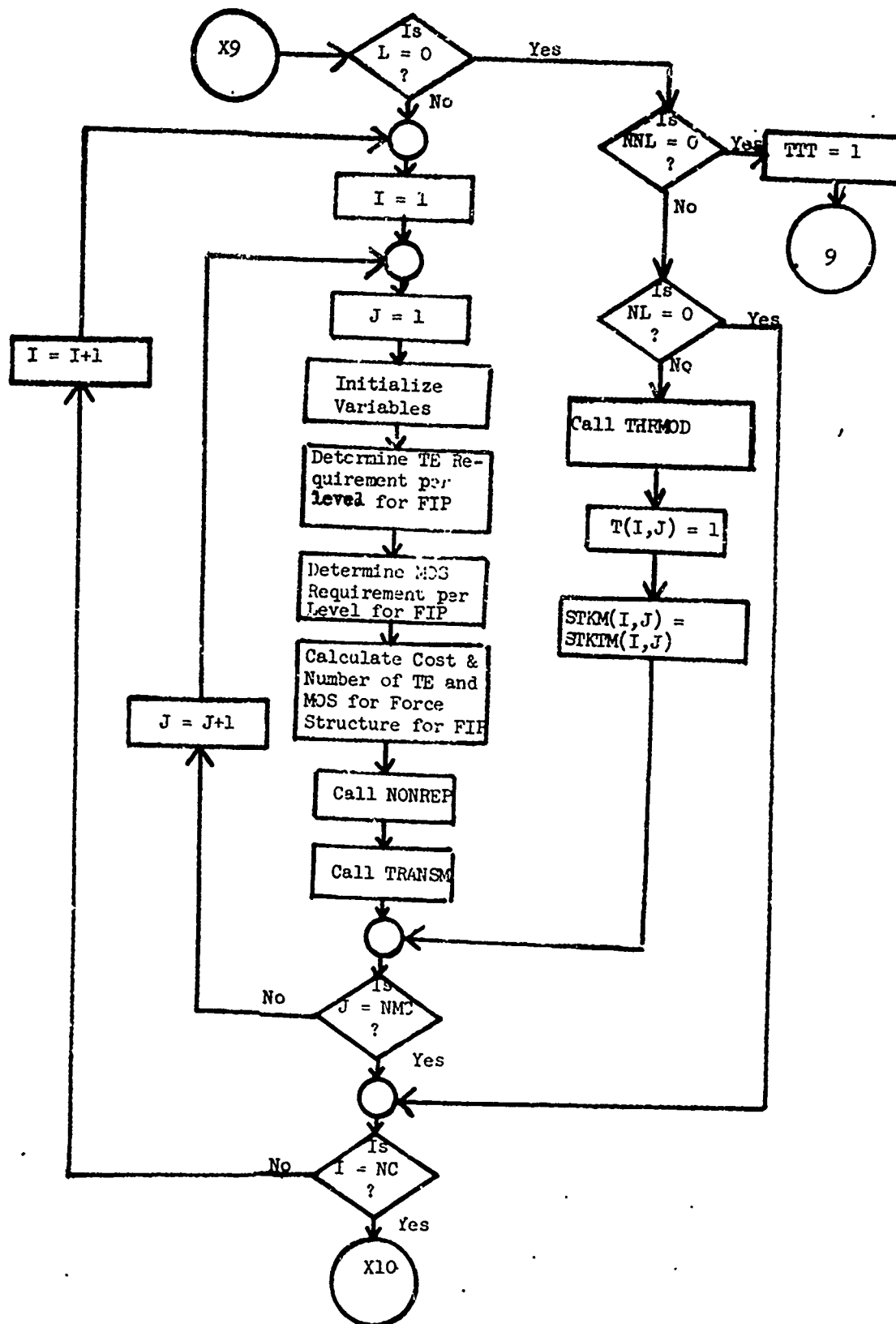


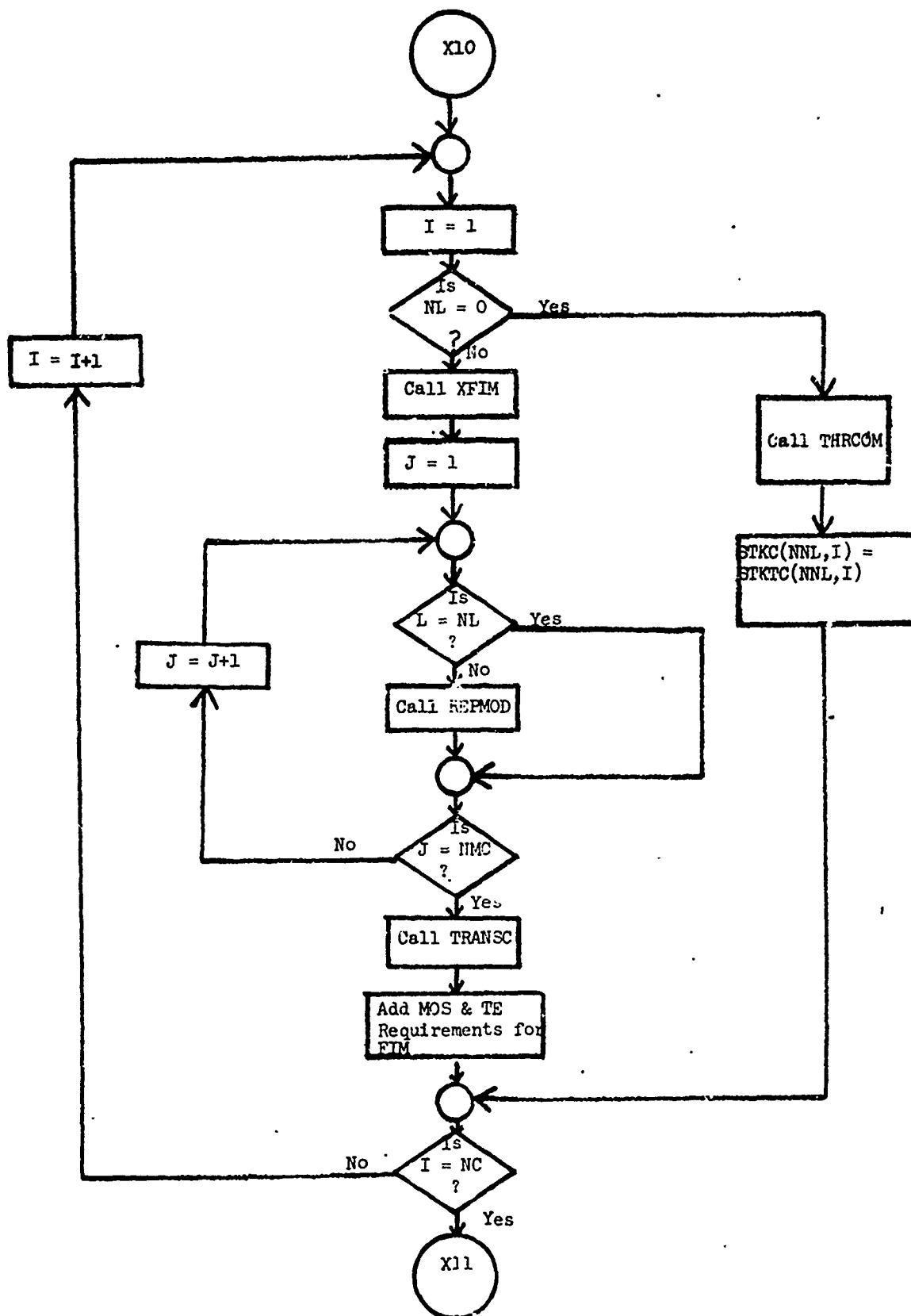


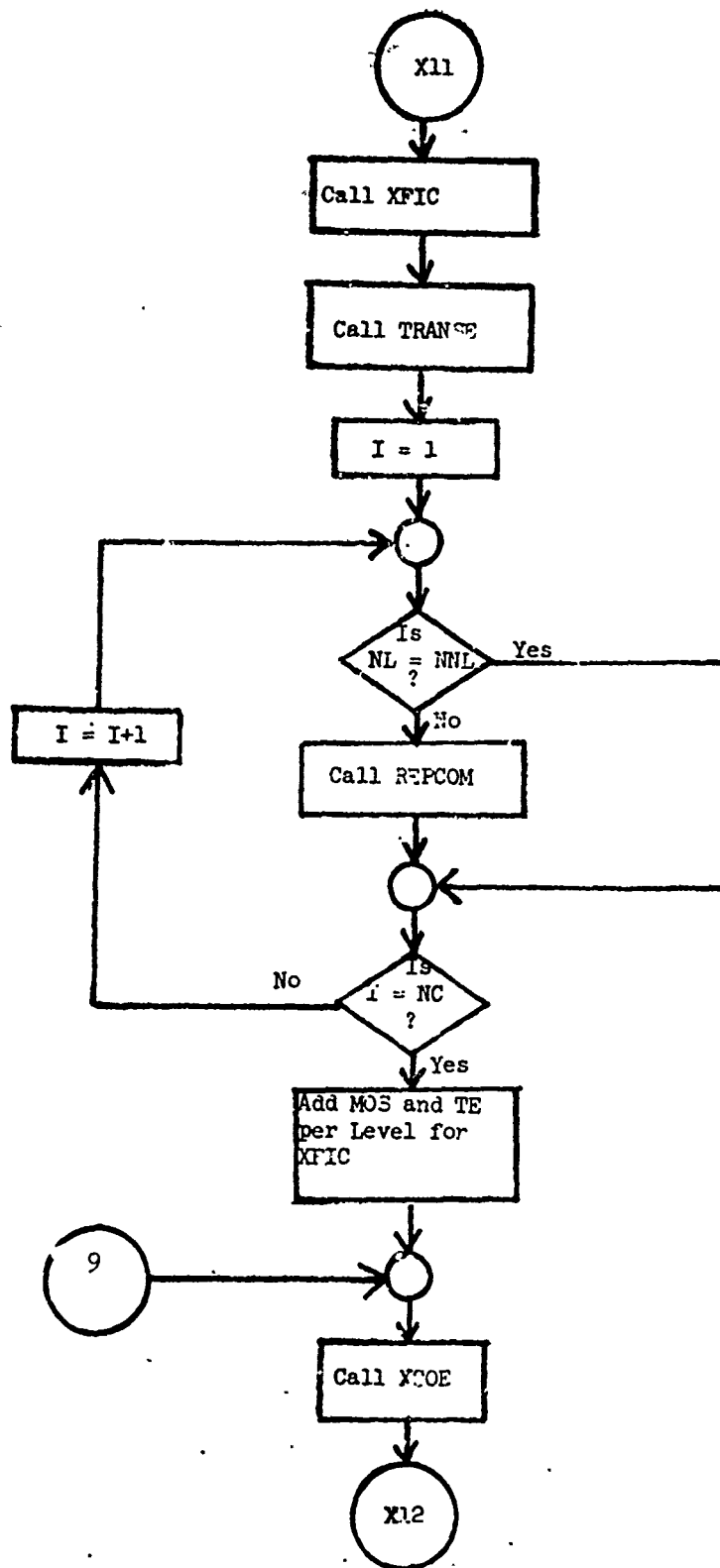


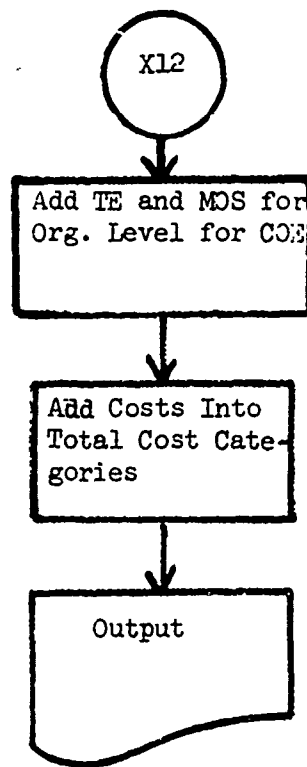




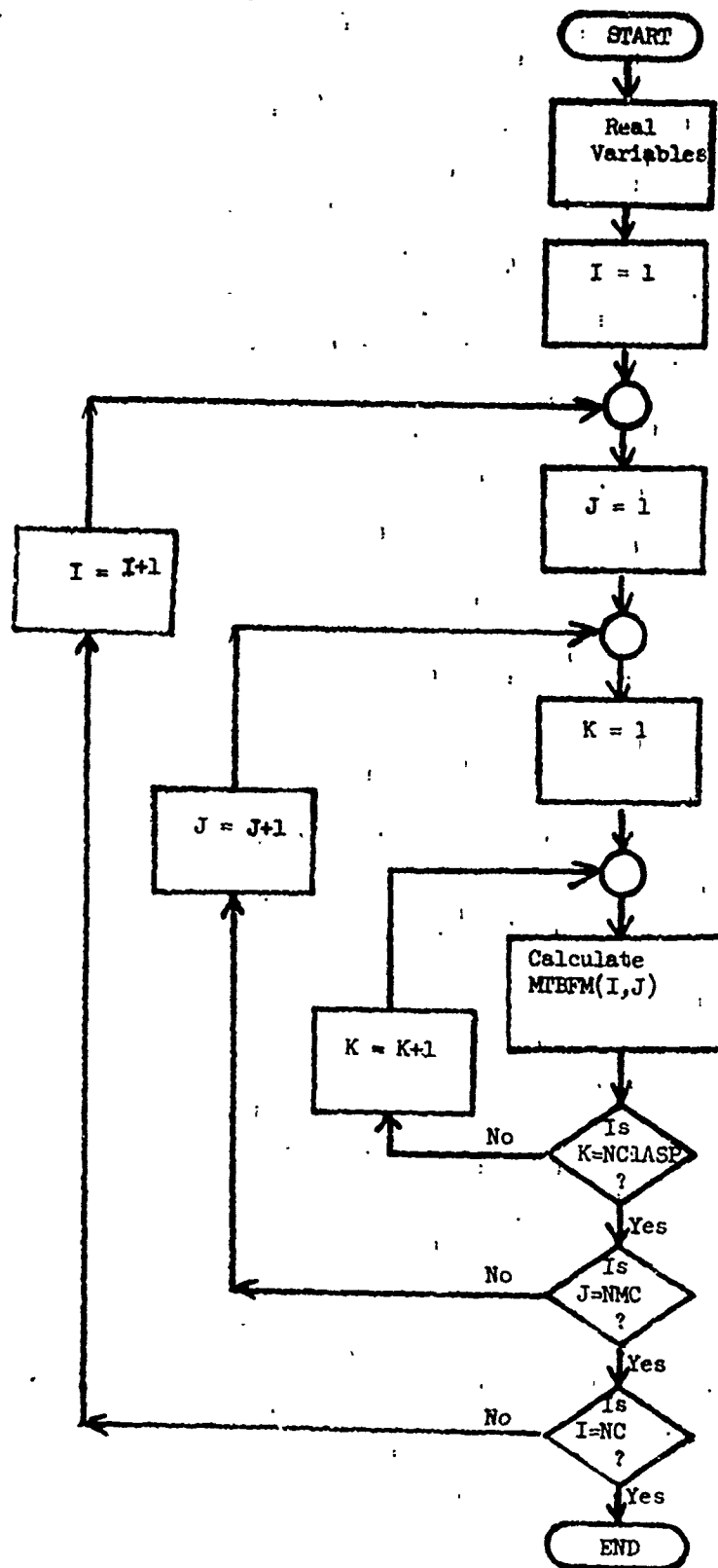




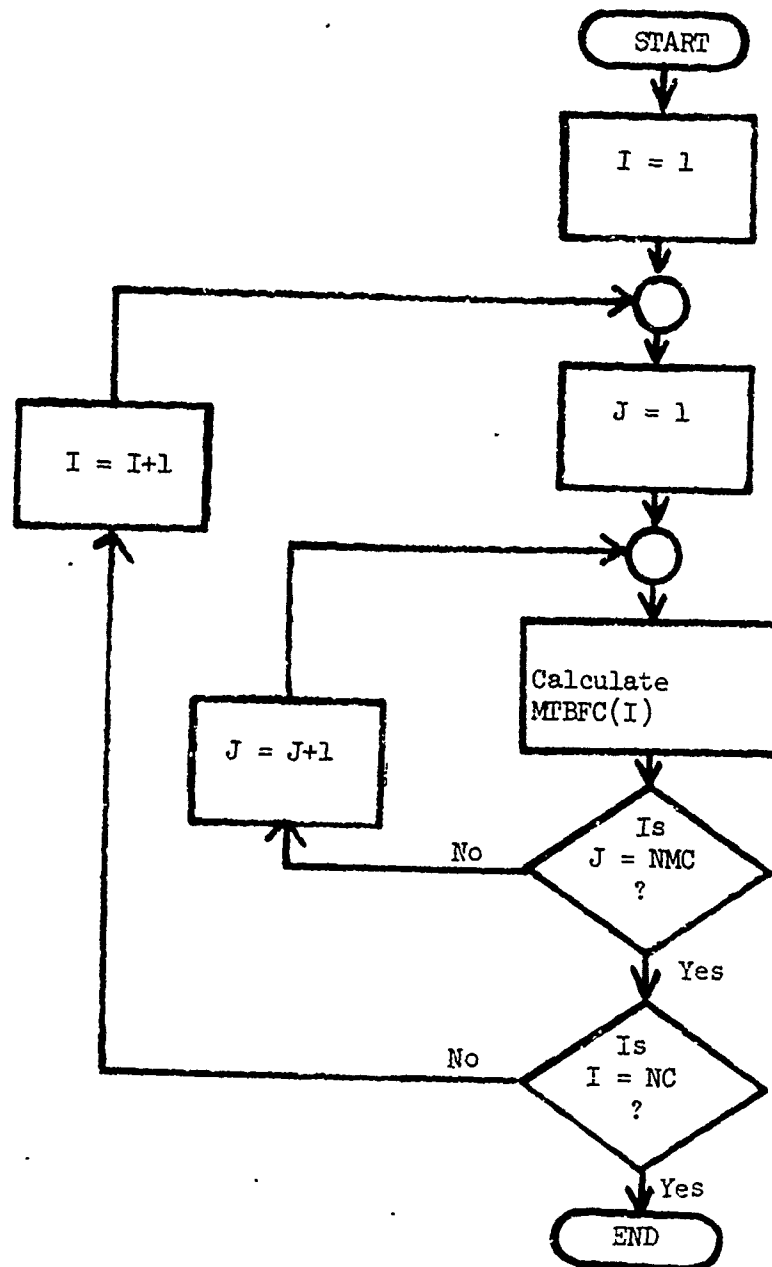




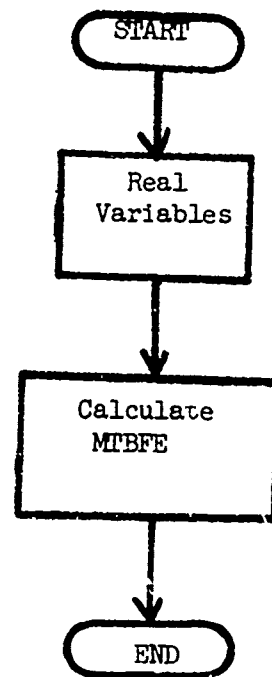
SUBROUTINE MTBFMD



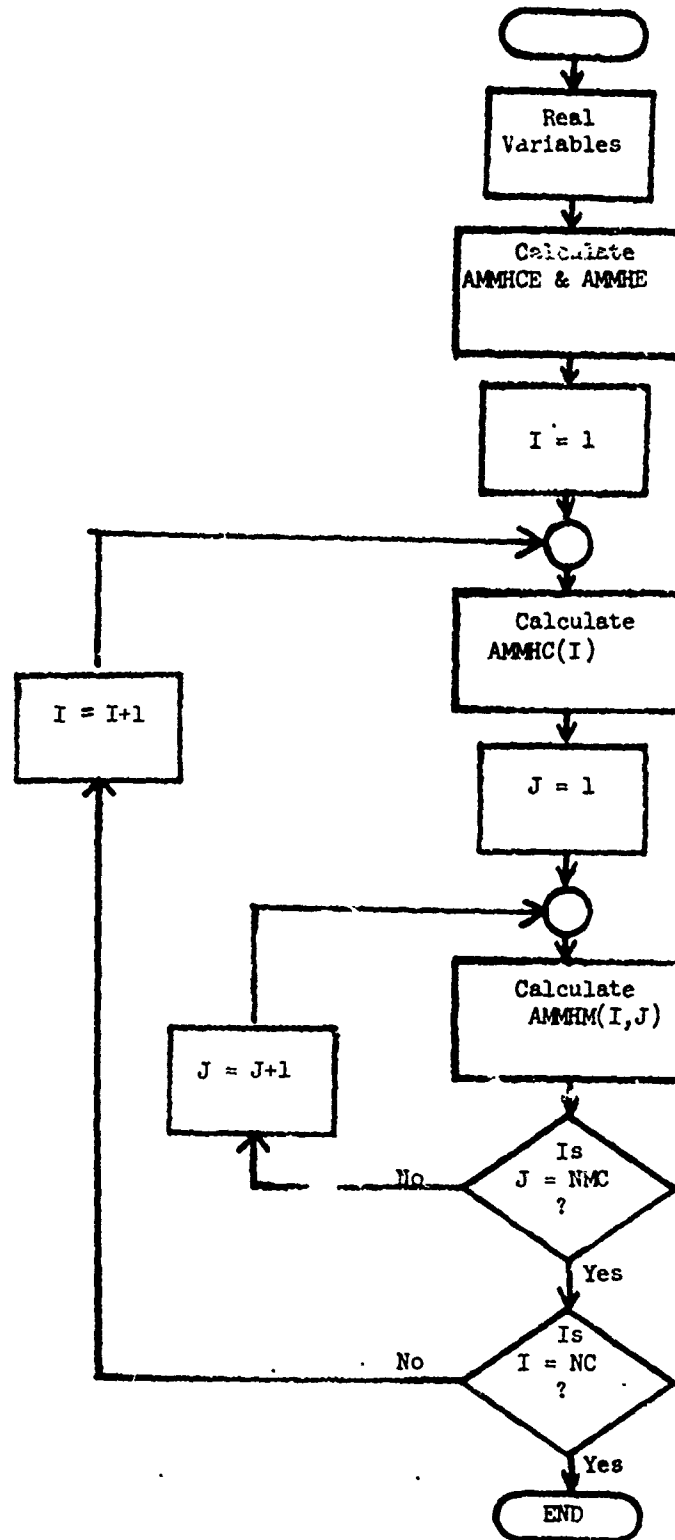
SUBROUTINE MTBFCM



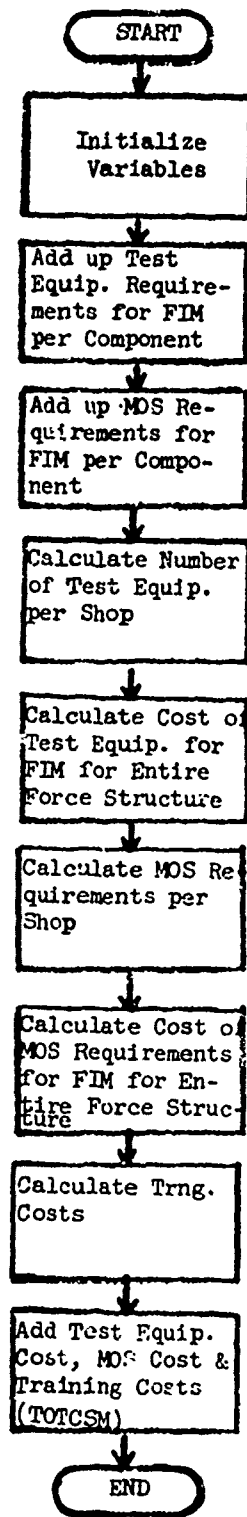
SUBROUTINE MTBFEQ



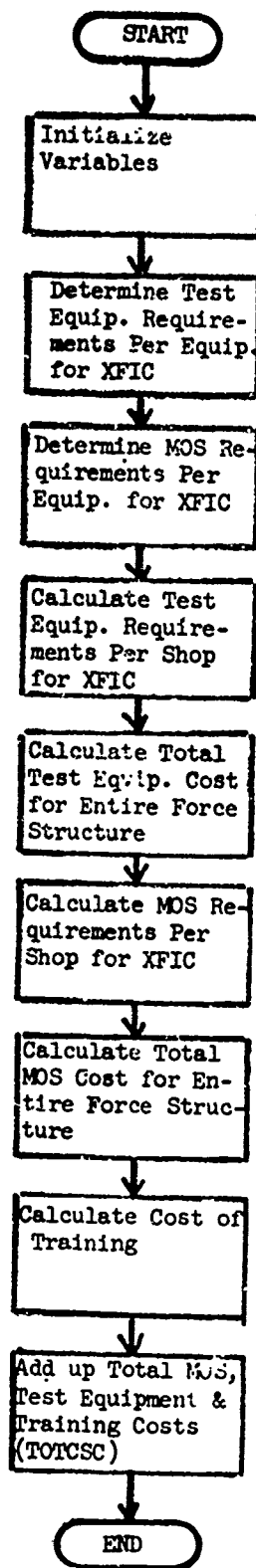
SUBROUTINE AMMH



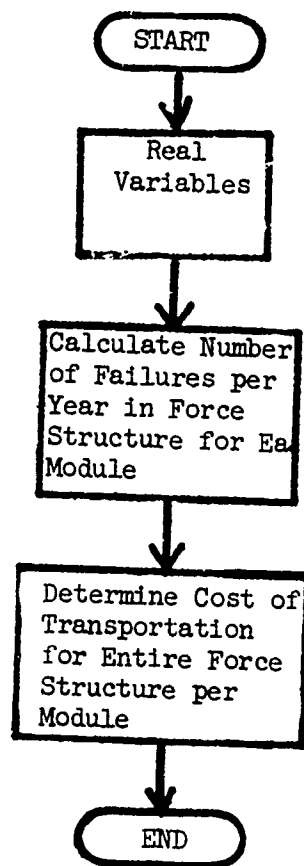
SUBROUTINE XFIM



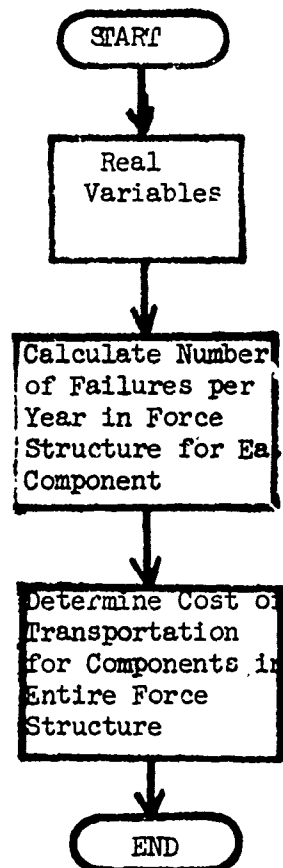
SUBROUTINE XFIC



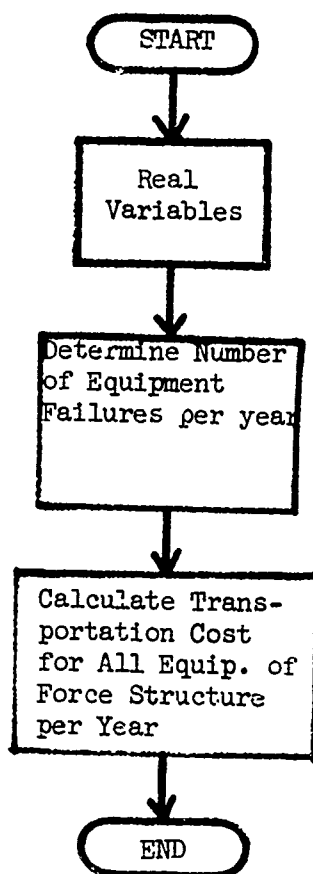
SUBROUTINE TRANSM



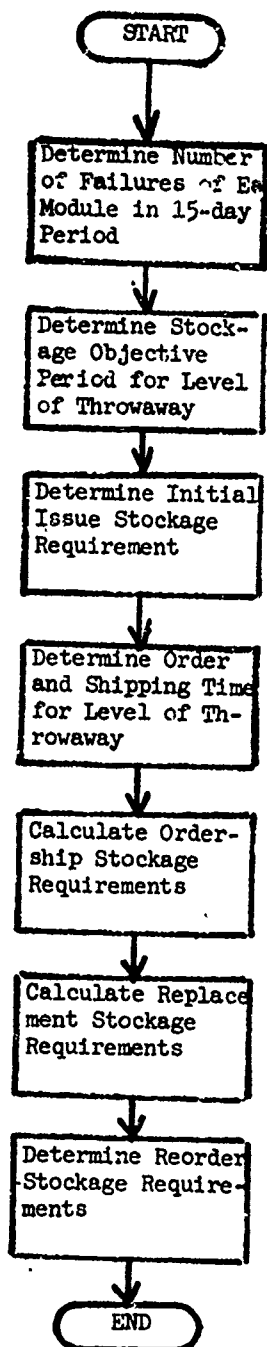
SUBROUTINE TRANSC



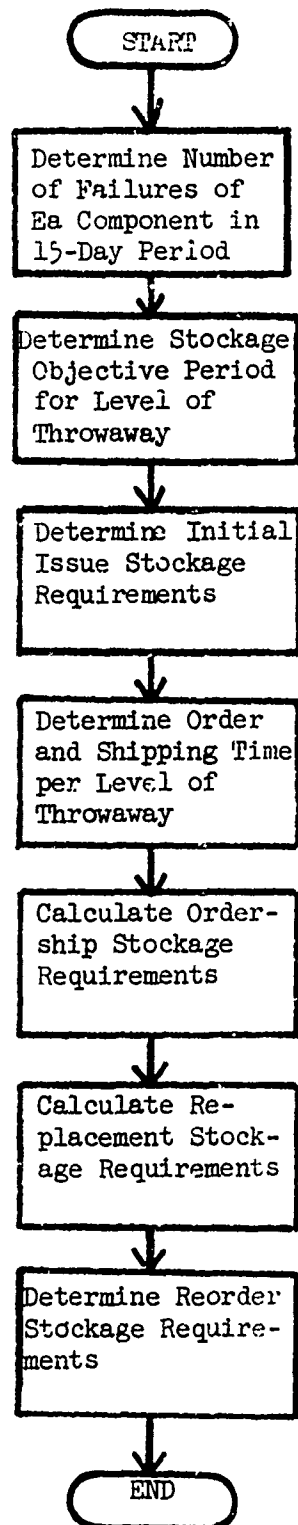
SUBROUTINE TRANSE



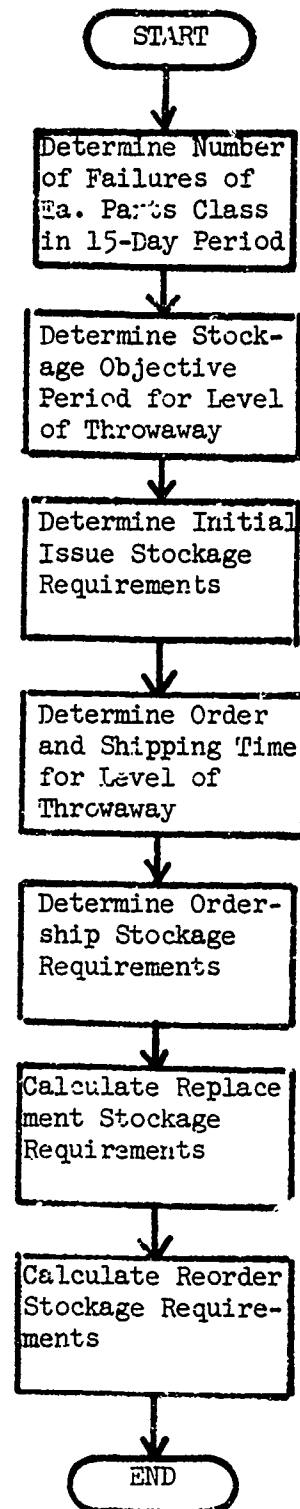
SUBROUTINE THRMOD



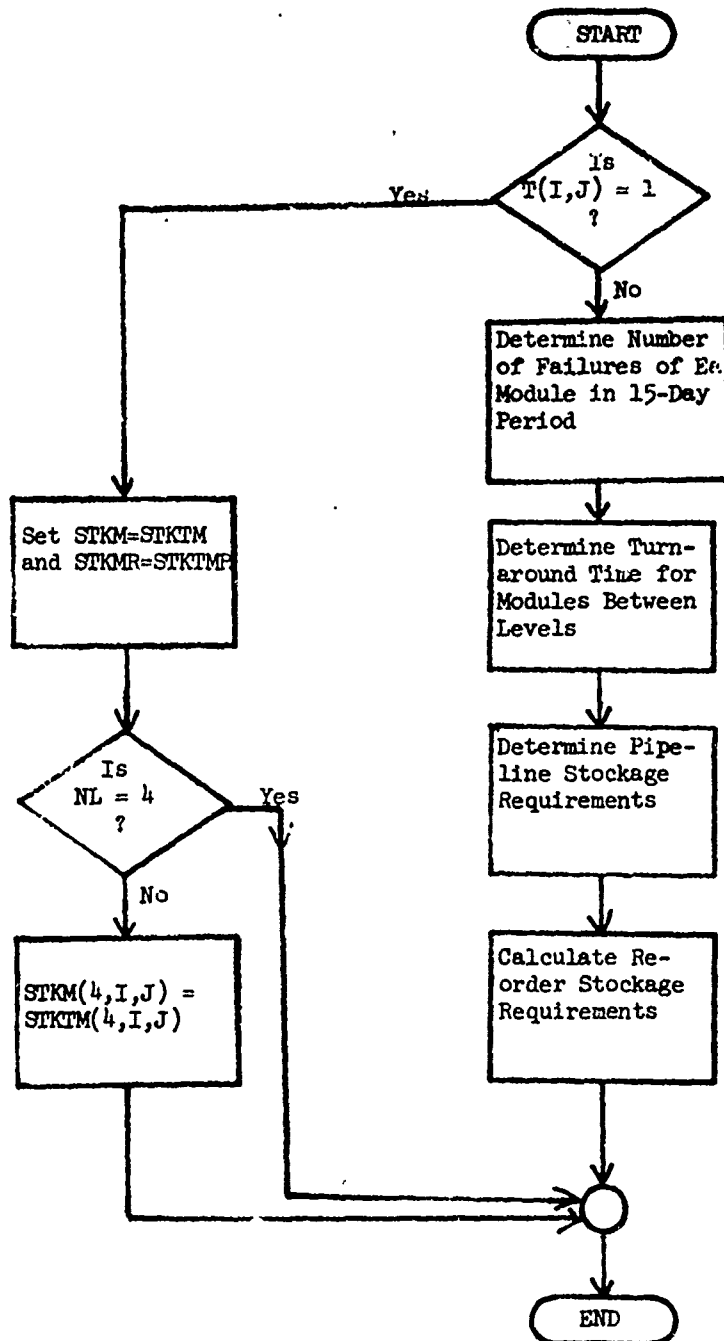
SUBROUTINE THRCOM



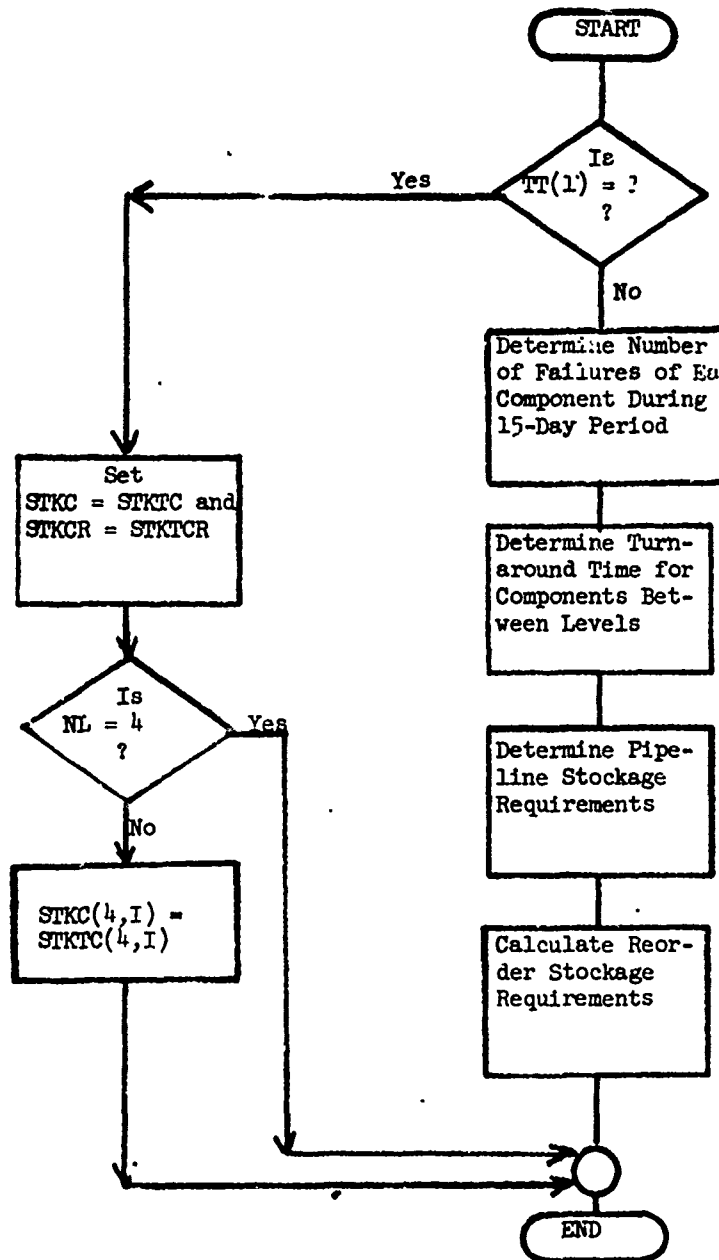
SUBROUTINE NONREP



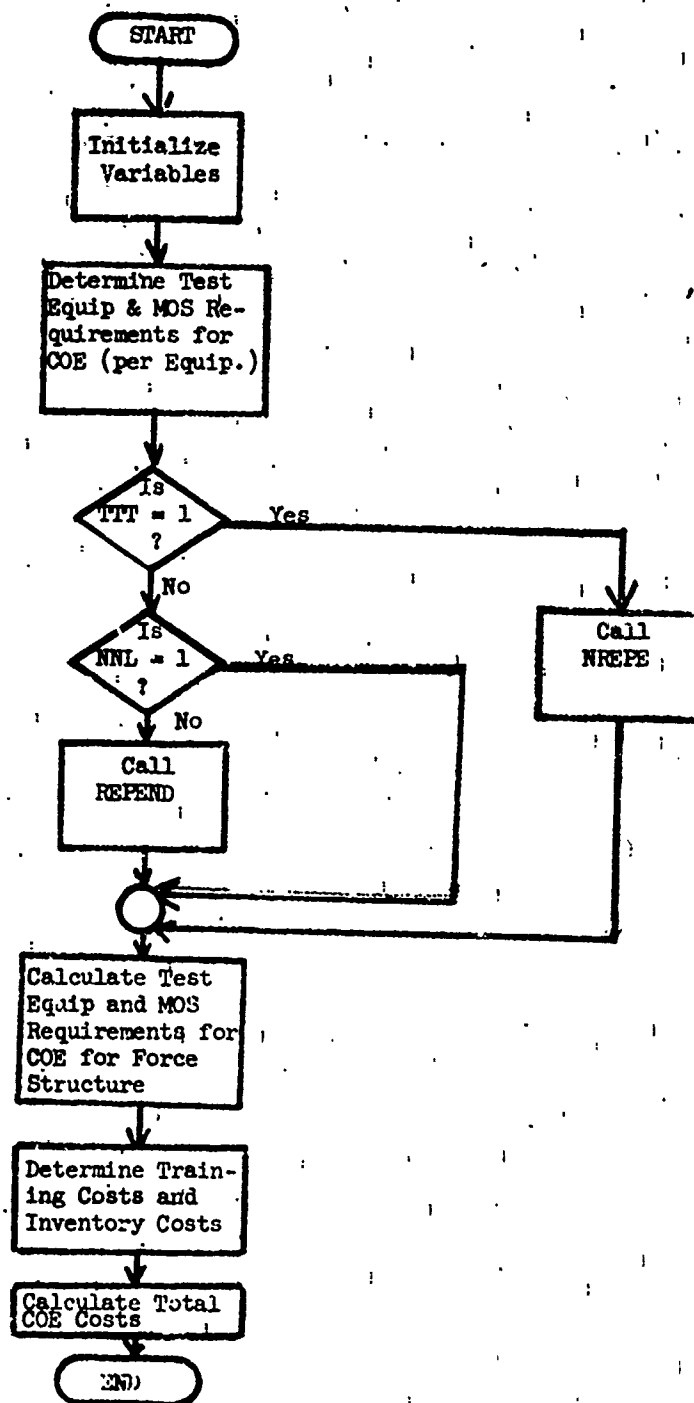
SUBROUTINE REPMOD



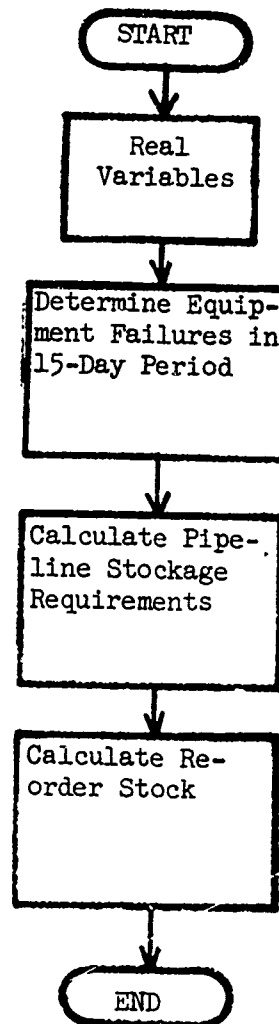
SUBROUTINE REPCOM



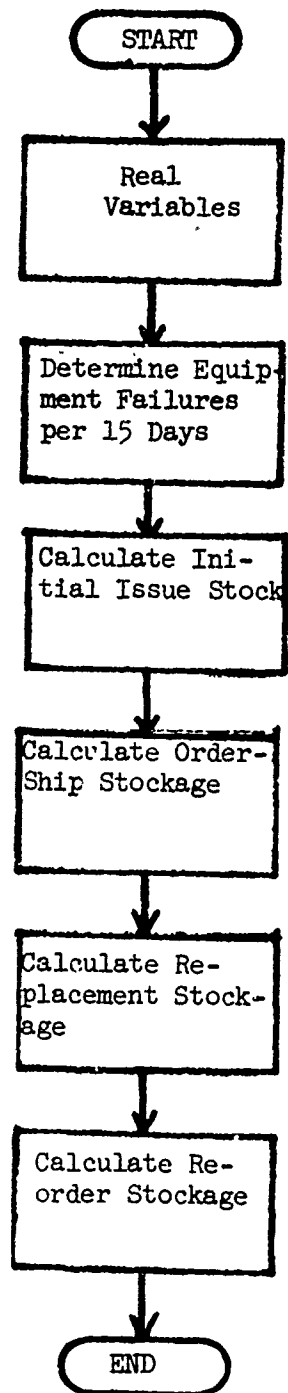
SL2ROUTINE XCOE



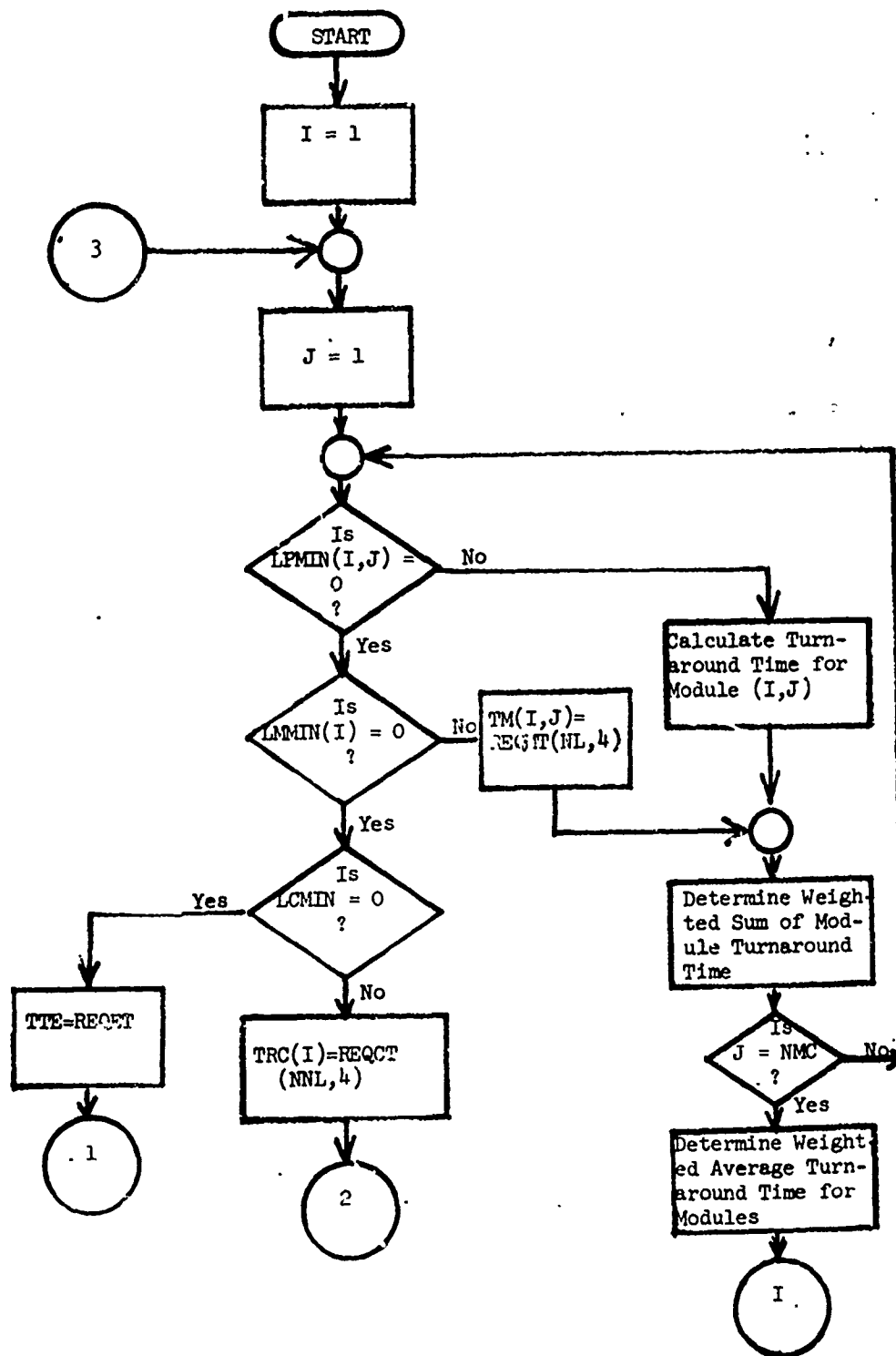
SUBROUTINE REPEND

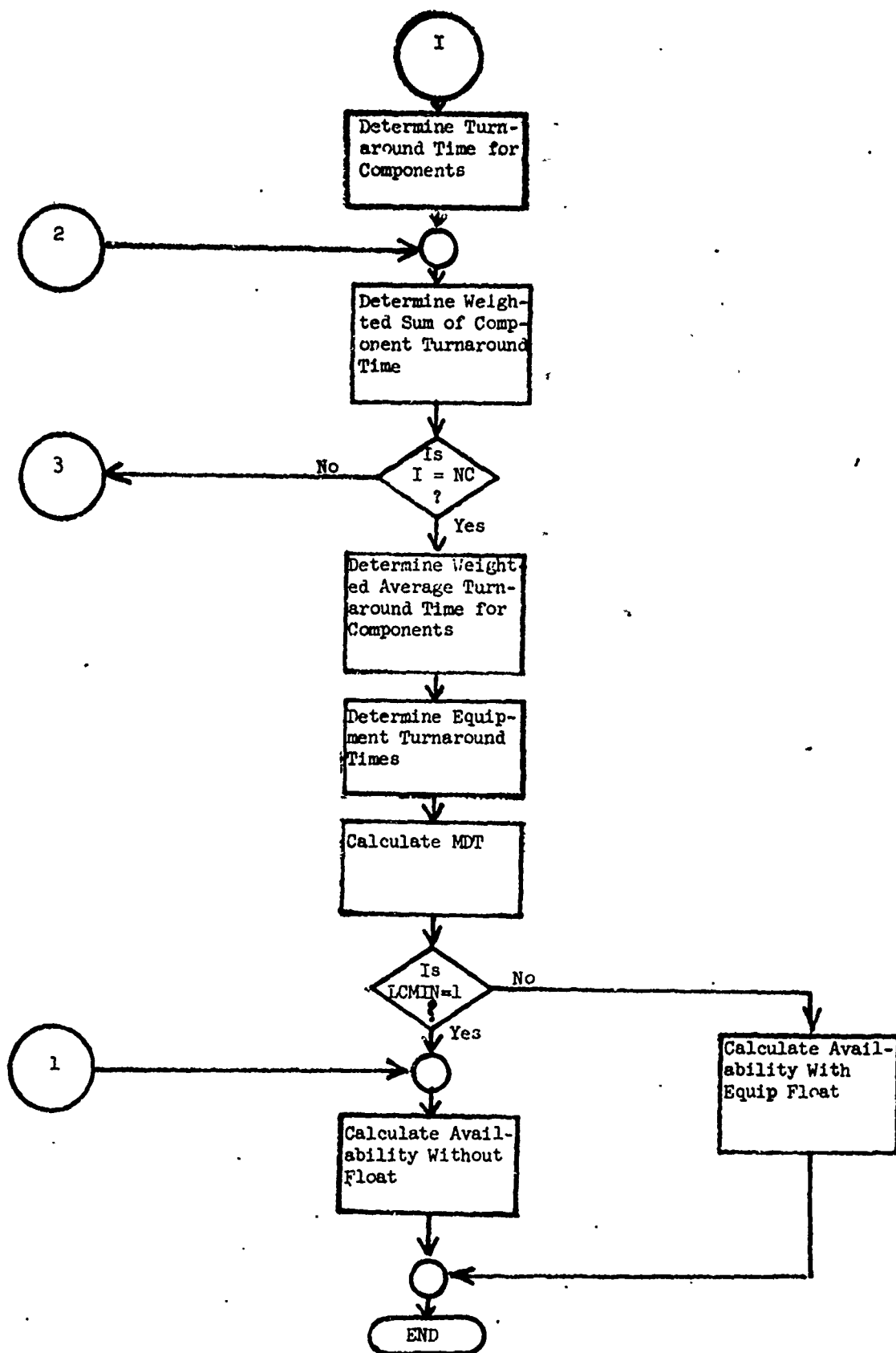


SUBROUTINE NREPE

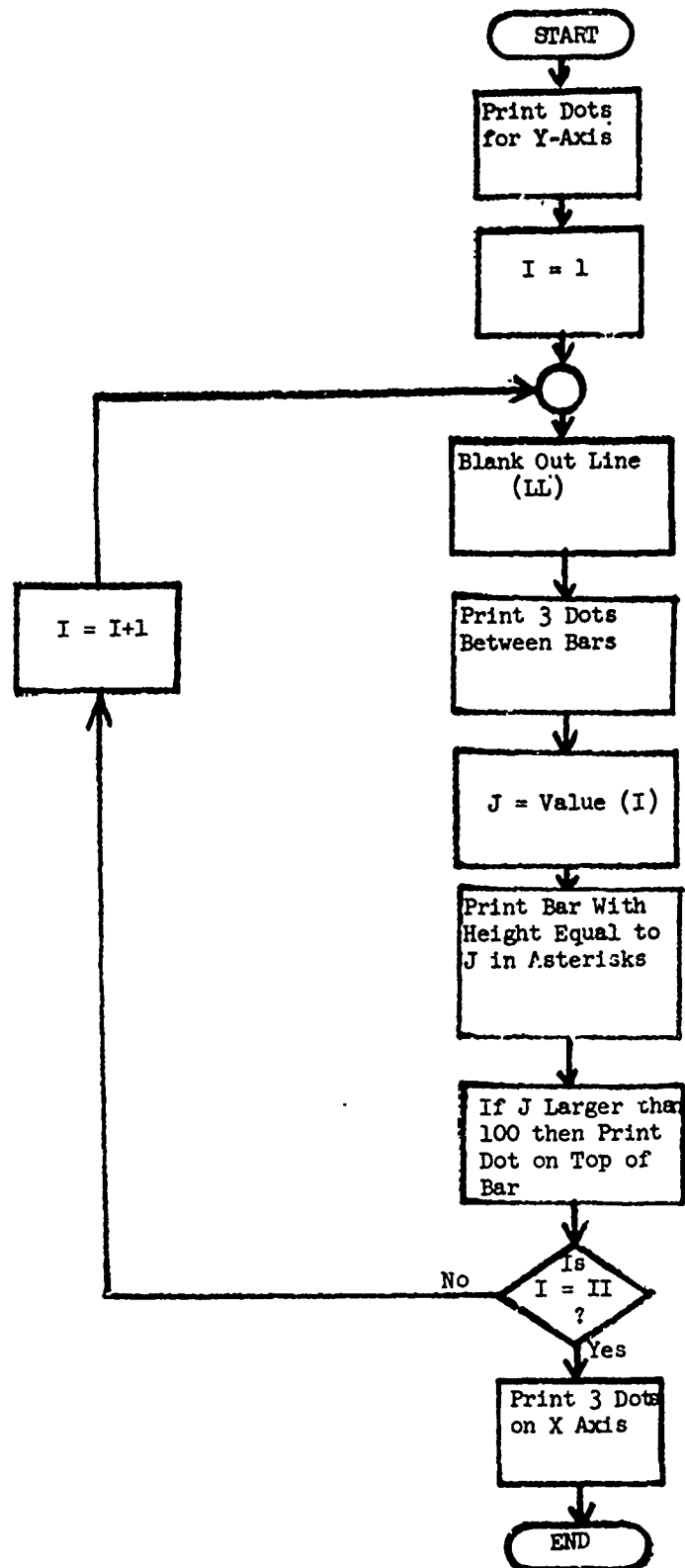


SUBROUTINE AVAIL





SUBROUTINE GRAPH A



APPENDIX D
PROGRAM LISTING

C	TO CHANGE NUMBER OF COMPONENTS-CHANGE ALL ELEMENTS IN GROUP 1,	00005850 R	0048
C	AND THE 1ST ELEMENTS IN GROUPS 2,3,AND 4,	00005851 R	0048
C	AND THE 2ND ELEMENTS IN GROUP 8.	00005852 R	0048
C	TO CHANGE NUMBER OF MODULES-CHANGE 2ND ELEMENTS IN GROUP 2,	00005853 R	0048
C	AND THE 3RD ELEMENTS IN GROUP 8.	00005854 R	0048
C	TO CHANGE NUMBER OF PARTS-CHANGE 3RD ELEMENT OF "NUMBR"	00005855 R	0048
C	IN GROUP 2,	00005856 R	0048
C	AND ALL ELEMENTS IN GROUP 5,	00005857 R	0048
C	AND 2ND ELEMENTS IN GROUP 9.	00005858 R	0048
C	TO CHANGE NUMBER OF TEST EQUIPMENTS-CHANGE 3RD ELEMENT	00005859 R	0048
C	IN "TEMI" IN GROUP 2,	00005860 R	0048
C	AND 2ND ELEMENTS IN GROUP 3,	00005861 R	0048
C	AND ALL ELEMENTS IN GROUP 6,	00005862 R	0048
C	AND 2ND ELEMENTS IN GROUP 10.	00005863 R	0048
C	TO CHANGE NUMBER OF MUS-CHANGE 3RD ELEMENT IN "MUSM"	00005864 R	0048
C	IN GROUP 2,	00005865 R	0048
C	AND 2ND ELEMENTS IN GROUP 4,	00005866 R	0048
C	AND ALL ELEMENTS IN GROUP 7,	00005867 R	0048
C	AND 2ND ELEMENTS IN GROUP 11,	00005868 R	0048

C GROUP 1

00005899 R 0048

START OF SEGMENT *****

DIMENSION AMMHC(4),CCC(4),CSTC(4),CSTRNC(4),CTUC(4),
 *FICZ(4),FIMS(4),FINI(4),LMMIN(4),LMS(4),MOSCM(4),MIBFC(4),
 *MTTRC(4),NMK(4),NUFAIC(4),PGM(4),PUBM(4),REPCCT(4),
 *STCM(4),STKCR(4),STKTCR(4),TBDC(4),TECM(4),TOTCSM(4),
 *TRANTC(4),TRC(4),TI(4),ITM(4),WIC(4)

124

C GROUP 2

00006300 R 0000
 00006399 R 0000

DIMENSION AMMHM(4,22),CC(4,22),CSTM(4,22),CSTRNM(4,22),
 *CTNM(4,22),
 *FIMZ(4,22),FIPS(4,22),FIPT(4,22),LPMIN(4,22),LPP(4,22),
 *LPS(4,22),MUSCP(4,22),MOSM(4,22,10),MTBFM(4,22),MTTRM(4,22),
 *NUFAL(4,22),NUMBK(4,22,38),PGP(4,22),PUAP(4,22),
 *RFPMT(4,22),STCP(4,22),STKMR(4,22),STKTMR(4,22),T(4,22),
 *TBNM(4,22),
 *TECP(4,22),TEMI(4,22,40),TM(4,22,4),TUTCSH(4,22,4),
 *TRANIM(4,22),WIM(4,22)

00006400 R 0000
 00006450 R 0000
 00006500 R 0000
 00006600 R 0000
 00006700 R 0000
 00006800 R 0000
 00006850 R 0000
 00006900 R 0000
 00007000 R 0000

C GROUP 3
 DIMENSION TECI(4,40)
 C GROUP 4
 DIMENSION MUSC(4,22)
 C GROUP 5
 DIMENSION C(38),MHP(38),ST(38),ST1(38),ST2(38),ST3(38),
 *STP(38)
 C GROUP 6
 DIMENSION NLEV(40),NNU(40),NUM(40),TECL(40),TEET(40),
 *TECUST(40)
 C GROUP 7
 DIMENSION MLEV(10),MMNUH(10),MNUM(10),MUSCE(10),MOSE(10),
 *YMAN(10)
 C GROUP 8
 DIMENSION CSTKC(4,4),CSIKM(4,4,22),STKC(4,4),SIKM(4,4,22),
 *STKTC(4,4),STKIM(4,4,22)

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C GROUP 9 00008099 R 0000

DIMENSION (STK(4,34),STK(4,38)

00008100 R 0000

C GROUP 10

00008199 R 0000

DIMENSION CNWLEV(4,40),NCLEV(4,40),NILEV(4,40),HNLEV(4,40),

00008200 R 0000

*TE(4,40)

00008300 R 0000

C GROUP 11

00008399 R 0000

DIMENSION CHMLEV(4,10),MCLEV(4,10),MCOSI(4,10),

00008400 R 0000

*MILEV(4,10),MMLEV(4,10),MUS(4,10)

00008410 R 0000

C GROUP 12

00008419 R 0000

DIMENSION R(4),CUSLB(4,4),G(4),NSHIP(4),NUMTS(4),

00008420 R 0000

*OPKSH(4),REQC(4,4),REQMT(4,4),REQPT(4,4),TRAIN(4),

00008430 R 0000

*TRANS(4,4),TRANST(4,4),TURN1(4),TURN2(4),WAIT(4)

00008440 R 0000

C GROUP 13

00008449 R 0000

DIMENSION CUE(35),FIC(35),FIM(35),FIP(35),H(35)

00008450 R 0000

C GROUP 1A

DIMENSION GVAL(40),GCOST(40),GCSTE(40)

INTEGER FIC, SENS, TELCE, TEEI, TELCI, TEMI, 1, TT, TTT, FIP, FIM, P, R

DATA CNE/35*1/

DATA FIC/15*1, 10*2, 0*3, 3*4, 0/

DATA FIM/5+1, 4*2, 3*3, 2*4, 0, 4*2, 3*3, 2*4, 0, 3*3, 2*4, 0, 4, 4, 2*0/

DATA FIP/1, 2, 3, 4, 0, 2, 3, 4, 0, 3, 4, 0, 4, 0, 0, 2, 3, 4, 0,

*3, 4, 0, 4, 0, 0, 3, 4, 0, 4, 0, 0, 4, 0, 4, 0, 0, 0/

DATA STK/152*0./

DATA TE/160*0./

REAL MTTRCF, MTIRE, MITRN, MTTRC, MTIRF, MTBFC, MIBFM, MTBFP, NSHNP,

*MCONST, I, AMCIUM, HUMRK, MUS, MDSKP, K1, K2, K3, MUSCM, MUSCC

REAL NLEV, NUM, MLEV, MINUM, NNLEV, MMLFV, MCLEV, MNLEV, MNNUM, NNUM

REAL NUMFS, MDSK

REAL NDAE, NDAY

DATA MDS/40*0./

00008459 R 0000

00008460 R 0000

00008520 R 0000

00008600 R 0000

00008700 R 0012

8800 R 0024

9000 R 0036

9100 R 0044

00009200 R 0048

00009300 R 0060

9400 R 0072

9500 R 0072

9600 R 0072

00009640 R 0072

00009645 R 0072

00009650 R 0072

CALL TIMEON		
		9900 R 0084
	II=0	
		10000 R 0084
	WRITE(6,8010)	
		10100 R 0085
8010	FORMAT(40X,17HINPUT INFORMATION//)	
		10200 R 0089
	READ(5,1950)NC,NCLASP	
		10300 R 0089
1950	FORMAT(10I3/10I3)	
		10400 R 0101
	WRITE(6,8011)NC,NCLASP	
		10500 R 0101
8011	FORMAT(30X,3HNC=,13,7HNCLASP=,13)	
		10600 R 0113
	READ(5,1950)(NMK(I),I=1,NC)	
		10700 R 0113
	WRITE(6,8012)(NMK(I),I=1,NC)	
		10800 R 0130
8012	FORMAT(30X,15HN K(COMPONENT)=,10I3)	
		10900 R 0147
	DO 1952 I=1,NC	
		11000 R 0147
	NMC=NMK(I)	
		11100 R 0152
	DO 1952 J=1,NMC	
		11200 R 0154
	READ(5,113) (NUMBK(1,J,KS),KS=1,NCLASP)	
		11300 R 0159

113	FORMAT (20F3.0)	11400 R 0182
	WRITE(6,8013)(NUMBR(I,J,KS),KS=1,NCLASP)	11500 R 0182
8013	FORMAT(30X,25HNUMBR(COMP,MODULE,CLASS)=,15F5.0)	11600 R 0204
1952	CONTINUE	11700 R 0204
1330	CONTINUE	11800 R 0205
	READ(5,213)(MTHFP(K),K=1,NCLASP)	11900 R 0205
	WRITE(6,8014)(MIBFP(K),K=1,NCLASP)	12000 R 0222
8014	FORMAT(30X,13HMTBFP(CLASS)=, 8F10.2)	12100 R 0239
213	FORMAT(10F8.2)	12200 R 0239
	READ (5,214) MTHFID	12300 R 0239
	WRITE(6,8015)MTHFID	12400 R 0248
8015	FORMAT(30X,7HMTBFIU=,I2)	12500 R 0259
214	FORMAT (I1)	12600 R 0259
	IF (MTHFID .NE. 1) GO TO 8600	12700 R 0259

12800 R 0261

12900 R 0266

13000 R 0268

13100 R 0286

13200 R 0305

13300 R 0305

13400 R 0322

13500 R 0339

13600 R 0339

13700 R 0348

13800 R 0359

13900 R 0359

14000 R 0359

14100 R 0359

14200 R 0360

00 1053 I=1,NC

NNC=NMK(I)

READ(5,213)(MTBFM(I,J),J=1,NMC)

1953 WRITE(6,8016)(NIBFM(I,J),J=1,NMC)

8016 FORMAT(30X,19HNIHFN(COMP,MODULE)=,10F8.2)

READ(5,213)(MTBFC(I),I=1,NC)

WRITE(6,8017)(MTBFC(I),I=1,NC)

8017 FORMAT(30X,12HNIHF(COMP)=,10F8.2)

READ(5,222)MTBFE

WRITE(6,8018)MTBFE

8018 FORMAT(30X,6HNIHFE=,F8.2)

222 FORMAT(F10.5)

1979 FORMAT(13)

GO TO 1957

8600 CONTINUE

CALL MTBFMD(NC,NMK,NCLASP,MTBFP,NUMBR,MTBFM,MTBFID)	14300 R 0360
CALL MTBFCM(NC,NMK,MTBFM,MTBFC,MTBFID)	14400 R 0366
CALL MTBFEQ(NC,MTBFC,MTBFE,MTBFID)	14500 R 0370
1957 CONTINUE	14600 R 0373
IF (I1.NE.0) GO TO 1981	14700 R 0373
1331 CONTINUE	14800 R 0376
READ(5,1955) MITRCE,MTTRE	14900 R 0376
WRITE(6,8019) MITRCE,MTTRE	15000 R 0387
8019 FORMAT(30X,7HMITRCE=F6.2,6HMTTRE=F6.2)	15100 R 0400
READ(5,1955)(MITRC(I),I=1,NC)	15200 R 0400
WRITE(6,8020)(MITRC(I),I=1,NC)	15300 R 0417
9020 FURNAT(30X,12HMITRC(COMP)=,10F6.2)	15400 R 0434
DO 1956 I=1,NC	15500 R 0434
NMC=VMK(I)	15600 R 0439
READ(5,1955)(MITRM(I,J),J=1,NMC)	15700 R 0441

WRITE(6,8021)(MTRM(I,J),J=1,NMC)

8021 FORMAT(30X,19HMMITHM(COMP,MODULE)=,10F10.2)

15800 R 0459

15900 R 0472

SEGMENT S IS 301

1956 CONTINUE

IF(IT,NE,0) GO TO 1981

16000 R 0477

16100 R 0477

1955 FORMAT(10F6.2/10F6.2)

16200 R 0480

1332 CONTINUE

16300 R 0480

READ(5,213)CSF1

16400 R 0480

WRITE(6,8022)CSE1

16500 R 0489

8022 FORMAT(30X,5HCSLI=,1F8.2)

16600 R 0500

REAL(5,213)(CCC(I),I=1,NC)

16700 R 0500

WRITE(6,8023)(CCC(I),I=1,NC)

16800 R 0517

8023 FORMAT(30X,10HCCC(COMP)=,10F8.2)

DO 1960 I=1,NC

16900 R 0534

17000 R 0534

NMC=NMK(I)

17100 R 0539

REAL(5,213)(CCC(I,J),J=1,NMC)

17200 R 0541

WRITE(6,8024)(CCC(I,J),J=1,NMC)

17300 R 0559

1960 CONTINUE

8024 FORMAT(30X,16HCC(COMP,MODULE)=,10F8.2)

REAL(5,213)(C(K),K=1,NCLASP)

WRITE(6,8025)(C(K),K=1,NCLASP)

8025 FORMAT(30X,9HC(CLASS)=,10F8.2)

TF(11,NE,0) GO TO 1981

1333 CONTINUE

REAL(5,1950)NTE

WRITE(6,8026)NTE

8026 FORMAT(30X,4H:ITE=,I3)

REAL(5,103)(TFCE(K),K=1,NTE)

WRITE(6,8027)(ICE(K),K=1,NTE)

8027 FORMAT(30X,11HICE(1YPE)=,40I1)

REAL(5,103)(TFEI(K),K=1,NTE)

WRITE(6,8028)(IEEI(K),K=1,NTE)

8028 FORMAT(30X,11HIEEI(1YPE)=,40I1)

DO 1961 I=1,NC

17400 R 0577

17500 R 0578

17600 R 0578

17700 R 0595

17800 R 0612

17900 R 0612

18000 P 0615

18100 R 0615

18200 R 0624

18300 R 0635

18400 R 0635

18500 R 0652

18600 R 0669

18700 R 0669

18800 R 0686

18900 R 0703

19000 R 0703

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READ(5,103)(TECI(I, KK), KK=1, NTE)

19100 R 0708

WRITE(6,8029)(IECI(I, KK), KK=1, NTE)

19200 R 0727

8029 FORMAT(30X, 16HIECI(COMP, TYPE)=, 40I1)

19300 R 0745

103 FORMAT (40I1)

19400 R 0745

1961 CONTINUE

19500 R 0745

DO 1962 I=1, NC

19600 R 0745

NMC=NPK(I)

19700 R 0750

DO 1962 J=1, NMC

19800 R 0752

REAL(5,103) (TEMI(I, J, KK), KK=1, NTF)

19900 R 0757

WRITE(6,8030)(TEMI(I, J, KK), KK=1, NTE)

20000 R 0780

8030 FORMAT(30X, 23HTEMI(COMP, MODULE, TYPE)=, 40I1)

20100 R 0802

1962 CONTINUE

20200 R 0802

READ(5,213)(TECUST(KK), KK=1, NTE)

20300 R 0803

WRITE(6,8031)(IECUST(KK), KK=1, NTE)

20400 R 0820

8031 FORMAT(30X, 13HIECUST(TYPE)=, 10F8.2)

20500 R 0837

IF(JJ.NE.0) GO TO 1981	20600 R 0837
1334 CONTINUE	20700 R 0840
READ(5,1950)NMUS	20800 R 0840
WRITE(6,8032)NMUS	20900 R 0849
8032 FORMAT(30X,5HNMUS=,I3)	21000 R 0860
READ(5,104)(MUSC(KM),KM=1,NMUS)	21100 R 0860
WRITE(6,8033)(MUSC(KM),KM=1,NMUS)	21200 R 0877
8033 FORMAT(30X,12HMUSC(TYPE)=,40I1)	21300 R 0894
READ(5,104)(MUSC(KM),KM=1,NMUS)	21400 R 0894
WRITE(6,8034)(MUSC(KM),KM=1,NMUS)	21500 R 0911
8034 FORMAT(30X,11HMUSC(TYPE)=,40I1)	21600 R 0928
DO 1963 I=1,NC	21700 R 0928
READ(5,104)(MUSC(I,KM),KM=1,NMUS)	21800 R 0933
WRITE(6,8035)(MUSC(I,KM),KM=1,NMUS)	21900 R 0952
8035 FORMAT(30X,16HMUSC(COMP,TYPE)=,40I1)	22000 R 0970

1963 CONTINUE

DO 1964 I=1,NC

NMC=NMK(I)

DO 1964 J=1,NMC

REAL(5,104) (MUSM(I,J,KM),KM=1,NMOS)

WRITE(6,8036)(MUSM(I,J,KM),KM=1,NMOS)

6036 FUPAT(30X,23HMUSM(CURP,MODULE,TYPE)=,4011)

104 FUPAT (1011)

1964 CONTINUE

DO 6439 L=1,4

SEGMENT 4 IS 10:

START OF SEGMENT *****

READ(5,213)(MCUST(L,KM),KM=1,NMOS)

6439 WRITE(6,8037)(MCUST(L,KM),KM=1,NMOS)

6037 FUPAT(30X,12HMCUST(TYPE)=,10F8.2)

IF(I1.NE.0) GO TO 1981

1335 CONTINUE

22100 R 0970

22200 R 0970

22300 R 0975

22400 R 0977

22500 R 0982

22600 R 1002

22700 R 1021

22800 R 1021

22900 R 1021

23000 R 1022

23100 R 0005

23200 R 0024

23300 R 0043

23400 R 0043

23500 R 0046

REAL(5,197A)WTE

23600 R 0046

WRITE(6,R036)WTE

23700 R 0055

R036 FORMAT(30X,4HFILE=F12.2)

23800 R 0066

REAL(5,197A)(WIC(I),I=1,NC)

23900 R 0066

WRITE(6,R039)(WIC(I),I=1,NC)

24000 R 0083

R039 FORMAT(30X,10HWTC(CUMF))=,10F7.2)

24100 R 0100

SEGMENT 7 IS 1

DO 1975 I=1,NC

24200 R 0100

NMC=NMK(I)

24300 R 0105

REAL(5,197A)(VIN(I,J),J=1,NMC)

24400 R 0107

WRITE(6,R040)(VIN(I,J),J=1,NMC)

24500 R 0125

1975 CONTINUE

24600 R 0143

R040 FORMAT(30X,17HWIM(CUMF,MODULE))=,10F7.2)

24700 P 0144

1974 FORMAT(10F7.2/10F7.2)

24800 R 0144

IF(JJ.NE.0) GO TO 19M1

24900 R 0144

1336 CONTINUE

25000 R 0147

```

      READ(5,219)(NSHUP(I),NUMFS(I),I=1,4)
      WRITE(6,8041)(NSHUP(I),I=1,4)
      8041 FOPHAT(30X,13HNSHUP(LEVEL)=,4F5.0)
      WRITE(6,8042)(NUMFS(I),I=1,4)
      8042 FOPHAT(30X,13HNUMFS(LEVEL)=,4F3.0)
      210 FOPHAT(4(F4.0,2X,12.0))
      IF(II.NE.0) GO TO 1981
      1337 CONTINUE
      READ(5,216)((TRANS(I,NL),COSLR(L,NL),L=NL,4),NL=1,4)
      WRITE(6,8043)((TRANS(I,NL),L=NL,4),NL=1,4)
      6043 FOPHAT(30X,25HTRANS(LEVEL,NEXT LEVEL)=,10F7.0)
      READ(5,5998)((TRANS(L,NL),L=NL,4),NL=1,4)
      WRITE(6,5999)((TRANS(L,NL),L=NL,4),NL=1,4)
      5998 FOPHAT(10 F5.2)
      5999 FOPHAT(30X,24HTRANS(LEVEL,NEXT LEVEL)=,10F7.2)
      WRITE(6,8044)((COSLR(L,NL),L=NL,4),NL=1,4)
      25100 R 0147
      25200 R 0167
      25300 R 0184
      25400 R 0184
      25500 R 0201
      25600 R 0201
      25700 R 0201
      25800 R 0204
      25900 R 0204
      26000 P 0233
      26100 R 0258
      26200 R 0258
      26300 R 0283
      26400 R 0308
      26500 R 0308
      26600 R 0308

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8044 FORMAT(30X,24HCUSL8(LEVEL,NEXT LEVEL),10F8,6)
216 FORMAT(5(F6.0,F7.7)/5(F6.0,F7.7))
      IF(JJ.NE.0) GO TO 1981
1336 CONTINUE
      READ(5,1212)(REQPT(L,4),REQMT(L,4),REQCT(L,4),L=1,4)
      DO 8046 L=1,4
8046 WRITE(6,8005)REQPT(L,4),REQMT(L,4),REQCT(L,4)
8045 FORMAT(30X,14HREQPT(LEVEL,L,4),F4.0,14HREQMT(LEVEL,L,4),F4.0,15HREQCT
      *(LEVEL,L,4),F4.0)
1212 FORMAT(3F4.0)
      READ(5,213)REQPT
      WRITE(6,9006)REQPT
      REAL(5,213)RFO
      WRITE(6,9561)RFO
9561 FORMAT(30X,4HREQCT,F10.2)
26700 R 0333
26800 R 0333
26900 R 0333
27000 R 0336
27100 R 0336
27200 R 0359
27300 R 0365
27400 R 0382
27500 R 0382
27600 R 0382
27700 R 0382
27800 R 0391
00027820 R 0401
00027830 R 0410
00027840 R 0421

```

```

9046 FORMAT(30X,6HRESET=F8.0)
      IF(IY.NE.0) GO TO 1981
      REAL(5,1214)(WAIT(L),L=1,4)
      WRITE(6,8047)(WAIT(L),L=1,4)
8047 FORMAT(30X,12HWAIT(LEVEL)=F6.0)
1214 FORMAT(4(F4.0,2X))
1339 CONTINUE
      REAL(5,333)(OPHMSH(L),L=1,4)
      WRITE(6,8048)(OPHMSH(L),L=1,4)
8048 FORMAT(30X,14HOPHMSH(LEVEL)=F5.2)
      REAL(5,9563)PRUD
9563 FORMAT(F8.4)
      WRITE(6,9567)PKOU
9567 FORMAT(30X,18HPRODUCTIVE FACTOR=F8.4)
      IF(IY.NE.0) GO TO 1981
1340 CONTINUE
      READ(5,1951)K1,K2,K3,XK4,TK1,TK2,TK3,TK4,PFNGO,ATRF,RUP
27900 R 0421
28000 R 0421
28100 R 0423
28200 R 0440
28300 R 0457
28400 R 0457
28500 R 0457
28600 R 0457
28700 R 0474
28800 R 0491
00028810 R 0491
00028820 R 0501
00028830 R 0501
00028840 R 0511
28900 R 0511
29000 R 0514
29100 R 0514

```

```

1951 FORMAT(30F4.3,F3.0)
29200 R 0544
SEGMENT A IS 1:
WRITE(6,8049)K1,K2,K3,XK4,TK1,TK2,TK3,TK4,PFNGU,ATRF,RQP
29300 R 0544
6049 FORMAT(30X,3HK1=,F5.2,3HK2=,F5.2,3HK3=,F5.2,4HXK4=,F5.2,4HTK1=,F5.
2,4HTK2=,F5.2,4HTK3=,F5.2,4HTK4=,F5.2,6HPFNGU=,F5.2,5HATRF=,F5.2,
*4HP(P=,F3.0)
29400 R 0574
29500 R 0574
29600 R 0574
29700 F 0574
29800 R 0577
29900 F 0577
30000 R 0603
30100 R 0609
30200 R 0629
30300 R 0629
30400 R 0629
30500 R 0632

```

```

1951 FORMAT(30F4.3,F3.0)

```

```

WRITE(6,8049)K1,K2,K3,XK4,TK1,TK2,TK3,TK4,PFNGU,ATRF,RQP

```

```

6049 FORMAT(30X,3HK1=,F5.2,3HK2=,F5.2,3HK3=,F5.2,4HXK4=,F5.2,4HTK1=,F5.
2,4HTK2=,F5.2,4HTK3=,F5.2,4HTK4=,F5.2,6HPFNGU=,F5.2,5HATRF=,F5.2,

```

```

*4HP(P=,F3.0)

```

```

IF(11.NE.0) GO TO 1981

```

```

1341 CONTINUE

```

```

REAL(5,333)(R(1),G(1),TURN:(1),TURN2(1),I=1,4)

```

```

DO 1051 I=1,4

```

```

8051 WRITE(6,8050)R(1),G(1),TURN1(I),TURN2(1)

```

```

8050 FORMAT(30X,9HR(LEVEL)=,F5.2,9HG(LEVEL)=,F5.2,13HTURN1(LEVEL)=,F5.2

```

```

*,13HTURN2(LEVEL)=,F5.2)

```

```

IF(11.NE.0) GO TO 1981

```

```

333 FORMAT (4(F5.2))

```

```

1342 CONTINUE
      REAL(5,1970)ELIFE
      WRITE(6,8052)ELIFE
8052 FORMAT(30X,6HELIFE=F5.2)
      REAL(5,1983)NDAY,UPHRDY,NDAE
      WRITE(6,8053)NDAY,UPHRDY,NDAE
8053 FORMAT(30X,5HNDAY=F5.0,7HUPHRDY=F5.0,5HNDAE=F5.0)
1983 FORMAT(3(73.0))
      IF(II.NE.0) GO TO 1981
1970 FORMAT(F5.2)
1343 CONTINUE
      REAL(5,1310)(XMAN(KM),KM=1,NMUS)
      WRITE(6,8054)(XMAN(KM),KM=1,NMUS)
8054 FORMAT(30X,10HXMAN(MUS)=,10F8.0)
      IF(II.NE.0) GO TO 1981
1310 FORMAT(10(2X,F5.0))
1344 CONTINUE

```

```

30600 R 0632
30700 R 0632
30800 R 0641
30900 R 0652
31000 R 0652
31100 R 0665
31200 R 0680
31300 R 0680
31400 R 0680
31500 R 0683
31600 R 0683
31700 R 0683
31800 R 0700
31900 R 0717
32000 R 0717
32100 R 0720
32200 R 0720

```

```

      READ(5,1972)FACIN,(THAIN(L),L=1,4),DMF
      WRITE(6,7792)FACIN,(THAIN(L),L=1,4),DMF
      IF(11.NE.0) GO TO 1981
1972 FORMAT(F5.3,5F4.2)
      READ(5,214) KNOWN
      WRITE(6,8056)KNOWN
      IF(KNDWN.EQ.0) GO TO 1450
1345 CONTINUE
      READ(5,214) LCMIN
      WRITE(6,8057)LCMIN
      IF(11.NE.0) GO TO 1981
1981 FORMAT(F5.3,5F4.2)
      WRITE(6,8969)PUC
      READ(5,103) (LMHIN(I),I=1,NC)

```

WRITE(6,8058)(LMMIN(I),I=1,NC)
 8058 FORMAT(30X,12HLMIN(COMP)=,10I2)

33700 R 0836
 33800 R 0853

DO 1451 I=1,NC

33900 R 0853

NMC=NWK(I)

34000 R 0858

READ(5,103)(LPMIN(I,J),J=1,NMC)

34100 R 0860

WRITE(6,8059)(LPMIN(I,J),J=1,NMC)

34200 R 0878

8059 FORMAT(30X,19HLPMIN(COMP,MODULE)=,10I2)

34300 R 0896

1451 CONTINUE

34400 R 0896

IF(II.NE.0) GO TO 1981

34500 R 0896

GO TO 1491

34600 R 0898

1450 CONTINUE

34700 R 0900

1432 READ(5,212)MMAX,(K(M),M=1,MMAX)

34800 R 0900

WRITE(6,8060)(K(M),M=1,MMAX)

34900 R 0919

8060 FORMAT(30X,8H2ULIGIES,3X,35I2)

35000 R 0936

SEGMENT 9 IS 123

212 FUPMTC 12,35I2)

35100 R 0936

IF(II.NE.0) GO TO 1981

35200 R 0936

1491 CONTINUE

35300 R 0939

1726 READ(5,3705)RANDU

35400 R 0939

WRITE(6,3706)RANDU

35500 R 0948

READ(5,3705)PDC

00035510 P 0958

WRITE(6,8969)PDC

00035520 P 0968

8969 FORMAT(30X,16HPRODUCTION COST=F13.2)

00035530 R 0979

3705 FORMAT(F12.2)

35600 R 0979

3706 FORMAT(30X,30HRESEARCH AND DEVELOPMENT COST=F13.2)

35700 R 0979

IF(11.NE.0) GO TO 1981

35800 R 0979

1346 READ(5,214)IRD

35900 R 0982

WRITE(6,8065)IRD

36000 R 0991

8065 FORMAT(30X,15HROUND UP EQUAL=I2)

36100 R 1002

IF(11.NE.0) GO TO 1981

36200 R 1002

1379 READ(5,1974)PPC

36300 R 1005

WRITE(6,7824)PPC

36400 R 1014

SEGMENT 8 IS 102

START OF SEGMENT *****

1824 FURMAT(30X,4HPGC=F6.2)

36500 R 0066

SEGMENT 11 IS :

READ(5,731R)PGC,PGF

36600 R 0006

WRITE(6,77R7)PGC,PGF

36700 P 0017

1787 FOPMAT(30X,4HPGC=F6.2,4HPGF=F6.2)

36800 R 0030

READ(5,7217)(PGM(I),I=1,NC)

36900 R 0030

WRITE(6,79R2)(PGM(I),I=1,NC)

37000 R 0047

1982 FURMAT(30X,10HPGM(CUMF)=,10F6.2)

37100 R 0064

DO 7317 I=1,NC

37200 R 0064

NMC=NPK(I)

37300 R 0069

READ(5,7217)(PGP(I,J),J=1,NMC)

37400 R 0071

7317 WRITE(6,79R3)(PGP(I,J),J=1,NMC)

37500 R 0069

1983 FURMAT(30X,17HPGP(CUMF,MODULE)=,10F6.2)

37600 R 0108

1217 FORMAT(10F5.0/10F5.0)

37700 R 0108

7318 FORMAT(2F5.0)

37800 R 0108

IF(II,NE,0) GO TO 1981	37900 R 0108
7731 READ(5,213)CTOE	00037902 R 0111
WRITE(6,8314)CTOE	00037904 R 0120
READ(5,213)(CTOC(I),I=1,NC)	00037906 R 0130
WRITE(6,8315)(CTOC(I),I=1,NC)	00037908 R 0147
DO 8316 I=1,NC	00037910 R 0164
NMC=NMC(I)	00037912 R 0169
READ(5,213)(CTUM(I,J),J=1,NMC)	00037914 R 0171
8316 WRITE(6,8317)(CTUM(I,J),J=1,NMC)	00037916 R 0189
8314 FUPRAT(30X,5HCTOE=,F10.2)	00037918 R 0208
8315 FUPRAT(30X,11HCTOC((UNP)=,F10.2)	00037920 R 0208
8317 FUPRAT(30X,15HCTOC((UNP,MQN)=,F10.2)	00037921 P 0208
READ(5,9217)TRUE	00037922 P 0208
9217 FUPRAT(20F3.0)	00037924 R 0218
WRITE(6,8319)TRUE	00037926 R 0218

```

READ(5,9217)(TBUC(I),I=1,NC)
WRITE(6,8321)(IBUC(I),I=1,NC)

DO 8320 I=1,NC
  NMC=NMC(I)
  READ(5,9217)(THUM(I,J),J=1,NMC)
  8320 WRITE(6,8322)(IBUM(I,J),J=1,NMC)
  8319 FORMAT(30X,5HTBUE=,F6.2)
  8321 FORMAT(30X,11HTBUC(CUMP)=,F6.2)
  8322 FORMAT(30X,15HTBUC(CUMP,MOD)=,F6.2)

  IF(II.NF.0)GO TO 1981

  1980 CONTINUE

C1****CALCULATE THE ANNUAL MAINTENANCE MANHOOR REQUIREMENTS FOR THE
C   REPAIR OF EACH MODULE, EACH COMPONENT AND THE EQUIPMENT.
C   CALL ANMH(MTTRCE,MTIME,UPHROD,NDAY,NC,NMK,MTTRM,MTBFM,
C   *MTTRC,MTBFC,AMMHN,AMMHC,AMMHF,AMMHCE,MTBFE)

C2****IF VARIABLE, KNOWN, IS EQUAL TO 0, THEN OPTIMUM POLICY MUST BE
C   DETERMINED. IF KNOWN NOT EQUAL TO 0, THEN A SPECIFIED POLICY IS TO

```

```

00037928 R 0227
00037930 R 0244
00037932 R 0261
00037934 R 0266
00037936 R 0268
00037938 R 0286
00037942 R 0305
00037944 R 0305
00037946 R 0305
00037948 R 0305
38000 R 0308
38100 R 0308
38200 R 0308
38300 R 0308
38400 R 0312
38500 R 0317
38600 R 0317

```

```

C RE EVALUATED (SU III 999). 38700 R 0317
IF (UNKNOWN.NF.O) GO TO 999 38800 R 0317
SU*FMN=0.0 38900 R 0319
C3***PARAMETERS DESCRIBING THE FIP FUNCTION ARE CALCULATED BETWEEN 39000 R 0319
C THIS POINT AND STATEMENT =98. REQUIREMENTS FOR TEST EQUIPMENT(TE), 39100 R 0319
C MAINTENANCE PERSONNEL(CHOS),PARTS STOCKAGE AND INVENTORY MANAGEMENT 39200 R 0319
C ARE DETERMINED. TRANSPORTATION COSTS AND THE EFFECT THAT THE 39300 R 0319
C LOCATION OF THE FIP FUNCTION WILL HAVE ON THE COST OF MODULE 39400 R 0319
C STOCKAGE WILL BE DETERMINED LATER. 39500 R 0319
DO 98 L=1,4 39600 R 0320
DO 98 I=1,NC 39700 R 0325
NF=NNR(I) 39800 R 0331
DO 98 J=1,NC 39900 R 0333
TF(L.EQ.4)AMMHM(I,J)=AMMHM(I,J)*(1.-DMF) 40000 R 0338
DO 481 KK=1,NTL 40100 R 0345

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481 TF(L, KK)=0.

DO 482 KM=1, NMUS

482 MUS(L, KM)=0.

DO 39 KK=1, NTE

C4*****TFMJ IDENTIFIES THE TE THAT IS REQUIRED FOR THE REPAIR OF A

C PARTICULAR MODULE.

IF(TFM(I, J, KK).NE.1) GO TO 39

TF(I, KK)=AMMHM(I, J)+IE(L, KK)

39 CONTINUE

DO 41 KM=1, NMJS

C5*****MOSM IDENTIFIES MUS FOR EACH MODULE REPAIR.

TF(MOSM(I, J, KM).NE.1) GO TO 41

MUS(I, KM)=AMMHM(I, J)+MDS(L, KM)

41 CONTINUE

TCNST=0.

DO 43 KK=1, NTE

YNIEV=TE(L, KK)/(OPHSH(L)*NDAE)*NSHQP(L)

40200 R 0352

40300 R 0355

40400 R 0361

40500 R 0364

40600 R 0365

40700 R 0365

40800 R 0369

40900 R 0377

41000 R 0384

41100 R 0384

41200 R 0385

41300 R 0389

41400 R 0394

41500 R 0402

41600 R 0402

41700 R 0403

41800 R 0408

```

NLFV(KK)=XNLEV          41900 R 0414
NU'(KK)=NLFV(KK)*NUMFS(L) 42000 R 0416
TCNST=TCNST+NUM(KK)*TECUST(KK) 42100 R 0419
TECH(I,J)=TCNST        42200 R 0423
43 CONTINUE            42300 R 0426
TCNST=0.               42400 R 0426
TRN=0.0                42500 R 0427
DO 45 KM=1,NMOS        42600 R 0428
  PRON=PRON             00042650 R 0433
  IF(L.E0.4)PRON=1.    00042660 R 0434
  XMLEV=MUS(L,KM)/(UPHSH(I)+PRON*NDDE)*NSHOP(L) 42700 R 0436
  MLEV(KM)=XMLEV       42800 R 0442
  MNUP(KM)=MLEV(KM)*NUMFS(L) 42900 R 0444
  TCNST=TCNST+MNUP(KM)*MCUST(L,KM) 43000 R 0448
  TRN= MNUP(KM)*XMAN(KM)*ELIFE/TRAIN(L)+TRN 43100 R 0452

```

45 CONTINUE

MOSCP(I,J)=TCOSI

TCOST=0.

C6*****NONREP SUBROUTINE DETERMINES PARTS STOCKAGES REQUIRED FOR MODULE

C REPAIR.

CALL NONREP (I,J,NCLASP,STK,NSHOP,L,OPHRDY,NDAY,NUMBR,MTBFP,NUMFS

*,K1,R,G,ST,STR,ELIFE,ROP,ATRF)

SUN=0.0

TINVIN=0.0

TINVIN=0.0

DO 47 K=1,NCLASP

TCOST=TCOST+ST(K)*C(K)

STOP(I,J)=TCOSI

SUN = SUN+STR(K)*C(K)

TINVIN=((ST(K)-STR(K)/(ELIFE-ROP/12.))/2.+(ST(K)-STR(K)

/(FLIFE-ROP/12.))((ELIFE-ROP/12.)+STR(K)/2.)*C(K)*FACTIN

**TINVIN

43200 R 0458

43300 R 0458

43400 R 0461

43500 R 0461

43600 R 0461

43700 R 0462

43800 R 0468

43900 R 0475

44000 R 0475

44100 R 0476

44200 R 0477

44300 R 0482

44400 R 0486

44500 R 0486

00044600 R 0492

00044610 R 0497

00044620 R 0504

47 CONTINUE

PUHP(I,J):=PGP(I,J)*PPC

C *****INTCSP(I,J,L) IS THE TOTAL COST FOR FIP OF EACH MODULE AT LEVEL,

C L. (DOES NOT INCLUDE TRANSPORTATION OR EFFECT OF MODULF STOCKAGE)

TUTCSP(I,J,L)=IECP(I,J)+MNSCP(I,J)*ELIFE+STUP(I,J)

**S'P'P+TTNVIH+TRM +PHHP(I,J)

9A CONTINUE

C *****SFT M=1 TO LOOK AT FIRST POLICY ON INPUT DATA CARD THAT

C SPECIFIES THE POLICIES TO BE INVESTIGATED.

M=1

99K S'P'P=0.

TK=M

T=1

C *****HAVE ALL COMPONENTS BEEN CONSIDERED, IF SO, LOOK AT EQUIPMENT

C REPAIR (STATEMENT =6441)

44700 R 0507

44800 R 0507

44900 R 0511

45000 R 0511

45100 R 0512

45200 R 0520

45300 R 0527

45400 R 0527

45500 R 0527

45600 R 0528

45700 R 0530

45800 R 0530

45900 R 0531

46000 R 0531

46100 R 0531

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100 IF(I,GT,NC) GO TO 6441

NMC=NMK(J)

Y = 0.

J=1

C10****HAVE ALL MODULES BEEN CONSIDERED, IF SO, LOOK AT COMPONENT REPAIR

C STATEMENT =6442)

99 IF(J,GT,NMC) GO TO 6442

C11****CAUSES RETURN IN FIRST POLICY UNDER GIVEN FIM TREE.

15 N=TH

X=I.

C12****POLICY P IS VALUE OF NUMBER, N(M), APPEARING ON INPUT DATA CARD.

1 P=N(M)

DO 483 L=1,4

DO 483 KK=1,NTE

483 TE(L,KK)=0.

DO 484 L=1,4

DO 484 KM=1,NMUS

46200 R 0533

46300 R 0535

46400 R 0536

46500 R 0537

46600 R 0537

46700 R 0537

46800 R 0539

46900 R 0540

47000 R 0542

47100 R 0542

47200 R 0542

47300 R 0544

47400 R 0545

47500 R 0550

47600 R 0557

47700 R 0560

47800 R 0566

484 MUS(L,KM)=0.

(=FIP(P)

47900 R 0573

48000 R 0576

NL=FIM(P)

48100 R 0578

NL=FIC(P)

48200 R 0579

C13***TEST FOR THROWAWAY MODULE

IF(L,EQ,0) GO TO 3000

48300 R 0580

NUIF=1-NI

48400 R 0581

IF(NDIF,EQ,0) GO TO 2

48500 R 0583

48600 R 0584

C14***CALCULATE TRANSPORTATION COSTS BETWEEN FIP LEVEL AND FIM LEVEL

48700 R 0586

CALL TRANSM(I,J,L,NL,NC,TRANST,COSLB,WITH,NDAY,MTRFM,GP

48800 R 0587

*HRDY,NSHOP,TRAKIM,CSTRNM,NUMFS)

48900 R 0592

GO TO 3

49000 R 0597

C15***FIP AND FIM ARE PERFORMED AT SAME LEVEL, THEREFORE NO

49100 R 0597

C TRANSPORTATION COSTS OR MODULE STOCKAGE RAMIFICATIONS.

49200 R 0597

2 FIP(I,J)=TUTCSH(I,J,L)

49300 R 0598

49400 R 0598

GO TO 4

49400 R 0603.

3 CONTINUE

49500 R 0605

STKM(NL,I,J)=0.

49600 R 0605

C16***CALCULATE MODULE STOCKAGE REQUIREMENTS.

49700 R 0608

63 CALL REPMUD(I,STKM,NL,NSHUP,NUMFS,MTHM,NDAY,NMK,K?,TURN1,

49800 R 0609

*DPHNDY,STKM,T,STKTM,ELIFF,STKMR,J,ATHF,RUP)

49900 R 0616

T(I,J)=0

50000 R 0621

TCOST=STKM(NL,I,J)*CC(I,J)

50100 R 0624

IF(NL.NE.4)TCOST=TCOST+STKM(4,I,J)*CC(I,J)

50200 R 0630

SUPN=STKMR(I,J)*CC(I,J)

50300 R 0637

SMPT=STKM(NL,I,J)

50400 R 0642

IF(NL.NE.4)SMRI=SMRI+STKM(4,I,J)

50500 R 0645

TIMEVIN=((SMKT-SIKMR(I,J))/(ELIFE-RDP/12.))/2.+(SMRT-STKMR(I,J)

00050600 R 0650

/(ELIFE-RGP/12.))(ELIFE-RDP/12.)+STKMR(I,J)/2.)*CC(I,J)

00050610 R 0656

**FACIN

00050620 R 0664

STCH(I)=TCOST

50700 R 0667

FIPT(I,J)=TOTCSP(I,J,L)+CSTRNM(I,J)*ELIFE+TCOST+TIMEVIN+SUNN

50800 R 0668

```

4 IF (X.EQ. 0.) GO TO 7
  IF (IPT(I,J).GT.FIPS(I,J)) GO TO 5
7 FIPS(I,J)=IPT(I,J)
  T(I,J)=0
  LPP(I,J)=FIP(I)
  IF (FIP(I).NE.0) GO TO 5
  T(I,J)=1
5 M=M+1
  IF (L.GT.MMAX) GO TO 2846
  LL=M(M)
  LX=M(M)
C17***TEST TO SEE IF POLICY HAS SAME FIM BRANCH AS NEXT POLICY TO BE
C   CONSIDERED.
  IF (FIM(P).NE.FIM(LL)) GO TO 2846
C18***FIM BRANCHES ARE IDENTICAL, NOW TEST TO SEE IF FIC OF POLICY IS

```

```

50900 R 0670
51000 R 0681
51100 R 0687
51200 R 0691
51300 R 0694
51400 R 0697
51500 R 0700
51600 R 0704
51700 R 0705
51800 R 0707
51900 R 0709
52000 R 0700
52100 R 0709
52200 R 0710
52300 R 0713

```

C SAME AS FIC OF NEXT POLICY.

IF (FIC(P).NE.FIC(LI)) GO TO 2846
X=1.

C19***EVALUATE NEXT POLICY FOR SAME MODULE.

GO TO 1

2846 J=J+1

C20***EVALUATE NEXT MODULE FOR ALL FIP S UNDER SAME FIM.

GO TO 99

6442 CONTINUE

C21***ALL MODULES HAVE NOW BEEN EVALUATED FOR ALL FIP S UNDER THE

C PARTICULAR FIM AND FIC NOW UNDER CONSIDERATION.

DO 666 J=1,NMC

666 CONTINUE

SUMP=0.

DO 97 J=1,NMC

SUMP=FIPS(I,J) +SUMP

97 CONTINUE

52400 R 0713

52500 R 0714

52600 R 0718

52700 R 0718

52800 R 0718

52900 R 0720

53000 R 0720

53100 R 0721

53200 R 0722

53300 R 0722

53400 R 0722

53500 R 0722

53600 P 0728

53700 R 0728

53800 R 0729

53900 R 0734

54000 R 0738

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C22***CALCULATE PARAMETERS DESCRIBING THE FIM MAINTENANCE FUNCTION.      54100 R 0738
      CALL XFIM(I,NL,NC,AMMHC,NIF,TECI,NMUS,MUS,MUSC,TE,OPHRSH,      54200 R 0738
      *NSHC,P,NUMFS,TECM,MUSCH,STCM,TOTCSM,TECUST,MLOST,CC,NMK,T,STKTM,      54300 R 0746
      *TUP,T,MTREF,NDAE,LPP,OPHRDY,STKHR,FACTIN,ELIFE,XMAN,THAIN,STKTM,      54400 R 0758
      *MILEV,NUM,MLEV,MNUM,STKM,TINVIN,IRM,ATH,PFC,PGM,PUBM,UMF,PROD )      54500 R 0765
      SUMH=SUMP+TOTCSM(I)
      NWI=FTC(P)
      NNDIF=NL>NNL
      IF(NNDIF.EQ.0) GO TO 8
      54600 R 0774
      54700 R 0776
      54800 R 0778
      54900 R 0779
C23***CALCULATE TRANSPORTATION OF COMPONENTS DURING MAINTENANCE ACTION      55000 R 0781
      CALL      TRANSC(I,NL>NNL,NC,TRANST,CUSLH,WTC,NDAY,MTBFC,DPH      55100 R 0781
      *RDV,NSHUP,TRANIC,CSIRNC,NUMFS)
      55200 R 0787
      55300 R 0791
C24***INITIAL COST OF MAINTENANCE THROUGH FIM FUNCTION IF NO
C      TRANSPORTATION, OR COMPONENT STUCK EFFECTS ARE INVOLVED.
      55400 R 0791
      55500 R 0791

```

```

      8 FINT(I)=SUMM
      GO TO 10
      9 CONTINUE
      STKC(NNL,I)=0.
C25***DTERMINE COMPONENT STOCKAGE REQUIREMENTS
      1163 CALL REPCUM(NNL,NSHOP,NUMFS,MIRFC,NDAY,KJ,NC,TURN2,OPHRDY
      *,STWC,STKTC,TT,STKTCR,ELIFE,STKCR,AIRF,I,ROP)
      TT(I)=0
      TCONST=STKC(NNL,I)*CCC(I)
      IF(NNL.NE.4) TCONST=TCONST+STKC(4,I)*CCC(I)
      SUPLN=STKCR(I)*CCC(I)
      SNPT=STKC(NNL,I)
      IF(NNL.NE.4) SNPT=SNPT+STKC(4,I)
      TINVIN=((SMRT-STKCR(I))/(ELTFF-ROP/12.))/2.+(SMRT-STKCR(I)
      */(ELTFF-ROP/12.))*(ELIFE-ROP/12.)+STKCR(I)/2.)*CCC(I)*FACIN
      FINT(I)=SUMM+(SNPT*(I)*PLIFE+TCONST+SUNNN+TINVIN
      10 IF(Y.NE.0) GO TO 14

```

C26*****RESETS POLICY INDICATOR BACK TO FIRST POLICY UNDER PARTICULAR

C FIC BRANCH.

7Z=IR

GU TO 16

C27*****TEST FOR LEAST COST FIN.

14 IF(FINT(I).GT.FIMS(I)) GO TO 11

16 FIPS(I)=FINT(I)

NM(=NMK(I)

DU 4617 J=1,NPC

C28*****SAVE LOCATION OF LEAST COST MAINTENANCE ALLOCATION FOR FIM AND

C FIP FOR EACH COMPONENT AND MODULE RESPECTIVELY.

4617 LPS(I,J)=LPP(I,J)

LMS(I)=FIM(I)

TI(I)=0

IF(IJM(P).NE.0) GU TO 11

57200 R 0849
57300 R 0849
57400 R 0850
57500 R 0851
57600 R 0851
57700 R 0852
57800 R 0856
57900 R 0856
58000 R 0860
58100 R 0860
58200 R 0860
58300 R 0866
58400 R 0871
58500 R 0873
58600 R 0875

YT(I)=1

NHC=NMK(I)

DO 1463 J=1,NHC

1463 IPS(I,J)=FIP(P)

11 CONTINUE

IF (.GT. MMAX) GO TO 96

C29***TFST TO SEE IF FIC OF POLICY BEING EVALUATED IS SAME AS FIC OF
C NEXT POLICY.

IF (FIC(P).NE.FIC(LX)) GO TO 96

Y=1.

J=1

C30***SETTING IP EQUAL TO K CAUSES NEXT POLICY TO BE EVALUATED.

IK = M

GO TO 15

96 SUPC=SUNC+FIMS(I)

C31***IP=ZZ CAUSES RETURN TO FIRST POLICY UNDER FIC BRANCH BEING

C EVALUATED AND NEXT COMPONENT IS INVESTIGATED (I=I+1) BY RETURNING

58700 R 0878

58800 R 0880

58900 R 0881

59000 R 0887

59100 R 0891

59200 R 0891

59300 R 0892

59400 R 0892

59500 R 0893

59600 R 0897

59700 R 0897

59800 R 0897

59900 P 0898

60000 R 0899

60100 R 0900

60200 R 0900

60300 R 0900

C	TU STATEMENT =100.	60400 R 0900
	TR=27	60500 R 0902
	I=I+1	60600 R 0903
	GO TO 100	60700 R 0904
	0441 CONTINUE	60800 R 0905
	C32***CALCULATE ALL PARAMETERS CONCERNING FIC MAINTENANCE REQUIREMENTS.	60900 R 0905
	CALL XFIC(RNL,AMHE,NTL,TEFI,NMUS,MUS,MUSE,JE,UPHRSH,NSHNP,	61000 R 0905
	*NUMFS,TECC,STCC,IUICSC,TECOST,MCONST,CCC,NC,IT,STKIC,TURN2,MTRFC,	61100 R 0912
	*MDAL,L,LMS,UPHRDY,SIXCH,FACTIN,ELLIFE,XMAN,INAIN,STKTCK	61200 R 0921
	*NLEV,NUM,HLEV,MNUM,STKC,MOSCC,IINVIN,IRN,AIRF,PPC,PGC,PIPC	61300 R 0926
	*JUT,PROD)	61400 R 0934
	TUOIF=MNI-1	61500 R 0935
	IF(IODIF,NF,0) GO TO 12	61600 R 0936
	C33***COST OF MAINTENANCE THROUGH FIC FUNCTION WHEN NO TRANSPORTATION	61700 P 0937
C	IS REQUIRED (FIC IS PERFORMED AT LEVEL 1)	61800 R 0937

FICT=TOTCSC

GO TO 13

12 CALL

TRANSE (NNL,TRANST,COSLB,WTE,MIBFE,OPHRDY,NSHOP,

*TRANTE,CSTPNE,NDAY,NUNFS)

FICT=TOTCSC + CSTRNE*ELIFE

C34***CALCULATE ALL PARAMETERS DESCRIBING THE CUE MAINTENANCE FUNCTION.

13 CALL XCUE(CANMHCE,NML,NTE,NMOS,OPHRSH,NSHOP,NUNFS,TECE,

*MOSCE,NDAY,STKE,OPHRDY,MCOST,TECOST,TOIEND,CSEI,TURN2,MTRFE

**STKFR,XMAN,FLIFE,TRAIN,NLFV,MLEV,NUM,MNUM,TEEC,MUSEC,STKEC,FACTIN

*TILVIN,TRF,ATRF,B,G,YK,G,PPC,PGE,PUBE,NDAF,IIT,KOP,PROD)

C35***TOTAL COST FOR MAINTENANCE EQUALS MAINTENANCE COST THROUGH FIC

C FUNCTION (FICT) + COST OF CUE FUNCTION (TOIEND)

SUPL=SUMC+FICT+TOIEND

C36***IF FIRST TIME THROUGH GO TO 968 AND SET SUMEMN EQUAL TO SUME.

995 IF (SUMEMN.EQ.0.) GO TO 968

C37***TEST FOR LEAST CUST EQUIPMENT MAINTENANCE.

IF (SUMF.GT.SUMEMN)GO TO 969

61900 R 0938

62000 R 0939

62100 R 0940

62200 R 0944

62300 R 0946

62400 R 0946

62500 R 0948

62600 R 0953

62700 R 0958

62800 R 0966

62900 R 0971

63000 R 0971

63100 R 0971

63200 R 0972

63300 R 0973

63400 R 0974

63500 R 0975

968 SUMLMN=SUMF

DO 310 I=1,NC

NMC=NMC(I)

DO 309 J=1,NMC

C38***LPI (I,J) IS OPTIMUM LEVEL FOR FIP UNDER GIVEN FIM, LPS (I,J) IS

C OPTIMUM LEVEL UNDER GIVEN FIC AND LPMIN (I,J) IS OPTIMUM LEVEL FOR

C FIP OF ALL POLICIES.

LPMIN(I,J)=LPS(I,J)

309 CONTINUE

C39***OPTIMUM FIM LEVEL

LPMIN(I)=LPS(I)

310 CONTINUE

C40***OPTIMUM FIC LEVEL

LCMIN=FIC(P)

63600 R 0978

63700 R 0978

63800 R 0984

63900 R 0986

64000 R 0987

64100 R 0987

64200 R 0987

64300 R 0991

64400 R 0997

64500 R 0997

64600 R 0997

64700 R 1000

64800 R 1000

64900 R 1000

65000 R 1000

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IF(LCMIN.NE.O) GO TO 969

DO 7931 I=1,NC

NMC=NHK(I)

LMIN(I)=0

DO 7931 J=1,NMC

7931 LMIN(I,J)=0

SEGMENT 10 IS 102

START OF SEGMENT *****

969 IF(M.GT.MMAX) GO TO 999

C41***GO TO 998 AND START OVER WITH COMPONENT 1 AND MODULE 1 AND

C PROCED AS BEFORE ON THE NEXT MAINTENANCE POLICY TO BE EVALUATED.

GO TO 998

C42***YOU ARE HERE BECAUSE THERE IS A THROWAWAY. IF THROWAWAY MODULE

C CONTINUE TO THRMUD AND CALCULATE COST THROWAWAY MODULE.

3000 IF(FIM(P),EQ.O) GO TO 150

CALL THRMUD(I,J,NL,NSHOP,NUMFS,MTBFM,NDAY,K2,B,G,UPHRDY,STKT

*M,RUP,T,STKIMR,ELIFE,ATMF)

SMPT=STKIM(NL,I,J)

65000 R 1002

65100 R 1004

65200 R 1009

65300 R 1011

65400 R 1013

65500 R 1019

65600 R 0002

65700 R 0003

65800 R 0003

65900 R 0004

66000 R 0004

66100 R 0004

66200 R 0005

66300 R 0008

66400 R 0014

66500 R 0018

```

IF(NL,NE,4)SMRI=SMRI+STKTM(4,I,J)                66600 R 0022
TINVIN=((SMRT-SIKTM(I,J))/(ELIFE-RUP/12.))/2.+(SMRT-STKIMR  00066700 R 0027
*(I,J)/(ELIFE-RUP/12.))*(ELIFE-RUP/12.)+STKIMR(I,J)/2.)  00066710 R 0032
**CC(I,J)*FACTIN                00066720 R 0040
FIPI(I,J)=SIKTM(NL,I,J)*CC(I,J)+STKTM(I,J)*CC(I,J)+TINVIN  66800 R 0043
IF(NL,NE,4)FIPI(I,J)=FIPI(I,J)+STKTM(4,I,J)*CC(I,J)  66900 R 0056
GO TO 4                67000 R 0067
C43***THROWAWAY WAS NOT MODULE THROWAWAY, TEST FOR THROWAWAY  67100 R 0067
C COMPONENT AND PROCEED TO THRCOM IF THROWAWAY COMPONENT.  67200 R 0067
150 IF(FIC(P),EQ, 0) GO TO 170                67300 R 0068
CALL THRCOM(I,NL,NSHOP,NUMFS,MTHFC,NUAY,K3,STKTC,NPHRDY,RDP  67400 R 0071
*,IT,STKICR,ELIFE,B,G,ATRF)                67500 R 0076
SMRT=STKTC(NL,I)                67600 R 0081
IF(NL,NE,4)SMRI=SMRT+STKTC(4,I)                67700 R 0084
TINVIN=((SMRT-STKTC(I))/(ELIFE-RUP/12.))/2.+(SMRT-STKICR(I)  06067800 R 0086

```

*(ELIFE=ROP/12.))**(ELIFE=ROP/12.)*STKTCR(I)/2.)*CCC(I)*
 *FACTIN

00067810 R 0002

00067820 R 0003

FINT(I)=STKTC(NNL,I)*CCC(I) +STKTCR(I)*CCC(I) +IINVIN
 IF(NNL.NE.4) FINT(I)=FINT(I)+STKTC(4,I)*CCC(I)
 M=M+1

67900 R 0100

68000 R 0108

68100 R 0115

C44***IF LAST POLICY TO BE EVALUATED GO TO NEXT COMPONENT AND RETURN TO
 C 10 IF NOT LAST POLICY, SET LX EQUAL TO NUMBER OF NEXT POLICY AND
 C RETURN TO 10.

68200 R 0115

68300 R 0115

68400 R 0115

IF(N.GT.MMAX)GO TO 171

68500 R 0115

LX=N(M)

68600 R 0110

171 GO TO 10

68700 R 0120

170 CONTINUE

68800 R 0121

TTT=1

68900 R 0121

C45***IF YOU GET HERE THEN YOU HAVE A THROWAWAY EQUIPMENT.

69000 R 0121

CALL XCODEC(AMHCE,NNL,NLE,NMOS,OPHRSH,NSHOP,NUMPS,TECE,

69100 R 0121

*MUSCE,NDAY,STKE,OPHNDY,MCOST,TECOST,TOTEND,CSEI,TURN2,MTRFE

69200 R 0127

*,STKER,XMAN,ELIFE,TRAIN,NLEV,NLEV,NUM,MNUM,TEEC,MDOSEC,STKEC,FACTIN

69300 R 0132

```

*ATTNIN,TRM,ATH,UB,UB,XK4,PPC,PGE,PUBE,NUAF,ITT,MUP,PROD)
SU'LE=TTTEND
M=M+1
GD IN 995
999 CONTINUE
C46***STEP OF OPTIMIZATION PORTION OF GENM. BEGIN CALCULATIONS FOR KNOWN
C MAINTENANCE POLICY OR RECALCULATION OF OPTIMUM POLICY PARAMETERS
DO 5106 L=1,4
DO 5106 K=1,NCLASH
STEP(K)=0.
STEP(L,K)=0.0
5106 CONTINUE
DO 5114 I=1,NC
NMC=NWK(I)
DO 5114 J=1,NMC

```

```

69400 R 0130
69500 R 0145
69600 R 0145
69700 R 0147
69800 R 0148
69900 R 0148
70000 R 0148
70100 R 0148
70200 R 0153
70300 R 0159
70400 R 0161
70500 R 0165
70600 R 0166
70700 R 0171
70800 R 0173

```

STKCR(I)=0.

STKCR(I,J)=0.

DO 5104 KK=1,NIE

DO 5104 L=1,4

STKC(L,J)=0.

STKC(L,I,J)=0.

NHLEV(L,KK)=0.

NNIP(KK)=0.

5104 CONTINUE

DO 5105 KM=1,NMUS

DO 5105 L=1,4

NHLEV(L,KM)=0.

NNUM(KM)=0.

5105 CONTINUE

5114 CONTINUE

ROPART=0.

CTINVI=0.

70900 R 0178

71000 R 0180

71100 R 0183

71200 R 0185

71300 R 0188

71400 R 0197

71500 R 0201

71600 R 0204

71700 R 0206

71800 R 0207

71900 R 0210

72000 R 0218

72100 R 0221

72200 R 0224

72300 R 0225

72400 R 0226

72500 R 0226

CTRM=0.

REST=0.

STKFR=0.

YPIIS=0.

TIT=0

CALL AMMH(MITRCE,MTIRE,UPHRDY,NDAY,NC,NMK,MTIRM,MTHEM,

*MITKNC,MITRFC,AMHHH,AMHHC,AMHHE,AMHCE,MTFFF)

C47***CALCULATE PIP PARAMETERS FOR ALL MODULES OF ALL COMPONENTS

NNI=LQMIN

DO 5108 I=1,NC

PHC=NMK(I)

NL=LMMIN(I)

DO 5107 J=1,NMC

T(I,J)=0

TI(I)=0

72600 R 0227

72700 R 0228

72800 R 0229

72900 R 0229

73000 R 0230

73100 R 0231

73200 R 0235

73300 R 0240

73400 R 0240

73500 R 0241

73600 R 0244

73700 R 0248

73800 R 0249

73900 R 0255

74000 R 0258

0259

L=LPMIN(I,J)

IF(L.EQ.4)AMMHM(I,J)=AMMHM(I,J)*(1.0ME)

IF(L.NE.0) GO TO 5100

CSTRNM(I,J)=0.0

TRANM(I,J)=0.0

IF(NL.NE.0)GO TO 3710

ITT=1

GO TO 3711

3710 CONTINUE

IF(NL.EQ.0) GO TO 5108

CALL THRMOD(I,J,NL,NSHP,NUM,S,ITBFM,NDAY,K2,B,G,DPHRDY,

*STKTM,ROP,T,STKTMK,ELIFE,ATRF)

STK(NI,I,J)=STKTM(NL,I,J)

T(I,J)=1

GO TO 5107

5100 NU 6800 KK=1,NIE

NLFV(KK)=0.

74100 R 0260

74200 R 0262

74300 R 0269

74400 R 0272

74500 R 0274

74600 R 0277

74700 R 0279

74800 R 0280

74900 R 0282

75000 R 0282

75100 R 0284

75200 R 0291

75300 R 0295

75400 R 0301

75500 R 0304

75600 R 0305

75700 R 0310

NUM(KK)=0.

6800 CONTINUE

DO 6801 KM=1,NHUS

HLFV(KM)=0.

NNUM(KM)=0.

6801 CONTINUE

DO 281 KK=1,NTE

281 TEL(KK)=0.

DO 282 KM=1,NHUS

282 MOS(L,KM)=0.

DO 29 KK=1,NTE

C48***DETERMINE TEST EQUIPMENT REQUIREMENTS PER LEVEL FOR FIP

IF(TFM1(I,J,KK).NL.1.) GO TO 29

TE(L,KK)=AMMH(1,J)

29 CONTINUE

75800 R 0312

75900 R 0315

76000 R 0315

76100 H 0320

76200 R 0322

76300 R 0325

76400 R 0325

76500 R 0331

76600 R 0334

76700 R 0340

76800 R 0343

76900 R 0344

77000 R 0348

77100 R 0356

77200 R 0361

DO 21 KM=1,NMOS

C49***DETERMINE MOS REQUIREMENTS PER LEVEL FOR FIP

IF (INSM(I,J,KM),NE,1) GO TO 21

MUS(L,KM)=AMMHM(I,J)

21 CONTINUE

TCNST=0.

DO 23 KK=1,NTF

YNI(V=TE(L,KK)/(NPHRS(L)*J(GAE)*NSHUP(L)

NLFV(KK)=XMLEV

NUM(KK)=NLEV(KK)*NUMS(L)

TCNST=TCNST+NUM(KK)*TCOST(KK)

TECP(I,J)=TCNST

23 CONTINUE

Y=TCNST*

TRD=0.0

TCNST=0.

DO 25 KM=1,NMOS

77300 R 0361

77400 R 0362

77500 R 0366

77600 R 0371

77700 R 0377

77800 R 0377

77900 R 0378

78000 R 0383

78100 R 0389

78200 R 0391

78300 R 0394

78400 R 0398

78500 R 0401

78600 R 0401

78700 R 0404

78800 R 0405

78900 R 0406

```

PRNM=PROD
IF(L.EQ.4)PRNM=1.
XMLEV=MOS(L,KM)/(UPHRSH(L)*PRNM+NDAE)*NSHOP(L)
MLEV(KM)=XMLEV
MNUM(KM)=MLEV(KM)*NUMFS(L)
TCOST=TCOST*MNUM(KM)+MCOST(L,KM)
MOSCP(I,J)=TCOST
TRM= MNUM(KM)*XMAN(KM)*ELIFE/TRAIN(L)+TRM
25 CONTINUE
TCOST=0.
C50***CALCULATE PARIS STOCKAGE REQUIREMENTS
CALL NONREP (I,J,NCLASH,STK,NSHOP,L,OPHRDY,NDAY,NIMBR,MTRFP,NUMFS
*,K1,R,G,ST,STR,ELIFE,ROP,ATRF)
SUM=0.0
TI,VIN=0.0

```

DD 27 K=1,NCLASH

80300 R 0454

TCOST=TCOST+ST(K)*C(K)

80400 R 0460

STCP(I,J)=TCOST

80500 R 0464

SUP = SUN+STR(K)*C(K)

80600 R 0468

TINVIN=((ST(K)-STR(K))/(ELIFE-RDP/12.))/2.+(ST(K)-STR(K)/

00080700 R 0470

(ELIFE-RDP/12.))((ELIFE-RDP/12.)+STR(K)/2.)*C(K)*

00080710 R 0476

*FACTIN+TINVIN

00080720 R 0482

27 CONTINUE

80800 R 0485

PUPP(T,J)=PGP(I,J)*PPC

80900 R 0485

C51***ADD UP COSTS OF TEST EQUIPMENT, MAINTENANCE PERSONNEL AND

C STORAGE FOR FIP.

81100 R 0489

TOTCSP(I,J,L)=IECP(I,J)+HUSCP(I,J)*ELIFE+STCP(I,J)

81200 R 0490

*+SUP+TINVIN+TRM +PUPP(I,J)

81300 R 0498

ROPART=ROPART+ SUN

81400 R 0504

TPUB=TPUB+PUPP(I,J)

81500 R 0506

CTINVIN=CTINVIN+TINVIN

81600 R 0509

CTRM=CTRM+TRM

81700 R 0510

C52***DETERMINE TRANSPORTATION COSTS DURING REPAIR OF MODULES

CALL TRANSM(I,J,L,NL,NC,TRANSI,CNSLR,XIM,NDAY,MTRFM,

*OPHNDY,NSHOP,TRANIM,CSTHNM,NUMFS)

DO 5102 KK=1,NIE

NNLEV(L,KK)=NNLEV(L,KK) + NLEV(KK)

5102 CONTINUE

DO 5103 KM=1,NMUS

NNLEV(L,KM)=MMLEV(L,KM)+MLEV(KM)

5103 CONTINUE

5107 CONTINUE

5108 CONTINUE

NNI=ICNIN

DO 5117 I=1,NC

NL=LMMIN(I)

IF(NL,NE,0) GO TO 5109

C53***CALCULATE STOCKAGE REQUIREMENTS FOR THROAWAY COMPONENTS.

CALL THRCOM(I,NNL,NSHOP,NUMFS,MTRFC,NDAY,K3,STKIC,OPHNDY,ROP,

81800 R 0510

81900 R 0511

82000 R 0517

82100 R 0521

82200 R 0527

82300 R 0534

82400 R 0534

82500 R 0539

82600 R 0546

82700 R 0547

82800 R 0548

82900 R 0549

83000 R 0549

83100 R 0555

83200 R 0557

83300 R 0558

83400 R 0559

* TT,STKTCR,ELJFE,B,G,ATRF)

TT(I)=1

STKC(NNL,I)=STKIC(NNL,I)

TRALTC(I)=0.0

CSIRNC(I)=0.0

GO TO 5117

5109 NNC=NMK(I)

GO 5118 J=1,NHL

LPS(I,J)=LPMJH(I,J)

5118 CONTINUE

C54****Determine FIM Parameters

CALL XFIM(T,NL,NC,ANMHC,NTF,TECI,NMUS,MUS,MUSC,TE,OPHRSH,

*NSH(OP,NUMFS,TECM,MUSCH,STCH,TUTCSM,TECUST,MCUST,CC,NMK,T,STKM,

*TUPN1,MTHFM,NDAL,LPH,UPHRUY,STKMK,FACTIN,ELIFE,XMAN,TRAIN,STKTMR

*NLEV,NUM,MLEV,MNUM,STKM,TINVIN,TRM,ATHF,PPC,PGM,PJBM,DMF,PROD)

83500 R 0565

83600 R 0570

83700 R 0571

83800 R 0576

83900 R 0578

84000 R 0579

84100 R 0581

84200 R 0582

84300 R 0587

84400 R 0593

84500 R 0593

84600 R 0593

84700 R 0601

84800 R 0613

84900 R 0620

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TPUB=TPUB+PUBM(I)

NMC=NMC(I)

TIJVIN=0.0

SURN=0.0

TCOST=0.

DO 3821 J=1,NMC

I=LPMIN(I,J)

IF(NL.EQ.L) GO TO 382;

STKM(NL,I,J)=0.

C55***DETERMINE MODULE STOCKAGE

CALL REPMU(I,STKM,NL,NSHP,NUMFS,MTHFM,NDAY,NMK,K2,TURN1,

*OPHNDY,STKM,T,STKTM,ELIFE,STKMK,J,ATRF,RUP)

T(I,J)=0

TCOST=TCOST+STKM(NL,I,J)*CC(I,J)

IF(NL.NE.4)TCOST=ICOST+STKM(4,I,J)*CC(I,J)

85000 R 0629

85100 R 0631

85200 R 0633

85300 R 0634

85400 R 0634

85500 R 0635

85600 R 0640

85700 R 0643

85800 R 0645

85900 R 0648

86000 R 0649

86100 R 0656

86200 R 0662

86300 R 0664

86400 R 0671

```

SUNK=SUNN+STKMR(I,J)*CC(I,J)
SMRT=STKM(NL,I,J)
IF(NL.NE.4)SMRT=SMRT+STKM(4,I,J)
      86500 R 0676
      86600 R 0683
      86700 R 0687
      00086800 R 0692
      00086810 R 0697
      00086820 R 0705
      86900 R 0709
      87000 R 0709
      87100 R 0710
      87200 R 0711
      87300 R 0712
      87400 R 0718
      87500 R 0722
      87600 R 0727
      87700 R 0734
      87800 R 0734
      87900 R 0739

      TIUVIN=((SMRT-STKMR(I,J))/(ELIFF-RUP/12.))/2+(SMRT-STKMR(I,J)
      */(FLIFE-RUP/12.))*(ELIFE-RUP/12.)+STKMR(I,J)/2.)*CC(I,J)
      **FACTIN+TIUVIN
      00086820 R 0705
      86900 R 0709
      87000 R 0709
      87100 R 0710
      87200 R 0711
      87300 R 0712
      87400 R 0718
      87500 R 0722
      87600 R 0727
      87700 R 0734
      87800 R 0734
      87900 R 0739

3821 CONTINUE
      CTINVI=CTINVI+TIUVIN
      STKM(I)=TCOST
C56***CALCULATE TRANSPORTATION COST DURING KEPA & J COMPONENTS
      CALL TRANSC(I,NL,NL,NC,TRANST,COSLB,WTC,NDAY,MTRFC,
      *DPHROY,NSHOP,TRANFC,CSTRNC,NUMFS)
      DO 5110 KK=1,NIE
      NMLEV(NL,KK)=NNLEV(NL,KK)+NLFV(KK)
5110 CONTINUE
      DO 5111 KM=1,NMUS
      MMLEV(NL,KM)=MMLEV(NL,KM)+MLEV(KM)

```

5111 CONTINUE

CTP=CTRM+TRM

5117 CONTINUE

DO 5119 I=1,NC

LMST)=LMNTN(I)

5119 CONTINUE

057***CALCULATE FIG PARAMETERS

CALL XFIC(NNL,AMME,NTE,TECI,NMUS,MUS,MUSE,TE,UPHRSH,NSHNP,

*NUMFS,TECC,STCC,ITULSC,TECNST,MCONST,CCC,NC,I,STKTC,TURNP,MTRFC,

*NDAE,L,LMS,UPHRDY,SIKCR,FACTIN,ELIFE,XMAN,TRAIN,SIKICR

*NIEV,MUM,MLEV,MNUM,STKC,MNOSC,IINVIN,IRM,ATRF,PPC,PGC,PUFC

*DWE,PRUD)

TIME=TPUR+PURC

CALL TRANSF (NNL,IRANST,COSLR,WIE,MIRFE,OPHKDY,NSHNP,

*TRANTE,CSTRNE,NUAY,NUMFS)

88000 R 0746

88100 R 0746

88200 R 0748

88300 R 0748

88400 R 0753

88500 R 0757

88600 R 0757

88700 R 0757

88800 R 0764

88900 R 0773

89000 R 0779

89100 R 0786

89200 R 0787

89300 R 0788

89400 R 0793

/(FLIFE-RDP/12.)) (CLIFE-RDP/12.)*SJKCK(I)/2.)*CCC(I)

**FACTIN+TINVIN

3819 CONTINUE

CTINVI=CTINVI+TINVIN

STCC=TCJST

DO 5112 KK=1,NIE

NNLEV(NNL,KK)=NNLEV(NNL,KK)+NLEV(KK)

5112 CONTINUE

DO 5113 KM=1,NMUS

NNLEV(NNL,KM)=MMLEV(NNL,KM)+ML # (KM)

5113 CONTINUE

CTIN=CTIN+TRM

3711 CONTINUE

C59***DFTIRINE CNE PARAMETERS

CALL XCODE(CAMHCE,NNL,NTE,NMDS,OPHRSH,NSHOP,NUMFS,TECE,

00091110 R 0846

00091120 R 0852

91200 R 0855

91300 R 0855

91400 R 0856

91500 R 0857

91600 R 0862

91700 R 0869

91800 R 0869

91900 R 0874

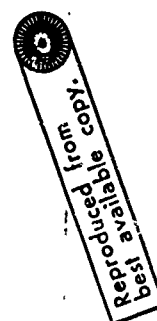
92000 R 0881

92100 R 0881

92200 R 0883

92300 R 0883

92400 R 0883



```

*+MUSCE,NDAY,STKE,UPHRDY,MCCOST,TECOST,TOTEND,CSEI,TURN2,MTRFE      92500 R 0888
*+STKER,XMAN,ELIFE,IRAIN,NLEV,MLEV,NUM,MNUM,TEEC,MNSEC,STKEC,FACTIN    92600 R 0893
*+TTINVIN,TRM,ATRT,B,G,XK4,PPC,PGE,PUHE,NDAE,ITT,RQP,PROD)          92700 R 0901
*+TPUR=TPUR+PUHE
*+DU 2317 KK=1,NLE
*+NLEV(1,KK)=NNLEV(1,KK)+NLEV(KK)
2317 CONTINUE
*+DU 2318 KM=1,MUS
*+MLEV(1,KM)=MMLEV(1,KM)+MLEV(KM)
2318 CONTINUE
*+TOS=0.
*+TUT=0.
C60***+DTERMINE TOTAL COSTS IN EACH COST CATEGORY.
*+CIPM=CIRM+TRM
*+CTINVI=CTINVI+TINVIN
*+TUTMS=CSTRNE
*+TUTK=STCC+STKEC

```

```

PEST=STKER+CSFI
DO 1919 I=1,NMC
  NMC=NMC(I)
  TOTRNS=TOTRNS+CSIRNC(I)
  TUSTK=TUSTK+STCM(I)
  PEST=PEST+STKCK(I)*CCC(I)
  DO 1919 J=1,NMC
    TOTRNS=TOTRNS+CSIRNC(I,J)
    TUSTK=TUSTK+STCF(I,J)
    PEST=PEST+STKCK(I,J)*CC(I,J)
  1919 CONTINUE
  PEST=PEST+H(IPAKI)
  WRITE(6,1401)
  1401 FORMAT(1H1)
  WRITE(6,9973)

```

```

94200 R 0935
94300 R 0936
94400 R 0942
94500 R 0944
94600 R 0946
94700 R 0948
94800 R 0951
94900 R 0954
95000 R 0959
95100 R 0962
95200 R 0968
95300 R 0969
95400 R 0970
95500 R 0974
95600 R 0974

```

```

+MUSCE,NDAY,STKE,OPHKUY,MCOST,TECOST,TOTEND,CSEI,TURN2,MTRFE      92500 R 0888
+STKER,XMAN,ELIFE,THAIN,NLEV,MLEV,NUM,MNUM,TEEC,MNSEC,STKEC,FACTIN  92600 R 0893
+CTINVIN,TRM,ATMT,B,G,XK4,PPC,PGE,PUHE,NDAE,ITT,KOP,PROD)      92700 R 0901
TPUT=TPUR+PUHE
NU 2317 KK=1,NLE
NNLEV(1,KK)=NNLEV(1,KK)+NLEV(KK)
2317 CONTINUE
NU 2319 KM=1,MUS
MMLEV(1,KM)=MMLEV(1,KM)+MLEV(KM)
2319 CONTINUE
TCUS=0.
TUTL=0.
C00***DTERMINE TOTAL COSTS IN EACH COST CATEGORY.
CIPM=CTHM+TRM
CTINV=CTINV1+CTINV2
TUTRHS=CTHME
TUTK=STCC+STKEC

```

C01***HIGH PRINTOUT OF OUTPUTS

9973 FORMAT(23X,23HRELIABILITY INFORMATION //)

WRITE(6,9974)

9974 FORMAT(26X,40HITEM MEAN TIME BETWEEN FAILURE

WRITE(6,9975) MIRTH

9975 FORMAT(24X,8HEND ITEM,16X,F8.3)

SEGMENT 13 IS 1

DO 9306 I=1,NC

WRITE(6,9976) I,MTHFC(I)

9976 FORMAT(24X,10HCOMPUTATION,12,12X,F10.3)

9306 CONTINUE

DO 9307 I=1,NC

NMT=NMTK(I)

DO 9307 J=1,NMC

SEGMENT 12 IS 10

START OF SEGMENT *****

WRITE(6,9977) I,J,MTHFM(I,J)

97000 R 0002

9977 FUPHAT(24X,7HMDUULT ,I2,I1H,I2,I5X,F10.3)

9307 CONTINUE

DO 5304 K=1,NCLASH

WRITE(6,9978) K,MHFP(K)

9978 FUPHAT(24X,10HPART TYPE ,I2,7X,F10.0)

9308 CONTINUE

WRITE(6,1441)

WRITE(6,9637)

9637 FUPHAT(14X,23H-AINIF,NANCE ALLOCATION //)

WRITE(6,9638)

9638 FUPHAT(10X,31HCUMP MUD FIC FIM FIP /)

DO 5204 I=1,NIC

NIC=NMK(I)

NL=LMMIN(I)

DO 5204 J=1,NMC

5204 CONTINUE

97100 R 0018

97200 R 0019

97300 R 0020

97400 R 0025

97500 R 0039

97600 R 0039

97700 R 0039

97800 R 0042

97900 R 0047

98000 R 0047

98100 R 0051

98200 R 0051

98300 R 0056

98400 R 0058

98500 R 0059

98600 R 0066

```

WRITE(6,6007) LUMIN
99700 R 0067

DU 6008 I=1,NC
99800 R 0076

NMC=NMC(I)
99900 R 0081

WRITE(6,6009) I,LMMIN(I)
99000 R 0083

DU 6009 J=1,NMC
99100 R 0096

WRITE(6,6010) I,J,IPMIN(I,J)
99200 R 0101

6008 CONTINUE
99300 R 0119

6007 FORMAT(26X,I1)
99400 R 0119

6009 FORMAT(11X,I2,21X,I1)
99500 R 0110

6010 FORMAT(11X,I2,6X,I2,20X,I1)
99600 R 0119

WRITE(6,6041)
99700 R 0119

WRITE(6,6150)
99800 R 0122

5150 FORMAT(///21X,14HPARTS STOCKAGE//)
99900 R 0126

WRITE(6,6151)
100000 R 0126

5151 FORMAT(7X,5HLEVEL,5X,5HCLASS,5X,8HQUANTITY,
*5X,4HCOST//)
100100 R 0130

100200 R 0130

```

```

      DO 5128 L=1,4
      DO 5128 K=1,N(LAST)
      CSTK(L,K)=STK(L,K)*C(K)
      WRITE(6,5191) L,K,STK(L,K),CSTK(L,K)
5191  FORMAT(8X,I2,9X,I2,4X,F10.0,4X,F14.2)
5128  CONTINUE
      WRITE(6,5160)
5160  FORMAT(///20X,15HMODULE STOCKAGE//)
      WRITE(6,5161)
5161  FORMAT(1X,9HCOMPONENT,1,3X,6HMODULE,5X,5HLFVFL,5X,5HSTUCK,
      +5X,4HCONST//)
      DO 5126 I=1,6
      DO 5126 J=1,NC
      NMC=NMK(I)
      NL=1MHIN(I)

```

100300 R	0130
100400 R	0135
100500 R	0141
100600 R	0147
100700 P	0168
100800 R	0168
100900 R	0169
101000 R	0173
101100 R	0173
101200 P	0177
101300 R	0177
101400 R	0177
101500 R	0182
101600 R	0188
101700 R	0190

101800 R 0191

101900 R 0197

102000 R 0206

102100 R 0231

102200 R 0231

102300 R 0232

102400 R 0236

102500 F 0236

102600 R 0240

102700 R 0240

SEGMENT 15 IS 1

102800 R 0240

102900 R 0245

103000 R 0251

103100 R 0257

103200 R 027A

103300 R 027A

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NO 512A J=1,NFC

CSFM(L,I,J)=SIKM(L,T,J)*CCC(I,J)

WRITE(6,5129) 1,J,1,SIKM(L,T,J),CSFM(L,T,J)

5129 FORMAT(3X,12,9X,12,9X,12,3X,F10.0,F14.2)

512A C(PTIME

WRITE(6,51A2)

5162 FORTUIT(////18X,10NCOMPONENT STUCKAGE//)

WRITE(6,51A3)

5163 FORTUIT(5X,5NCOMPONENT 1.3X,6HLE VFL,5X,5HSINCR,5X,

*4H(CST/)

NO 5130 L=1,4

NO 5130 I=1,NFC

CSFM(L,I)=SIKM(L,T)*CCC(I)

WRITE(6,5131) I,L,SIKM(L,T),CSFM(L,I)

5131 FORMAT(3X,12,9X,12,9X,12,3X,F10.0,F14.2)

5130 C(PTIME

5166 WRITE(6,5170)	104900 R 0327
5170 FORMAT(1X,15HDIRECT SUPPORT"/)	105000 R 0328
GO TO 5181	105100 R 0331
5167 WRITE(6,5171)	105200 R 0332
5171 FORMAT(1X,16GENERAL SUPPORT"/)	105300 R 0336
GO TO 5181	105400 R 0336
5168 WRITE(6,5172)	105500 R 0337
5172 FORMAT(1X,14HDEPOT SUPPORT"/)	105600 R 0341
5181 WRITE(6,5206)	105700 R 0341
5206 FORMAT(13X,4HTYPE,5X,8HQUANTITY,5X,4HCUST)	105800 R 0345
5173 GO 5132 KK=1,N1E	105900 R 0345
IF(IRD.EQ.0)GO TO 5373	106000 R 0350
N1LEV(1,KK)=NNLEV(1,KK)+.9999	106100 R 0353
NNLEV(L,KK)=N1LEV(1,KK)	106200 R 0360
GO TO 5374	106300 R 0364
5373 NNLEV(L,KK)=NNLEV(1,KK)	106400 R 0366
5374 CANLEV(L,KK)=NNLEV(L,KK)+TECNST(KK)	106500 R 0371

```

      WRITE(6,5134) KK,NCLEV(L,KK),CANNLEV(L,KK)
5134 FORMAT(14X,I2,/X,F7.3,3X,F14.2)
      NIMP(KK)=NNUM(KK)+NCLEV(L,KK)*NUMFS(L)
5132 CONTINUE
      WRITE(6,51A2)
51B2 FORMAT(/8X,33HIDIAL TEST EQUIPMENT REQUIREMENTS/)
      WRITE(6,51A3)
51B3 FORMAT(17X,4HTYPE,AX,8HQUANTITY)
      DO 513B KK=1,NIE
      WRITE(6,5196) KK,NNUM(KK)
      TLT=TOTE+NNUM(KK)*IECOST(KK)
5196 FORMAT(18X,I2,13X,F6.3)
513B CONTINUE
      WRITE(6,1441)
      WRITE(6,5174)

```

```

106600 R 0376
106700 R 0395
106800 R 0395
106900 R 0401
107000 R 0402
107100 R 0406
107200 R 0406
107300 R 0410
107400 R 0410
107500 R 0415
107600 R 0428
107700 R 0432
107800 R 0432
107900 R 0432
108000 R 0435

```

5174 FURKAT(////10X,30MAINTENANCE PERSONNEL PER SHUP//)

NO 5135 L=1,4

36 TN (5175,516,517,5178),1

5175 WHITE(4,5169)

30 17 5180

5176 WHITE(4,5170)

30 17 5180

5177 WHITE(4,5171)

30 17 5180

5178 WHITE(4,5172)

5180 WHITE(4,5207)

5207 FURKAT(14X,3H11J5,5X,4HQUANTITY,5X,4HCOST)

5179 NO 5135 KM=1,NAUS

IF(IRD.EQ.0) GO TO 5379

WHITEV(L,KM)=MMLEEV(1,KM)+.9999

HCIEV(1,KM)=MILEEV(L,KM)

108100 R 0440

108200 R 0440

108300 R 0445

108400 R 0453

108500 R 0456

108600 R 0457

108700 R 0460

108800 R 0461

108900 R 0464

109000 R 0465

109100 R 0469

109200 R 0473

SEGMENT 16 IS 1

109300 R 0473

109400 R 0478

109500 R 0481

109600 R 0488

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GO TO 5380

5379 MC1EV(L,KM)=MC1EV(L,KM)

5380 CM1LFV(L,KM)=MC1EV(L,KM)+MCOST(L,KM)

WRITE(6,5137)KM,MC1EV(L,KM),CM1LFV(L,KM)

5137 FORMAT(14X,I2,X,F8.3,X,F14.2)

IF CM1(KM)=MMNUN(KM)+MC1EV(L,KM)*RUPFS(L)

5135 CONTINUE

WRITE(6,5184)

5184 FORMAT(//5X,40H)DIAL MAINTENANCE PERSONNEL REQUIREMENTS/)

WRITE(6,5185)

5185 FORMAT(17X,40H)DISPATCH QUANTITY)

CTPR=0.

GO 5141 KM=1,NHUS

WRITE(6,5140) KM,MMNUN(KM)

109700 R 0492

109800 R 0494

109900 R 0499

110000 R 0505

110100 R 0524

110200 R 0524

110300 R 0530

110400 R 0531

110500 R 0535

110600 R 0535

110700 R 0539

110800 R 0539

110900 R 0539

111000 R 0545

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```

5140 FORMAT(10X,I2,13X,F9.3)
      DO 5141 L=1,4
      TO'DS=TOTALS+MCLEV(L,KM)*NUMFS(L)*MCUST(L,KM)
      CTRM=CTRM+XMAN(KM)*ELIFE/TPATN(L)*MCLEV(L,KM)*NUMFS(L)
5141 CONTINUE
      WRITE(6,1441)
      WRITE(6,9980)
9980 FORMAT(//30X,16HLIFE CYCLE COSTS //)
      WRITE(6,3707)RANDU
3707 FORMAT(30X,12HF AND D CUST ,15X,F13.2)
      WRITE(6,3708)PUC
3708 FORMAT(30X,15HPRODUCTION COST ,12X,F13.2)
      WRITE(6,9981) TUTE
9981 FORMAT(30X,15HTEST EQUIPMENT ,13X,F12.2/)
      WRITE(6,9982)
9982 FORMAT(30X,6HSTOCKAGE )
      WRITE(6,9983) TUSTK
9983 FORMAT(30X,20HINITIAL PROVISIONING ,8X,F12.2)

```

```

111100 R 0559
00111150 R 0559
00111200 R 0564
111400 R 0571
111500 R 0579
111600 R 0580
111700 R 0583
111800 R 0587
111900 R 0587
112000 R 0597
112200 R 0597
112300 R 0607
112400 R 0607
112500 R 0617
112600 R 0617
112700 R 0621
112800 R 0621
112900 R 0631

```

WRITE(6,9984) MST	113000 R	0631
9984 FORMAT(30X,13HREORDER STOCK ,15X,F12.2)	113100 R	0641
TSTUCK=REST+TOSIK	113200 R	0641
WRITE(6,9985) ISTUCK	113300 R	0642
9985 FORMAT(30X,11HINITIAL STOCK ,17X,F12.2/)	113400 R	0653
TOTUSS=TOMMS+ELIFE	113500 R	0653
WRITE(6,9986) TUMUSS	113600 R	0654
9986 FORMAT(30X,6HMANPOWER ,16X,F16.2/)	113700 R	0665
WRITE(6,9987) CIRM	113800 R	0665
9987 FORMAT(30X,8HTRAINING ,20X,F12.2/)	113900 R	0675
WRITE(6,9988) CIIIVI	114000 R	0675
9988 FORMAT(30X,9HINVENTORY ,19X,F12.2/)	114100 R	0685
TOTKSS=TOTRNS+ELIFE	114200 R	0685
WRITE(6,9989) IOIRSS	114300 R	0686
9989 FORMAT(30X,14HTRANSPORTATION ,14X,F12.2/)	114400 R	0697

WRITE(6,7116)TPUB

7116 FORMAT(30X,11HPUBLICATION ,17X,F12.2/)

IOH=0

IOH=ELIFE/TBDF+.999

OH=IOH-1

OH=CTOE*OH

DO 8761 I=1,NC

IOH=ELIFE/TBDC(I)+.999

OH=IOH-1

8761 OH=OH+OH*CTDC(I)

DO 8762 I=1,NC

NMC=NMC(I)

DO 8762 J=1,NMC

IOH=ELIFE/TBDM(I,J)+.999

OH=IOH-1

8762 OH=OH+OH*CTDM(I,J)

114500 R 0697

114600 R 0707

SEGMENT 17 IS 1

00114605 R 0707

00114610 R 0707

00114615 R 0712

00114620 R 0713

00114625 R 0714

00114630 R 0720

00114635 R 0725

00114640 R 0727

00114645 R 0730

00114650 R 0735

00114655 R 0737

00114660 R 0742

00114665 R 0748

00114670 R 0750

WRITE (6,8771)UHC

8771 FORMAT(30X,14HVERHAUL COST=,14X,F12.2/)

SUMEMN=TOTRSS+CTINVI+CIRM+TOMUSS+TSTOCK+TOTE

SUMEMN=SUMFMN+HANDU+PDC+TPUR+JHC

WRITE(6,9990) SUMEMN

9990 FORMAT(30X,21HUTAL LIFE CYCLE COST ,3X,F16.2//)

CALL AVAIL(NC,NMK,LPMIN,LCMIN,WALL,MIBFM,MTTRC,

*REOCT,REOPI,MTBFC,HEQMT,MTBFE,MTTRE,MTINCE,IK1,PFNGU,

*TK2,TK3,TK4,MDI,ITF,AVAILA ,REGEI,TRANS ,MTTRM,REQ)

WRITE(6,9111)AVAILA

9111 FORMAT(30X,21HOPERATIONAL AVAILABILITY,3X,F6.4)

WRITE(6,1441)

II=II+1

CAVAL(II)=AVAILA *100.

CONST(II)=SUMEMN/1000000.

00114675 R 0754

00114680 R 0765

114700 R 0765

114800 R 0768

114900 R 0771

115000 R 0781

115100 R 0781

115200 R 0787

115300 R 0793

115400 R 0797

115500 R 0808

115600 R 0808

115700 R 0811

115800 R 0812

115900 R 0814

```

GCSTE(II)=AVAILA/SUMEMN*1E7*ELIFE
1981 READ(5,1979) SENS
WRITE(6,8061)II,SENS
8061 FORMAT(// 30X,11HSENSITIVITY,13,X,4HTYPE,13)
IF(SENS.EQ.100) GU IO 1433
IF(SENS.EQ.0) GU IO 1980
GU IO(1330,1331,1332,1333,1334,1335,1336,1337,1338,1339,1340,
+1341,1342,1343,1344,1345,1432,1726,1346,1379,7731),SENS
1433 CONTINUE
IF(II.EQ.1) GO IO 8075
CALL GRAPH(II,GCUSI)
WRITE(6,1471)
1471 FORMAT(//40X,31HLIFE CYCLE COST VERSUS POLICY )
CALL GRAPH(II,GAVAL)
WRITE(6,1470)
1470 FORMAT(//40X,28HAVALABILITY VERSUS POLICY )
CALL GRAPH(II,GCSTE)

```

WRITE(6,1472)	117700 R 0886
1472 FORMAT(//40X,34HCUSI EFFECTIVENESS VERSUS POLICY)	117800 R 0891
WRITE(6,1441)	117900 R 0891
WRITE(6,8077)	118000 R 0894
8077 FORMAT(// 45X,13HSUMMARY TABLE //)	118100 R 0898
WRITE(6,8089)	118200 R 0898
8089 FORMAT(30X,6HPOLICY,4X,4HCNST,11X,5HAVAII,6X,8HCUST-EFF /)	118300 R 0902
DO 8076 I=1,11	118400 R 0902
8076 WRITE(6,8088)I,GCUSI(I),GAVAL(I),GCSTE(I)	118500 R 0908
8088 FORMAT(33X,I2,112.5,5X,19.3,5X,F9.4)	118600 R 0927
8075 CONTINUE	118700 R 0927
CALL TIMEOFF	118800 R 0927
END	118900 R 0927
	SEGMENT 14 IS 1C

START OF SEGMENT *****

SUBROUTINE MTBFMD(NC,NMK,NCLASP,MTBFP,NUMBR,MTBFM,MTBFIU)

119000 R 0000

C62*** THIS SUBROUTINE APPORTIONS PARIS CLASS FAILURE RATES TO EACH

119100 R 0000

C MODULE.

119200 R 0000

C GROUP 1

00119300 R 0000

DIMENSION NMK(4)

00119305 R 0000

C GROUP 2

00119310 R 0000

DIMENSION MTBFP(4,22),NUMBR(4,22,38)

00119315 R 0000

C GROUP 5

00119320 R 0000

DIMENSION MTBFP(38)

00119325 R 0000

REAL MTBFM,MTBFP,NUMBR

119400 R 0000

DO 9000 I=1,NC

119500 R 0000

NMC=NMK(I)

119600 R 0005

DO 9000 J=1,NMC

119700 R 0007

FARAT=0.

DO 8000 K=1,NCLASH

8000 FARAT = FARAT + NUMB(I,J,K)/MIBFP(K)

MIBFM(I,J) = 1.0/FARAT

9000 CONTINUE

RETURN

END

119800 R 0013

119900 R 0014

120000 R 0020

120100 R 0026

120200 R 0032

120300 R 0033

120400 R 0036

SEGMENT 19 JS

START OF SEGMENT *****

SUBROUTINE MTBFC(NC,NMK,MTBFM,MTBFC,MTBFIJ)

120500 R 0000

C63***THIS SUBROUTINE APPORTIONS MODULE FAILURE RATES TO EACH COMPONENT 120600 R 0000

C GROUP 1

00120700 R 0000

DIMENSION MTRFC(4),NMK(4)

00120710 R 0000

C GROUP 2

00120720 R 0000

DIMENSION MTHFM(4,22)

00120730 R 0000

DO 9150 I=1,NC

120800 R 0000

REAL MTBFC,MTBFM

120900 R 0005

NMC=NMK(I)

121000 R 0005

FARAT = 0.

121100 R 0007

DO 9100 J=1,NMC

121200 R 0008

9100 FARAT = FARAT + 1.0/MTHFM(I,J)

121300 R 0014

MTRFC(I) = 1.0/FARAT

121400 R 0020

9150 CONTINUE

121500 R 0025

RETURN

121600 R 0025

END

121700 R 0026

START OF SEGMENT *****

SUBROUTINE MTBFLO(NC,MTBFC,MTBFE,MTBFID)

121800 R 0000

C64****FAILURE RATE OF END ITEM DETERMINED FROM COMPONENT FAILURE RATES. 121900 R 0000

C GROUP1

00121999 R 0000

DIMENSION MTBFC(4)

122000 R 0000

REAL MTBFE,MTBFC

122100 R 0000

FARAT=0.

122200 R 0000

DO 9200 I=1,NC

122300 R 0000

9200 FARAT = FARAT + 1.0/MTBFC(I)

122400 R 0007

MTBFE = 1.0/FARAT

122500 R 0012

9260 RETURN

122600 R 0015

END

122700 R 0016

SEGMENT 21 IS 2

START OF SFGMENT *****

SUBROUTINE AMMH(MTRKCE,MTRF,OPHRDY,NDAY,NC,NMK,MTRM,MTRFM,MTRRC, 122800 R 0000

*MTRIC,AMMHM,AMMHC,AMMHE,AMHCE,MTRFE)

122900 R 0000

C65*****THIS SUBROUTINE CALCULATES THE ANNUAL MAINTENANCE MANHOUR

123000 R 0000

C REQUIREMENTS FOR CHECKING OUT THE EQUIPMENT, AND REPAIRING THE

123100 R 0000

C EQUIPMENT AND EACH COMPONENT AND EACH MODULE OF THE EQUIPMENT.

123200 R 0000

C GROUP 1

00123299 R 0000

DIMENSION AMHC(4),MTRFC(4),MTRCC(4),NMK(4)

00123300 R 0000

C GROUP 2

00123309 R 0000

DIMENSION AMMHM(4,22),MTRFM(4,22),MTRM(4,22)

00123400 R 0000

REAL MTRCF,MTRHE,MTRM,MTRC,MTRFF,MTRFC,MTRFM,NDAY

123500 R 0000

AMHCE=OPHRDY*MTRCL/MTRFE*NDAY

123600 R 0000

AMMHE=OPHRDY*MTRC/MTRFE*NDAY

123700 R 0002

DO 32 I=1,NC

NMC=NMC(I)

DO 32 J=1,NMC

AMMCM(I,J)=OPHRDY*MITRM(I,J)/MTBFM(I,J)*NDAY

32 CONTINUE

DO 34 I=1,NC

AMMCC(I)=OPHRDY*MITMC(I)/MTBFC(I)*NDAY

34 CONTINUE

RETURN

END

123800 R 0004

123900 R 0009

124000 R 0011

124100 R 0017

124200 R 0027

124300 R 0028

124400 R 0033

124500 R 0040

124600 R 0040

124700 R 0043

SEGMENT 22 IS 73

START OF SEGMENT *****

SUBROUTINE XFIM (I,NL,NC,AMMHC,NTE,TECI,NMUS,MUS,MNSC,TE,DPHRSH, 124800 R 0030

*NSHOP,NUMFS,TECM,MNSCM,STCM,TUTCSM,TECUST,MDCST,CC,NMK,T,STKTM, 124900 R 0000

*TURN1,MTRFM,NDAY,LPH,DPHRDY,STKMR,FACTIN,ELIFE,XMAN,TRAIN,STKTHR 125000 R 0000

*NLEV,NUM,MLEV,MNUM,STKM,TINVIN,IRM,ATHF,PHC,PGM,PUBM,DMF,PROD) 125100 R 0000

C66*****THIS SUBROUTINE CALCULATES PARAMETERS DESCRIBING THE FIM 125200 R 0000

C MAINTENANCE FUNCTION. 125300 R 0000

C GROUP 1 00125399 R 0000

DIMENSION AMMHC(4),MUSCH(4),NMK(4),PUBM(4),PGM(4), 00125400 R 0000

*STCM(4),TECM(4),TUTCSM(4) 00125450 R 0000

C GROUP 2 00125499 R 0000

DIMENSION CC(4,22),LPP(4,22),MNSC(4,22),MTRFM(4,22), 00125500 R 0000

*STKMR(4,22),STKIMR(4,22),I(4,22) 00125550 R 0000

C GROUP 3 00125599 R 0000

DIMENSION TECI(4,40) 00125600 R 0000

C	GROUP 6		00125649 R 0000
	DIMENSION NLEV(40),NUM(40),TECOST(40)		00125650 R 0000
C	GROUP 7		00125699 R 0000
	DIMENSION MLEV(10),MNUM(10),XMAN(10)		00125700 R 0000
C	GROUP 8		00125749 R 0000
	DIMENSION STKM(4,4,22),STKTM(4,4,22)		00125750 R 0000
C	GROUP 10		00125799 R 0000
	DIMENSION FE(4,4J)		00125800 R 0000
C	GROUP 11		00125849 R 0000
	DIMENSION MCONSI(4,J),MUS(4,10)		00125850 R 0000
C	GROUP 12		00125899 R 0000
	DIMENSION NSHOP(4),NUMFS(4),OPHRSH(4),THAIN(4)		00125900 R 0000
	*TURN1(4)		00125950 R 0000
	REAL NSHOP,MCONSI,MUS,MUSCM,MTBFM,NDAY		126000 R 0000
	REAL NLEV,NUM,MLEV,MNUM,NNLEV,MMLEV		126100 R 0000
	REAL NUMFS		00126150 R 0000
	IF(NL,EQ,4)AMMHC(I)=AMMHC(I)*(1.-DMF)		126200 R 0000

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```

        DO 6802 KK=1,NIE
          NLFV(KK)=0.
          NUM(KK)=0.
        6802 CONTINUE
        DO 6803 KM=1,NMUS
          NLFV(KM)=0.
          NUM(KM)=0.
        6803 CONTINUE
        DO 2220 KK=1,NIE
          2220 TL(NL,KK)=0.
          DO 2219 KM=1,NMUS
            2219 NDS(NL,KM)=0.
          C67***DTERMINE TEST EQUIPMENT REQUIREMENTS PER LEVEL FOR FIM
          DO 58 KK=1,NTE
            IF(TECI(I,KK).NE.1) GO TO 58

```

126300	R	0006
126400	R	0011
126500	R	0014
126600	R	0017
126700	R	0017
126800	R	0022
126900	R	0025
127000	R	0028
127100	R	0028
127200	R	0034
127300	R	0037
127400	R	0044
127500	R	0046
127600	R	0047
127700	R	0053

```

TE(NL, KK) = AMMHG(I) + IE(NL, KK)
58 CONTINUE
C68***DTERMINE MOS REQUIREMENTS PER LEVEL FOR FIM
DO 59 KM=1, NMOS
IF(MDSC(I, KM).NE.1) GO TO 59
MUS(NL, KM) = AMMHG(I) * MUS(NL, KM)
59 CONTINUE
65 TCNST=0.
C69***DTERMINE TEST EQUIPMENT REQUIREMENTS FOR FIM FOR FORCE STRUCTURE
DO 60 KK=1, NTE
XNLEV=TE(NI, KK)/(UPHRSH(NL)*NDAY)*NSHUP(NL)
NLFV(KK)=XNLEV
NUM(KK)=NLFV(KK)*NUMFS(NL)
TCNST=TCNST+NUM(KK)*TECUST(KK)
TECP(I)=TCNST
60 CONTINUE
TCNST=0.

```

```

127800 R 0058
127900 R 0066
128000 R 0066
128100 R 0066
128200 R 0071
128300 R 0076
128400 R 0084
128500 R 0085
128600 R 0085
128700 R 0085
128800 R 0091
128900 R 0098
129000 R 0101
129100 R 0106
129200 R 0110
129300 R 0113
129400 R 0113

```

```

      TRM=0.0
      C70***CALCULATE MOS REQUIREMENTS FOR ENTIRE FORCE STRUCTURE FOR FIM.
      DO 61 KM=1,NMOS
      PRNM=PROD
      IF(NL,FQ.4)PRDM=1.
      XMLEV=MOS(NL,KM)/(OPHRSH(NL)*PRDM*NDAY)*NSHUP(NL)
      MLFV(KM)=XMLEV
      XMH(KM)=MLEV(KM)*NUMFS(NL)
      TCNST=TCOST+MMUM(KM)*MCOST(NL,KM)
      MUSCM(I)=TCOST
      C71***DETERMINE TRAINING COSTS
      TRV=TRM+MMUM(KM)*XMH(KM)*ELIFE/TRAIN(NL)
      61 CONTINUE
      PURM(I)=PPC*PGM(I)
      TOTCSM(I)=TECH(I)+MUSCM(I)+ELIFE*TRM+PURM(I)
      RETURN
      END

```

START OF SEGMENT *****

SUBROUTINE XFIC (NNL,AMMHE,NTL,IEEI,NMUS,MUS,MUSE,TE,OPHRSH,NSHOP, 131000 R 0000

*NUMFS,TECC,STCC,TOTCSC,TECOST,MCDST,CCC,NC,TT,STKTC,TURNP,MTRFC, 131100 R 0000

* WDAY,L,LMS,OPHMDY,SIKCR,FACTIN,ELIFE,XMAN,TRAIN,STKTCR 131200 R 0000

* NLEV,NUM,MLEV,MNUM,STKC,MNSCC,TINVIN,TRM,AIRF,PPC,PGC,PURC 131300 R 0000

* DMF,PRON) 131400 R 0000

C72*****CALCULATE PARAMETERS DESCRIBING FIC MAINTENANCE ACTION.

C GROUP 1 131500 R 0000

DIMENSION CCC(4),LMS(4),MTRFC(4),STKCR(4),SIKTCR(4), 00131500 R 0000

*TT(4) 00131600 R 0000

C GROUP 6 00131650 R 0000

DIMENSION NLFV(40),NUM(40),TECOST(40),IEEI(40) 00131699 R 0000

C GROUP 7 00131700 R 0000

DIMENSION MLEV(10),MNUM(10),MUSE(10),XMAN(10) 00131749 R 0000

00131750 R 0000

```

C GROUP 9
    DIMENSION STKC(4,4),STKTC(4,4)
C GROUP 10
    DIMENSION TE(4,40)
C GROUP 11
    DIMENSION MCONS(4,10),MDS(4,10)
C GROUP 12
    DIMENSION NSHNP(4),NUMFS(4),DPHRSH(4),TKAIN(4),
    *TURN2(4)
    REAL NSHNP,MCONS,MUS,MUSCC,MTBFC,NPAY
    REAL NLEV,NUM,MLEV,MNUM,MNIEV,MLEV
    REAL NUMFS
    IF(NNL.EQ.4)AMMHE=AMMHE*(1.-DMF)
    DO 6804 KK=1,NLE
        NLEV(KK)=0.
        NUM(KK)=0.
6804 CONTINUE
    DO 6805 KM=1,NMUS

```

```

00131799 R 0000
00131800 R 0000
00131849 R 0000
00131850 R 0000
00131899 R 0000
00131900 R 0000
00131949 R 0000
00131950 R 0000
00132000 R 0000
    132100 R 0000
    132200 R 0000
00132250 R 0000
    132300 R 0000
    132400 R 0003
    132500 R 0008
    132600 R 0011
    132700 R 0014
    132800 R 0014

```

MLFV(KM)=0.

MNIA(KK)=0.

6805 CONTINUE

DO 2221 KK=1,NLE

2221 TE(NNL,KK)=0.

DO 2222 KM=1,NMUS

2222 MDS(NNL,KM)=0.

STCC = 0.

DO 163 KK=1,NTE

C73***CALCULATE TEST EQUIPMENT REQUIREMENTS PER LEVEL FOR FIC.

IF(1FEJ(KK).NE.1.) GO TO 163

TE(NNL,KK)=AMNH+TE(NNL,KK)

163 CONTINUE

C74***DETERMINE MOS REQUIREMENTS PER LEVEL FOR FIC

132900 R 0019

133000 R 0022

133100 R 0025

133200 R 0025

133300 R 0031

133400 R 0034

133500 R 0041

133600 R 0044

133700 R 0045

133800 R 0046

133900 R 0050

134000 R 0054

134100 R 0061

134200 R 0061

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DO 164 KM=1,NMUS
IF(MNSE(KM),NE.1) GO TO 164
MOS(NNL,KM)=AMMHE+MUS(NNL,KM)
134300 R 0061
134400 P 0066
134500 R 0070
134600 R 0077
164 CONTINUE
C75***CALCULATE TEST EQUIPMENT REQUIREMENTS FOR FIC FOR FORCE STRUCTURE
134700 R 0077
162 TCRST=0.
134800 R 0078
134900 R 0078
DO 165 KK=1,NTE
XNLEV=TE(NNL,KK)/(NPHRSH(NNL)*NDAY)*NSHOP(NNL)
135000 R 0084
NLFV(KK)=XNLEV
135100 R 0091
AUM(KK)=NLEV(KK)*NUMFS(NNL)
135200 P 0094
TCNST=TCOST+NUM(KK)*TECUST(KK)
135300 R 0099
TECC=TCUST
135400 R 0103
165 CONTINUE
135500 R 0105
TRN=0.0
135600 P 0105
TCRST=C.0
135700 R 0106
C76***CALCULATE MOS REQUIREMENTS FOR FIC FOR FORCE STRUCTURE.
135800 R 0106
DO 66 KM=1,NMOS
135900 P 0107
PRCV=PRCD
00135940 R 0112

```

IF(NNL.EQ.4)PROM=1.

XMLEV=XUS(NNL,KM)/(UPHRSH(NNL)*PROM*NDAY)*NSHDP(NNL)

XMLEV(NNL)=XMLEV

MNLF(NNL)=MLEV(NNL)*NUMFS(NNL)

TCNST=TCNST+MNLF(NNL)*MCUST(NNL,KM)

PUSC=TCNST

C77***CALCULATE TRAINING REQUIREMENTS FOR FIC MAINTENANCE.

TRM=TRM+MNLF(NNL)*XMAN(KM)*ELIFE/TRAIN(NNL)

66 CONTINUE

TCNST=C.

67 CONTINUE

PUPC=PPC*PGC

C78***ADD UP TOTAL FIC COSTS.

TOTCSC=TECC+MUSC*LLIFE+TRM+PUPC

RETURN

END

00135950 R 0113

136000 R 0115

136100 R 0123

136200 R 0125

136300 R 0130

136400 R 0136

136500 R 0136

136600 R 0136

136700 R 0144

136800 R 0144

136900 R 0146

137000 R 0146

137100 R 0146

137200 R 0147

137300 R 0150

137400 R 0153

CESMENT 24 IS 2

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START OF SEGMENT *****

SUMROUTINE TRANSN(I,J,L,NL,NC,TRANS1,CUSLB,WTM,NDAY,MTRFM,OPHRDY 137500 R 0000

*NSHOP,TRANIM,CSTRNM,NUMFS 137600 R 0000

C79*****CALCULATE TRANSPORTATION COSTS FOR SHIPPING MODULES FROM FIM 137700 R 0000

C LEVEL TO FIP LEVEL. 137800 R 0000

C GROUP ? 00137899 R 0000

DI:ENSION CSTRNM(4,22),MTRFM(4,22),NOFAIL(4,22), 00137900 R 0000

*TRANIM(4,22),WIM(4,22) 00137950 R 0000

C GROUP 12 00137999 R 0000

DI:ENSION CUSLB(4,4),NSHOP(4),NUMFS(4),TRANSI(4,4) 00138000 R 0000

REAL MTRFM,NSHOP,NDAY 138100 R 0000

REAL NUMFS 00138150 R 0000

NOFAIL(I,J)=NSHOP(NL)*OPHRDY*NDAY/MTRFM(I,J) + .9999 138200 R 0000

TRANIM(I,J)=TRANSI(L,NL) 138300 R 0010

NOFAIL(I,J)=NOFAIL(I,J)*NUMFS(NL) 138400 R 0015

CSTRNM(I,J)=CUSLB(L,NL)*WTM(I,J)*NOFAIL(I,J)+THANTM(I,J) 138500 R 0022

RETURN 138600 R 0035

END 138700 R 0038

START OF SFGMENT *****

SUBROUTINE TRANS(C,I,NL,NL,NC,TRANSI,CUSLR,WTC,HDAY,MTBFC,OPHRDY, 139900 R 0000

*NSHUP,TRANIC,CSTRNC,NUMFS)

139900 R 0000

C80*****Determine TRANSPORTATION COSTS FOR SHIPPING COMPONENTS FROM FIC 139000 R 0000

C LEVEL TO FIM LEVEL.

139100 R 0000

C GROUP 1

00139199 R 0000

01 LENSTON CSTRNC(4),WTC(4),NOFAIC(4),TRANIC(4),WTC(4)

00139200 R 0000

C GROUP 12

00139299 R 0000

01 LENSTON CUSLR(4,4),NSHUP(4),NUMFS(4),TRANSI(4,4)

00139300 R 0000

DEAL MTBFC,NSHUP,NDAY

139400 R 0000

DEAL NUMFS

00139450 R 0000

NOFAIC(I)=NSHUP(NNL)*OPHRDY*NDAY/MTBFC(I) + .9999

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139500 R 0000

NOFAIC(I)=NOFAIC(I)*NUMFS(NNL)

139600 R 0000

TRANIC(I)=TRANSI(NL,NL)

139700 R 0013

CSTRNC(I)=CUSLR(NL,NL)*WTC(I)*NOFAIC(I)*TRANIC(I)

139800 R 0017

RETURN

139900 R 0026

END

140000 R 0029

START OF SEGMENT *****

SUBROUTINE TRANSE(NNL,TRANST,COSLB,WTE,MTBFE,OPHRDY,NSHOP,
140100 R 0000

*TRANTE,CSTRNE,NDAY,NUMFS)
140200 R 0000

C81***CALCULATE TRANSPORTATION COSTS FOR SHIPPING END ITEM FROM COE
140300 R 0000

C LEVEL TO FIG LEVEL.
140400 R 0000

C GROUP 12
00140499 R 0000

NDIMENSION COSLB(4,4),NSHOP(4),NUMFS(4),TRANST(4,4)
00140500 R 0000

REAL MTBFE,NSHUP,NDAY
140600 R 0000

REAL NUMFS
00140650 R 0000

NOFAIE=NSHOP(1)*OPHRDY*NDAY/MTBFE + .9999
140700 R 0000

NOFAIE=NOFAIE+NUMFS(1)
140800 R 0005

TRANTE=TRANST(VNL,1)
140900 R 0007

CSTRNE=COSLB(NNL,1)*WTE+NOFAIE*TRANTE
141000 R 0009

RETURN
141100 R 0012

END
141200 R 0015

START OF SEGMENT *****

SUBROUTINE THRMUD(I,J,NL,NSHOP,NUMFS,MTRFM,NDAY,K2,B,G,OPHRDY,STKT 141300 R 0000

*M,POP,T,STKTMR,ELIFE,ATHF) 141400 R 0000

C82*****THIS SUBROUTINE CALCULATES STOCKAGE REQUIREMENTS IF MODULES ARE 141500 R 0000

C THRUWN AWAY. 141600 R 0000

C GROUP 2 00141699 R 0000

DIMENSION MTRFM(4,22),STKTMR(4,22),I(4,22) 00141700 R 0000

C GROUP 8 00141749 R 0000

DIMENSION STKTM(4,4,22) 00141750 R 0000

C GROUP 12 00141799 R 0000

DIMENSION R(4),G(4),NSHUP(4),NUMFS(4) 00141800 R 0000

REAL MTRCE,MTRNE,MTRM,MTRC,MTRFE,MTRFC,MTRFM,MTRFP,NSHOP, 141900 R 0000

*MCONST,LIMCUM,NUMBK,MUS,MOSCP,K1,K2,K3,NDAY 142000 R 0000

REAL NUMFS 00142050 R 0000

STKTM(I,J)=0.

C83***CALCULATE MODULE FAILURES DURING 15 DAY PERIOD.

FAILMT=OPHRLY*NUAY*.04/MTBFM(I,J)

C84***ASSIGN STOCKAGE SUBJECTIVE PERIOD ACCORDING TO LEVEL OF THROWAWAY

GO TO(750,751,752,753),N1

750 TC=E(1)

GL TO 754

751 TC=E(2)

GL TO 754

752 TC=E(3)

GL TO 754

753 TC=E(4)

C85***CALCULATE INITIAL ISSUE STOCKAGE

754 TXFAIL=T0*NSHOW(NL)*FAILMT

TSTK=TXFAIL+K2*SQRT (TXFAIL)

NTSTK=TSTK+.9999

STKTM(NL,I,J)=NTSTK*NUMPS(NL)

C86***ASSIGN ORDER-SHIPPING TIMES ACCORDING TO LEVEL OF THROWAWAY

142100 R 0000

142200 R 0003

142300 R 0003

142400 R 0007

142500 R 0010

142600 R 0018

142700 R 0019

142800 R 0020

142900 R 0021

143000 R 0023

143100 R 0024

143200 R 0026

143300 R 0026

143400 R 0028

143500 R 0031

143600 R 0033

143700 R 0037

143800 R 0041

GO TO(760,761,762,763),NL

760 IF=6(1)

GO TO 764

761 IF=6(2)

GO TO 764

762 IF=6(3)

GO TO 764

763 IF=6(4)

C87***CALCULATE ORDER-SHIP STOCKAGE

764 TSTK=TH*NSHUP(NL)*FAILMT

NTSTK=TSTK+.9999

STKTM(NL,I,J)=NISTK*NUMFS(NL)+STKTM(NL,I,J)

C88***CALCULATE REPLACEMENT STOCKAGE AT DEPOT

STKTM(4,I,J)=2.*RUP*NSHUP(4)*NUMFS(4)*FAILMT +STKTM(4,I,J)

143900 R 0043

144000 P 0051

144100 R 0052

144200 R 0053

144300 R 0054

144400 R 0056

144500 R 0057

144600 R 0059

144700 R 0059

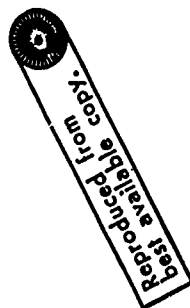
144800 R 0061

144900 P 0064

145000 P 0067

145100 R 0073

145200 R 0077



C89**+CALCULATE REORDER STOCKAGE

145300 R 0084

MTKTR=(FAILMT+24,*(ELIFE=ROP/12.)*NSHOP(NL)*NUMFS(NL))*

145400 R 0087

*(1.+ATRF)+.999

00145450 P 0093

STKTR(I,J)=MYKTR

145500 R 0097

RETURN

145600 R 0100

END

145700 R 0103

SEGMENT 28 TS 13

SUBROUTINE THFCUM(I,NNL,NSHIP,NUMFS,MTBFC,NUAY,K3,STKTC,OPHRDY,RUP,145600 R 0000

*1T,STKTCR,ELIPE,B6,ATKF)

C90***THIS SUBROUTINE CALCULATES COMPONENT STOCKAGE FOR THROWAWAY 146000 R 0000

COMMENTS.

00146199 R 0000

DINSTON WLFU(4),SLKTCR(4),T1(4)

C CRUIP 2 00146249 P 0000

01PENSIUN STKTC(4,22)

C C-70E 12

00146299 B 0000

```
DI'ENSION P(4),G(4),WSHUP(4),NIIFS(4)
```

REAL 1:7TRCF,MTIME,NILTRM,MTRTRC,MTHFF,MTHFC,MHFM,MTRFP,NSHOP,
146400 R 0000

*MCOST,LAMCUM,NUNHK,MUS,MJSCP,K1,K2,K3,NDAY
146500 R 0000

REAL TIME
00146550 R 0000

STVTC(4,I)=0.

```

C91***CALCULATE COMPONENT FAILURES IN 15 DAY PERIOD
      FAILCT=OPHKUY*NUAY*.04/MTBFCC(I)
C92***ASSIGN STOCKAGE OBJECTIVE PERIOD ACCORDING TO LEVFL OF COMPONENT
C      TMF(UWAY*AY.
      GU 10(170,771,112,113),NNL
      770 TTQZR(1)
      GU 10 774
      771 TTQZR(2)
      GU 10 774
      772 TTQZR(3)
      GU 10 774
      773 TTQZR(4)
C93***DETERMINE INITIAL ISSUE STOCKAGE
      774 TFAIL=TTQZNSHUP(NNL)*FAILCT
      TTSTK=TFAIL+K3*SQRT(TFAIL)
      NITSTK=TTSTK+.9999
      STKJC(NNL,I)=NITSTK*NUMFS(NNL)
146700 R 0002
146800 R 0002
146900 R 0006
147000 R 0006
147100 R 0008
147200 R 0016
147300 R 0017
147400 R 0018
147500 R 0019
147600 R 0021
147700 R 0022
147800 R 0024
147900 R 0024
148000 R 0026
148100 R 0029
148200 R 0031
148300 R 0035

```

C94***ASSIGN ORDER=SHIPPING TIMES ACCORDING TO LEVEL OF COMPONENT

C THP(WAWAY.

GU IN (780,781,782,783)*NHL

780 TTP=G(1)

GU IN 784

781 TTP=G(2)

GU IN 784

782 TTP=G(3)

GU IN 784

783 TTP=G(4)

C95***CALCULATE ORDER=SHIP STOCKAGE

784 TTSTK=TTTH*ASHCP(NNL)*FAILCT

NTSTK=TTSTK+.9999

STVTC(NNL,T)=NTSTK*NUMFS(NNL)+STKTC(NNL,T)

148400 R 0038

148500 R 0038

148600 R 0040

148700 R 0048

148800 R 0049

148900 R 0050

149000 R 0051

149100 R 0053

149200 R 0054

149300 R 0056

149400 R 0056

149500 R 0058

149600 R 0061

149700 R 0064

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C96***DTERMINE REPLACEMENT STOCKAGE REQUIREMENTS AT THE DEPOT	149800 R 0069
STKTC(4,I)=2.*RUP*NSHOP(4)*NUMFS(4)*FAILCT+STKIC(4,I)	149900 R 0072
C97***CALCULATE REMDUEK STOCKAGE	150000 R 0078
MTKTCR=(FAILCT*24.*(ELIFE=RUP/12.)*NSHOP(NNL)*NUMFS(NNL))*	150100 R 0080
*(1.+ATRF)+.99	00150150 R 0086
STKTC(I)=MTKTCR	150200 R 0090
RETURN	150300 R 0092
ENDIF	150400 R 0095
SEGMENT 29 IS 1	

START OF SEGMENT *****

SUBROUTINE NNNK(P,I,J,NCLASP,STK,NSHOP,L,UPHRY,NDA,Y,NUMRR,MTRFP,
 *NUMFS,P1,R,G,ST,STK,ELTFE,RUP,AIRF)

C9A***** THIS SUBROUTINE DETERMINES PARTS STOCKAGE REQUIREMENTS.

C GROUP 2

DIFFNSTON NUMRR(4,22,38)

C GROUP 5

DIFFNSTON MTRFP(38),ST(38),ST1(38),ST2(38),ST3(38),
 *STK(38)

C GROUP 9

DIFFNSTON STK(4,38)

C GROUP 12

DIFFNSTON R(4),G(4),NSHUP(4),NUMFS(4)

REAL MTRCF,MTRFE,MTRFM,MTRFC,MTRFF,MTRFC,MTRFM,MTRFP,NSHOP,
 *MCOST,LAMCUM,NUMRR,MUS,MNOSCP,K1,K2,K3,NDA,Y

150500 R 0000
 150600 P 0000
 150700 R 0000
 00150709 R 0000
 00150800 R 0000
 00150809 R 0000
 00150850 R 0000
 00150900 R 0000
 00150924 R 0000
 00150925 R 0000
 00150949 R 0000
 00150950 R 0000
 151000 R 0000
 151100 R 0000

RELAT NUMFS

NU /01 K=1,NCLASP

STP(K)=0.0

ST1(K)=0.

ST2(K)=0.

ST3(K)=0.

C99***CALCULATE FAILURES IN A 15 DAY-PERIOD FOR EACH PARTS CLASS

FAT1=NUMBR(I,J,K)*UPHRY*NDAY*.04/MTRFP(K)

C100***ASSIGN STOCKAGE URJECTIVE PERIOD BASED ON LEVEL OF FIP.

GU IN (702,703,704,705),L

702 Q=P(1)

GU TO 706

703 Q=P(2)

GU TO 706

704 Q=P(3)

GU TO 706

705 Q=P(4)

00151150 R 0000

151200 R 0000

151300 R 0005

151400 R 0008

151500 R 0009

151600 R 0011

151700 R 0012

151800 R 0013

151900 R 0020

152000 R 0022

152100 R 0030

152200 R 0031

152300 R 0032

152400 R 0033

152500 R 0035

152600 R 0036

152700 R 0038

C101***CALCULATE INITIAL ISSUE PARTS STOCKAGE

706 YFAIL=Q*NSHUP(L)*FAIL

SIMP=YFAIL+PI*SQRT (XFAIL)

NSTP=STKK+.9999

ST(K)=NSTK*N(MFS(I)

STK(I,K)=ST3(P)+STK(L,K)

C102***ASSIGN ORDER-SHIP PERIODS BASED ON FIP LEVEL

GO TO (716,707,706,709),L

716 H=C(1)

GO TO 710

707 H=C(2)

GO TO 710

706 H=C(3)

GO TO 710

709 H=C(4)

152800 R 0038

152900 R 0040

153000 P 0043

153100 R 0045

153200 R 0049

153300 R 0052

153400 R 0056

153500 R 0059

153600 R 0067

153700 R 0068

153800 R 0069

153900 R 0070

154000 P 0072

154100 R 0073

154200 R 0075

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C103**CALCULATE ORDER*SHIPPING STOCKAGE FOR PARTS

154300 R 0075

710 STK=H*NSHOP(L)*FAIL

154400 R 0077

NSTK=STK+.9999

154500 R 0080

ST1(K)=NSTK*NUMFS(L)

154600 R 0083

ST(L,K)=ST1(K)+STK(L,K)

154700 R 0086

C104**CALCULATE PARTS REPLACEMENT STOCK AT THE DEPT

154800 R 0090

ST2(K)=2.*ROP*NSHOP(L)*NUMFS(L)*FAIL

154900 R 0093

STK(4,K)=ST2(K)+STK(4,K)

155000 R 0099

ST(K)= ST1(K)+ST2(K)+ST3(K)

155100 R 0105

C105**DEFERRED PARTS REORDER STOCKAGE

155200 R 0109

MTF=(FAIL*.24.*(ELIFE=ROP/12.)*NSHOP(L)*NUMFS(L))*(1.+ATRF)+.9999

155300 R 0111

STR(K)=MTF

155400 R 0121

701 CONTINUE

155500 R 0124

RETURN

155600 R 0124

END

155700 R 0127

SEGMENT 30 IS 1

START OF SFGMENT *****

SUBROUTINE KEPMUD(I,STKM,NL,NSHOF,NUMFS,MTHFM,NDAY,NMK,K?,TURN1, 155900 R 0000

*OPHNDY,STKM,T,STKIMK,ELIFF,STKMR,J,ATKF,RUP) 155900 P 0000

C106**THIS SUBROUTINE CALCULATES MODULE STOCKAGE WHEN MODULES ARE 156000 R 0000

C REPAIRABLE. 156100 R 0000

C GROUP 1 00156199 R 0000

DIMENSION NMK(4) 00156200 R 0000

C GROUP 2 00156224 R 0000

DIMENSION MTRFM(4,22),STKMR(4,22),STKTMK(4,22),T(4,22) 00156225 R 0000

C GROUP 3 00156249 R 0000

DIMENSION STKM(4,4,22),STKTM(4,4,22) 00156250 R 0000

C GROUP 12 00156299 R 0000

DIMENSION NSHUP(4),NUMFS(4),TURN1(4) 00156300 R 0000

REAL MTRCF,MTRKE,MTRM,MTRC,MTRFE,MTRFC,MTRFM,MTBFP,NSHUP, 156400 R 0000

*MCNST,LAMCUN,NUMBK,MUS,MOSCP,X1,K?,K3,NDAY 156500 R 0000

REAL NUMFS 00156550 R 0000

STRT(4,I,J)=0.0	156600 R	0000
TF(T(I,J),FW,I)GO TO 209	156700 R	0003
C107**DEFERRED MODULE FAILURES PER 15 DAY PERIOD	156800 R	0007
FATLM=OPHRRDY*NDAY*.04/MTRFM(J,J)	156900 R	0008
C108**ASSIGN ORDER-SHIPING TIMES DEPENDING UPON FIM LEVEL.	157000 R	0011
GO TO (R00,R01,R02,R03),NI	157100 R	0014
R00 QQ=TURN1(1)	157200 R	0022
GO TO R04	157300 R	0023
R01 QQ=TURN1(2)	157400 R	0024
GO TO R04	157500 R	0025
R02 QQ=TURN1(3)	157600 R	0027
GO TO R04	157700 R	0028
R03 QQ=TURN1(4)	157800 R	0030
C109**CALCULATE PIPELINE STOCKAGE OF MODULES	157900 R	0030
R04 XXFAIL=QQ*FATLM*NSHUP(NL)	158000 R	0032
STKKK=XXFAIL+K2*SKRI (XXFATL)	158100 R	0035

NNSTK=STKKK+.9999

158200 R 0037

STK(NL,I,J)=NNSTK*NUMFS(NL)

158300 R 0041

C110**CALCULATE NEUTRON MODULE STOCKAGE

158400 R 0045

MTKPR=CFAI(M*24.)*(ELIFF-RGP/12.)*NSHOP(NL)*NUMFS(NL))*ATRF+.9999

158500 R 0047

STKPR(T,J)=MTKNK

158600 R 0057

GO TO 799

158700 R 0060

800 STK(NL,I,J)=STKTM(NL,I,J)

158800 R 0062

STKPR(T,J)=STKTM(T,J)

158900 R 0069

IF(EL.FW.4)GO TO 799

159000 R 0075

STKPR(4,I,J)=STKTM(4,I,J)

159100 R 0077

799 CONTINUE

159200 R 0084

RETURN

159300 R 0084

END

159400 R 0087

SEGMENT 31 IS 1

START OF SFGMENT *****

SUBROUTINE REPCUM(NNL,NSHUP,NUMFS,MIRFC,NDAY,K3,NC,TURN2,OPHRDY 159500 R 0000

*,STKC,STKTC,IT,STKTCK,ELIFE,SIKCH,ATRF,I,ROF) 159600 R 0000

C111***THIS SUBROUTINE CALCULATES COMPONENT STOCKAGE WHEN COMPONENTS ARE 159700 R 0000

C RFPATRALE. 159800 R 0000

C GROUP 1 00159899 R 0000

DIMENSION MIRFC(4),SIKCH(4),STKTC(4),IT(4) 00159900 R 0000

C GROUP 2 00159949 R 0000

DIMENSION STKC(4,4),STKTC(4,4) 00159950 R 0000

C GROUP 12 00159999 R 0000

DIMENSION NSHUP(4),NUMFS(4),TURN2(4) 00160000 R 0000

REAL MTTRCF,MTIKE,MITRH,MTTRC,MTBFE,MTHFC,MTHEF,MTHEF,NSHOP, 160100 R 0000

*MC1ST,LAMCHM,NUMBR,NUS,MUSCP,K1,K2,K3,NDAY 160200 R 0000

REAL NUMFS 00160250 R 0000

STKC(4,1)=0.0 160300 R 0000

```

IF(IT(I),EQ,1) GO TO 914
C112**OFTFRTIME FAILURES OF COMPONENT PER 15 DAY PERIOD
      160400 R 0002
      160500 R 0005
      160600 R 0006
      160700 R 0009
      160800 R 0011
      160900 R 0019
      161000 R 0020
      161100 R 0021
      161200 R 0022
      161300 R 0024
      161400 R 0025
      161500 R 0027
      161600 R 0027
      161700 R 0029
      161800 R 0032
      161900 R 0034
      162000 R 0038

      FAILC=OPHRDY*NDAY*.04/NTRFC(I)
C113**ASSIGN ORDER=SHIP PERIODS BASED ON LEVEL OF FIC
      GU TO(901,902,903,904),NNL
      901 YQ=TURN2(1)
      GU TO 910
      902 YQ=TURN2(2)
      GU TO 910
      903 YQ=TURN2(3)
      GU TO 910
      904 YQ=TURN2(4)
C114**CALCULATE COMPONENT PIPELINE STOCKAGE
      910 YXFATL=YQ*FAILC*NSHUP(NNL)
      YSTKK=YXFATL+K3*SQR1 (YXFATL)
      HNSTK=YSTKK+.9999
      STKC(NNL,I)=MNSTK*NUMFS(NNL)

```

```

C115**CALCULATE COMPONENT REORDER STOCKAGE
      MTK(R=FAIIC*24.*(ELIFE=HUP/12.)*NSHOP(NNL)*NUMFS(NNL))*ATRF+
      *0099
      STKCR(I)=MTKCH
      GO TO 900
914 STK((NML,I))=STKIC(NNL,I)
      STKCR(I)=STKTC(I)
      IF(NML.EQ.4) GO TO 900
      STK((4,I))=STKTC(4,I)
900 CONTINUE
      RETURN
      END

```

SEGMENT 32 IS 1



```

DIMENSION R(4),G(4),NSHOP(4),NUMFS(4),DPHRSH(4),
*TRAIN(4),TURN2(4)
REAL NSHOP,MCOST,MUS,NDAY,MTBFF
REAL NLEV,NUM,MLEV,MNUM,NNLEV,NMLEV,MSECC,NDAC
REAL NUMFS
DO 2319 KM=1,NMUS
  MNUM(KM)=0.
  MLEV(KM)=0.
  MDS(1,KM)=0.
2319 CONTINUE
DO 2320 KK=1,NLE
  NLEV(KK)=0.
  NUM(KK)=0.
2320 TF(1,KK)=0.
C117**CALCULATE TEST EQUIPMENT REQUIREMENTS FOR COE AT ORGANIZATIONAL
C  LEVEL
DO 487 KK=1,NTE

```

00163900	R	0000
00164100	R	0000
164200	R	0000
164300	R	0000
00164350	R	0000
164400	R	0000
164500	R	0005
164600	R	0008
164700	R	0010
164800	R	0013
164900	R	0013
165000	R	0018
165100	R	0025
165200	R	0026
165300	R	0025
165400	R	0025
165500	R	0026

```

      IF (TFCE(KK),NE.1) GO TO 487
      TF(1,KK)=AMHCE
      487 CONTINUE
      C118**CALCULATE MOS REQUIREMENTS FOR ONE AT ORGANIZATIONAL LEVEL
      DO 488 KM=1,NMUS
      IF (INSCCE(KM),NE.1) GO TO 488
      MOS(1,KM)=AMHCE
      STVL=0.
      488 CONTINUE
      STREC=0.
      C119**TEST FOR THROWAWAY EQUIPMENT
      IF (ITT,NE.1) GO TO 1347
      C120**CALCULATE END ITLM STOCKAGE FOR THROWAWAY EQUIPMENT.
      CALL NREPE(OPHRDY,NDAY,4THFE,NSHUP,XK4,NUMFS,B,G,ROP,ELIFE

```

```

      165600 R 0032
      165700 R 0036
      165800 R 0039
      165900 R 0039
      166000 R 0039
      166100 R 0044
      166200 R 0048
      166300 R 0050
      166400 R 0052
      166500 R 0052
      166600 R 0052
      166700 R 0053
      166800 R 0054
      166900 R 0055

```

```

**AIRF,SIKEP,SIKE)
GO TO 1348
1347 CONTINUE
IF(1.NF.NNI)GO TO 489
GO TO 490
C121**+DTERMINE END ITEM STOCKAGE REQUIREMENTS FOR REPAIRABLE END ITEMS
489 CALL RFPEND(NSHUP,NUMFS,XK4,TURN2,OPHRDY,SIKE,NDAY,MTBFE
**STKFR,ELLIFL,AIRF,RUP)
1348 CONTINUE
STKFC=SIKE*CSF1
490 TCOST=0.
C122**+DTERMINE TEST EQUIPMENT REQUIREMENTS FOR CUE FOR FORCE STRUCTURE
DO 492 KK=1,NTE
XN1FV=TE(1,KK)/(OPHRSH(1)+ND4E)*NSHUP(1)
NLFV(KK)=XN1FV
NUM(KK)=NLFV(KK)*NUMFS(1)
492 TCOST=TCOST+NUM(KK)*TECOST(KK)
TEFC=TCOST

```

TCOST=0.

TRM=0.0

C123**CALCULATE MOS REQUIREMENTS FOR COE FOR FORCE STRUCTURE

DO 493 KM=1,NMUS

PRON=PRON

MLEV=MUS(1,KM)/(UPHSH(1)*PRON*NDAL)*NSHOP(1)

MLEV(KM)=XMLEV

MNUP(KM)=MLEV(KM)*NUMIS(1)

TCOST=TCOST+MNUP(KM)*MCOST(1,KM)

C124**CALCULATE TRAINING COSTS FOR CUE REPAIRMEN

TRM=TRM+MNUP(KM)*XMAN(KM)*ELIFE/TRAIN(1)

493 CONTINUE

MOSEC =TCOST

168800 R 0097

168900 R 0098

169000 R 0099

169100 R 0099

00169150 R 0100

169200 R 0105

169300 R 0110

169400 R 0112

169500 R 0116

169600 R 0118

169700 R 0121

169800 R 0127

169900 R 0127

C125**CALCULATE INVENTORY MANAGEMENT COSTS

170000 R 0127

TIPVIN=((STKE-STKER/(ELIFE-ROP/12.))/2.+(SIKE-STKER/(ELIFE-

00170100 R 0128

ROP/12.))((ELIFE-ROP/12.))+STKER/2)*CSEI*FACTIN

00170110 R 0131

PURE=PPC*PGE

170200 R 0137

C126**ADD UP COE COSTS

170300 R 0137

TOTEND=STKEC+IEEC+MOSEC*ELIFE+STKFR*CSEI+IINVIN+TRM+PUBF

170400 R 0138

RETURN

170500 R 0143

END

170600 R 0146

SEGMENT 33 IS 2

START OF SEGMENT *****

SUBROUTINE REPEND(NSHOP,NUMFS,XK4,TURN2,OPHRDY,STKE,NDAY,MTBFF 170700 R 0000

**STKER,ELIFE,ATKF,RUP) 170800 R 0000

C127**THIS SUBROUTINE CALCULATES END ITEM STOCKAGE FOR REPAIRABLE END

C 171000 R 0000

C GROUP 12 00171099 R 0000

DIMENSION NSHOP(4),NUMFS(4),TURN2(4)

REAL NDAY,NSHOP,MTBFF 171100 R 0000

REAL NUMFS 171200 R 0000

C128**CALCULATE PIPELINE STOCKAGE OF END ITEMS 00171250 R 0000

FAILE=OPHRDY*NUAY*.04/MTBFF 171300 R 0000

XFAIL=TURN2(1)*FAILE*NSHOP(1) 171400 R 0000

YSTKE=XFAIL+XK4*SQRT(XFAIL) 171500 R 0004

MTSTKF=XSTKE+.9999 171600 R 0006

STKE=HSTKE*NUMFS(1) 171700 R 0008

C129**CALCULATE END ITEM REORDER STOCK 171800 R 0012

NTKER=(FAILE*24.+(ELIFE-ROP/12.)*NSHOP(1)*NUMFS(1))*ATKF+.9999 171900 R 0012

STKER=NTKER 172000 R 0013

RETURN 172100 R 0021

END) 172200 R 0022

172300 R 0025

START OF SEGMENT ***

SUBROUTINE NREPE(NDAY,NDA/MTBFE,NSHUP,XK4,NUMFS,B,G,RDP,FLIFF 172400 R 0000

*,ATKF,STKER,STKE) 172500 R 0000

C130***THIS SUBROUTINE CALCULATES FND ITEM STORAGE FOR A THROUWAY END 17 600 R 0000

C IFN 172700 R 0000

C GROUP 12 00172700 R 0000

DIMENSION R(4),G(4),NSHUP(4),NUMFS(4) 00172800 R 0000

REAL NDAY,MTBFE,NSHUP 172900 R 0000

REAL NUMFS 00172950 R 0000

FAIL=NDAY*NDAY*.04/MTBFE*NSHUP(1) 173000 R 0000

C131***INITIAL ISSUE STUCK 173100 R 0003

ISTK=FAIL*R(1)+XK4*SQR1(FAIL*B(1))+.999 173200 R 0005

ISTK=ISTK+NUMFS(1) 173300 R 0011

C132***CUPFH=SHIP STUCK 173400 R 0011

```

      NUSSIK=FAIL*G(1)+.999
      NUSSIK=NOSSIK+NUMFS(1)
C133***REF PLACEMENT SIUCK
      NKOFST=FAIL*2*KUP*NUMFS(1)+.999
      STVL=ISTK+NUSSIK+NRUPST
C134***REF ORDER STUCK
      MKTR=(FAIL*24.*(ELIFE=KOP/12.)*NUMFS(1))+(1.+ATRF)+.999
      S1KER=MKTR
      RETURN
      END
      SEGMENT 35 IS

```

START OF SEGMENT *****

SUBROUTINE AVAIL(NC,NMK,LPMIN,LMMIN,LCMIN,WAIT,MTBFM, 174500 R 0000

*MTTKC,REQCT,REQPT,MIBFC,REQMT,MIBFF,MTIME,MTTRCE, 174600 R 0000

*TK1,PFNGO,TK2,IK3,TK4,MUT,TTE,AVAILA ,REQCT,TRANS,MTTRN,REQ) 174700 R 0000

C135**THIS SUBROUTINE CALCULATES THE EQUIPMENT OPERATIONAL AVAILABILITY 174800 R 0000

REAL NDAY,NSHNP

174900 R 0000

C GROUP 1

00174999 R 0000

DIMENSION LMMIN(4),MTBFC(4),MTTKC(4),NMK(4),TRC(4),

00175000 R 0000

*T1"(4)

00175100 R 0000

C GROUP 2

00175199 R 0000

DIMENSION LPMIN(4,22),MTBFM(4,22),MTTRM(4,22),IM(4,22)

00175200 R 0000

C GROUP 3

00175299 R 0000

DIMENSION REQCT(1,4),REQMT(4,4),REQPT(4,22),TRANS(4,4),

00175300 R 0000

*WAIT(4),WEIT(4)

00175310 R 0000

REAL MTTRM,MTTKC,MTIME,MTTRCE,MTBFM,MTTKC,MIBFE

175400 R 0000

SUMS=0.

SUM=0.

00 921 I=1,NC

NMC=NMK(I)

00 920 J=1,NMC

L=LPMIN(I,J)

C136**TEST FOR THROUWAY MODULE, COMPONENT AND EQUIPMENT

TF(LPMIN(I,J),NL,U) GO TO 922

TF(LMMIN(I),NF,U) GO TO 923

TF(LCMIN,NF,U) GU IU925

TTF=RFQET

GU TO 1417

922 L=LPMIN(I,J)

NL=LMMIN(I)

NLI=LCPIN

C137**CALCULATE TURNAROUND TIME FOR REPAIRABLE MODULES

WETT(L)=WATT(L)

175500 R 0000

175600 R 0000

175700 R 0001

175800 R 0006

175900 R 0008

176000 R 0014

176100 R 0015

176200 R 0017

176300 R 0022

176400 R 0025

176500 R 0028

176600 R 0028

176700 R 0030

176800 R 0033

176900 R 0035

177000 R 0035

00177010 R 0035

```

IF (MMIN(I).EQ.LPMIN(I,J))WEIT(L)=0
TM(I,J)=2.*TRANS(L,NL)+WEIT(I)+MTHM(I,J)+(1-TK1)*REOPT(I,4)
GO TO 924
923 NI=IMMIN(I)
NM=LCHIN
C138**CALCULATE TURNAROUND TIME FOR THROUGHWAY MODULES
TM(I,J)=REOPT(NL,4)
C139**DETERMINE WEIGHTED SUM OF MODULE TURNAROUND
924 SUM=SUM+TM(I,J)/MTHM(I,J)
920 CONTINUE
C140**CALCULATE WEIGHTED AVERAGE TURNAROUND TIME FOR MODULES.
TI(I)=MTBFC(I)*SUM
GO TO 927
925 NM=LCHIN
C141**CALCULATE TURNAROUND TIME FOR THROUGHWAY COMPONENTS

```

00177020 R	0038
177100 R	0045
177200 R	0057
177300 R	0059
177400 R	0061
177500 R	0061
177600 R	0061
177700 R	0064
177800 R	0066
177900 R	0072
178000 R	0072
178100 R	0072
178200 R	0076
178300 R	0077
178400 R	0077

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TRC(I)=REOCT(I,PL,4)

GO TO 928

C142**CALCULATE TURNAROUND TIME FOR REPAIRABLE COMPONENTS

927 WAIT(NI)=WAIT(NL)

IF (LCMTN(I).EQ.LCMTN)WAIT(NL)=0

TRC(I)=2.*TRANS(NL,NNI)+WAIT(NL)+MTTRC(I)+TIM(I)*(1-TK2)

C143**AFTER TIME WEIGHTED SUM OF COMPONENT TURNAROUND TIME.

928 SUMS = SUMS+1./MTBFC(I)*TRC(I)

921 CONTINUE

C144**CALCULATE WEIGHTED AVERAGE TURNAROUND TIME FOR COMPONENTS

TTC=MTBFF*SUMS

C145**CALCULATE TURN AROUND TIME FOR REPAIRABLE EQUIPMENT.

WAIT(NNL)=WAIT(NNL)

IF (LCMIN.FO.1)WAIT(NNL)=0

TTF=PPNGO*(MTTRCE+2.*TRANS(1,1))+(1-PFNGO)*(2.*TRANS(NNL,1)

**WAIT(NNL)+MTTRC+(1-TK3)*TTC

C146**CALCULATE MEAN DOWNTIME OF EQUIPMENT

178500 P 0077

178600 R 0080

178700 R 0080

00178710 R 0082

00178720 R 0085

00178800 R 0089

178900 R 0098

179000 R 0100

179100 R 0105

179200 R 0105

179300 R 0105

179400 R 0105

00179410 R 0106

00179420 R 0109

179500 R 0113

179600 R 0116

179700 R 0121

MDT=(TK4*REQ)+(1-TK4)*TTF

179800 R 0122

IF(LCMIN*EQ.1) GO TO 1417

179900 R 0125

C147**Determine AVAILABILITY WHEN END ITEM MAINTENANCE FLOAT IS

180000 R 0126

C AVAILABLE.

180100 R 0126

AVAILA=MTBFE/(MTBFE+MDT)

180200 R 0127

GO TO 1410

180300 R 0129

C148**Determine AVAILABILITY WITHOUT END ITEM FLOAT

180400 R 0129

1417 AVAILA=MTBFE/(MTBFE+TTF)

180500 R 0130

1418 CONTINUE

180600 R 0132

RETURN

180700 R 0132

END

180800 R 0135

SEGMENT 36 TS 1

START OF SEGMENT *****

SUBROUTINE GRAPHAC(I,VALUE)

180900 R 0000

C149**THIS SUBROUTINE YIELDS GRAPHICAL PRINT OUT FROM THE RESULTS OF

181000 R 0000

C SENSITIVITY ANALYSTS.

181100 R 0000

DIMENSION LINE(400),VALUE(40)

181200 R 0000

BLANK=" "

181300 R 0000

DOT="."

181400 R 0002

ASTER="**"

181500 R 0005

DO 1462 I=1,100

181600 R 0008

1462 LINE(I)=DOT

181700 R 0014

C150**PRINT DOTS FOR Y-AXIS

181800 R 0015

WRITE(6,1463)(LINE(I),I=1,100)

181900 R 0016

1463 FORMAT(1H,100A1)

182000 R 0034

C151**IT IS THE NUMBER OF BARS TO BE PRINTED

182100 R 0034

DO 1465 I=1,II

182200 R 0034

```

      DO 1464 LL=1,100
1464 LINE(LL)=BLANK
C152**PRINT THREE DOTS BETWEEN BARS OF HARCHART
      DO 1466 J=1,3
        LINE(1)=DOT
1466 WRITE(6,1467)(LINE(K),K=1,100)
1467 FORMAT(1H,100A1)
C153**PRINT BAR HAVING HEIGHT EQUAL TO VALUE (I) USING ASTERISKS.
      J=VALUE(I)
      DO 1468 JJ=2,J
1468 LINE(JJ)=ASIR
C154**IF VALUE (I) IS LARGER THAN 100 UNITS, DENOTE BY PRINTING DOT AT
C      TOP OF BAR.
      IF(JJ.GT.100) LINE(100)=DOT
      WRITE(6,1467)(LINE(L),L=1,100)
1465 CONTINUE
C155**PRINT 3 DOTS ON X-AXIS AFTER LAST BAR.

```

```

182300 R 0039
182400 R 0046
182500 R 0047
182600 R 0048
182700 R 0054
182800 R 0057
182900 R 0075
183000 R 0075
183100 R 0075
183200 R 0077
183300 R 0083
183400 R 0084
183500 R 0084
183600 R 0085
183700 R 0089
183800 R 0106
183900 R 0106

```

DO 1441 J=1,100

1441 LINE(J)=BLANK

DO 1469 I=1,3

LINE(I)=DOT

1469 WRITE(6,1467)(LINE(M),M=1,100)

RETURN

END

184000 R 0106

184100 R 0117

184200 R 0114

184300 R 0120

184400 P 0123

184500 R 0140

184600 R 0143

SEGMENT 37 IS 1