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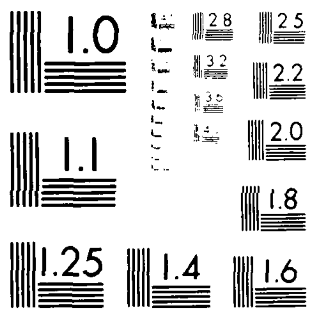

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AERIAL PORT OF EMBARKATION
CAPABILITY PLANNING
VOLUME I

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LSSR 62-83

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The complex nature of the base reception process, combined with the variability of processing requirements, arrival times, and departure times, make planning for the mobilization and deployment of U.S. forces difficult to accurately accomplish. This thesis developed a management tool applicable to all APOE bases to create and evaluate reception plans. The computerized model was fully validated and then used to determine adequate resource levels to achieve on-time preparation of deploying assets. The simulation results were analyzed statistically to ensure resource optimization. Actual warplan data were used in Volume II to generate resource levels required to support the OPLAN.

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AERIAL PORT OF EMBARKATION

CAPABILITY PLANNING

VOLUME I

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

By

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BACKGROUND

World crisis is a common occurance in the political arena of today. Recent conflicts in Lebanon, El Salvador, Poland, and Afghanistan have all upset the stability of international relations. In the environment of flaring national tempers, world economic strife, and territorial greed, the United States military must maintain a constant readiness to preserve U.S. national interests anywhere in the world. U.S. Military response to an international situation may vary from the deterrence provided by our force capability to full mobilization and deployment of those forces. When called upon to mobilize, the Air Force will be one of the primary agencies charged not only with deploying its own combat forces but also with moving the other services' personnel and equipment to the crisis area. Extensive planning goes into our ability to move huge amounts of resources to any location in the world. Despite the detailed nature of those plans, changing conditions always threaten their effectiveness.

The military services have developed warplans as a preliminary estimate of force requirements for various world contingencies. These plans identify required cargo and personnel along with projected movement tables. In the event of warplan execution an installation serving as an Aerial Port of Embarkation (APOE) must receive and process these resources and accomplish many divergent time phased activities.

The APOE will deploy units permanently assigned to the base as well as receive and deploy units of all services mobilized elsewhere in their geographic area. Certain APOEs located at Air Logistic Centers (ALCs) serving as aerial ports of resupply will also handle a large volume of unit related and non-unit related cargo moving in relation to the deployment. AFR 28-4, USAF Mobility Planning, specifies how base reception plans will be developed (18:A-1); however, planners interpret this to apply only to overseas locations (10). As the result of an Air Force audit which criticized the lack of guidance for CONUS base reception (21), Headquarters USAF/XOORB is revising AFR 28-4 and requiring CONUS APOE bases as well as overseas locations to develop reception plans (6).

The preparation of a realistic APOE reception plan requires familiarity with warplan development and APOE mobility procedures. Development of a warplan is an encompassing process supported at all levels of the DoD structure and results in an extensive data base. Mobility preparation of cargo and personnel for deployment, a labor intensive process, requires close coordination among many diverse and separate activities to ensure on-schedule departures. The base reception plan which coordinates these activities must integrate the warplan data base with mobility activities to ensure adequate base support for any specific warplan.

Warplan development (Appendix B) describes the forces and material that will be required to meet a particular contingency. The planning process further defines specific units to be deployed, amounts of cargo required, the routing to be used, and the timing for each group to be moved to the crisis area. This information is summarized in the Time Phased Force Deployment Data (TPFDD) report and is crucial to APOE planners in determining workloads for the base reception system. The TPFDD data are the inputs to the APOE base reception system. These inputs will be processed through the reception system enroute to the crisis destination to meet the contingency requirements of the plan being executed. Effective reception planning is mandatory to ensure the rapid, on-time processing of personnel and cargo being deployed as a result of a national emergency.

BASE RECEPTION

Despite the critical nature of APOE base reception, this process has not been defined or standardized by

Headquarters USAF. One definition of the reception process limits activites to providing food, shelter, and other necessities to units and individuals arriving from off-base; and receiving, sorting, and preparing off-base unit related cargo for loading. Mobility processing of on-base unit related and non-unit related cargo or personnel, and all Air Cargo Terminal activities are explicitly excluded (10).

For this thesis, however, the reception process will include all support activities, including base mobility, associated with deploying cargo and personnel identified in the operation plan (OPLAN) movement tables. This more inclusive definition represents the total work load created by the OPLAN, and allows planners to identify work centers which may be simultaneously tasked by different sources.

The APOE will process many categories of personnel and cargo arriving from a multitude of sources and requiring specialized services. Deploying cargo and personnel, for example, will originate from both on and off-base locations and will be either unit related or non-unit related. In addition, retrograde cargo and personnel, which includes damaged equipment returning to depots for repair and evacuated non-combatants, must all be processed by the APOE. The base reception process can be best understood by viewing the categories of inputs that require processing by the reception operation.

On-base unit related cargo and personnel will receive mobility processing by their unit. Once this is done, cargo will proceed directly to the marshalling area and personnel will return to their quarters until departure. The majority of non-unit related cargo originates from the ALC warehousing system or the ALC maintenance facilities. The Combat Logistics Support Squadron at the ALC prepares these items for shipment and delivers them directly to the APOE Air Cargo Terminal (3:4) where they are palletized for air shipment.

Off-base unit related and non-unit related cargo and personnel generally undergo mobility processing at their home station, and do not report to the APOE until shortly before their departure time. Off-base cargo and passengers may arrive by commercial surface transport or by LOGAIR. The cargo may or may not have been prepared for airlift. Upon arrival the APOE must validate mobility processing and cargo preparation to detect errors or omissions and direct the cargo or personnel to the appropriate processing area. Additionally, the APOE must supply food and shelter for these personnel as they await departure transportation (11).

Retrograde cargo and personnel will be returning to the APOE from the theater. Repairable spares must be sorted and routed to the appropriate repair facilities.

Wounded personnel will require special attention, such as medical care at the APOE or transfer to an air evacuation aircraft. Aircraft returning to the APOE directly from the theater will also contain full loads of non-combatant military dependents and U.S. citizens fleeing the hostilities. The APOE must coordinate transportation to commercial terminals and provide food and shelter as required for these people (10). For some APOEs this could create excessive workloads simultaneously with maximum deployment demands.

Mobility processing is accomplished by parent units for unit assets or by the APOE for non-unit assets; both must be checked during the APOE reception. The APOE units must mobility process all on-base cargo and personnel as well as ensure all off-base cargo and personnel were properly processed. Mobility processing is achieved through a time-phased schedule defined by the Mobility Control Center (MCC), reflecting the best estimates of the time required to accomplish mobility tasks. The essential steps in the mobility process include manifesting, selecting and preparing loads, marshalling cargo, processing, and assembling personnel and cargo at unit assembly areas, and loading aircraft (18:p.3-1). Some of these steps will be accomplished prior to entry into the base reception system; others will not.

Mobility work centers will accomplish the time-phased actions reflected in the mobility schedule spontaneously rather than by direction of the MCC. Generally each work center accomplishes a primary task. For example, load planners coordinate load build-up with the air cargo terminal and the passenger terminal. A controller monitors mobility activities and reports problems to the MCC. Quality control personnel audit cargo and passenger manifests before the scheduled aircraft load time. The Ramp Coordinator monitors cargo marshalling and aircraft loading operations. The Air Cargo Terminal function receives and inspects cargo at the cargo marshalling area and checks for proper preparation and marking, air transportability, and proper documentation. Equipment is then marshalled by load number. The Air Passenger Terminal function provides complete passenger services to prepare and process personnel for deployment. These services include passenger briefings, troop commander briefings, baggage handling, passenger manifesting, anti-hijacking procedures, and passenger loading. The Sub-Motor Pool provides vehicles and drivers to transport deploying personnel to the mobility processing area, material to the marshalling area, and passengers to the aircraft load site (18:p.3-3).

PROBLEM STATEMENT

APOE managers presently have no means to integrate

OPLAN movement data with reception processing requirements to determine time-phased workloads for preparation of APOE reception plans.

JUSTIFICATION

While APOE managers are tasked with planning for and managing an extremely large, complex, and dynamic system, many unit level managers do not have the World Wide Military Comand and Control System (WWMCCS) Integrated Network (WIN) capability to access the Joint Operations Planning System (JOPS) (Appendix B). They also do not have ready access to MAC or MTMC deployment movement tables. Even with these movement tables it is nearly impossible to manually determine workloads for the numerous tasks. Also, during mobilization the published movement table may change suddenly. With current capabilities managers have no way to quickly evaluate the effects of these changes on their reception system.

The OPLANs are written to deploy only the minimum essential assets to sustain combat operations during the initial phases of conflict (20:36), so the APOE must be prepared to efficiently process all resources identified on the movement tables. Some APOEs are tasked to deploy such a large number of units from different commands simultaneously, that requirements may exceed the capability of the installation to receive supporting aircraft, or process and load personnel and equipment to meet departure times. In those instances the mobility work centers should be expanded to accomodate the most demanding OPLAN tasking for that unit (18:p.3-4). Managers know the estimated total resources scheduled through their APOE; however, without the timing of that flow they cannot determine how work centers must be expanded to accomadate OPLAN tasking.

OBJECTIVE

The objective of this thesis is to create a model of the APOE base reception process and validate that model so that it can be used as an effective management tool. The model should be flexible enough to be used at any APOE and capable of evaluating present resource levels as well as generating optimum resource requirements to accomplish base reception.

A previous thesis attempted to model base reception (3). Model development was well documented; however, many assumptions were proposed, and the model was not sufficiently validated. Also, that thesis did not tie the simulation into an existing data base to provide actual information.

This thesis uses this existing reception model as a departure point. Our efforts will concentrate on model accuracy, and building confidence in the simulation results through substantiating assumptions and model validation. We will establish a means to transfer data from the TPFDD to a computer system with simulation language software. Finally, we will use actual movement data to generate workload information to demonstrate model usefulness.

RESEARCH QUESTIONS

To model base reception four key questions must be resolved:

1. What are the critical factors representing the reception process?
2. What are the duration distributions associated with reception activities?

In order for simulation results to be accepted and implemented the model must be thoroughly validated. Yet, wartime simulations possess inherent validation difficulties in that the simulation cannot be compared with existing real world peacetime operations.

3. What technique will best validate the reception model?

The final objective of modeling and computer simulation should assist managers in their decision process. The computer output should clearly demonstrate this attribute.

4. Does the simulation clearly identify critical shortfalls?

SCOPE

This thesis will provide managers a means to develop alternative reception plans for APOE mobility/deployment OPLAN taskings or evaluate present plans using the existing data base. A computer simulation model of the reception process will generate two types of information. First, it will determine expected demands for a specific OPLAN, allowing for the APOE manager to determine work center adequacy. This information allows for reception planning and justification for work center expansion as required by AFR 28-4 (18:p.3-4). Second, upon OPLAN execution, the simulation can be run with actual work center facilities and expected inputs to anticipate shortfalls. Managers can then take corrective action prior to the actual development of a critical shortfall.

This model should be generic to the extent that it will apply to any APOE. To narrow the range of assumptions and to facilitate validation, modeling data will be collected at Wright-Patterson AFB. The structure of Wright-Patterson's reception process is similiar to other APOEs (10), so this model should apply to any APOE with a minimal change of parameters within the model.

CHAPTER SUMMARY

APOE base reception is a critical, but neglected factor in the mobilization and deployment of U.S. forces. The complex nature of the reception process, combined with the variability of processing requirements, arrival times, and departure times make planning for this system difficult to accurately accomplish. Because of its vital importance to military readiness, APOE managers need an effective management tool to create and evaluate reception plans. The goal of this thesis is to develop that tool, prove its accuracy, and demonstrate its usefulness as a valuable aid in the planning process.

CHAPTER 2

METHODOLOGY

In order to provide a useful tool for managers to successfully meet the requirements of planning a full scale mobilization, a system of very complex components and relationships must be understood and evaluated. The problem of precisely describing such a complex operation calls for a systems analysis approach (14:6). This analysis provides a better understanding of the system's operating characteristics. To evaluate the reception system's capabilities and operation exactly (eg. actually mobilize our forces) would be very expensive and impractical given the ramifications of full mobilization in today's political environment. The analyst must pursue a more reasonable method for understanding this complex system.

SYSTEM ANALYSIS

The Rand Corporation (4:6) classifies a spectrum of systems analysis methods ranging from the least to most abstract as follows:

1. Real World
2. Observations from the real world
3. One to one simulation
4. Game simulation

5. All computer simulation
6. Mathematical analysis.

The "observation" level depends on real world environmental factors to validate the observations. While the U.S. military services do perform mobility exercises, they are never executed in the crisis environment when all military activity would be focused on the mobilization. In fact normal operations often supersede mobility exercise operations, thus limiting exercise realism.

One to one and game simulations were developed largely for training situations and focus on the trainees and their decisions rather than on the system. Our interest is in an accurate understanding of the system's characteristics and operations. Perhaps after a validated and verified system model is developed, game simulation could be accomplished by varying the decision rules. This would provide sensitivity data on certain decisions, but, is only possible <u>after</u> a validated system model is achieved.

Mathematical analysis, the most abstract method, is more applicable to the physical sciences. In our case the statistical decision theory or linear programing approach:

1. Oversimplifies the complex goals of a large system,
2. Requires mathematically precise rules which have not been discovered,
3. Requires impossible-to-obtain information, considering the degree of abstraction [4:7].

Drawbacks and real world limitations of these analysis techniques of the Rand spectrum point to the all computer simulation approach as the most suitable method for our purpose.

COMPUTER SIMULATION

Computer simulation is the most important and useful tool in analyzing the capability and operation of complex systems (13:1). This method is highly abstract, but still provides ample flexibility for our purpose. Several advantages are present:

1. The component to be optimized need not be specified. In fact, the simulation will identify critical factors.

2. Detail and complexity need not be sacrificed to arrive at a conclusion.

3. Random behavior and time considerations can readily be incorporated into the model.

The major drawback to this method is the requirement to specify all relationships between activities and resources, that is, to provide a decision rule for any situation (ie. represent the human decision maker). While expert advice and experience are excellent guides in this area, it is still recognized as a limitation and sensitivity analysis must be performed on decision variables to account for the human factor where such considerations are required.

While the use of simulation appeals to managers because of its apparent simplicity and face validity, several inherent shortcomings must be considered. The expense in dollars and man-hours to develop and computerize a simulation model must be weighed against the perceived benefits. Verification, validation, and sensitivity analysis of the model are always required, because models are prone to inaccuracy, high sensitivity, and unrealistic representation of the real system (13:13). Assumptions should be scrutinized and questioned, as well as techniques for verification, validation, and sensitivity analysis. Sometimes these shortcomings must be accepted, because simulation can provide answers to questions not attainable by other means (eg. war scenarios) (13:12). This study deals with a situation not readily verifiable in the real world, and some of these shortcomings are present. More detailed analysis of these limitations is presented in later chapters.

PROBLEM SOLVING PARADIGM

Robert E. Shannon provides an excellent structure or problem solving paradigm for our computer simulation systems analysis.

> 1. System Definition--Determine the boundries, restrictions and measure of effectiveness to be used in defining the system to be studied.
> 2. Model Formulation--Reduction or abstraction

of the real system to a logic flow diagram.

3. Data Preparation--Identification of the data needed by the model, and their reduction to an appropriate form.

4. Model Translation--Description of the model in a language acceptable to the computer to be used.

5. Validation--Increasing to an acceptable level the confidence that an inference drawn from the model about the real system will be correct.

6. Strategic Planning--Design of an experiment that will yield the desired information.

7. Tactical Planning--Determination of how each of the test runs specified in the experimental design is to be executed.

8. Experimentation--Execution of the simulation to generate the desired data and to perform sensitivity analysis.

9. Interpretation--Drawing inferences from the data generated by the simulation.

10. Implementation--Putting the model/or results to use [13:23].

Complete, accurate execution of each of these steps will produce a simulation model that is easy to understand, achieves its purpose, provides reasonable answers, includes all relevant factors, and provides managers with a reliable tool to use in planning APOE base reception activities. The following activities are general guidelines for the accomplishment of each step. Readers familiar with this paradigm may procede to Chapter 3 without loss of continuity.

SYSTEM DEFINITION

This initial step establishes boundries, restrictions, and measures of effectiveness. Every system is a subsystem or element of a larger system, so in order to establish these factors we must establish an analytical approach to define our system. We will use the General Systems Theory systems analysis approach and definition to identify our system. This approach defines a system as

> a set of objects together with relationships between the objects and between their attributes connected or related to each other and to their environment in such a manner as to form an entirety or whole [14:12].

To define our system consistent with this definition we must first identify the system objects along with their attributes, and relationships. These objects form a goal seeking entity distinctly separate from their environment, yet dependent upon interactions with the environment (13:25;12:1).

Open systems receive resources from the environment as inputs and perform transformations to create outputs. A complete system definition must determine essential environmental resources, and the desired system outputs. All systems must be goal oriented in order to integrate various system elements toward desired outputs. The degree of goal achievement determines system effectiveness and efficiency (13:26).

With these concepts the boundary separating the system from the environment can be determined. Elements and relationships within the boundary are considered controllable by the system while elements outside the boundary represent environmental factors and may influence the system but are not directly controllable by the system.

The initial modeling effort should concentrate on the controllable system elements and relationships (13:27).

MODEL FORMULATION

The simulation effort implies a perceived problem in system operation. The modeler's first task must center around an accurate and concise formulation of the perceived problem. An accurate statement of the problem begins with desired goals. These goals bound the system by identifying desired outputs, thus defining relevant elements and inputs. Problem formulation should concentrate on examining all these bounded elements to determine their attributes and relationships. This examination should identify the critical attributes and relationships. This represents the most important step in model definition for it allows the modeler to eliminate insignificant elements and relationships. Often simply identifying the critical components will identify the causes of the problem. If further analysis is required, it can concentrate on critical components for model formulation (13:27,12:11).

Once the modeler has defined and limited the system to critical components he must acquire a thorough understanding of how the system is supposed to operate, as well as how it actually operates. In this stage he must observe, participate, interview, and examine documentation, always questioning the validity of the facts (13:45). The progressive development of a graphical representation of the system may facilitate this process and begins the actual model development (13:46).

With increased understanding of the system and the formulation of a structural model, the modeler must incorporate all relevant variables. Variables can be divided into four groups. Endogenous variables represent factors within the system and which are under system control. Exogenous variables are necessary inputs from the environment. They have direct influence on the system but cannot be directly controlled. Status variables change with system operation; therefore, they represent the current state of the system. Finally, the criterion variable represents the system objective or goal. It is the final measure to determine system effectiveness (13:15-16).

The structural model along with all variables represents the working model for development of the simulation. A model flowchart should be prepared at this stage. The flowchart has the advantage of a graphical representation of component relationships along with relevant variables. The flowchart also prepares the model for the computerization step (13:151).

The modeler must be aware that the structural model is never complete and final. As he continues his system investigation and data collection new relationships and variables will become apparent (12:11-12). The intial working model should be simplified to include only the relevant critical components and modified as system definition dictates (13:26).

DATA PREPARATION

The model formulation identified four types of variables important in the model. Endogenous and criterion variables are internal to the system and can be specified for the simulation. Status variables result from system operation. Exogenous variables represent a problem in that their values must be estimated or generated, and then input into the simulation. This process is a critical step in the system's analysis as it lays the foundation for further model evaluation (13:28).

There are several methods to generate exogenous variables. These values may be hypothesized based on the initial system analysis and model formulation and then reviewed by individuals familiar with system operations to substantiate variable value validity. A second method involves reviewing system records for required data. This method is dependent on availability of accurate records containing the required information. A final technique requires actual field collection of the data. This technique is most expensive and time consuming but results in the most accurate estimation of the exogenous variables

(13:28;12:43-44).

Once the exogenous variable data are collected they can be applied two ways. First, the actual historical data can be input into the simulation and various endogenous variable combinations tested against thes data. This will indicate the best solution under historical conditions. A second approach requires analysis of the historical data to determine representative distributions. These representative distributions can then produce new exogenous values representative of the historical data. This technique allows various endogenous variables to be tested against possible future events (13:27-28).

The second technique allows more flexibility; however, it requires more effort and caution to validate the inputs. The first step in this process requires analysis of the historical data. The data should be plotted on a histogram, fitted to a curve, and statistically analyzed to identify characteristic paramenters. A representative distribution can then be hypothesized and a Chi-square Goodness of Fit statistical analysis performed to confirm the hypothesized distribution (12:48). Once the distribution is confirmed a computer program can be written which will generate samples conforming to this distribution. Monte-Carlo sampling will randomly extract variates from this distribution for input into the simulation (13:65). Before running the Monte-Carlo simulation the distribution should be tested by drawing a variate sample and performing a Chi-square Goodness of Fit or Kolmogorov-Smirnov statistical analysis to confirm the sample represents the original historical distribution (12:48). Depending on the importance of the variable in the simulation other statistical tests for autocorrelation and variate randomness should be performed before accepting the Monte-Carlo variates (13:355-356).

MODEL TRANSLATION

In this step the working model must be translated to a computer language. Many different simulation oriented computer languages have been developed to aid the simulator in computerization. The appropriate language depends on the nature of the model, the purpose of the simulation, and the type of computer (13:28,98,12:12).

Common model orientations include network, event, or structure. Q-Gert and SLAM languages are network orientated (12:445). In these languages the modeler formulates the system as an interconnected network of activities and decision points. Entities or transactions then flow through the network activities and decision points. SIMSCRIPT is primarily an event oriented language (12:451). In this language the model is defined by entities, attributes and logical groupings of entities. The language monitors the system's changing structure at specific event times. DYNAMO is an example of a structural language. It was developed by Forrester to analyze complex problems relating to system dynamics. This language monitors non- linear system state or structure variables represented by levels (12:461).

The purpose of the simulation dictates a discrete or continuous computer model. Discrete or continuous refers to the incrementation on the independent variable, "time" within the simulation. Discrete simulation advances time discretely at specified points (12:65). The time advance can be either continuous fixed interval advances, or discrete variable event oriented advances. The dependent variables change only when the time advances. A discrete simulation applies to event oriented problems. GASP, Q-Gert, and SIMSCRIPT are discrete languages. In continuous simulations the dependent variable changes continuously over time. Continuous simulations use partial derivitives to specify system states and originally applied to analog computers for population analysis and for process state analysis. Modern high speed digital computers and newer languages such as SLAM have developed integration algorithms which allow digital computers to approximate continuous simulations (12:71).

The selection of a language for a simulation is dependent on the model, simulation purpose, type of computer, and software availability. Commonly available languages in DoD include SIMSCRIPT II, Q-Gert, and SLAM II (9).

VALIDATION

The validation step increases confidence in the simulation output. It shows that the simulation satisfactorily represents the real world, thereby giving management more confidence to implement the results.

The validation process consists of two steps, verification and validation. Verification confirms that the computer model is performing as the original working model intended. All models can and must be verified. Validation reviews the concepts, assumptions, and restrictions of the original working model to affirm they represent the original system. Validation reflects an inherent weakness of simulation. Simulation is most directly applicable to systems which cannot be measured directly. Therefore, direct measurement of, or experimentation with the actual system for comparison is impossible (13:30;12:12).

Three commonly accepted techniques for verification are hand duplication of a computer run, trace statements, and canned data. Hand duplication is a time consuming procedure, but it allows the values of each variable to be calculated to confirm that the logic in the computerization follows the working model logic. This technique is applicable only to simple simulations. A second technique places trace statements throughout the computer program to print out critical variables. This allows the computer to do the time consuming calculations, and then the variables can be analyzed to confirm the logic is valid. Finally, canned inputs with predetermined results can be run to verify that the computer output agrees with the anticipated results. This technique must input data which exercises all subroutines in the program. To do so usually requires several runs with data representing mean values and values to each extreme (13:30,12:12-13).

Simulation models cannot be measured directly for validity so several philosophies have evolved for acceptable techniques. Rationalists, closely associated with mathematics and logic, theorize that one must accept fundamental basic unproven premises from which the rest of the model can be logically developed. The problem with this approach is the unquestioned acceptance of the basic premises (13:212). Empiricists represent the opposite extreme and will not accept any premise without experimental evidence (13:214). Simulation techniques can be proven empirically; however, system model formulation or simulation application cannot be validated experimently. Pragmatists are not concerned with the actual validity of the model. Instead, they concentrate on model usefulness in a predictive nature. Do inputs accurately predict outputs? The problem with this approach is that the model cannot be evaluated until after implementation to determine prediction accuracy (13:214).

The final philosophy, the utilitarian approach, combines the three previous philosophies (13:215). Utilitarian validation is a realistic progressive means to evaluate the working model. First the model is expressed in mathematically logical terms using fundamental system knowledge for basic premises. Next the simulation is experimentally tested within the range of available limits. Finally, the predictive nature of the model is demonstrated by comparing the model to the real world wherever possible. The simulator should combine the three techniques of model logic, experimentation, and real world comparisons to convince management that the model represents the real world (13:215-217). Once managemnt accepts the model's validity, they should accept the simulation results and support subsequent implementation.

STRATEGIC PLANNING

Strategic planning pertains to developing the experimental design which will best identify relationships between the independent variables and the dependent variable. Experimential design for a simulation is subject to the same constraints and statistical analysis as a true physical scientific experiment. However, simulation allows the experimenter increased control over independent variables and experimental conditions. In simulation the experimenter can reduce spurious experimental variance by testing different treatments under identical conditions to determine the best solution (13:30).

Shannon (13:151) proposes a three step process to experimental design. First, develop the structural model, then identify the functional model, and finally, design the experimental model.

The structural model consists of the desired independent variables and the number of treatment levels for each variable. The objectives of the experiment, measurability of the factors, and nonlinear effects should determine the required factors and levels. The number of different experimental treatments required is exponentially related to the number of factors and levels. In the structural model the experimenter should not limit factors or levels to conform to resource constraints (13:155). The structural model reflects the ideal experiment.

The functional model determines how many of the treatments will actually be measured. A complete functional model measures each treatment thus duplicating the desired structural model, while an incomplete functional model measures only a portion of the treatments. Usually labor, money, or computer time limits the simulation effort, so an incomplete functional model must be adopted. To derive the best incomplete functional model the experimenter should analyze the system and working model to eliminate logically infeasible treatments. The functional model reflects the actual practical experiment (13:155).

The experimental model determines how the experimental results will be statistically analyzed. The experimental design may be concerned with determining the means and variances of different alternatives, effects of different variables, or optimal values for the variables. Each purpose of the simulation requires a different type of statistical analysis and a different experimental approach. The experimental model will determine the number of simulation repetitions for each treatment (sample size) required for significant statistical analysis (12:498).

The strategic planning process determines which endogenous variables and associated values should be examined in the simulation. Additionally, the required statistical tests are identified and appropriate sample size calculated to obtain statistically significant results (13:30-31).

TACTICAL PLANNING

Tactical planning investigates the proper experimental data collection procedure to reduce simulation induced variance. Reduction of this variance strengthens the experimental design developed during strategic planning and increases the statistical significance of the independent/dependent variable relationship (13:31).

The majority of simulation induced variance results from start up transients (13:181). Generally the simulated system is an ongoing steady state process with inputs at various stages of processing. The simulation cannot start in a steady state, so the initial data will be erroneous when compared to the real world. Running the simulation for a long enough period to cause the intial data to be insignificant compared to the steady state data reduces start up variance; however, this solution is often prohibitive due to excessive requirements for computer time (13:181). A second solution discards the initial data and analyzes only the steady state data. This solution must determine when the simulation reaches steady state in order to begin data collection (13:181). One common technique calculates a moving average of the simulation data. When the third order moving average changes less than 2% equilibrium can be assumed (2).

Most statistical testing of simulation results assumes independent and uncorrelated samples (13:187).

This may be a faulty assumption because simulation often produces autocorrelated data. Autocorrelated data implies the previous results influence the present or future results. If the simulation data is collected through time the output should be analyzed for autocorrelation. If autocorrelation exists the experimenter has several options. He can determine the factor causing the autocorrelation and include it in the functional model as a factor; or, he can take a larger sample size to reduce the significance of the autocorrelation. Finally, he can randomly introduce dead spaces in the simulatior where no data is collected to reduce autocorrelation. The larger sample or simulation dead space will increase computer time and must be considered when designing the functional model (2;13:187).

EXPERIMENTATION

In this step the simulation is run and the output data are collected. The data should then be statistically analyzed to determine the factors producing the optimum criterion variable. This optimum answer reflects the assumed and measured distributions introduced as exogenous variable inputs. These experimental inputs may vary from the real world, so before the optimum solution can be positively selected, its sensitivity to exogenous variable inputs must be determined (13:32;12:13).

Sensitivity analysis increases confidence in the simulation results. For this process the exogenous variable distributions and original data collection techniques must be reviewed. If the validity of a distribution is questionable the distribution parameters should be increased or decreased one at a time to determine the effects on the criterion variable. If the optimal solution does not change as the exogenous variables are adjusted, the experimentor can be more confident with the simulation solution (13:32).

INTERPRETATION

By this step the simulation is complete. For nonsensitive optimal solutions, interpretation is simple; management can accept the simulation solution with a relative high degree of confidence.

If the optimal solution changes when the initial experimental data are modified, then the results are sensitive to inputs, eliminating a clearcut optimum solution. For a sensitive solution management must select from the best solutions or revalidate the sensitive input variables to reconfirm the simulation's original optimum solution. For sensitive solutions the difference in cost between the optimal solutions will indicate to management the value of better information to revalidate the exogenous variables (13:31;12:13).

IMPLEMENTATION

In this stage the simulator's responsibility centers around proper documentation and briefings so that management has a thorough understanding of the simulation process. A thorough accomplishment of the previous nine steps should provide a good projection of the real world, allowing management to accept and implement the findings with confidence (13:32-33;12:13).

CHAPTER SUMMARY

Computer simulation is the best method to accomplish the systems analysis of the APOE reception process and provide a tool for evaluation and planning. This approach ensures accurate and flexible representation of the system and can be accomplished using Shannon's ten step problem solving paradigm (12:23). Detailed application of the paradigm to APOE reception follows in Chapter 3.

CHAPTER 3

MODEL APPLICATION

The general aspects of base reception covered in Chapter 1 were fitted to the problem solving paradigm described in Chapter 2. The system description was expanded, resulting in a model of APOE base reception. This model was then further processed through the steps on the paradigm and resulted in a useful planning and evaluation tool for APOE reception managers.

Because APOE reception is comprised of similar tasks at all reception bases, a specific model for the Wright-Patterson AFB (WPAFB) reception function can be used as a basis for models of other APOEs (10). The first and most critical step in developing the WPAFB model and using it as a planning tool was system definition (13:90).

SYSTEM DEFINITION

During mobilization, reception will be only one of the many functions being performed at WPAFB. The reception activities, however, will have priority (7). Research, experimentation, procurement, and other usual base functions will have minimal direct impact on the mobility effort and are not included in this model. Some of the reception activities described in Chapter 1 do not directly affect the APOE's ability to mobilize cargo and personnel, so they too are not considered in this model. Other factors, such as retrograde cargo or specific aircraft load planning, have not been estimated by the planning community, so are not included in this model.

The goal of the reception effort is to receive and process cargo and personnel for shipment on-time to the crisis area. Our system is confined to those factors directly relevant to personnel and cargo being received and processed for on-time departures. The initial system boundary is the arrival point where cargo and personnel are received and directed to their next stop within the system. At WPAFB this boundary is the reception gate. The outbound limit of the reception system is either the marshalling area boundary where cargo is loaded onto K-loaders to be put on aircraft, or the passenger terminal where personnel depart the system to be loaded on aircraft. K-loader and passenger loading operations, while potentially of interest to the total war effort, are not considered part of base reception cargo preparation (10).

This system incorporates the reception personnel and resources anticipated to be available. Available resources include resources on hand as well as resources planned to move to WPAFB to assist in reception (eg. augmentation personnel). The system inputs are the personnel and cargo requiring processing. The outputs are passengers ready to be loaded on aircraft, and cargo properly palletized for air shipment and ready to load on aircraft.

The restrictions on our system are imposed by TPFDD requirements, operating policy/regulations, and safety regulations. The local politics concerning where to locate certain functions (passenger terminal, marshalling area, explosive cargo area, etc.) can also impose restrictions (7).

A successful reception system prepares an acceptable percentage of cargo and personnel for timely transport (1;7;10). This percentage can be used as a measure of system effectiveness, and its desired value must be set by system managers. This model will aid managers by allowing them to adjust individual controllable variables to evaluate their effect on the entire system.

MODEL FORMULATION

Within these boundaries and restrictions a more detailed description of the reception process at WPAFB was pursued. A graphic model (Appendix C) was created to identify system elements, attributes, and relationships. Only the critical elements were retained in the model. For WPAFB, exogenous variables (outside system control) include the amounts of cargo and personnel arriving, their arrival times, processing and transportation times, and the weather. Endogenous variables (within system control) are the number of people available to process the arrivals, the amount of space provided for processing and storing the arrivals, and the equipment needed to process the arrivals (forklifts, buses,etc.). Status variables are the number of people billeted, people waiting for/or in processing, pallets in the marshalling area, and the amount of cargo awaiting various processing steps. The criterion variable (system evaluation) is the percentage of inputs processed for departure on-time. The relationships of these variables can best be described by considering the two types of arrivals (personnel or cargo) separately.

PERSONNEL RECEPTION

Arriving personnel will fall into three categories: non-deploying augmentees, unit related personnel, and non-unit related personnel. Arriving personnel are transported, processed, billeted, and fed in terms of a Force Requirement Number (FRN). A FRN may be one person or 500 people. Part of a FRN may be transported within the system, but, only complete FRN's are processed (briefed, etc.), and the entire FRN must be processed before it will depart the sytem.

All personnel will be directed to arrive at gate 26C for reception (11). At the reception point mobility personnel will direct the arrivals to their next stop. Augmentee personnel will be directed to non-temporary quarters and from there exit the reception system.

FRNs departing within 18 hours will proceed directly to the passenger staging or holding area (11). Many FRNs will have their own vehicles which they can use for transportation to the staging area. After the personnel are in the staging area the vehicles will be driven to the vehicle processing area and be prepared for air shipment (7). If the deploying FRN does not have its own vehicles, the personnel must await bus transportation and then move in groups of up to 40 to the passenger staging area.

FRNs departing in more than 18 hours will proceed to billeting either by their own transportation or via base bus as described above. Billeting may be assigned in VOQ facilities (Area A), the Kittyhawk Area, or downtown (within 10 miles of the base) (11). If the FRN requires feeding, personnel will eat in the billeting area. Rather than move people to messing facitlites, hot lunches or box lunches will be prepared in central messing facilities and then distributed to billeting areas as required. Approximately eight hours prior to departure the FRN will leave billeting and proceed to the passenger staging area. This allows ample time to transport personnel using unit vehicles and still begin processing those vehicles six hours before departure . All deploying vehicles should begin processing at least six hours prior to departure (7;11).

Once a FRN departs the reception point, the mobility person directing the FRN (the inchecker) is free to assist another FRN. One inchecker is required for each FRN. Unit related personnel deploying from on-base units will not require an inchecker and will enter the reception system directly at passenger staging.

Distribution of one box lunch per person and final troop commander briefings are accomplished at passenger staging. From there, FRNs will move either by foot or bus to the passenger terminal. One passenger agent per FRN will deliver final passenger briefings and distribute another box lunch for the flight. After final passenger processing 60% of the FRNs will walk to the aircraft while 40% will require buses (7). The passenger agent will be free to assist another FRN once his FRN departs to be loaded on the aircraft. Upon arriving at the aircraft the FRN departs the reception system.

First-in-first-out (FIFO) priority is used for all personnel processing and transportation through passenger staging. Beyond this point the FRN with the earliest departure time receives priority over other FRNs (11).

CARGO RECEPTION

Arriving cargo is separated into the categories of unit related (vehicular and non-vehicular), non-unit related, and explosive. Unit related vehicles must be delivered to processing at least six hours before departure (7;11). Unit cargo and vehicles will arrive at Gate 26C and be directed for processing by a cargo agent at the reception point. Vehicles will need washing and/or processing. Those requiring both washing and processing will first be washed then proceed to the processing area. After processing the vehicles will be parked awaiting joint inspection by the shipper, APOE personnel, and the aircrew. Vehicles that pass this inspection are parked in the marshalling area awaiting loading onto an aircraft. Vehicles that fail this inspection can fail because of improper washing or processing, and will be rerouted to correct the deficiency.

Unit related cargo will arrive palletized for air shipment (10). Pallets with discrepancies discovered during incheck will be sent to the frustrated cargo area for rework. Acceptable cargo will be routed to the marshalling area, unloaded by forklift and inspected by the joint inspection team. Cargo that passes inspection will await loading onto an aircraft. Cargo that fails inspection will be routed to the frustrated cargo area for correction of deviations. This cargo will then be reinspected and if satisfactory be marshallled to await loading (11).

Non-unit related cargo will be input into the system from either on-base or off-base sources. Off-base non-unit cargo will arrive on wooden pallets and will need preparation for airlift (10). It will be received by a cargo agent who examines the paperwork for completeness and determines its destination and time of departure. The cargo is then routed to the unloading/palletizing area. At WPAFB this cargo (as well as explosive cargo) will arrive on flatbed trucks (7). The TPFDD measures this cargo in tons. For modeling purposes all cargo is divided by 1.7 tons (average weight of a pallet) (22) and processed as individual pallet loads. On-base non-unit cargo will not be received through the freight channels. Rather, this cargo will be sent directly to the unloading area for palletization.

After unloading, non-unit cargo is palletized by Air Force crews with continuous inspection by both quality control personnel and one supervisor for every three crews (22). Pallets are then moved by forklift to the marshalling area to await loading onto an aircraft.

Explosive cargo is the most restrictive input to the reception process. Special routing for trucks carrying this cargo is required. Explosive cargo will arrive at gate 26C by prior arrangement with the shippers (7). The mobility representative at that gate will direct the drivers to the explosive area near Taxiway 12 via an approved route, separate from other APOE activity and other base functions. At the explosives area the cargo will be unloaded and palletized by Air Force crews as above. Pallets will then await loading onto aircraft.

All cargo will be processed with a priority determined by earliest departure time first. A cargo item that has begun a phase of processing (ie. palletizing, washing, etc.) will not be interrupted for new arrivals with earlier departure times. These arrivals, however, will be ordered in the queue with the earliest departing first.

Most APOE activity will be conducted on the west side of WPAFB. Passenger processing and staging; unit and non-unit cargo processing, inspection, and marshalling; and vehicle processing, inspection, and marshalling will be conducted in the area adjacent to or in buildings 4022, 4024, 4026, and 4028 (7). The location of these functions determines the transit times between the various activities described above.

DATA PREPARATION

The values for the variables listed below have been collected from interviews of mobility experts, actual field measurements, and other sources as indicated. Variables common to all APOE locations are expressed as Uniform distributions (minimum value, maximum value) or Triangular distributions (minimum value, most likely value, maximum value). The type of distribution with the parameters indicated in parenthesies determine the variable value. Expressing these common variables (eg.processing times) this way provides greater realism (13:68) and a basis for comparison amoung various APOE bases. Base specific variables like transportation times were determined by actually driving the routes described or by expert estimates of their true value (1;7;8;10;11). These variables are represented by average times. Using distributions rather than average values for base-specific variables would make the model much more difficult to apply to different APOEs. In the interest of simplifying the model application, base-specific distributions are not used.

The following four categories of variables and their values are required to use this model. The source of the value is indicated in parenthesies, where (FS) indicates field study values and (EST) indicates values estimated by the authors in consultation with others. All triangular distribtuion parameters are in minutes.

EXOGENOUS VARIABLES

The weather

Flight time to destination plus clock time change.

Amount of cargo arriving--Extracted from representative TPFDD data created for model validation and experimentation (Appendix F).

Number of people arriving--Extracted from representative TPFDD data created for model validation and experimentation (Appendix F).

Arrival time of personnel and cargo--Drawn from a uniform (earliest allowable, latest allowable) distribution. The earliest and latest times are based on the available to load date (ALD). The time of arrival is randomly selected from this 24 hour window.

Departure time of personnel and cargo--Drawn from a uniform (earliest possible, latest allowable) distribution. The earliest possible departure is either the earliest time to allow arrival at 0000 hours on the TPFDD earliest arrival date (EAD) or the actual arrival time plus a minimum processing time. For personnel the minimum processing time is six hours (7; 11). For cargo the minimum processing time is either six hours or two minutes per ton, whichever is greater (7; 11). The latest allowable time is the latest that the resource can depart the reception system and still arrive at the destination by 2400 hours on the latest arrival date (LAD).

Minimum possible time to prepare an FRN--6 hours (7; 11).

Percentage of units with own transportation--50% (7).

Transit time from reception point to:
- Passenger staging--3 minutes (FS)
- Billeting at VOQ--10 minutes (FS)
- Billeting at Kittyhawk--12 minutes (FS)
- Billeting at Commercial Hotels--20 minutes (EST).

Earliest time an FRN may report to passenger staging--8 hours (7).

Waiting time after dispatching for bus transportation to reach the pick up point--Drawn from a triangular (0,10,15) (EST) distribution. The three parameters represent the shortest, most likely, and longest times. A bus may be atthe pickup point so there would be no waiting. Fifteen minutes is the longest it could take to arrive and ten minutes is the most likely.

Reception point inchecker processing time--Drawn from a triangular (15,30,60) distribution (7).

Transit time to passenger staging from:
- VOQ--13 minutes (FS)
- Kittyhawk--15 minutes (FS)
- Commercial Hotels--20 minutes (EST).

Processing time at passenger staging--Drawn from a triangular (30,45,60) distribution (7).

Transit time from passenger staging to the passenger terminal--2 minutes (FS).

Transit time from the mobility line to passenger staging--30 minutes (EST)

Processing time at the passenger terminal--30 seconds per passenger plus 10 minutes per FRN (7).

Percentage of aircraft parking spaces within walking distance of the passenger terminal--60% (7).

Transit time from the passenger terminal to the aircraft by walking--15 minutes (EST).

Transit time from the passenger terminal to the aircraft by bus--20 minutes (EST).

Cargo agent processing time per pallet--Drawn from a triangular (6,10,20) distribution (7).

Average weight of a vehicle--2.0 tons (EST)

Transit time to washrack from:
Reception point-3 minutes (FS)
Passenger staging--2 minutes (FS).

Percentage of vehicles that need washing--75% (1;7;11)

Processing time at washrack--Drawn from a triangular (10,15,30) distribution (7).

Transit time to vehicle processing from:
Reception point--2 minutes (FS)
Passenger staging--2 minutes (FS)
Washrack--2 minutes (FS).

Processing time at vehicle processing--Drawn from a triangular (10,15,20) distribution (7).

Transit time from processing to vehicle parking--3 minutes (FS).

Vehicle joint inspection time--Drawn from a triangular (10,15,20) distribution (7).

Percentage of vehicles that fail joint inspection--4% (7), 20% (1;11).

Percentage of failed vehicles failing joint inspection due to processing--25% (1;7;11).

Transit time from vehicle inspection to washrack--2 minutes (FS).

Transit time from vehicle inspection to processing--3 minutes (EST).

Transit time to palletizing area from reception point--3 minutes (FS).

Percentage of unit pallets that fail incheck inspection--50% (1; 11).

Percentage of unit pallets that fail joint inspection--4% (1; 7; 11).

Transit time to marshalling area from reception point--2 minutes (FS).

Time to inprocess non-unit cargo--Drawn from a triangular (5,7,15) distribution (7).

Time to unload a pallet from a truck--8 minutes (22).

Time to build/inspect a pallet--Drawn from a triangular (30,45,60) distribution (7; 11).

Transit time from palletizing area to marshalling--3 minutes (FS).

Time to load a pallet on a K-loader--Drawn from a triangular distribution (.6,1,3.) (7).

Average weight of a pallet--1.7 tons (22).

Transit time from marshalling area to frustrated cargo area--3 minutes (FS).

Processing time at frustrated cargo area--Drawn from a triangular (15,60,120) distribution (7).

Transit time from reception point to explosive cargo area--60 minutes (FS).

Time to unload a pallet of explosives cargo from a truck--Drawn from a triangular (10,12,15) distribution (7).

Time to palletize explosives--Drawn from a triangular (45,60,90) distribution (7).

Average weight of an explosive cargo pallet--4 tons (7).

ENDOGENOUS VARIABLES

Number of reception point incheckers--3 (7).

Number of reception point cargo agents--3 (7).

Number of non-unit cargo agents--4 (EST)

Number of passenger agents--9 (22).

Number of unloading crews--6, divided between cargo and explosives (22).

Time before departure that unit vehicles must be turned in for processing--6 hours (7).

Number of palletizing crews--26, divided between cargo and explosives (22).

Number of washracks--2 (11)

Number of forklifts--Unlimited, divided between marshalling area, explosive area, cargo terminal area, and palletizing crews (8;11).

Number of buses--23 (11).

Minimum time before departure to justify billeting--18 hours (1;11).

Number of beds available at:
VOQ--490 (11)
Kittyhawk--227 (11)
Commercial motels--705 (11).

Feeding capacity--4950 meals/shift (11).

Space at reception point--Unlimited (11).

Space at passenger terminal--2000 people (11).

Space at palletizing area--Unlimited (11).

Space at marshalling area--Unlimited (11).

Space at explosive processing/marshalling area--Unlimited (7).

Time before reception system departure to load pallets on a K-loader or move vehicles to the aircraft--1.0 hours (7)

STATUS VARIABLES

Status variables change as the system operates; their values are determined by the system. Such variables as numbers of people awaiting transportation, or cargo awaiting processing resources are indicators of system bottlenecks. These variables can be evaluated to improve effectiveness as measured by the criterion variable.

CRITERION VARIABLE

The criterion variable is the percentage of people, or the percentage of cargo, prepared on time for shipment. The minimum acceptable target value of this variable is determined by the system managers and compared to the simulation value to determine system effectiveness. For this thesis 95% of the cargo and 100% of the personnel prepared on-time were selected as minimum acceptable criterion values. These high values reflect the critical nature of force deployments during a crisis.

ASSUMPTIONS

Mobility/OPLAN operations and requirements take priority over all other base activity (1; 11).

All work centers will operate 24 hours per day, 7 days per week (22).

Cargo and personnel will arrive primarily by truck or bus (22).

Operations will occur in all types of weather (22).

All non-unit cargo will require palletization for air transport (10).

Load planning will be accomplished simultaneously with other reception activity and will be completed prior to departure from the reception system (7).

Sufficient K-loaders will be available to handle aircraft loading without inducing reception system delays.

MODEL TRANSLATION

Simulation Language for Alternative Modeling (SLAM) was selected for computerization of the reception model. Because the arrivals and departures during OPLAN execution must fall within not-earlier-than and not-later-than limits, these events must be scheduled. Once assets arrive, they must flow through a process of varying activity best represented by a network. SLAM's capability to combine network modeling with discrete event scheduling allows the required flexibility for this model (12:402-403). The subroutine options available with SLAM also provide additional programing flexibility and thus additional model realism (12:231).

For this study, the SLAM model consisted of a main program, event subroutines, user function subroutines, allocation subroutines, and the network. The main program allows the SLAM internal pointer arrays (NSET and QSET) to be dimensioned to entity attributes and anticipated network activity. Entity monitoring in this model requires nine attributes (eg. arrival time, departure time, amount of cargo, number of people, etc., associated with the FRN) for each entity traveling through the network. Each entity represents a FRN of people, or one pallet of cargo, or one piece of rolling stock. The SLAM program adds four internal attributes to each entity, so each modeled activity requires 13 memory locations in NSET and QSET. The ASD Cyber will accept AFIT batch jobs requiring up to 350,000 fields of core memory. The SLAM language and the model code required approximately 200,000 fields of memory. An analysis of TPFDD data indicated that during some periods the system may be processing between 4000 and 4500 simultaneous entities. NSET and QSET were dimensioned to 70,000 each, which allows up to 5000 simultaneous entities. With this dimensioning total core requirements are approximatly 335,000 fields.

The event subroutine initially reads the input data, establishes entity attributes, and builds the event file. During the simulation this subroutine monitors the scheduled events and sends them to the network at the appropriate time.

The network portion models the various reception activities calling on user functions to determine certain variable values (eg. drawing random samples from distributions). Allocation and event subroutines are also called to assign and free resources (eg. buses).

The original graphic model (Appendix C) evolved into a SLAM flowchart (Appendix D). From the SLAM flowchart, the simulation model was coded into the SLAM language (Appendix E). A list of variables and resources used in the model is included in the computer code (Appendix E) and explained in the User's Manual (Appendix I).

VALIDATION

A utilitarian model validation was accomplished in a three step (validate, verify, validate) process. Initial validation of the working model consisted of detailed briefings and discussions with mobility experts from transportation, mobility planning, and AFLC War Plans Divisions. After constructing the Integrated Computer-Aided Manufacturing Definition Method (IDEF) and SLAM flowchart models, as well as collecting values for the resources and variables mentioned above, step by step progress through the network was briefied to each of the above agencies. Each briefing included thorough discussions about the model assumptions, resource and variable values, and the network chain of events. Where initial errors were made, the model was adjusted to incorporate the correct value. General agreement was reached by all agencies that the model was an accurate representation of the present WPAFB mobility plan and the resources and variables noted were accurate estimates of available assets (1;7;10).

Model verification was achieved through the use of user generated input data, SLAM nodal tracing, and user written "debug" statements. User generated data were designed to exercise each path of the network and the output was analyzed to ensure the program's accuracy.

SLAM nodal tracing provided information showing the time of arrival and releases at each node along with selected entity attributes. Analysis of each node arrival and release assured that entities were flowing through the network properly.

The user written "debug" statements were employed to verify the Fortran code used in user functions, event, allocation, and output subroutines. The "debug" statements returned all the user function distribution values as well as other critical activity traces. All routines were verified to be working as intended. The user functions used SLAM routines to generate random numbers and Monte Carlo deviates. Since the Cyber random number generator and SLAM distribution subroutines have been previously evaluated for Goodness of Fit (2), the generated variables were not retested for distribution conformity. From these analyses we concluded the computer code was operating exactly as the model was designed.

Final validation was accomplished through a process very similar to inital validation. Base and MAJCOM level briefings and discussions were again conducted; however, the emphasis of these briefings was on model output rather than model mechanics. Various output from runs of the model were analyzed and questioned for accuracy in relation to "real world" mobility reception. The results of this analysis are more thoroughly covered in Chapter 4 and Volume II. All managers agreed that the model and its results were accurate representations of the WPAFB system and its expected capability (1;7;10).

STRATEGIC PLANNING

Shannon's 3-step development of the experimental design was used to accomplish the simulation experiment (13:151). The structural model (the ideal experiment) consists of 28 quantitative factors (essential resources) that could be examined at many different levels. The interaction of these factors determined the information desired from the model: the percentage of people prepared for deployment on-time, and the percentage of cargo prepared for deployment on time. Ideally the most accurate information about the reception system would be provided by varying each factor individually at many levels. However, computer time constraints limited the number of factors and levels actually examined. For example, if the reception model was run at only 2 levels for each factor, 2^{28}, or 268,435,000 separate cells or experiments would be required (13:155). Each cell requires a number of simulation repetitions for statistical confidence. For this model with hypothetical data, each simulation repetition required approximately 66 seconds of Cyber CPU execution time. This extremely large amount of computer time required greatly limited full factorial experimentation.

To overcome the large number of computer runs indicated by the structural model, the number of levels considered for each factor was reduced in the functional model. To develop the functional model the experiment began at one level for each factor. To fix the proper level for each factor expert estimates of resource availablity presented in the data section were used. The levels represent actual resources available, so they represent management's greatest concern.

An initial simulation of ten runs at the estimated levels for all resources was accomplished. The results of this simulation were then analyzed and bottlenecks (areas of insufficient resources) and excesses were discovered. The factors representing bottlenecks were then adjusted one factor at a time (with ten runs each) to allow for a One-way Analysis of Variance (ANOVA) grouping analysis to determine if changing a particular resource level significantly changed the criterion variable. The experimental model consisted of a randomized block design using the same arrivals and departure times for each block. All activitiy distributions were reseeded for each repetition.

The criterion variable for the simulation is the ratio of personnel or cargo prepared on-time over total personnel or cargo. Since the desired cargo criterion variable is 95% the associated distribution is highly skewed. With this degree of skewness, a normal distribution should not be assumed. For statistical analysis of the blocks, the Kruskal-Wallis nonparametric One-Way ANOVA with multiple comparisons for grouping was selected (5:175-192).

This single factor analysis approach allowed use of the model to evaluate current capability and identify areas of reception processing requiring additonal planning. The model also provided planners with expected changes in the percentages of personnel and cargo prepared on time as individual resources were varied.

TACTICAL PLANNING

Tactical planning considers data collection procedures to minimize variance and determination of repetitions required for statistical analysis and inference. The reduction of simulation induced variance focuses on eliminating start up transients. The criterion variable data for these simulations represent thirty days of activity so initial transient variance is insignificant. Also, for this model start up transients are part of the system and should not be eliminated since base reception will begin on day zero with no entities in the system.

The increased variablility in the early portion of the system operation actually adds realism to the model and can be considered the normal confusion associated with the system start up.

Determination of the proper number of runs for each simulation for statistical inference depends on the variance between runs, the nature of the distribution associated with the criterion variable, variable independence, and autocorrelation (13:187,194). The lack of correlation between runs and independence of the results are built into the experimental randomized block design and pose no obstacle for this analysis. The criterion variable is highly skewed so, a unimodal non-normal distribution is assumed. Since the distribution is assumed unimodal the Camp Meidal extension of Tchebycheff's theorem was invoked to determine the number of runs required to assure a given level of precision (13:189).

To conserve computer resources with this simulation the run repetitions were limited to ten. A sample simulation of ten runs with anticipated resources yielded a variance of 0.000228. The Camp Meidal k value for 95% confidence is 2.98. With these parameters, future simulations of ten repetitions are within .014 of the actual population mean with 95% confidence (13:189).

CHAPTER SUMMARY

Shannon's problem solving paradigm was applied to the APOE reception process at WPAFB. The system was defined, a model formulated and computerized, and data collected and validated. Furthermore, the model was verified and validated and planning for experimentation with the model was accomplished. The following chapter will describe the execution of the experiment, and the results.

CHAPTER 4

EXPERIMENTATION AND INTERPRETATION

This chapter details the experimentation and interpretation steps in the problem solving paradigm. After carefully developing the model of APC[illegible]tion, collecting accurate resource data, and planning the experimental design, computer execution of the simulation model was accomplished. The results of that experiment are discussed here. Statistical analysis of the results as well as sensitivity analysis of certain model parameters enabled accurate interpretation of those results and pointed out certain strengths and weaknesses of the reception system plan.

Since actual OPLAN input data (cargo type, quantity, personnel, timing, etc.) are classified, a data set resembling actual TPFDD information was created for model analysis (Appendix F). This data set is used for model demonstration and is not classified. Actual TPFDD data were also applied to the model and the results of that experiment are included in Volume II, which is classified SECRET.

EXPERIMENTATION

Initial experimentation began by applying the input hypothetical TPFDD data (Appendix F) to the reception model with estimated WPAFB resources. The purpose of this step was to evaluate estimated base capability and identify excesses and bottlenecks (Appendix G). Ten computer runs of the model generated average criterion values of 100% for passengers and 83.4% for cargo. Only the passenger portion of the system produced at acceptable levels. These runs revealed that a maximum of six buses were used out of 23 buses available. Furthermore, two activities, joint inspection teams and palletizing crews built up significant queues during the simulation (Appendix G, page 175).

From a planning viewpoint, reception managers could conserve resources by diverting excesses into more critical areas. For example, passenger resources may be used to expedite cargo handling. This action could increase cargo flow through the system and improve the on-time cargo percentage without reducing passenger on-time statistics. To facilitate planning, buses, joint inspection teams, and palletizing crews were further analyzed.

Buses were evaluated at four levels: five, four, three, and two buses. Passenger on-time percentages for five, four, and three buses remained at 100%. With two buses, the passenger on-time percentage fell to approximately 99%.

For the cargo network analysis, joint inspection teams and palletizing crews were individually evaluated. Joint inspection team levels included five, four, three, and two teams. Palletizing crew levels of 26, 22, 18, 14, and 10 crews were also evaluated. A full factor interactive evaluation for two factors at these levels would require $4^2 + 4$ or 20 separate simulations of ten repetitions each. Again to conserve computer resources, an incomplete exponential factor analysis consisting of eight simulations was performed and is summarized in Table 4-1.

Group	Joint Inspection Teams	Palletizing Crews	10 Run Average Ratio On Time
1	4	26	.9580
2	5	26	.9842
3	3	26	.8342
4	2	26	.1959
5	4	22	.9644
6	4	18	.9602
7	4	14	.9482
8	4	10	.9095

Table 4-1: CRITERION VARIABLE AVERAGES

In addition to the tests above, the reception model was evaluated for its sensitivity to errors in the estimates for: (1) the vehicular joint inspection failure rates for cargo reception and (2) the percentage of units that will arrive with and continue to use their own vehicles for transportation during passenger reception. Vehicular joint inspection failure rate was selected for this analysis because of varying expert estimates for its value. Transportation experts (7;8) estimated a 4% failure rate, while mobility planners (1;11) estimated failure rates up to 20%. Organic transporation was considered for sensitivity because during adverse weather units may need to turn vehicles into washing early which would increase demand for base transportaion. For the sensitivity analysis the vehicle failure rate was adjusted from 4% to 15% and the percentage of units with organic transportation was adjusted from 50% to 40%. This system was evaluated with the resource levels of 3 buses, 4 joint inspection teams, and 18 palletizing teams. The criterion variable for these ten runs dropped from 96.02% to 50.82% for cargo and from 100% to 99.89% for personnel.

Model experimentation showed that with this hypothetical input data, WPAFB APOE managers can be confident that 100% of the personnel transiting their system will be prepared on-time. For a 95% cargo on-time rate, however, cargo resources must be adjusted.

INTERPRETATION

Statistical and comparative interpretation of the simulation results was accomplished to determine acceptable joint inspection team and palletizing crew levels. Kruskal-Wallis nonparametric procedures for grouping (Appendix H) were employed to determine if the evaluated resource groupings resulted in significantly different criterion values. Since nonparametric tests measure only sample relationships rather than the magnitude of the distance between samples, the average criterion values were also compared with the desired system performance. This analysis approach considered both statistical grouping and the objective percentage of cargo prepared on-time.

The Kruskal-Wallis test and group composition are recorded in Appendix H. This test showed a significant difference between Group 1 and Group 3 which contain four and three joint inspection teams respectively, but not between Group 1 and Group 2 which contain four and five teams each. With 26 palletizing crews, the criterion variable average for three joint inspection teams was below 95%, while four and five teams produced values above 95%. The nonparametric grouping and criterion variable value eliminate the three palletizing team group as an acceptable solution. Since with 26 palletizing crews there is no statistically significant difference between four or five teams, economically, the better selection is four teams.

The selection of the proper number of palletizing crews was not as clear cut. Statistically, with 4 joint inspection teams there was no significant difference between using 26, 22, 18, 14, or 10 palletizing crews (Appendix H). Considering only this nonparametric grouping analysis 10 palletizing crews would be an acceptable solution.

The average on-time ratios differ from .9095 with 10 crews to .9644 with 22 crews. These values indicated that 18 palletizing crews with a .9602 average value were the minimum number of crews that could produce an acceptable 95% criterion variable. Without an analysis of the simulation criterion variable variance and associated statistical confidence level, 18 palletizng crews with 4 joint inspection teams represents an acceptable choice to satisfy the desired on-time criterion with minimum resources.

The simulation criterion value variance was calculated in the tactical planning section. This calculation showed that with 95% confidence the 10 run average could vary up to .014 from the true population mean. If the manager requires 95% confidence of a .95 on-time ratio, the simulation resource levels must produce at least a .9500 + .0140 or .9640 criterion value. Four joint inspection teams with 22 palletizing crews are the minimum resource levels to produce an average crierion value over .9640. From this experiment, planners can determine with 95% confidence that 4 joint inspection teams combined with 22 palletizing crews will provide satisfactory system performance.

To obtain the optimum solution the full factorial analysis should be completed to determine all acceptable solutions. For example, 5 joint inspection teams with 18 palletizing crews may also provide satisfactory performance. From the set of acceptable solutions management can evaluate the cost of each resource and choose the optimum combination.

The cargo results of the sensitivity analysis were included in the ANOVA grouping analysis which confirmed that the sensitivity group (Group 9) differed significantly from the comparison group (Group 6). The model is sensitive to variablility in the percentage of vehicles that fail joint inspection. When the failure rate was increased from 4% to 15% the on-time percentage dropped over 45%. The true value of this failure rate requires more study and evaluation to reduce the disagreement between transportation and mobility experts. The inspection failure rate should be monitored during an actual joint mobilization, especially if the percentage of cargo prepared on-time drops below an acceptable level. Adjustments in inspection techniques or criteria could reduce the failure rate and significantly improve the percentage of cargo departing on-time.

The sensitivity analysis of the passenger network indicated a criterion variable drop from 100% to 99.89%. This slight drop indicates passenger preparation is not sensitive to changing levels of organic tranportation.

After determining optimum resource levels, additional sizing information can be extracted from the SLAM summary report (Appendix G). For example, at optimum resource levels, the maximum number of pallets in the marshalling area at any one time was 835. Using the recommended pallet storing layout for open storage (19:p2-43,44) these pallets require approximately 125-square feet of space each, or 104,375-square feet total. With 266,700-square feet of pallet storage space available at WPAFB, adequate storage was provided (7). Similarly, the maximum vehicle storage space, explosive cargo marshalling space, unloading, and processing area space requirements can be determined.

Space requirements can be further evaluated by considering the amount of paved space available. Unpaved space for marshalling and processing will probably result in a requirement for more vehilcle washing and more inspection failures of vehicles. As shown before, vehicle inspection failures can severely lower the percentage of cargo prepared on-time. Furthermore, rain or snow will soften unpaved storage surfaces and may render forklifts useless due to mud or ice. The effects of these conditions could be estimated using this model, and plans for such contingencies can be developed. For example, PSP can be laid along forklift aisles and loaded pallets could be set on wooden warehouse pallets. If APOE managers know that unpaved marshalling will be used (by using the reception simulation) they can ensure adequate materials are on hand and additional washracks are provided in case of rain or snow.

Billeting requirements can also be determined. For these data, base facilities and contract quarters within ten miles of WPAFB were sufficient to billet all transient personnel. However, if these resource levels had been exceeded, the simulation would indicate the overages, so that planners could take steps to minimize the impact. The use of tents and related equipment such as cots, latrines, and communications networks could be thoroughly planned in advance. Another option would be for reception managers to schedule the arrival of FRNs with large numbers of personnel to ensure that billeting was not required; or spread the arrival times out so that other FRNs vacate quarters before large FRNs arrive.

At the request of WPAFB base mobility planners, the ability to determine box lunch requirements was added to the model. Planners estimated that each departing person would require a box lunch while in passenger staging as well as one lunch upon departure from the passenger terminal to eat during the flight (11). Feeding requirements prior to passenger staging are met in the billeting portion of the model. The box lunch per hour requirements generated with simulated data showed that base capability was adequate.

Workloads for other base agencies can also be estimated from the model. The days with large amounts of cargo and/or personnel arriving can be determined and adequate security police service can be arranged. Similarly, the quantity of cargo departing each day can indicate the number of aircraft arrivals and departures at WPAFB. This information could be used by both air traffic control personnel and base aircraft maintenance personnel in planning parking, fuel, spare parts, and manpower requirements. Proper maintenance planning would include analysis of malfunctions on incoming aircraft and pre-stocking of anticipated parts requiements, as well as ensuring that the proper types of ground servicing equipment is available.

LIMITATIONS

Certain model limitations were observed during the evaluation of the results. The major area that limits the model is the lack of an effective method to plan actual aircraft loads of people and cargo. While movement tables estimate this factor, varying aircraft configurations adversely affect current planning (7;11). For example Civil Reserve Air Fleet (CRAF) aircraft which will accomplish much of the personnel strategic airlift, possess different capacities depending on the type of aircraft as well as the airline from which the aircraft came (17). Furthermore, it is probable that some airplanes will arrive improperly configured (eg. passenger seats in an airplane designated to carry cargo). In this situation, the aircraft may be loaded with passengers rather than cargo to save the time required for reconfiguration. Passengers departing early and cargo departing later than expected could affect the flow of assets through the reception system by causing back-ups in the passenger terminal or the marshalling area. Additionally, without specific load planning, the equipment required to load the aircraft may be limited which would cause additional backups. Without accurate estimates of the plane loads of cargo, modeling K-loader operations, a potentially critical resource, is impossible.

The solution to this problem lies in the accurate estimation of which pallets, or groups of passengers will travel on which airplanes. Until these estimates are available, the limitation of evaluating the system in terms of individual FRNs or pallets instead of plane loads of cargo or personnel will exist.

Another major limitation of current planning is the omission of retrograde cargo and returning personnel (10). Storage and handling requirements of cargo returning from the conflict area will require space, facilities, personnel, and equipment resources. Returning non-combatants and wounded personnel will also use resources in competition with the deployment operation. Without estimates of this additional workload (10) the impact on the reception system is unknown. Depending on the number of U.S. non-combatants in the crisis area, this additional workload could also severely hinder the deployment effort.

CHAPTER SUMMARY

Experimentation with the computerized base reception model was accomplished using simulated TPFDD data. The results of this experiment were analyzed statistically to determine the optimum resource levels. The model was also tested for system sensitivity to changing parameters. The combination of estimated base resources did not meet the requirments of the cargo criterion variable. Acceptable performance in the modeled system was achieved by reducing the buses required to 3, increasing joint inspection teams to 4, and decreasing the palletizing crews to 22. Additional information about maximum workloads for box lunch preparation, billeting, and space requirements was extracted from the model and its planning value discussed. The limitations to the model were also identified and their impact on the model results was explained.

A similar experiment and interpertation was accomplished using actual TPFDD warplan data. Description and analysis of that experiment is presented in Volume II which is classified, SECRET.

CHAPTER 5

IMPLEMENTATION AND RECOMMENDATIONS

Answering the research questions and meeting the objective described in Chapter 1 is only the first phase of model implementation. Management must be informed of the simulation results so that they can incorporate this information into the decison process. Finally, the users should constantly attempt to improve the model to obtain the most meaningful results. This chapter reviews the research questions and objective, summarizes user and management level briefings, and proposes recommendations to further improve the model.

RESEARCH QUESTIONS

The research questions from Chapter 1 provide a framework for the conclusions drawn from this effort.

What are the critical factors representing the reception process?

The critical resources were fully ascertained through detailed interviews with MAJCOM and base level planners and evaluators. These experts verified that all the major factors of the reception system were considered and included in the model. With the hypothetical TPFDD, joint inspection teams and palletizing crews were the most critical factors.

<u>What are the duration distributions associated with reception activities?</u>

Activity durations were determined through a process that integrated field study results with expert estimates and documented values. To aid model application to different APOEs, durations which were base specific were expressed by average values. Those factors that were not base specific (eg. palletizing and other general processing times) were expressed as distributions. These distributions account for the variability inherent in these processes and added realism to the model. The parameters of these distributions were again gained from expert estimates and documented planning factors.

<u>What technique will best validate the reception model?</u>

Real world validation of this type of model is impossible, so the authors employed a utilitarian validation technique used by the simulation experts at Headquarters Military Airlift Command (15). This technique involved developing model logic, and experimentation with the model paramenters. The model structure, and simulation results were evaluated by MAJCOM and base level reception technicians and managers to ensure an accurate appraisal. All evaluators accepted this model as an accurate representation of the actual reception system. Acceptance by the most knowledgable managers in the mobility/reception field is strong evidence that the model is valid. Furthermore, WPAFB managers are using the simulation results to aid their planning process (1;7).

Does the simulation identify critical shortages?

The reception model output, through queuing and resource utilization summaries, clearly indentified critical shortages in existing plans and produced resolution of those deficiencies through simulation experimentation. These shortages are best observed in Volume II where the synergistic effects of insufficient resources are most dramatically demonstrated.

CONCLUSION

In answering these research questions the research objective was fully met. The model provides managers with an effective planning tool that integrates OPLAN movement data with reception processing requirements. The computer simulation provides validated estimates of time-phased workloads that can be used in planning APOE reception systems as well as allowing experimentation to determine optimum resource levels. Peak workload information may also be applied to related base service functions (eg. security police and transient maintenance personnel) to ensure adequate resources in those areas.

A User's Manual provides model application and modification instructions. With these instructions, planners can easily adapt the model to different APOEs or varying system conditions.

IMPLEMENTATION

The model was developed in conjunction with base level mobility planners (1;7). They have accepted the final simulation results (Volume II) as accurate and are using these results for sizing estimates. The WPAFB senior management (Wing Commander and Crisis Action Team Members) were briefed on the simulation findings to promote base level interagency implementation coordination. The model and Volume II results were presented to the Headquarters AFLC mobility planning staff to demonstrate model applicability of other AFLC APOEs. Headquarters USAF/LE was briefed for model application to APOEs throughout the U.S. Air Force. Finally, the model and Volume II results were presented to the Forecasting and Planning working group at the 1983 Military Operations Research Society symposium to promote incorporation of this model into other simulation research efforts.

RECOMMENDATIONS

Recommendations for the application of this research fall into three categories: model use, model improvement, and model incorporation.

MODEL USE

The model should be used at base level and by MAJCOMs to evaluate current reception plans and base capability. Shortage areas identified by the model should be fully evaluated and plans should be altered to eliminate those deficiencies. In order to fully exploit the many facets of this model, a qualified individual holding an advanced degree in Logistics Management from AFIT should be assigned to each APOE. This would ensure adequate consideration of the many logistics issues involved in the reception process. APOE bases that do not have the ability to run this computer model should procure that ability or coordinate with other commands that can process SLAM programs.

MODEL IMPROVEMENT

The model should be improved by constant review of model parameters, by obtaining accurate estimates of plane loads of cargo and personnel, and by developing accurate estimates of retrograde cargo and returning personnel. As palletizing techniques or other processes are improved or changed, parameters must be adjusted to reflect the actual values. The dynamic nature of base reception and its many aspects requires continuing model update.

More detailed planning should be accomplished to provide APOE managers accurate estimates of outbound plane load capacities and schedules so that cargo and personnel processing can be evaluated in terms of plane loads. This would allow a more accurate computation of cargo and personnel departing the base on time. It would also allow for modeling of the aircraft loading function. Actual aircraft scheduling and loading will affect the amount of cargo and personnel actually departing the APOE on time. These improvements to the reception model would make it a more realistic and effective planning tool.

Returning cargo and personnel, which will place demands on the reception system should also be studied. The effect of retrograde cargo and personnel would be minimal for OPLANs concerned with such areas as Southwest Asia. However, a conflict in Europe would create a flood of non-combatants to the U.S. that could cripple the mobility effort. Evacuation plans for non-combatants and casualty estimates for various areas could be used as a basis for this evaluation. Once the amount of returning cargo and personnel is estimated, destinations could be predicted and APOE managers could plan for this additional workload. Once the estimates are made, these factors could be added to the computer model to test their effect.

on the system

MODEL INCORPORATION

The reception model should be incorporated into other computer planning models, (specifically MAC's M-14) to add realism and accuracy to larger scale planning tools. The MAC M-14 model simulates the worldwide strategic airlift system and includes aircraft scheduling, maintenance, loading, turn-around times and flight times. MAC presently uses average times for the reception process in the M-14 and assumes that 100% of the cargo will be prepared on time (15). The addition of this model to the M-14 would enable evaluation of the MAC system's response to cargo and personnel not prepared on-time. These delays will affect the flow of personnel and equipment to meet OPLAN requirements. Incorporation of the reception model into the M-14 would add the realism of varying cargo and personnel processing and thus enhance the accuracy of the M-14 strategic model. The SLAM reception model will be compatable with the M-14 which is being translated from the GASP IV computer language to SLAM (9), and its incorporation into the M-14 should be relatively easy.

CHAPTER SUMMARY

The original research questions were reviewed and briefly answered. The researchers concluded that all the questions were answered and the original research objective was fully satisfied. Base level, MAJCOM and service level managers were briefed to encourage implementation of the experimental findings. Recommendations for model use, improvement, and incorporation were suggested.

APPENDICES

APPENDIX A

ACRONYMS

ADP	Automatic Data Processing
ALC	Air Logistics Center
ANOVA	Analysis of Variance
APOE	Aerial Port of Embarkation
CONUS	Continental United States
CRAF	Civil Reserve Air Fleet
EAD	Earliest Arrival Day
FRN	Force Requirement Number
JCS	Joint Chiefs of Staff
JDA	Joint Deployment Agency
JOPS	Joint Operations Planning System
JSPS	Joint Strategic Planning System
LAD	Latest Arrival Day
MAC	Military Airlift Command
MAJCOM	Major Command
MCC	Mobility Control Center
MTMC	Military Traffic Management Command
OPLAN	Operation Plan
POD	Port of Debarkation
POE	Port of Embarkation
SLAM	Simulation Language for Alternative Modeling
TPFDL	Time-Phased Force Deployment List
TPTRL	Time-Phased Transportation Requirements List
TTFDD	Time-Phased Force Deployment Data
TUCHA	Time Unit Characterisitcs

WIN	WWMCCS Integrated Network
WMP	USAF War and Mobilization Plan
WPAFB	Wright-Patterson Air Force Base
WWMCCS	Worldwide Military Command and Control System
UTC	Unit Type Code

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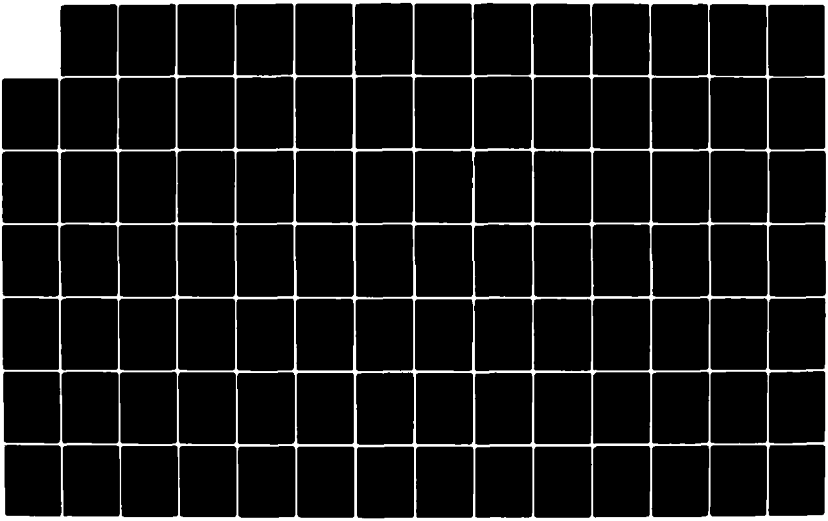

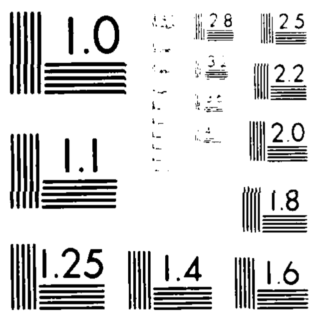
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APPENDIX B

WARPLAN DEVELOPMENT

DoD warplans reflect national command authority guidance as indicated by the Joint Strategic Planning System (JSPS). The JSPS contains a series of long range strategic plans (fifteen year or longer projections) developed at the Joint Chiefs of Staff (JCS) level. These strategic plans assess current and projected world conditions and task the theater unified commanders to develop specific plans to support the interests of the United States.

The theater unified commander analyzes specific contingencies and prepares necessary estimates, develops a concept of operations, and tasks the Service component commanders to develop supporting plans. When the JCS approves the basic plan, all tasked agencies prepare supporting operation plans (OPLANs). Supporting Air Force major commands (MAJCOMs) will submit their OPLANs to the theater Air Force component command having primary planning responsibility (20:31).

The JCS recognized the overwhelming difficulty in coordinating Service plans in support of joint military operations; so, in 1970 they approved the Joint Operations Planning System (JOPS). JOPS guidance consists of four volumes which consolidate policies and procedures for the development, review, and approval of joint plans. The JOPS provides an automatic data processing (ADP) support system which serves as a consolidated planning data source. The objective of JOPS is the timely development of adequate, suitable, and feasible operation plans (20:15).

USAF MAJCOMs must use the USAF War and Mobilization Plan (WMP) for current Air Force policies and planning factors for the conduct and support of wartime operations. The WMP also establishes requirements for developing mobilization and production plans to support sustained contingency operations, as well as specific planning functions necessary to match facilities, manpower, and material with planned wartime activities (20:19).

Detailed Air Force planning begins with a projected inventory position with respect to units, aircraft, missiles, personnel and installations. The projectd inventory positon estimates Air Force assets by unit type code (UTC). A unit type code package represents a certain capability, such as an airlift squadron. Each UTC has a specific defined mission capability. Planners identify force requirements and available assets by UTC rather than by specific military organizations.

JOPS III provides the standard data files, format, and application programs for force planning (20:34). The JOPS III application programs analyze the force projections to determine unit related resources, and non-unit related cargo and personnel requirements as well as an initial transportation feasibility estimate. Unit related resources include equipment or accompanying supplies and personnel identified with a specific UTC. Equipment and personnel not identified with a specific UTC, primarily replacement resources and spares, deploy as non-unit related resources (16:x). The product of the JOPS III effort is the Time-Phased Force Deployment Data (TPFDD).

The TPFDD consists of two data files, the Time-Phased Force Deployment List (TPFDL) and the Time-Phased Transportation Requirements List (TPTRL). The TPFDL lists the type of units to support an OPLAN, and data concerning their routing from origin to destination. The TPTRL lists force movement characteristics, non-unit related cargo characteristics and routing, and non-unit related personnel data (20:36). The specific TPFDD information includes types of forces required, Type Unit Characteristics (TUCHA) movement data, proposed routing information, proposed origin, proposed ready to load date at origin, earliest and latest arrival at the Port of Debarkation (POD), desired POD, required delivery date at destination, non-unit records, non-unit routing data, and providing organization (16:p.4-2). The Joint Deployment Agency (JDA) is responisble for maintaing the TPFDD. Planners have access to the TPFDD through the Worldwide Military Command and Control System (WWMCCS).

MAJCOMs must evaluate their capability to support the TPDFL force requirements and report deficiencies to the JCS

(20:41). The Military Airlift Command (MAC) and the Military Traffic Management Command (MTMC) must assess lift support capabilities and align lift resources with TPFDD requirements (20:41). They prepare lift restricted movement tables which provide information concerning the scheduled movement to the POE, intermediate locations, POD, and destination. Additional information includes transportaion mode and source, tons of cargo, number of personnel, and arrival dates and location for each required movement (20:256). The JDA monitors CONUS movements and intertheater deployments involving common-user lift, and maintains the MAC and MTMC movement tables (16:p.2-2).

Transportation planning is a significant factor in the development of the final plan for any operation. Transportation planning should indicate the concepts for movement and reception of all forces, identify facilities to be used in the reception of forces, and identify limiting factors which could adversely affect mobility operations. Total movement requirements to include combat and support unit strategic deployment, deployment of replacement and filler personnel, filler shortages of prepositioned war reserve stock, items of equipment required by theater in-place units to make them combat effective, resupply, and movement of retrograde cargo must be considered (20:186). The transportation plan as reflected in the movement tables should consider all the forces and supplies needed by the OPLAN, and show how these resources will be routed through the various ports of embarkation to reach the destination.

APPENDIX C

GRAPHIC MODEL

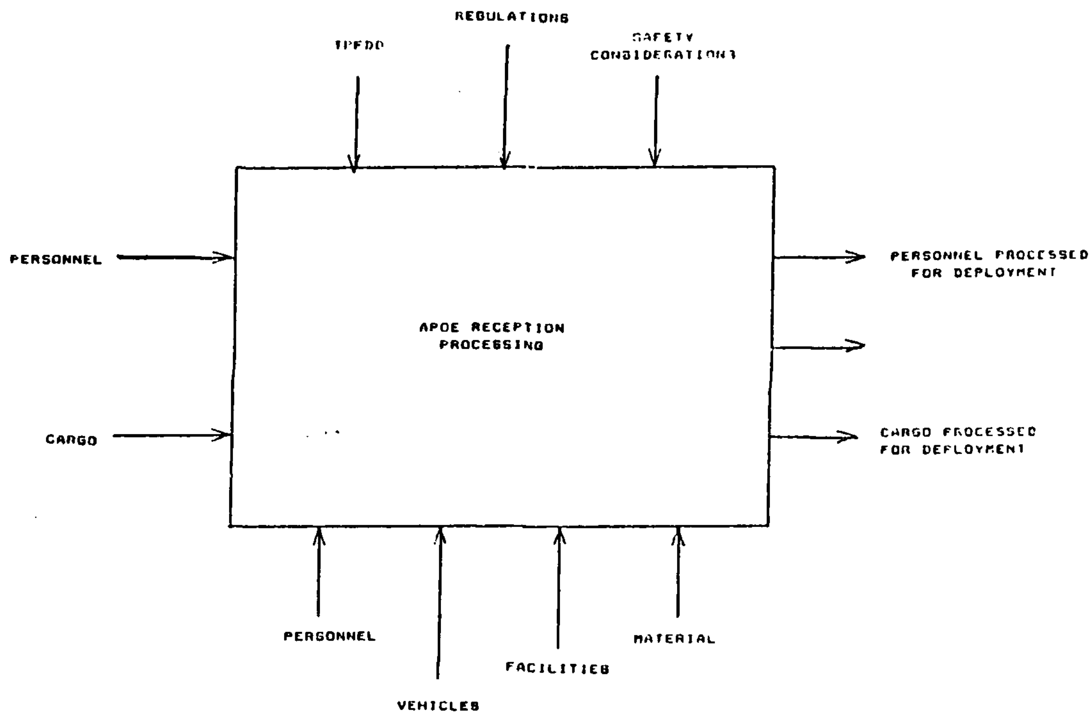

FIGURE C-1: APOE RECEPTION PROCESSING

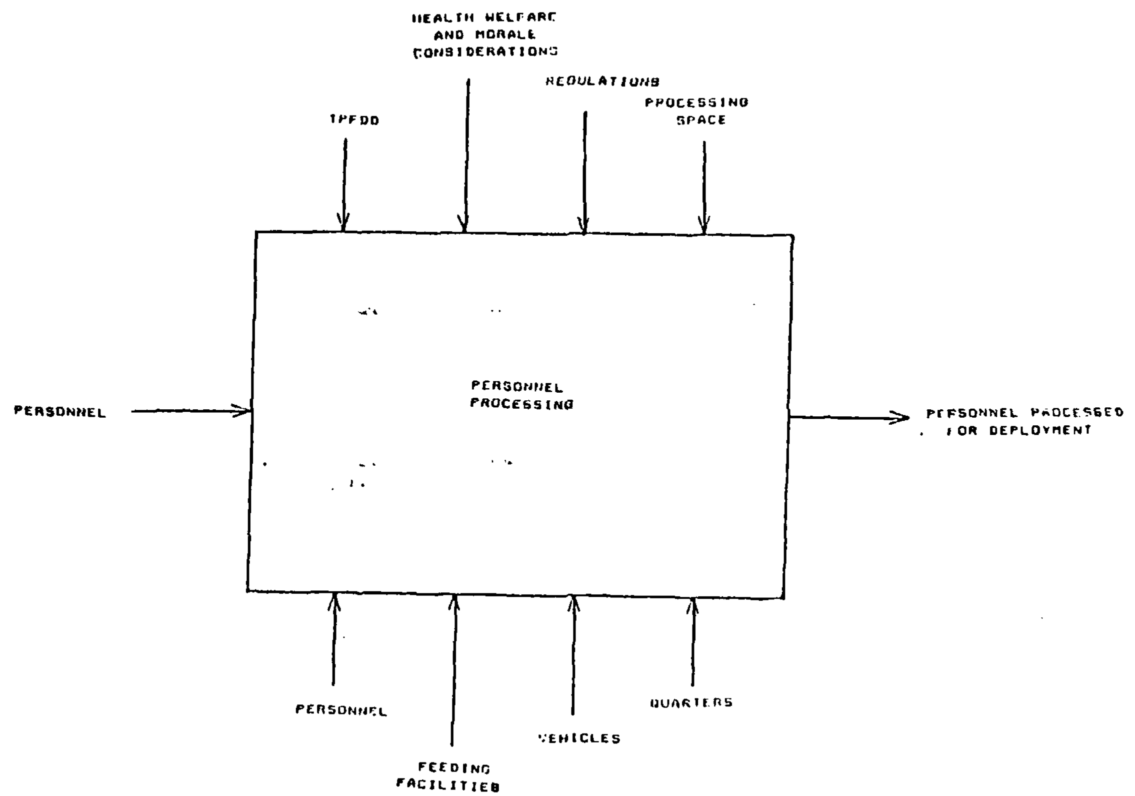

FIGURE C-2: PERSONNEL RECEPTION

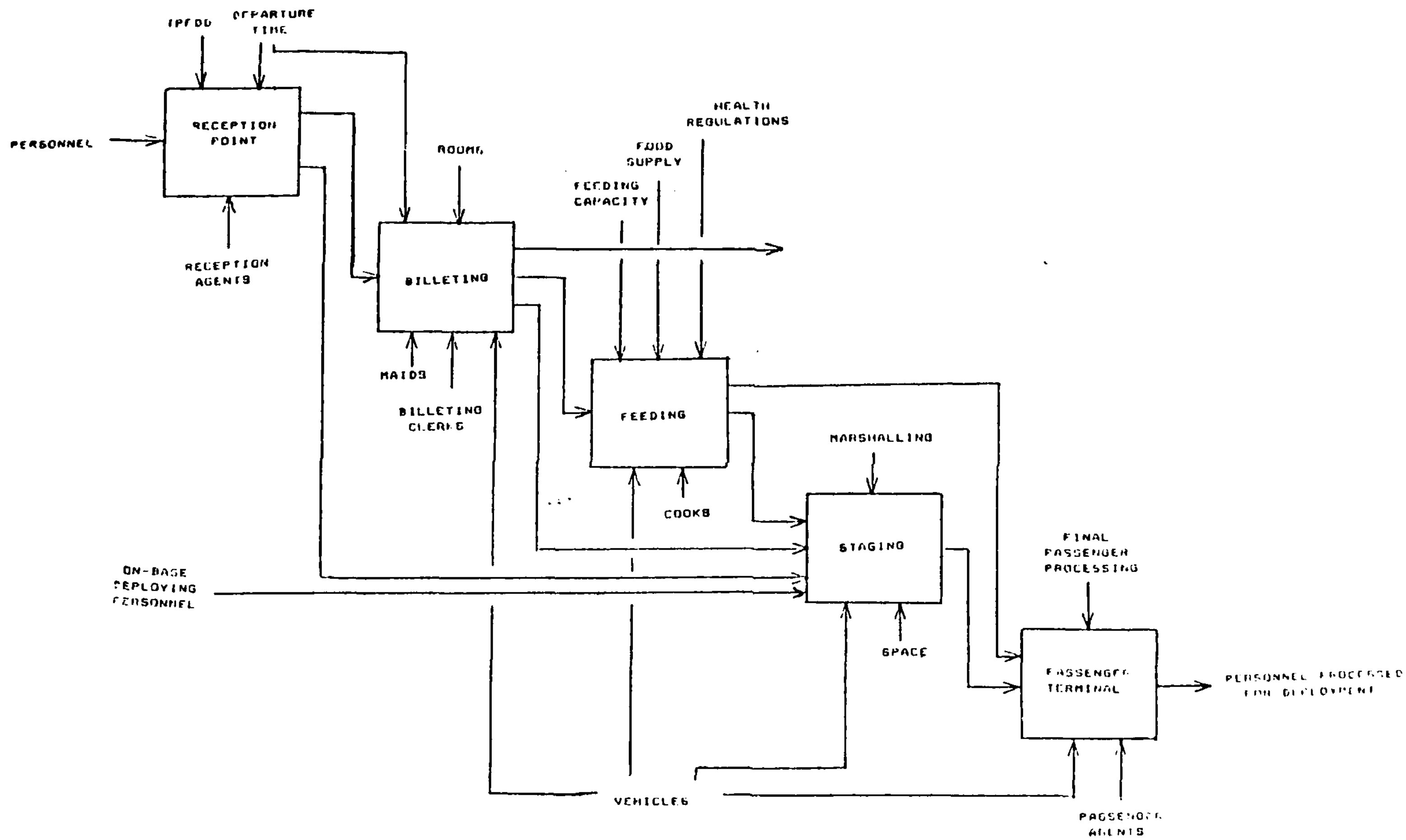

FIGURE C-3: PERSONNEL PROCESSING

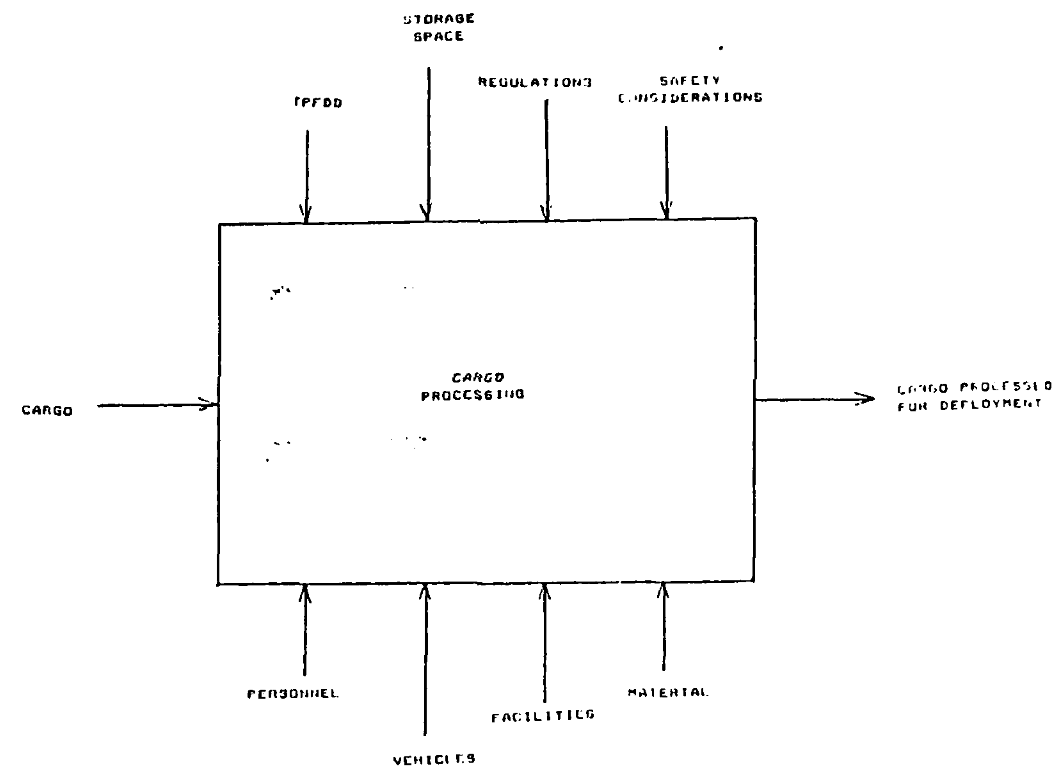

FIGURE C-4: CARGO RECEPTION

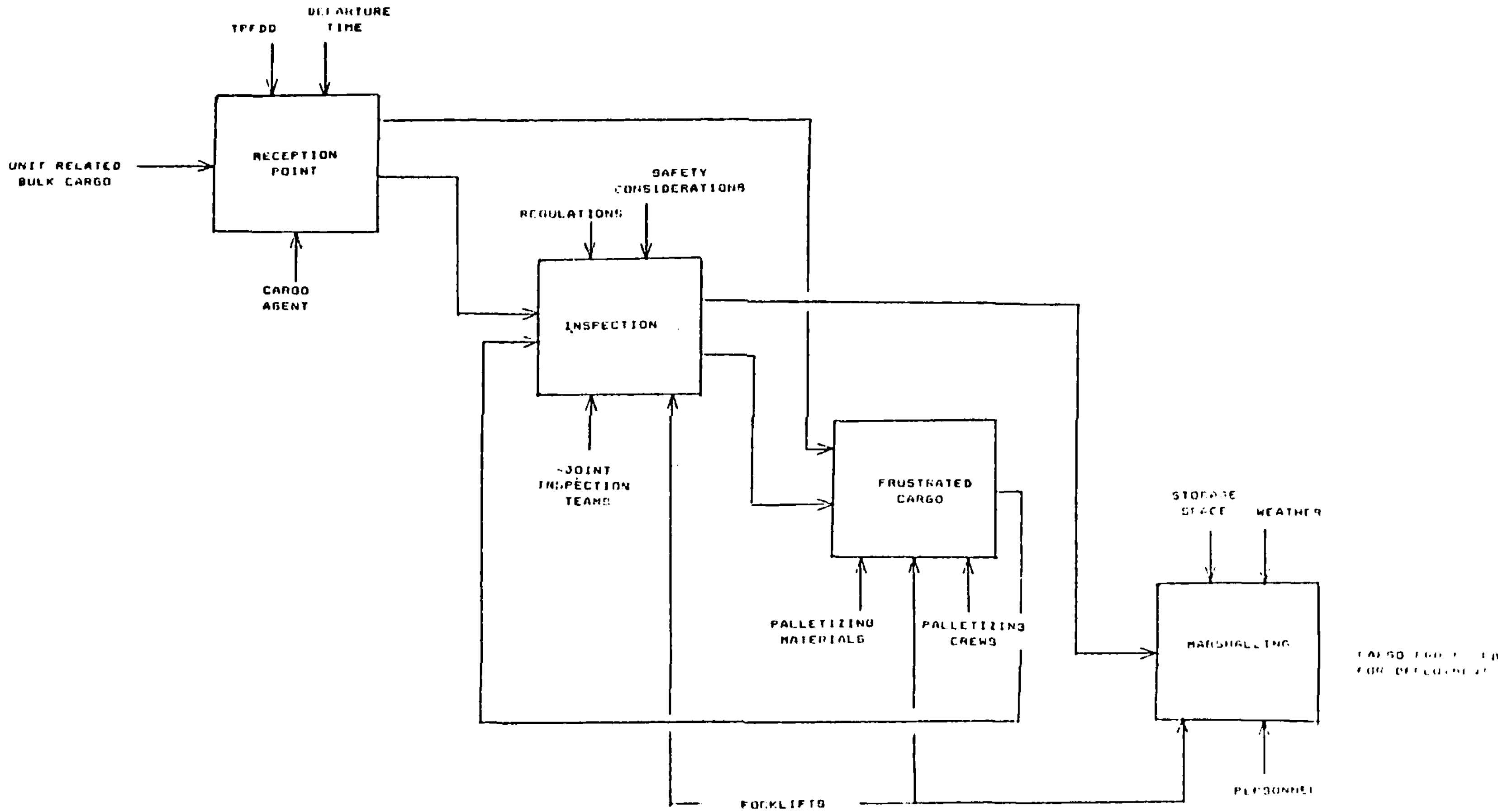

FIGURE C-5: UNIT RELATED CARGO PROCESSING

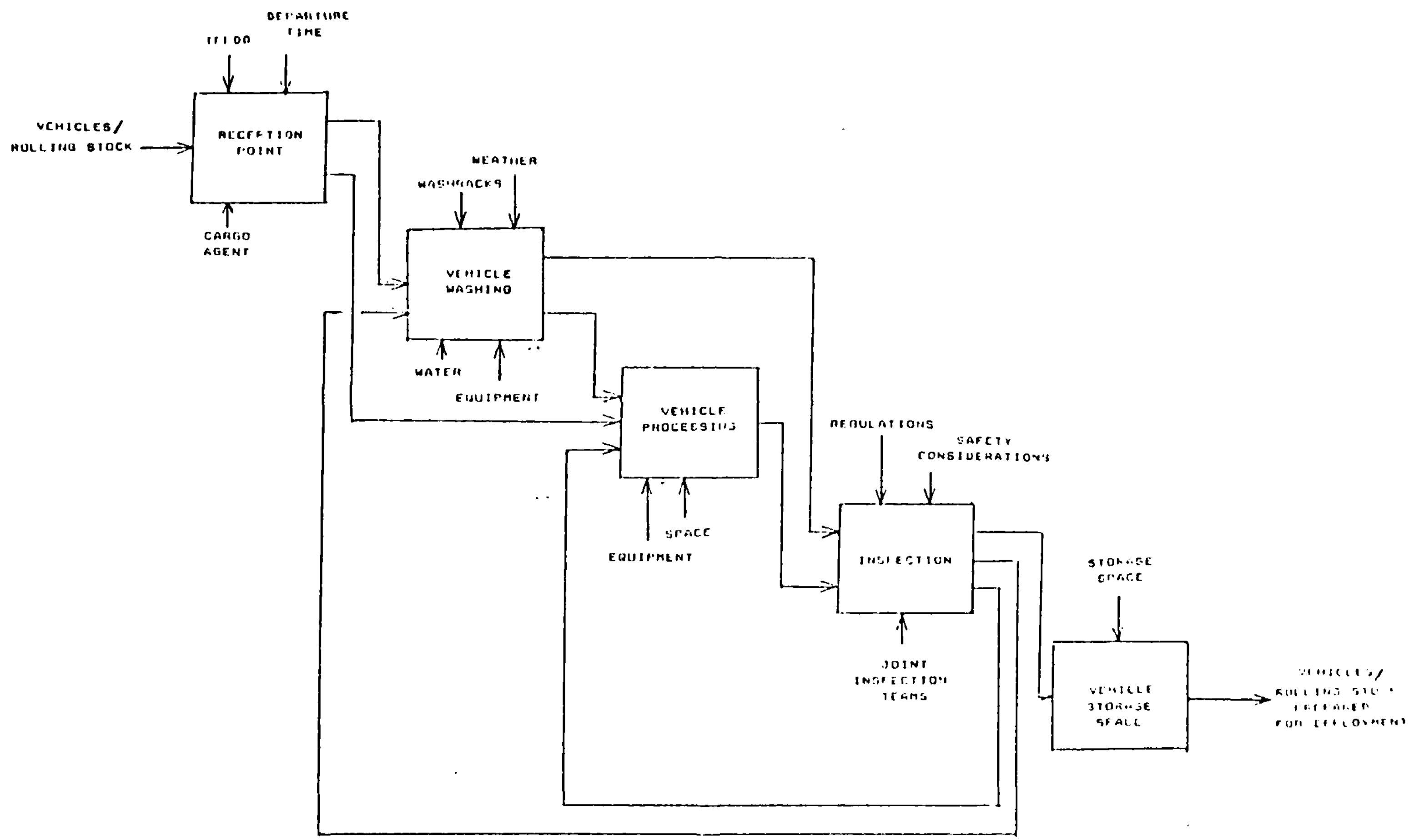

FIGURE C-6: VEHICLE FROCESSING

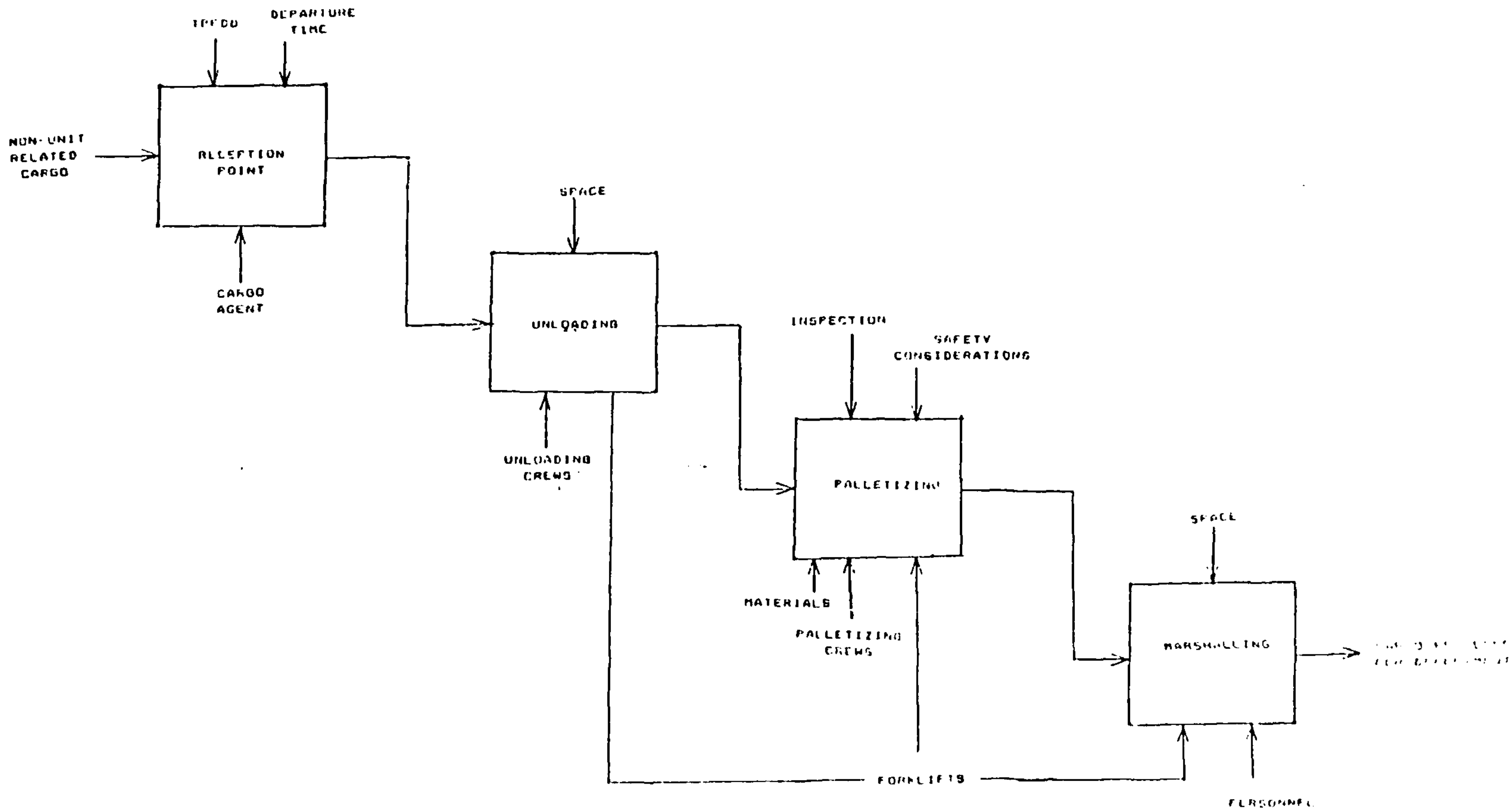

FIGURE C-7: NON-UNIT RELATED CARGO PROCESSING

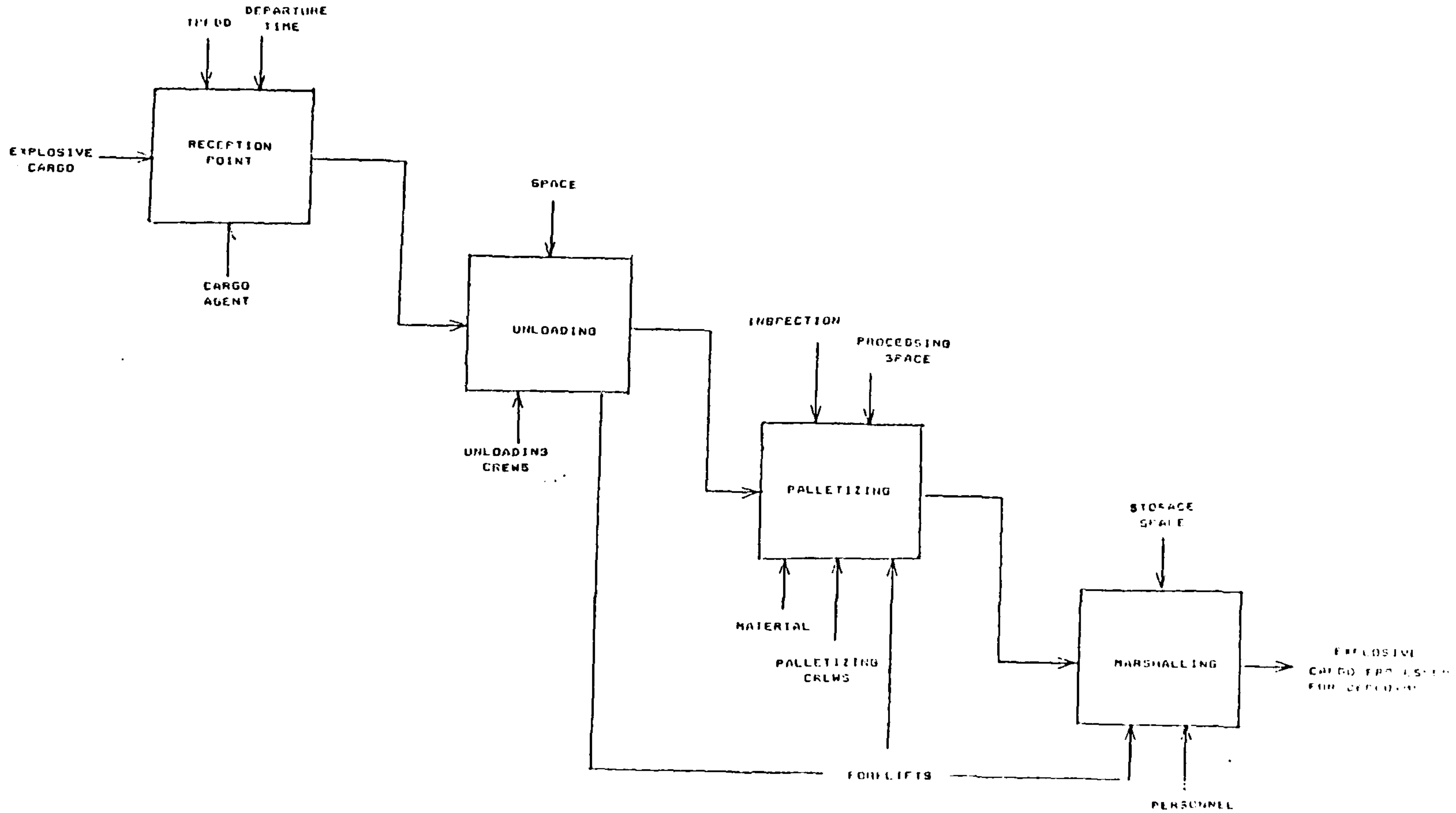

FIGURE C-8: EXPLOSIVE CARGO PROCESSING

APPENDIX D

SLAM NETWORK FLOWCHART

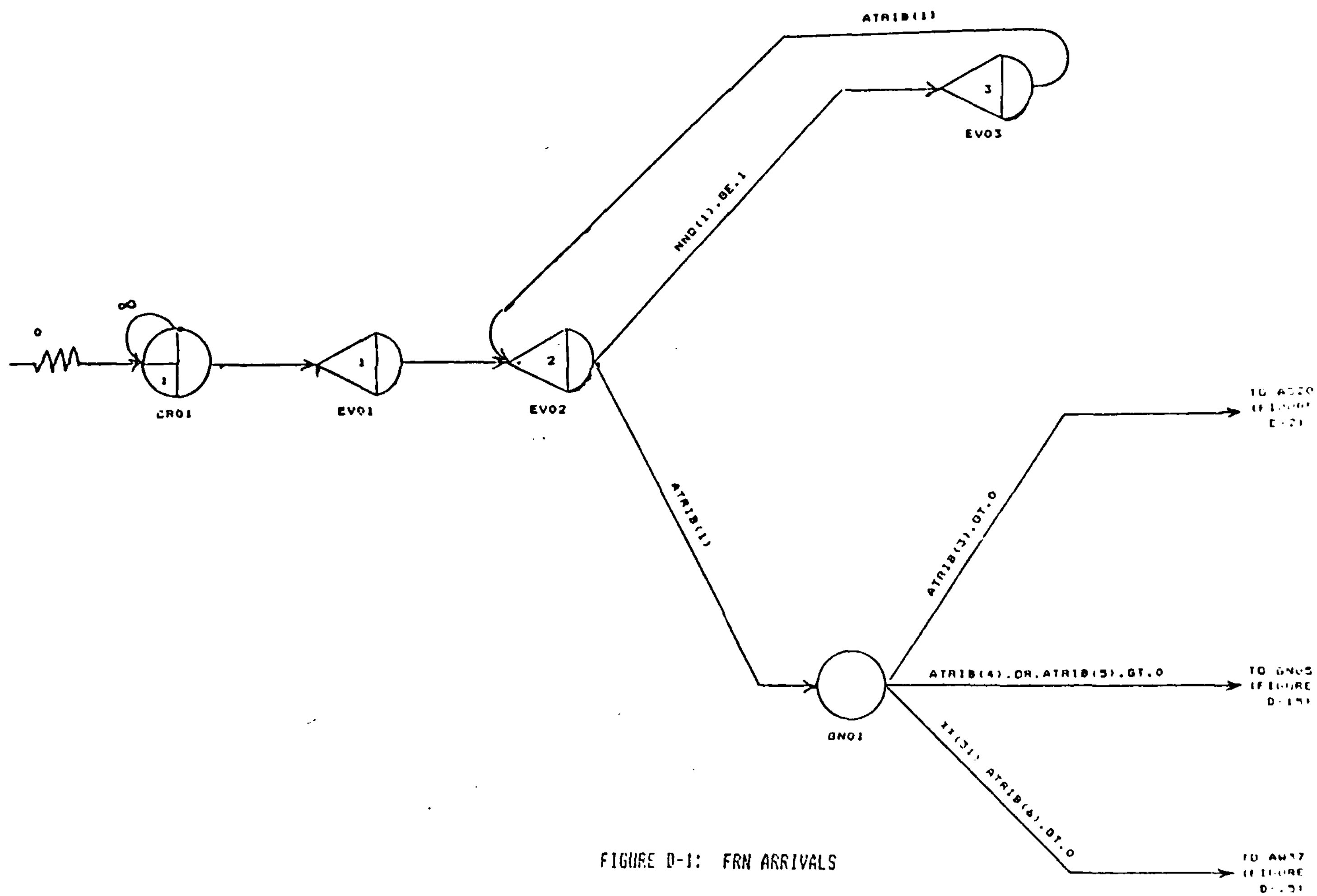

FIGURE D-1: FRN ARRIVALS

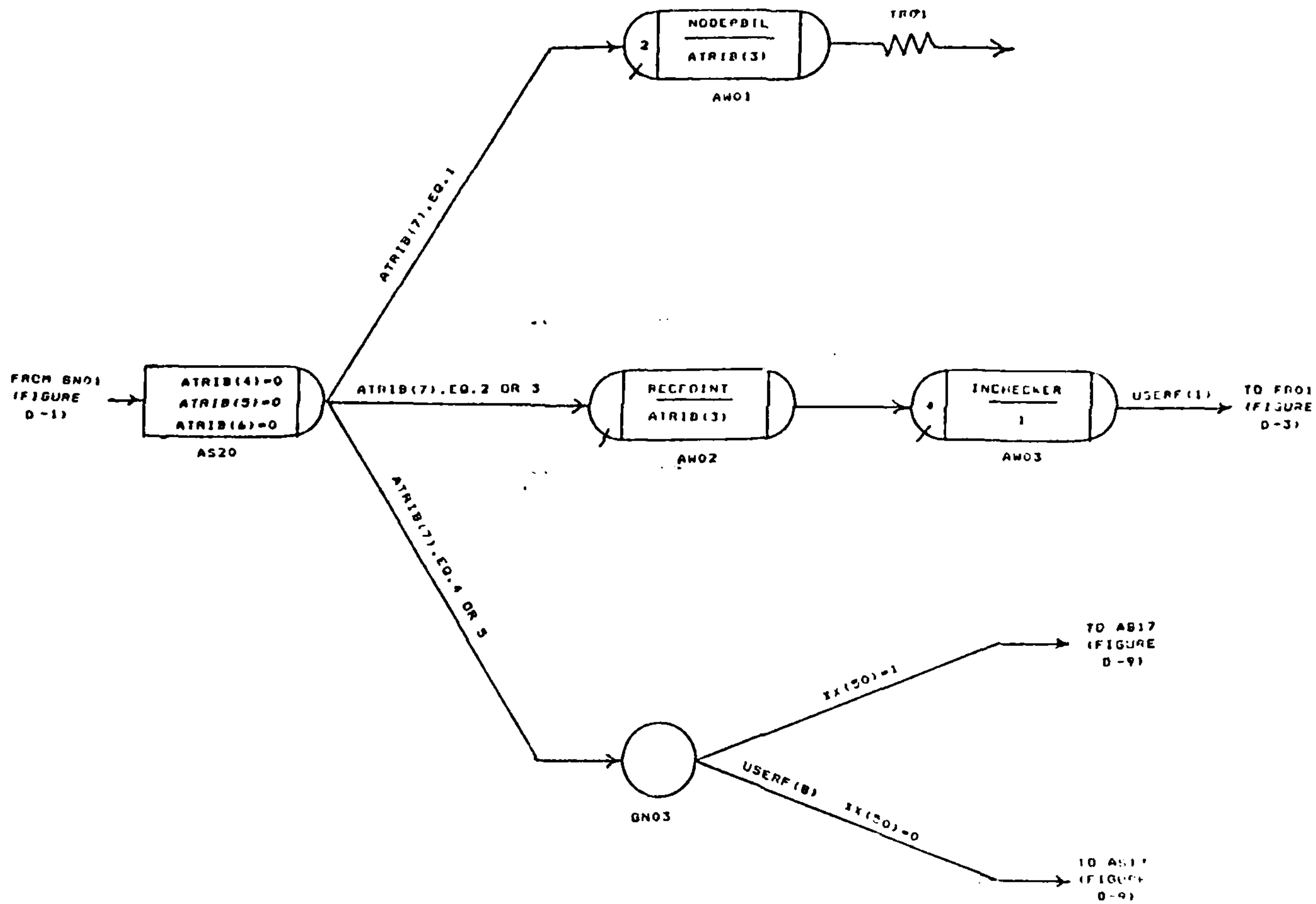

FIGURE D-2: PERSONNEL RECEPTION

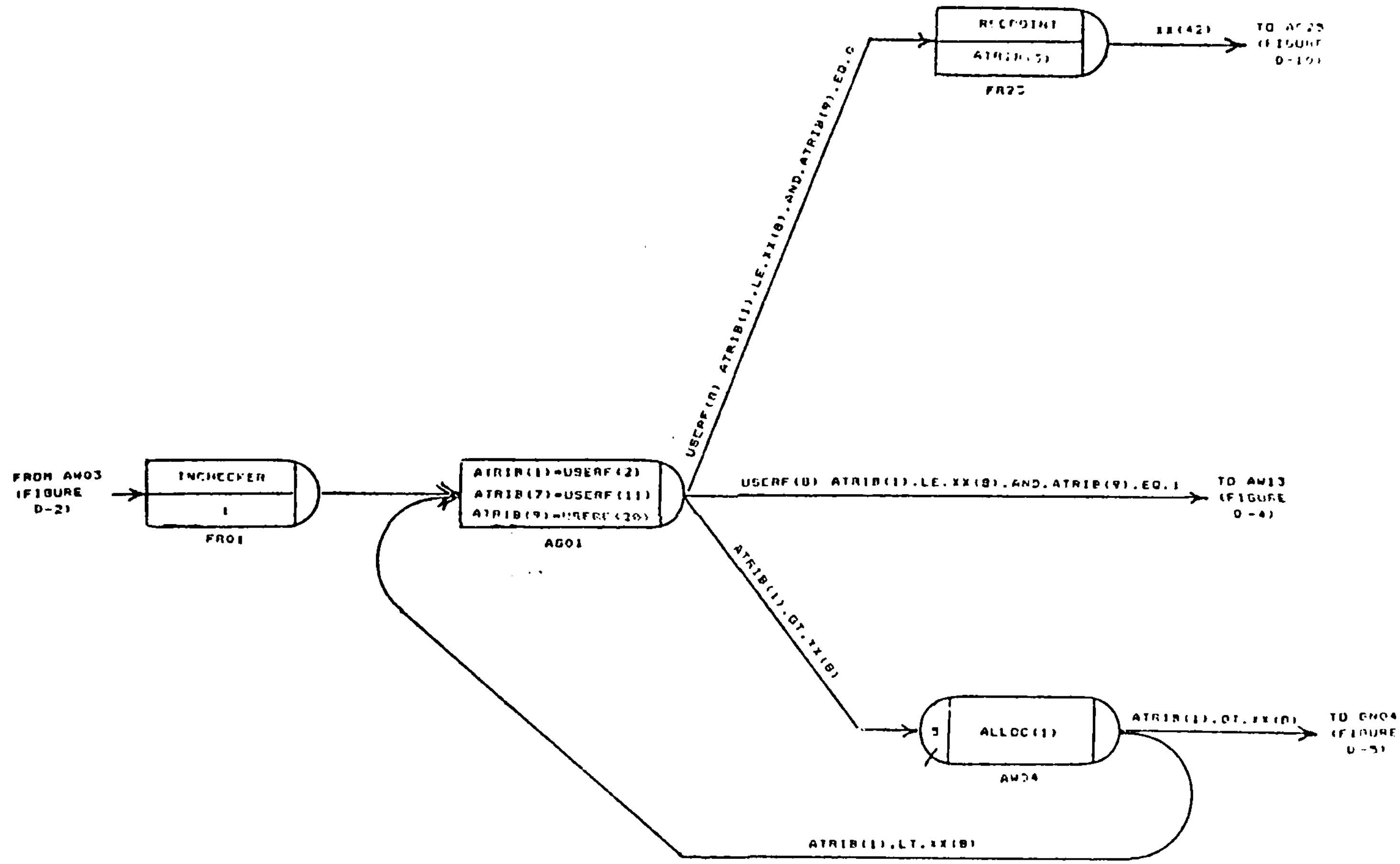

FIGURE D-3: BILLETING ALLOCATION

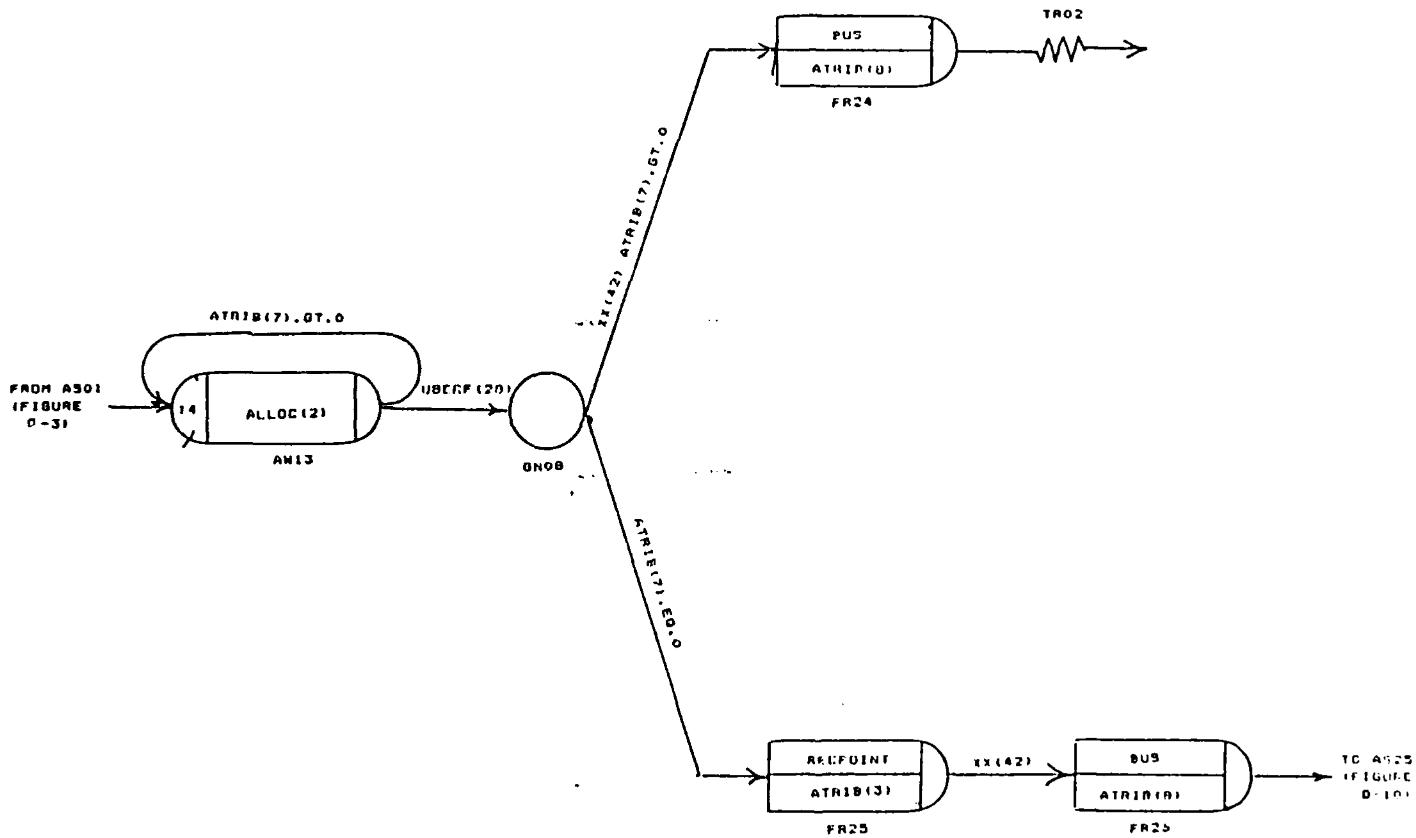

FIGURE D-4: BUS TRANSPORTATION FROM PASSENGER RECEPTION TO STAGING

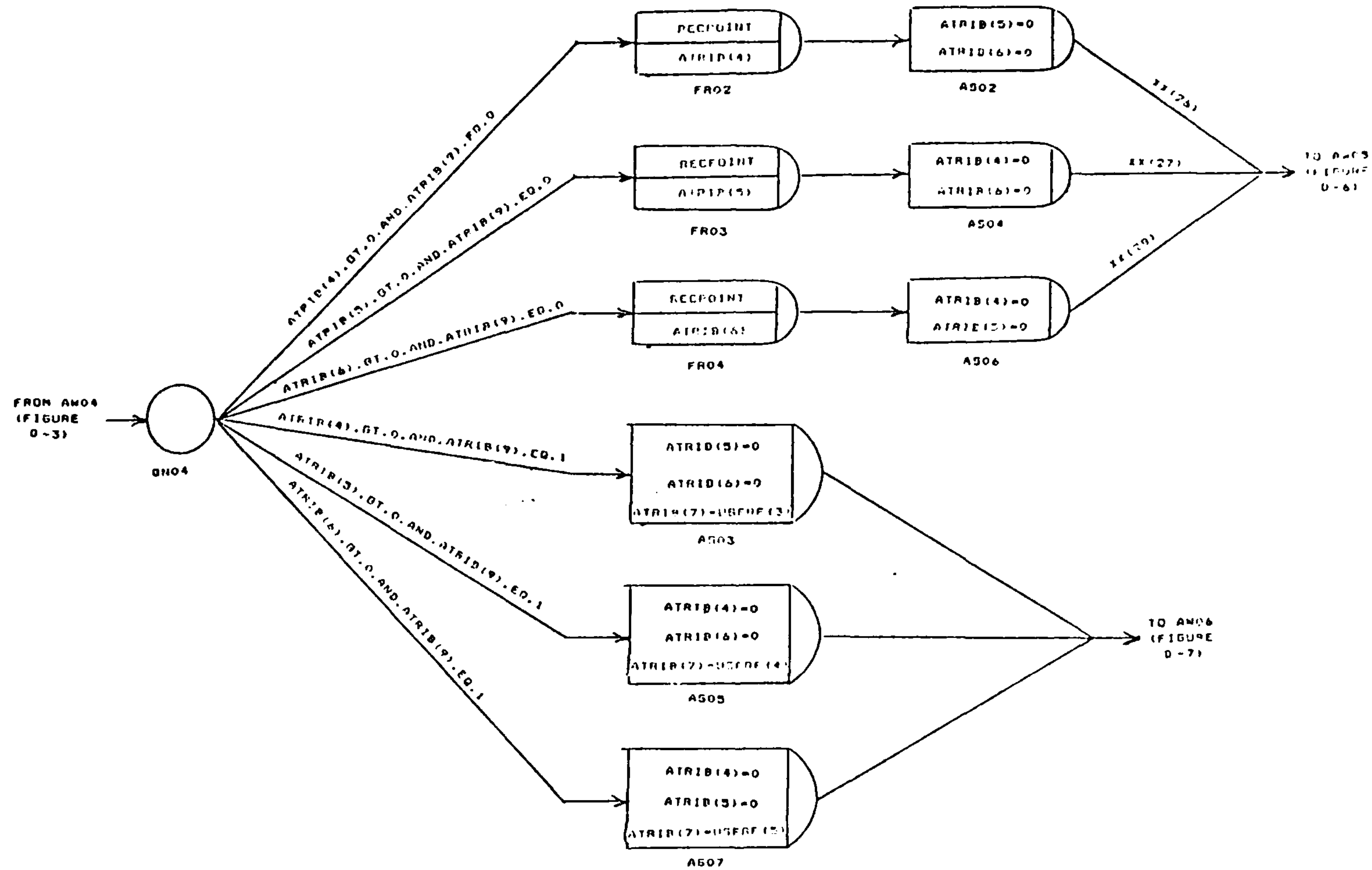

FIGURE D-5: TRANSIENT BILLETING

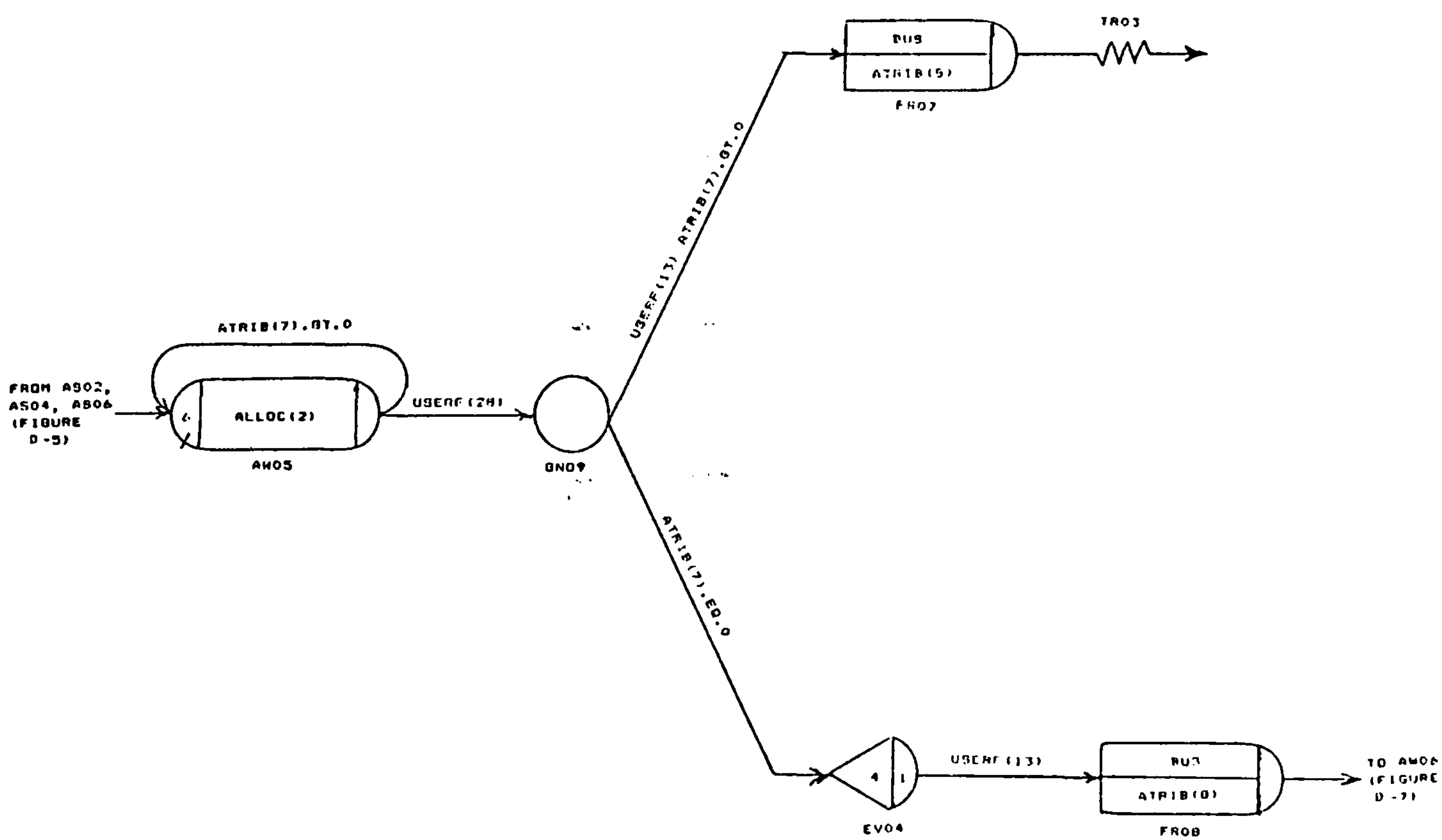

FIGURE D-6: BUS TRANSPORTATION FROM PASSENGER RECEPTION TO BILLETING

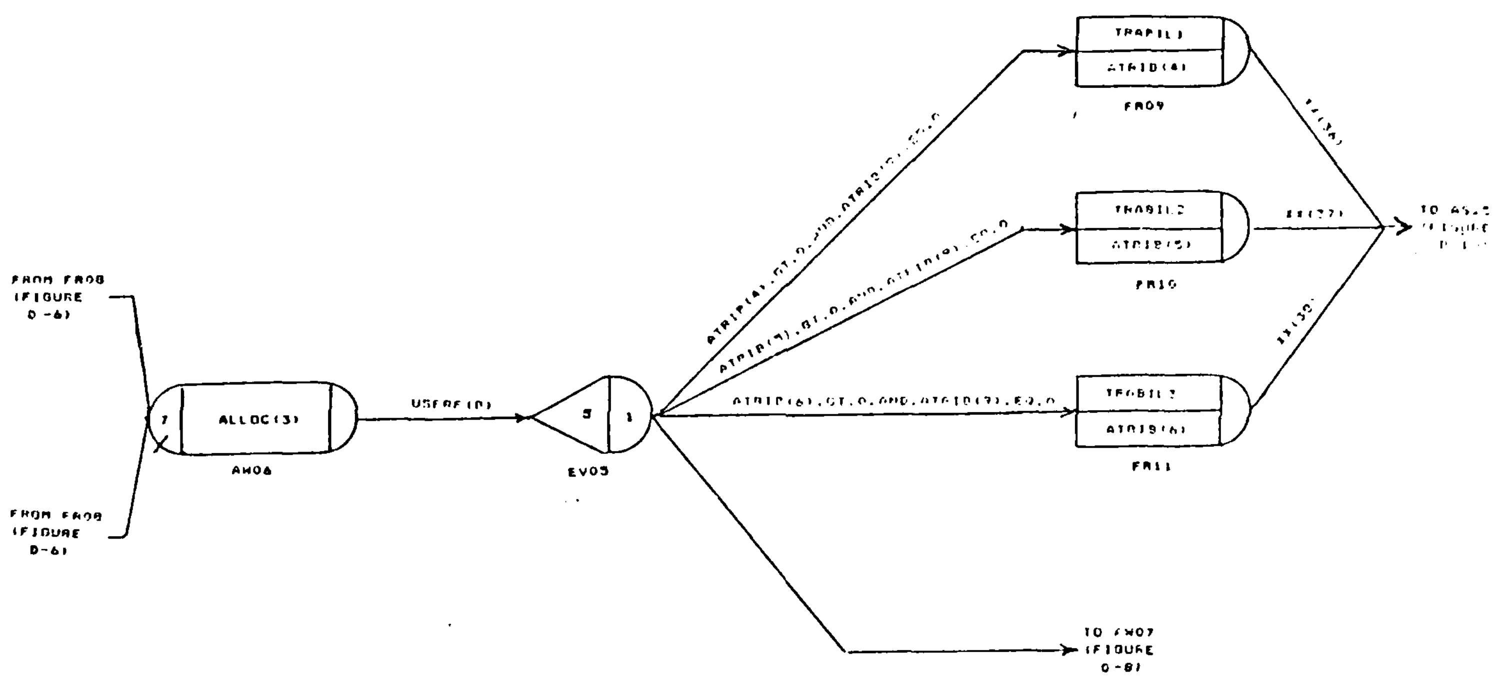

FIGURE D-7: DEPARTING BILLETING

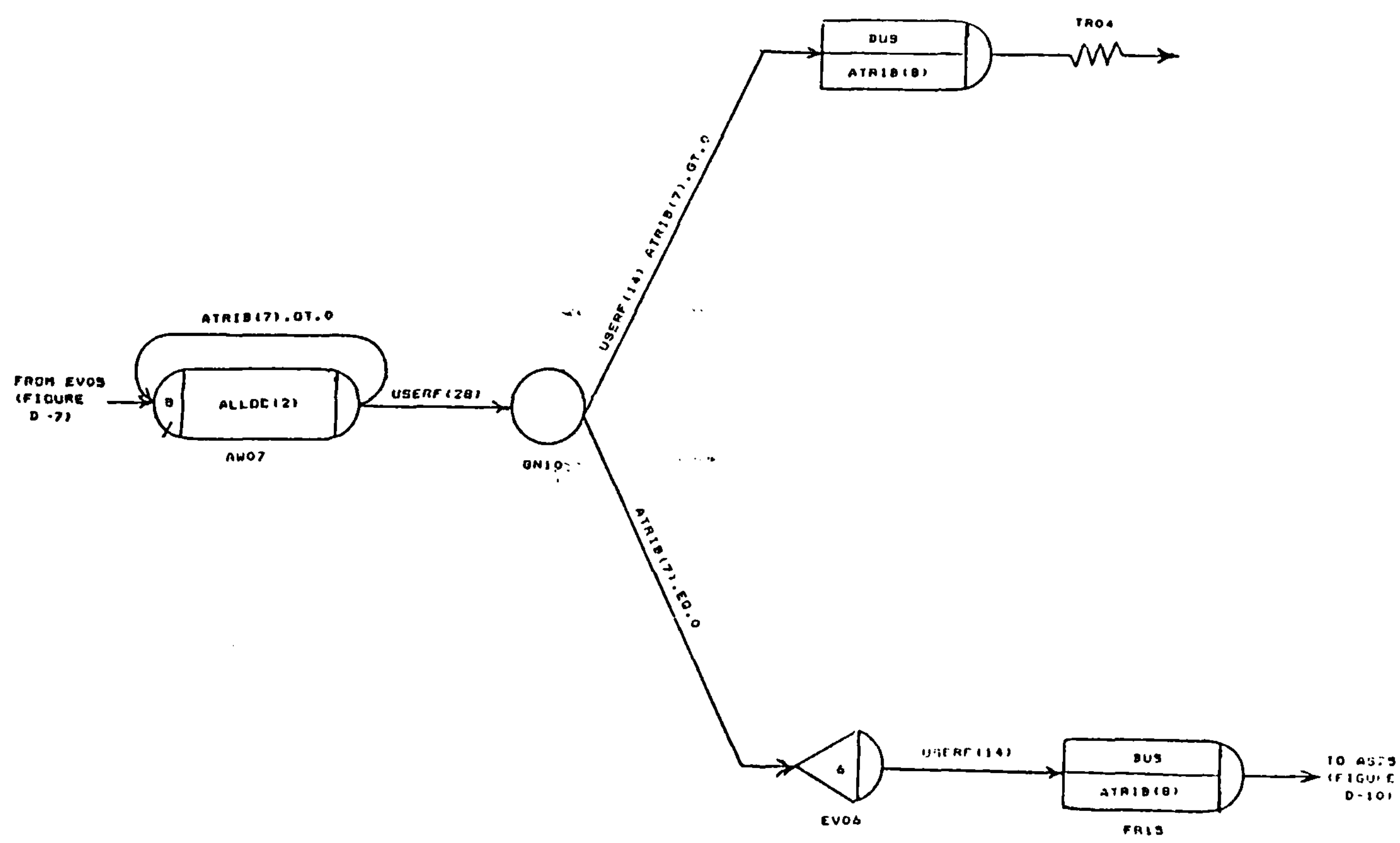

FIGURE D-8: BUS TRANSPORTATION FROM BILLETING TO STAGING

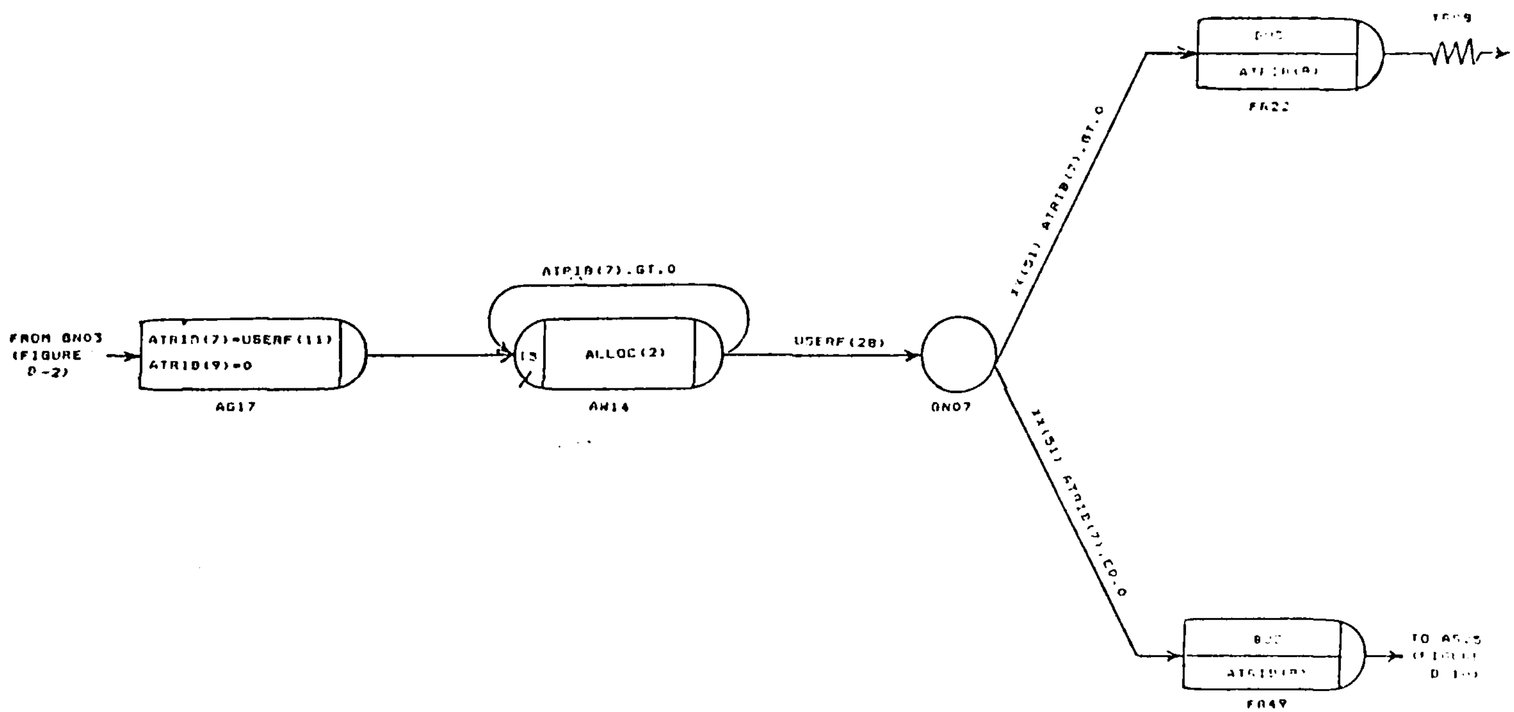

FIGURE D-9: NON-UNIT PERSONNEL BUS TRANSPORTATION TO STAGING

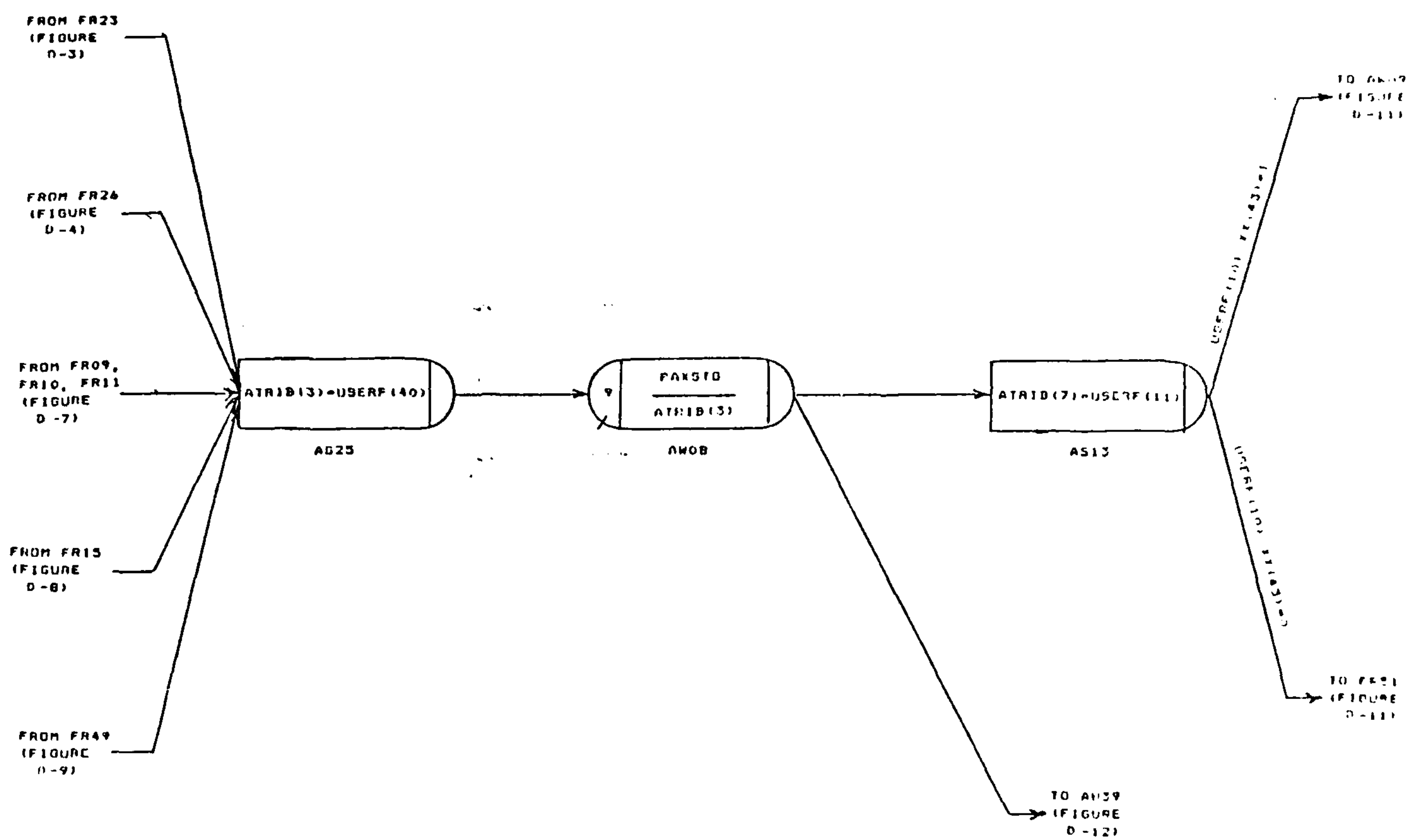

FIGURE D-10: PASSENGER STAGING

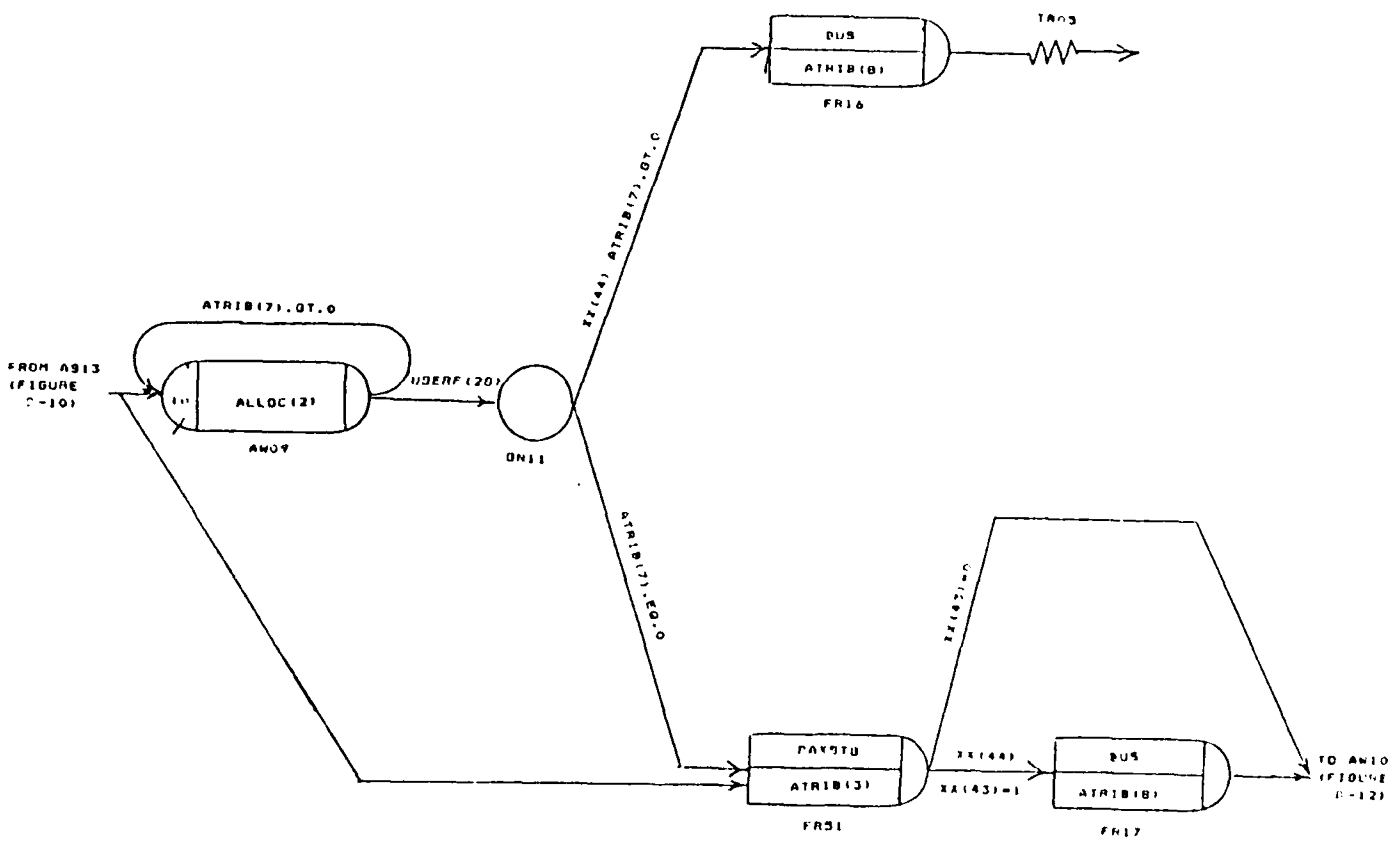

FIGURE D-11: TRANSPORTATION FROM PASSENGER STAGING TO TERMINAL

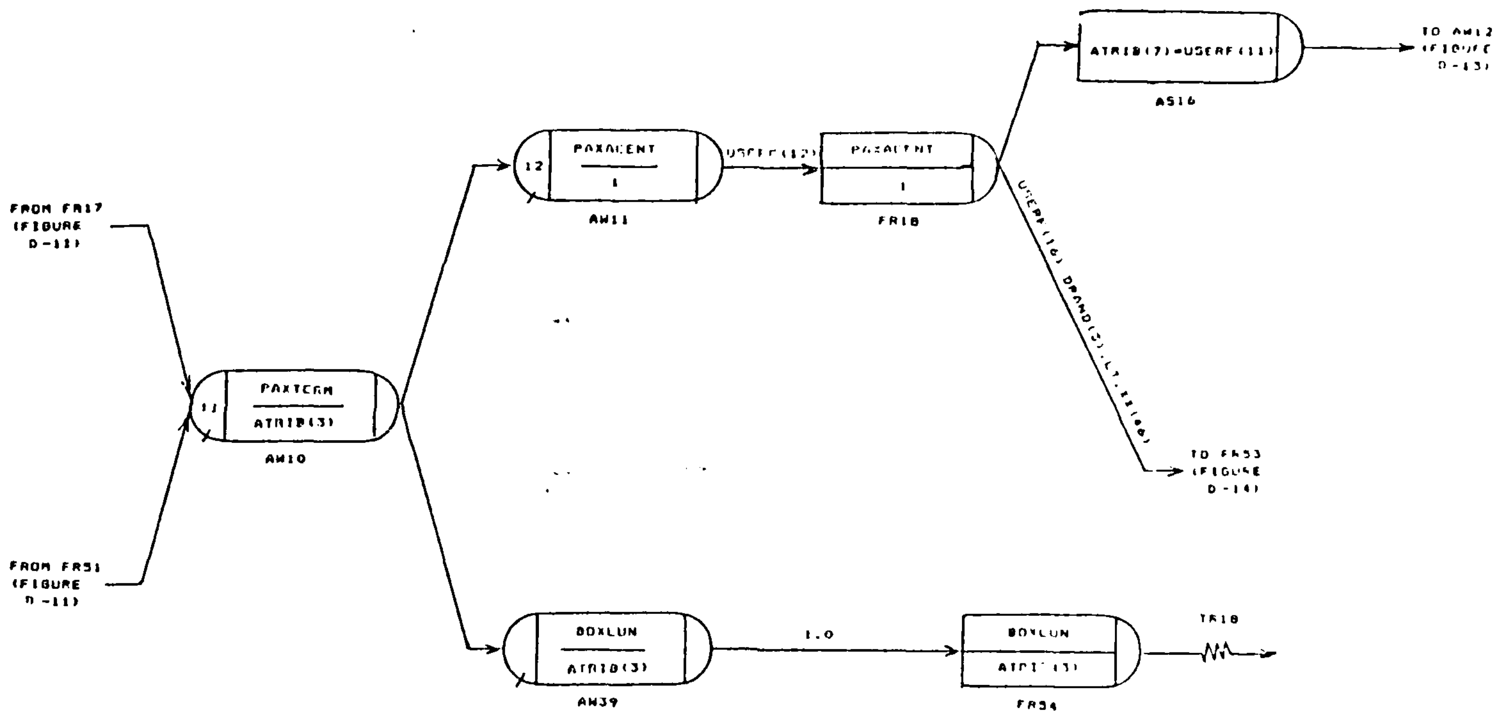

FIGURE D-12: PASSENGER TERMINAL

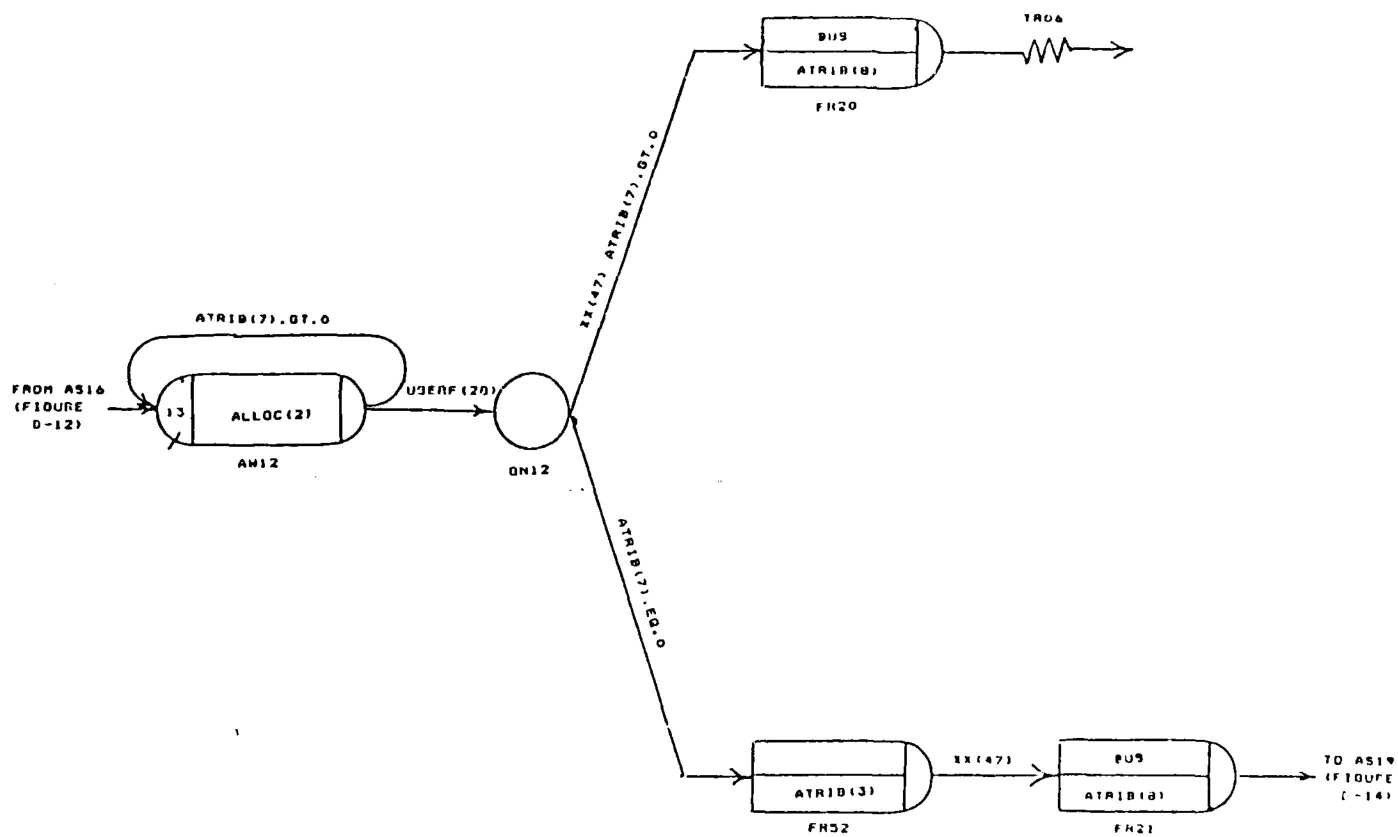

FIGURE D-13: BUS TRANSPORTATION TO AIRCRAFT

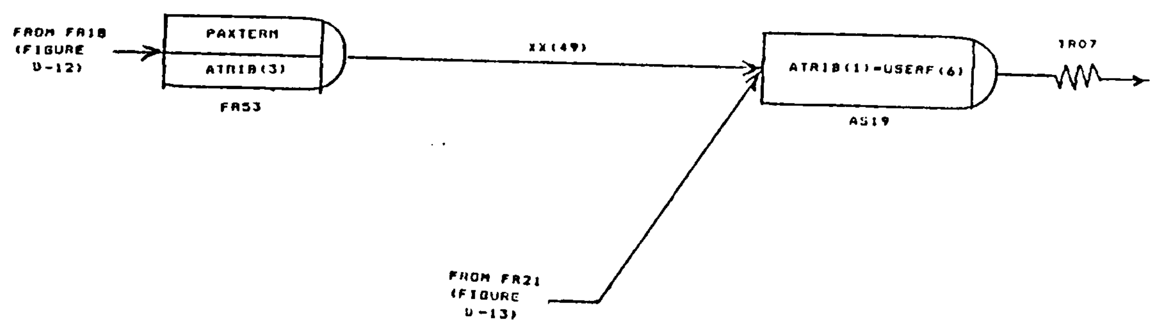

FIGURE D-14: PASSENGER DEPARTURE

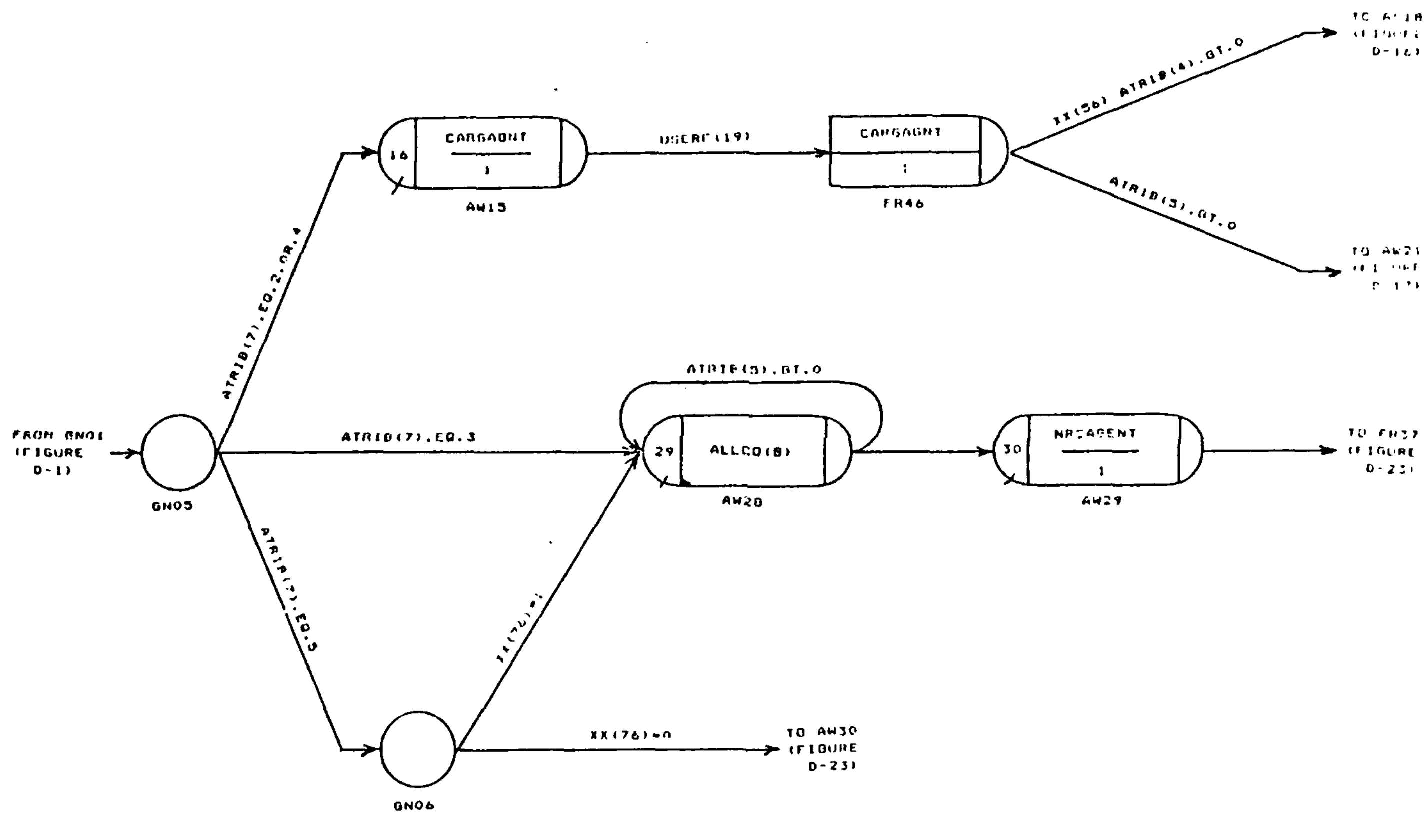

FIGURE D-15: CARGO ARRIVAL

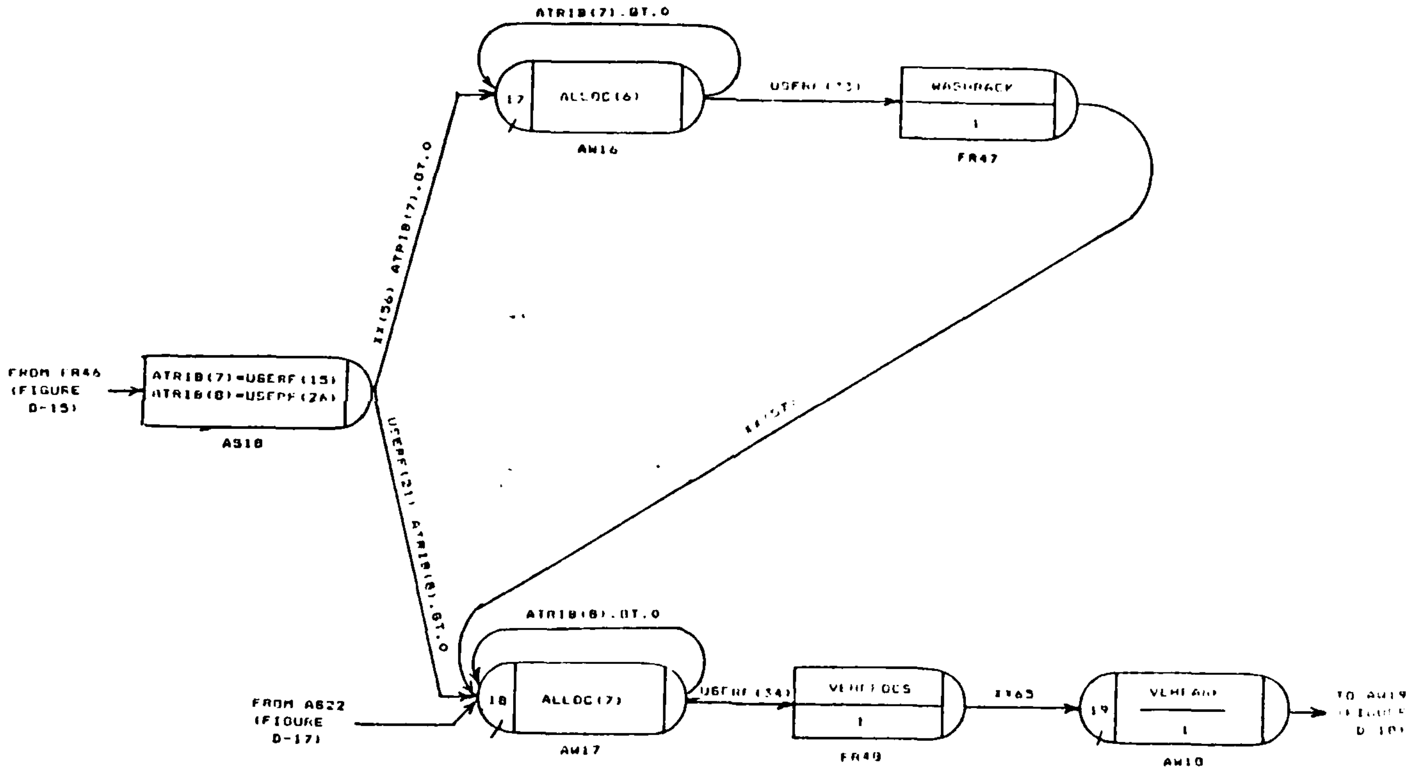

FIGURE D-16: VEHICLE WASHING AND PROCESSING

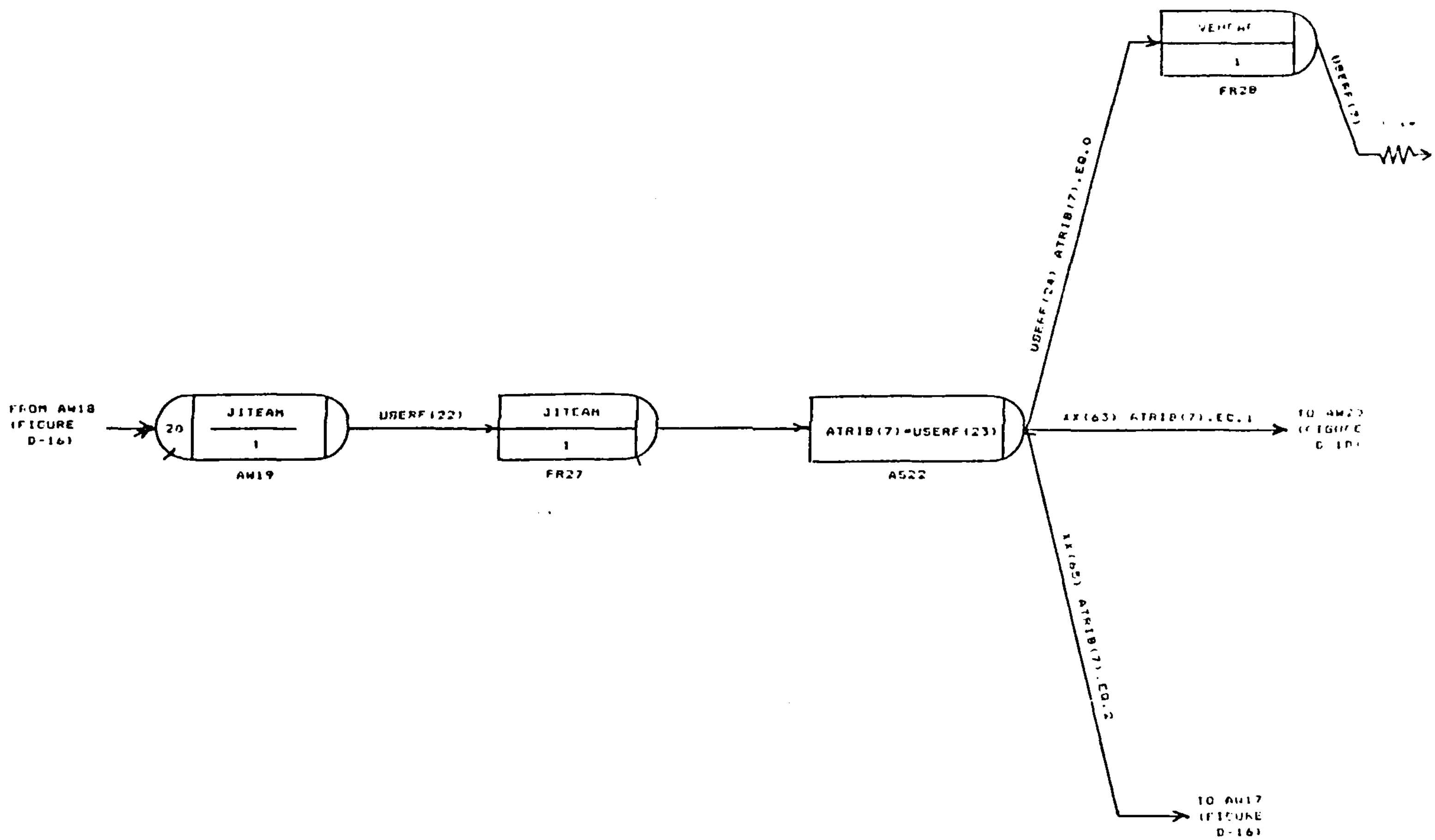

FIGURE D-17: VEHICLE INSPECTION AND DEPARTURE

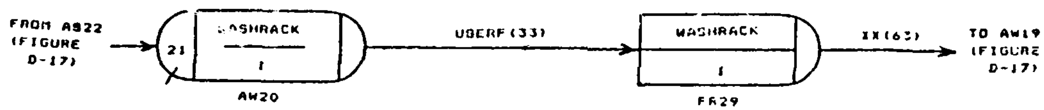

FIGURE D-13: FRUSTRATED VEHICLE REWASHING

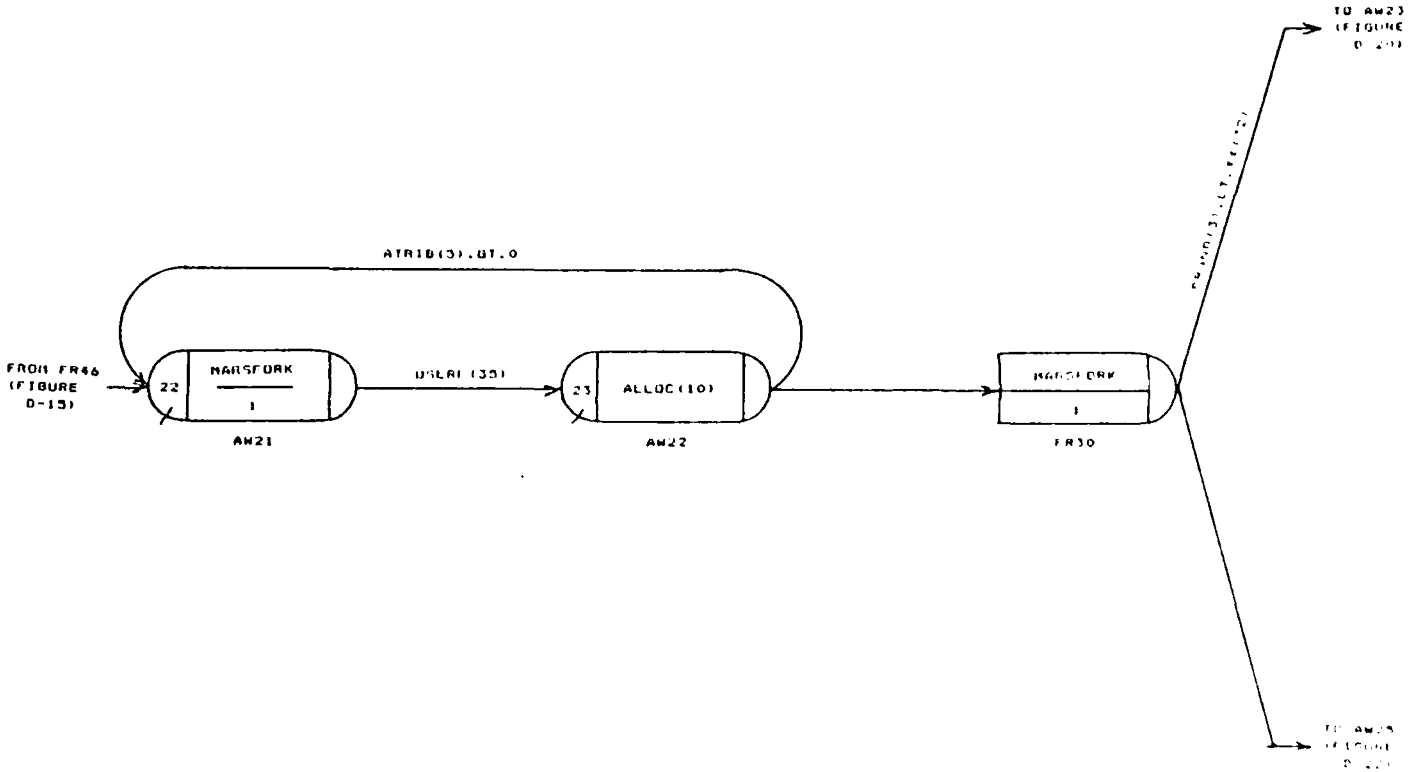

FIGURE D-17: UNIT RELATED PALLET UNLOADING

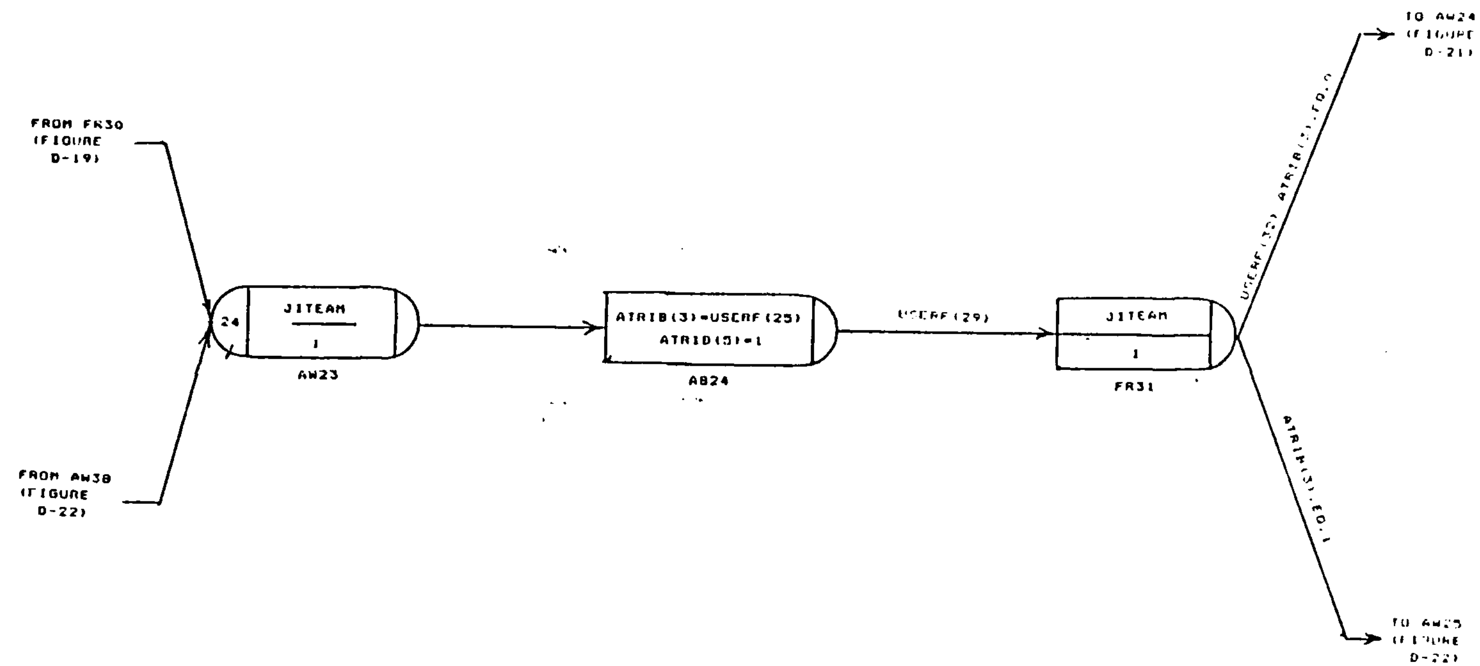

FIGURE D-20: UNIT RELATED PALLET INSPECTION

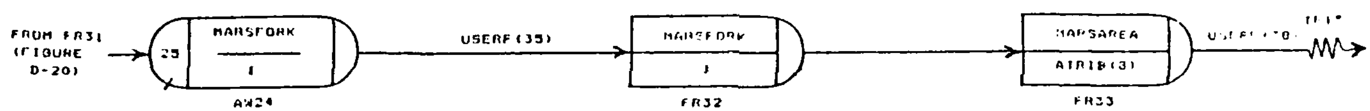

FIGURE D-21: UNIT RELATED PALLET STRUCTURE

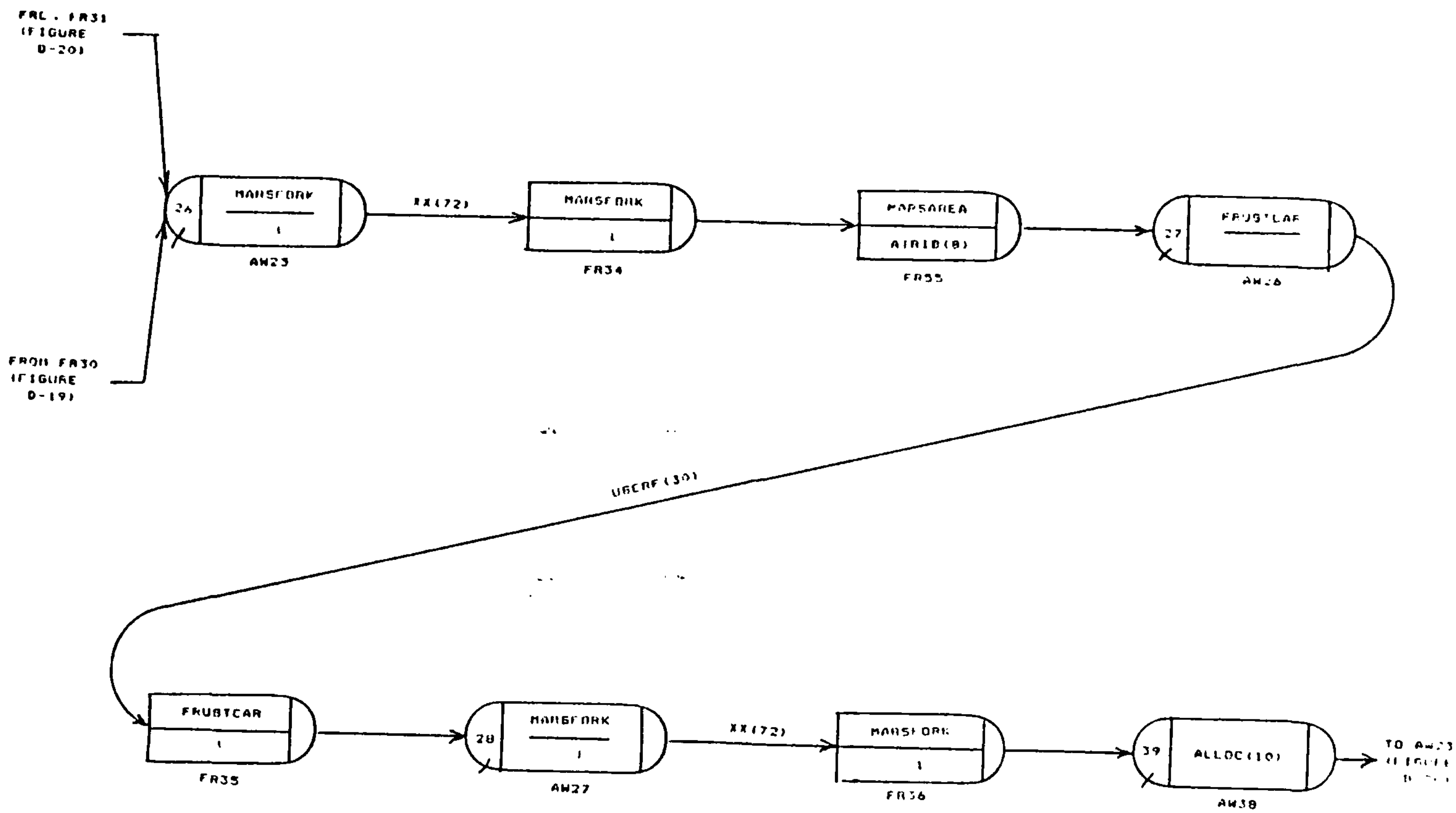

FIGURE D-22: FRUSTRATED UNIT RELATED PALLETS

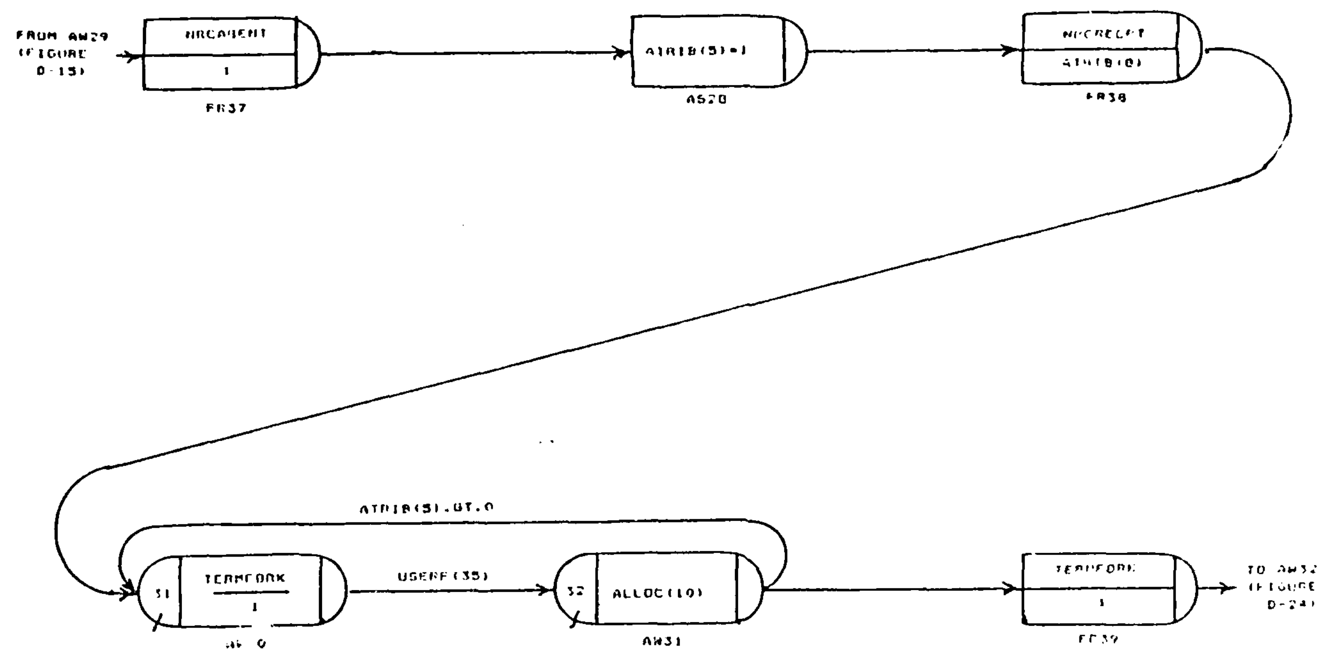

FIGURE D-23: NON-UNIT RELATED CARGO UNLOADING

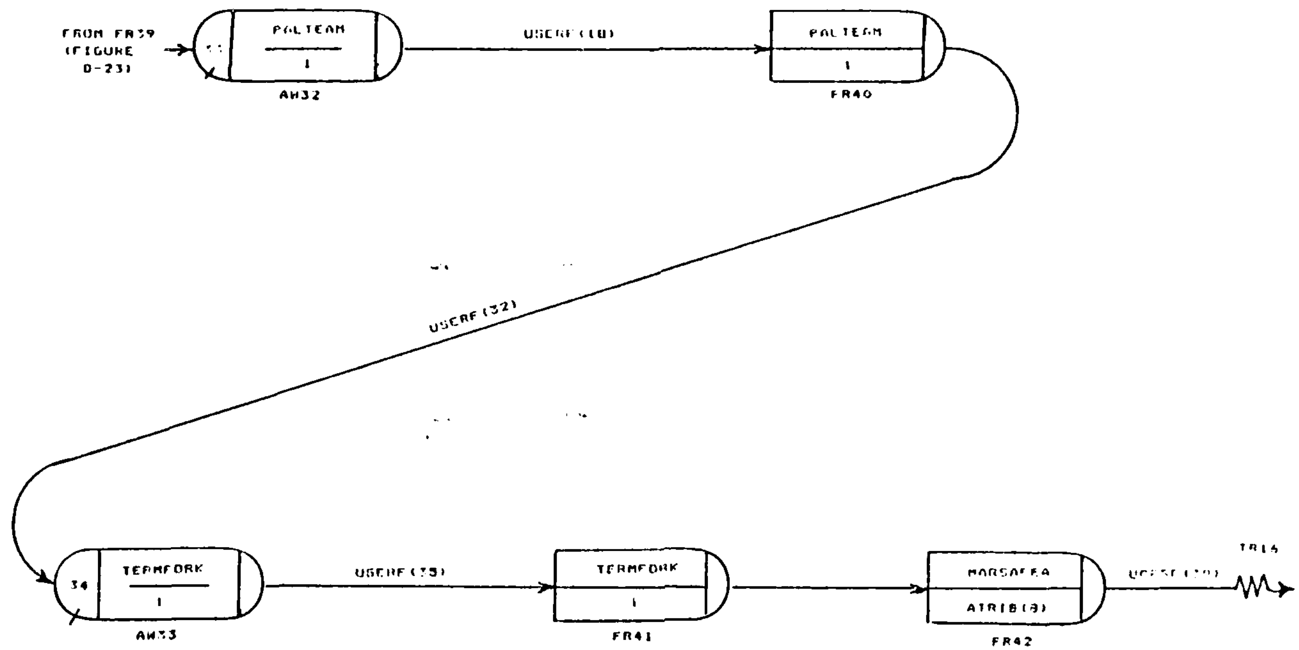

FIGURE D-24: NON-UNIT RELATED CARGO PALLETIZATION AND DEPARTURE

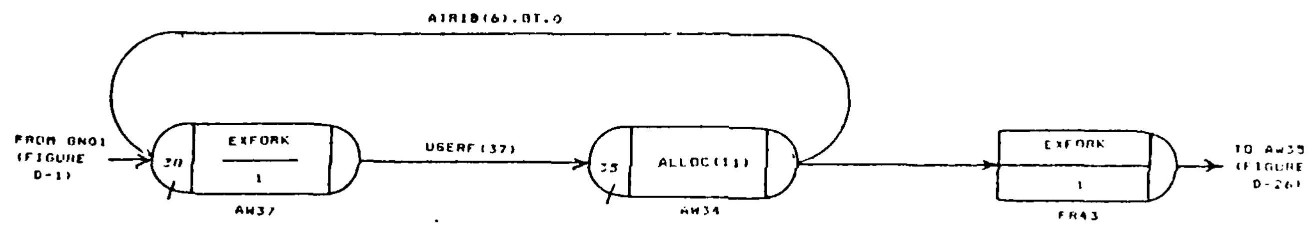

FIGURE D-25: EXPLOSIVES UNLOADING

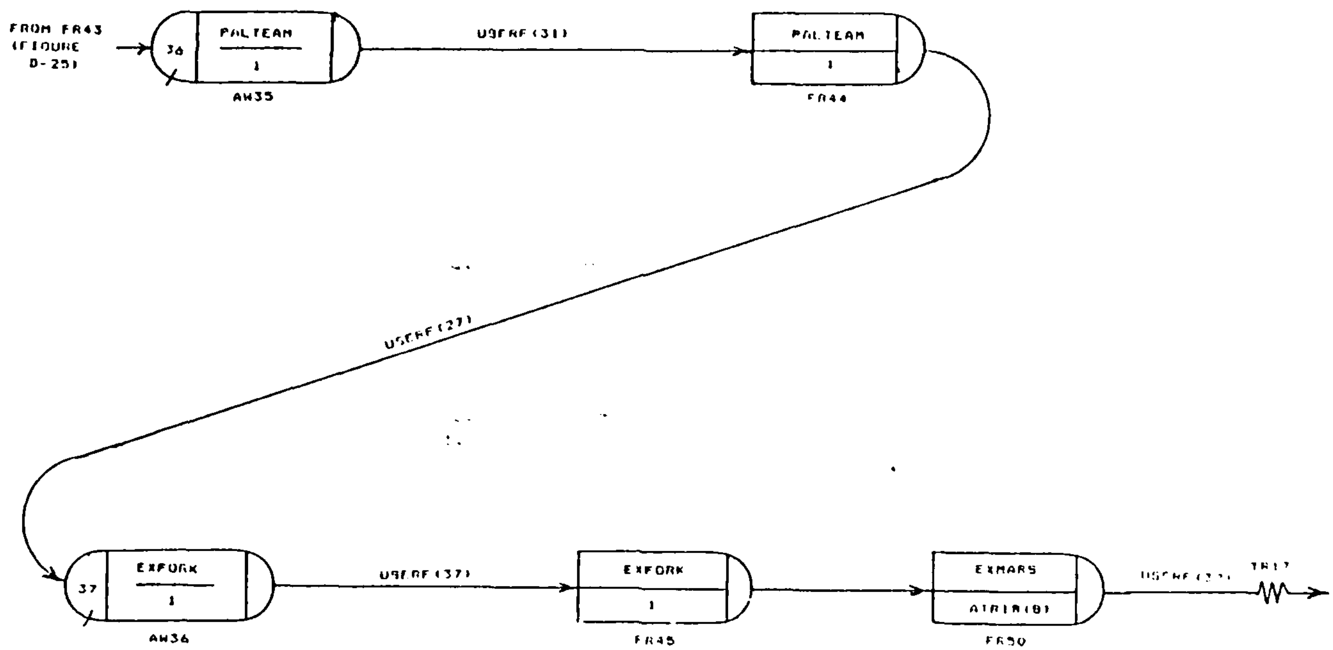

FIGURE D-26: EXPLOSIVES PALLETIZATION AND DEPARTURE

APPENDIX E

COMPUTER CODE

SLAM NETWORK

```
100=GEN,G. L. WHITE,RECEPTION MODEL,1/7/83;
110=LIMITS,40,9,4500;
120=SEEDS,066371131(2);
130=PRIORITY/1,LVF(1)/9,LVF(2)/10,LVF(2)/11,LVF(2)/12,LVF(2)/13,LVF(2);
140=PRIORITY/14,LVF(2)/15,LVF(2)/16,LVF(2)/17,LVF(2)/18,LVF(2)/19,LVF(2);
150=PRIORITY/20,LVF(2)/21,LVF(2)/22,LVF(2)/23,LVF(2)/24,LVF(2)/25,LVF(2);
160=PRIORITY/26,LVF(2)/27,LVF(2)/28,LVF(2)/29,LVF(2)/30,LVF(2)/31,LVF(2);
170=PRIORITY/32,LVF(2)/33,LVF(2)/34,LVF(2)/35,LVF(2)/36,LVF(2)/37,LVF(2);
180=PRIORITY/38,LVF(2)/39,LVF(2)/40,LVF(2);
190=NETWORK;
200=      RESOURCE/NODEPBIL(1376),2;                  RESOURCE #1
210=;                                                   ESSENTIAL
220=      RESOURCE/RECPOINT(2000),3;                  RESOURCE #2
230=;                                                   ESSENTIAL
240=      RESOURCE/INCHECKR(3),4;                     RESOURCE #3
250=;                                                   ESSENTIAL
260=      RESOURCE/BUS(3),13,10,8,6,15,14;            RESOURCE #4
270=;                                                   ESSENTIAL
280=      RESOURCE/PAXSTG(500),9;                     RESOURCE #5
290=;                                                   ESSENTIAL
300=      RESOURCE/BOXLUN(500),40;                    RESOURCE #6
310=;                                                   ESSENTIAL
320=      RESOURCE/BILFEED1(1000),7;                  RESOURCE #7
330=;                                                   NONESSENTIAL
340=      RESOURCE/BILFEED2(1000),7;                  RESOURCE #8
350=;                                                   NONESSENTIAL
360=      RESOURCE/BILFEED3(1000),7;                  RESOURCE #9
370=;                                                   NONESSENTIAL
380=      RESOURCE/TRABIL1(491),5;                    RESOURCE #10
390=;                                                   ESSENTIAL
400=      RESOURCE/TRABIL2(227),5;                    RESOURCE #11
410=;                                                   ESSENTIAL
420=      RESOURCE/TRABIL3(705),5;                    RESOURCE #12
430=;                                                   ESSENTIAL
440=      RESOURCE/PAXTERM(500),11;                   RESOURCE #13
450=;                                                   ESSENTIAL
460=      RESOURCE/PAXAGENT(3),12;                    RESOURCE #14
470=;                                                   ESSENTIAL
480=      RESOURCE/CARGAGNT(3),16;                    RESOURCE #15
490=;                                                   ESSENTIAL
500=      RESOURCE/WASHRACK(2),21,17;                 RESOURCE #16
510=;                                                   ESSENTIAL
520=      RESOURCE/VEHPROCS(5),18;                    RESOURCE #17
530=;                                                   ESSENTIAL
540=      RESOURCE/VEHPARK(2000),19;                  RESOURCE #18
550=;                                                   ESSENTIAL
560=      RESOURCE/JITEAM(4),20,24;                   RESOURCE #19
570=;                                                   ESSENTIAL
580=      RESOURCE/MARSAREA(2000),23,32,39;           RESOURCE #20
```

```
;                                                    NONESSENTIAL
        RESOURCE/PALTEAM(14),36,33;                RESOURCE #21
;                                                    ESSENTIAL
        RESOURCE/EXFORK(6),37,38;                  RESOURCE #22
;                                                    ESSENTIAL
        RESOURCE/EXMARS(2000),35;                  RESOURCE #23
;                                                    ESSENTIAL
        RESOURCE/FRUSTCAR(2000),27;                RESOURCE #24
;                                                    ESSENTIAL
        RESOURCE/MARSFORK(6),26,28,25,22;          RESOURCE #25
;                                                    ESSENTIAL
        RESOURCE/NRCRECPT(2000),29;                RESOURCE #26
;                                                    ESSENTIAL
        RESOURCE/NRCAGENT(6),30;                   RESOURCE #27
;                                                    ESSENTIAL
        RESOURCE/TERMFORK(6),34,31;                RESOURCE #28
;                                                    ESSENTIAL
;
CR01    CREAT;
EV01    EVENT,1;
EV02    EVENT,2;
        ACT,,NNQ(1).GE.1,EV03;
        ACT,ATRIB(1),,GN01;
EV03    EVENT,3;
        ACT,ATRIB(1),,EV02;
GN01    GOON;
        ACT,,ATRIB(3).GT.0,AS20;
        ACT,,ATRIB(4).GT.0.OR.ATRIB(5).GT.0,GN05;
        ACT,XX(31),ATRIB(6).GT.0,AW37;
;
;       PASSENGER SUBNETWORK
AS20    ASSIGN,ATRIB(4)=0,ATRIB(5)=0,ATRIB(6)=0;
        ACT,,ATRIB(7).EQ.1,AW01;
        ACT,,ATRIB(7).EQ.2.OR.ATRIB(7).EQ.3,AW02;
        ACT,,ATRIB(7).EQ.4.OR.ATRIB(7).EQ.5,GN03;
;
;       NONDEPLOYING PERSONNEL
AW01    AWAIT(2),NODEPBIL/ATRIB(3);
TR01    TERM;
;
;       OFFBASE DEPLOYING PERSONNEL
AW02    AWAIT(3),RECPOINT/ATRIB(3);
AW03    AWAIT(4),INCHECKR/1;
        ACT,USERF(1);
FR01    FREE,INCHECKR/1;
AS01    ASSIGN,ATRIB(1)=USERF(2),ATRIB(7)=USERF(11),ATRIB(9)=USERF( 20);
        ACT,USERF(8),ATRIB(1).LE.XX(8).AND.ATRIB(9).EQ.0,FR23;
        ACT,USERF(8),ATRIB(1).LE.XX(8).AND.ATRIB(9).EQ.1,AW13;
        ACT,,ATRIB(1).GT.XX(8),AW04;
;
;       BRANCH IF THEY HAVE OWN TRANSPORT
FR23    FREE,RECPOINT/ATRIB(3);
```

```
1110=      ACT,XX(42),,AS25;
1120=;
1130=;     BRANCH IF RIDING BUS TO PAX STAGING
1140=AW13  AWAIT(14),ALLOC(2);
1150=      ACT,USERF(28),,GN08;
1160=      ACT,,ATRIB(7).GT.0,AW13;
1170=GN08  GOON;
1180=      ACT,XX(42),ATRIB(7).GT.0,FR24;
1190=      ACT,,ATRIB(7).EQ.0,FR25;
1200=FR24  FREE,BUS/ATRIB(8);
1210=TR02  TERM;
1220=FR25  FREE,RECPOINT/ATRIB(3);
1230=      ACT,XX(42);
1240=FR26  FREE,BUS/ATRIB(8);
1250=      ACT,,,AS25;
1260=;
1270=;     BRANCH INTO TRANSIENT BILLETING
1280=AW04  AWAIT(5),ALLOC(1);
1290=      ACT,,ATRIB(1).LE.XX(8),AS01;
1300=      ACT,,ATRIB(1).GT.XX(8),GN04;
1310=GN04  GOON;
1320=      ACT,,ATRIB(4).GT.0.AND.ATRIB(9).EQ.0,FR02;
1330=      ACT,,ATRIB(5).GT.0.AND.ATRIB(9).EQ.0,FR03;
1340=      ACT,,ATRIB(6).GT.0.AND.ATRIB(9).EQ.0,FR04;
1350=      ACT,,ATRIB(4).GT.0.AND.ATRIB(9).EQ.1,AS03;
1360=      ACT,,ATRIB(5).GT.0.AND.ATRIB(9).EQ.1,AS05;
1370=      ACT,,ATRIB(6).GT.0.AND.ATRIB(9).EQ.1,AS07;
1380=;
1390=;     MOVE TO BILLETING AREA(S) BY OWN TRANSPORTATION.
1400=;     AREA 1
1410=FR02  FREE,RECPOINT/ATRIB(4);
1420=AS02  ASSIGN,ATRIB(5)=0,ATRIB(6)=0;
1430=      ACT,XX(26),,AW06;
1440=;     AREA 2
1450=FR03  FREE,RECPOINT/ATRIB(5);
1460=AS04  ASSIGN,ATRIB(4)=0,ATRIB(6)=0;
1470=      ACT,XX(27),,AW06;
1480=;     AREA 3
1490=FR04  FREE,RECPOINT/ATRIB(6);
1500=AS06  ASSIGN,ATRIB(4)=0,ATRIB(5)=0;
1510=      ACT,XX(28),,AW06;
1520=;     AREA 1
1530=AS03  ASSIGN,ATRIB(5)=0,ATRIB(6)=0,
1540=         ATRIB(7)=USERF(3);
1550=      ACT,,,AW05;
1560=;     AREA 2
1570=AS05  ASSIGN,ATRIB(4)=0,ATRIB(6)=0,
1580=         ATRIB(7)=USERF(4);
1590=      ACT,,,AW05;
1600=;     AREA 3
1610=AS07  ASSIGN,ATRIB(4)=0,ATRIB(5)=0,
1620=         ATRIB(7)=USERF(5);
```

```
          ACT,,,AW05;
;
AW05      AWAIT(6),ALLOC(2);
          ACT,USERF(28),,GN09;
          ACT,,ATRIB(7).GT.0,AW05;
GN09      GOON;
          ACT,USERF(13),ATRIB(7).GT.0,FR07;
          ACT,,ATRIB(7).EQ.0,EV04;
FR07      FREE,BUS/ATRIB(8);
TR03      TERM;
;
EV04      EVENT,4;
          ACT,USERF(13);
FR08      FREE,BUS/ATRIB(8);
;
;         NOW IN THE BILLETING AREA(S), ALLOCATE FEEDING
AW06      AWAIT(7),ALLOC(3);
          ACT,USERF(8);
EV05      EVENT,5,1;
;
;         READY TO LEAVE BILLETING AREA(S) BY OWN TRANSPORT
          ACT,,ATRIB(4).GT.0.AND.ATRIB(9).EQ.0,FR09;
          ACT,,ATRIB(5).GT.0.AND.ATRIB(9).EQ.0,FR10;
          ACT,,ATRIB(6).GT.0.AND.ATRIB(9).EQ.0,FR11;
;         THEN IF BY BUS
          ACT,,,AW07;
;
;         OWN TRANSPORTATION THROUGH THESE NODES
FR09      FREE,TRABIL1/ATRIB(4);
          ACT,XX(36),,AS25;
FR10      FREE,TRABIL2/ATRIB(5);
          ACT,XX(37),,AS25;
FR11      FREE,TRABIL3/ATRIB(6);
          ACT,XX(38),,AS25;
;
;         RIDERS MUST AWAIT BUSES
AW07      AWAIT(8),ALLOC(2);
          ACT,USERF(28),,GN10;
          ACT,,ATRIB(7).GT.0,AW07;
GN10      GOON;
          ACT,USERF(14),ATRIB(7).GT.0,FR14;
          ACT,,ATRIB(7).EQ.0,EV06;
FR14      FREE,BUS/ATRIB(8);
TR04      TERM;
;
EV06      EVENT,6;
          ACT,USERF(14);
FR15      FREE,BUS/ATRIB(8);
;
;         PASSENGER STAGING AREA
AS25      ASSIGN,ATRIB(3)=USERF(40);
AW08      AWAIT(9),PAXSTG/ATRIB(3);
```

```
2150=      ACT,USERF(9);
2160=      ACT,,,AW39;
2170=AS13  ASSIGN,ATRIB(7)=USERF(11);
2180=      ACT,USERF(10),XX(43).EQ.1,AW09;
2190=      ACT,USERF(10),XX(43).EQ.0,FR51;
2200=;
2210=;     LEAVING PAS STAGING- FIRST BY FOOT
2220=FR51  FREE,PAXSTG/ATRIB(3);
2230=      ACT,XX(44),XX(43).EQ.0,AW10;
2240=      ACT,XX(44),XX(43).EQ.1,FR17;
2250=;
2260=;     THEN BY BUS
2270=AW09  AWAIT(10),ALLOC(2);
2280=      ACT,USERF(28),,GN11;
2290=      ACT,,ATRIB(7).GT.0,AW09;
2300=GN11  GOON;
2310=      ACT,XX(44),ATRIB(7).GT.0,FR16;
2320=      ACT,,ATRIB(7).EQ.0,FR51;
2330=FR16  FREE,BUS/ATRIB(8);
2340=TR05  TERM;
2350=FR17  FREE,BUS/ATRIB(8);
2360=;
2370=;     PASSENGER TERMINAL
2380=AW10  AWAIT(11),PAXTERM/ATRIB(3);
2390=      ACT,,,AW11;
2400=      ACT,,,AW39;
2410=AW39  AWAIT(40),BOXLUN/ATRIB(3);
2420=      ACT,1.0;
2430=FR54  FREE,BOXLUN/ATRIB(3);
2440=TR18  TERM;
2450=AW11  AWAIT(12),PAXAGENT/1;
2460=      ACT,USERF(12);
2470=FR18  FREE,PAXAGENT/1,1;
2480=      ACT,USERF(16),DRAND(3).LT.XX(46),FR53;
2490=      ACT,,,AS16;
2500=;
2510=;     SOME WILL WALK TO THE AIRCRAFT
2520=FR53  FREE,PAXTERM/ATRIB(3);
2530=      ACT,XX(49),;
2540=AS19  ASSIGN,ATRIB(1)=USERF(6);
2550=TR07  TERM;
2560=;
2570=;     SOME WILL RIDE BUSES
2580=AS16  ASSIGN,ATRIB(7)=USERF(11);
2590=      ACT,USERF(17);
2600=AW12  AWAIT(13),ALLOC(2);
2610=      ACT,USERF(28),,GN12;
2620=      ACT,,ATRIB(7).GT.0,AW12;
2630=GN12  GOON;
2640=      ACT,XX(47),ATRIB(7).GT.0,FR20;
2650=      ACT,,ATRIB(7).EQ.0,FR52;
2660=FR20  FREE,BUS/ATRIB(8);
```

```
TR06  TERM;
;
FR52  FREE,PAXTERM/ATRIB(3);
      ACT,XX(47);
FR21  FREE,BUS/ATRIB(8);
;
;     STATISTICS ARE COLLECTED
      ACT,,,AS19;
;
;     ON BASE DEPLOYING PERSONNEL
GN03  GOON;
      ACT,USERF(8),XX(50).EQ.0,AS25;
;
;     IF NEED BUS TRANSPORT TO PAX STAGING
      ACT,USERF(8),XX(50).EQ.1,AS17;
AS17  ASSIGN,ATRIB(7)=USERF(11);
AW14  AWAIT(15),ALLOC(2);
      ACT,USERF(28),,GN07;
      ACT,,ATRIB(7).GT.0,AW14;
GN07  GOON;
      ACT,XX(51),ATRIB(7).GT.0,FR22;
      ACT,XX(51),ATRIB(7).EQ.0,FR49;
FR22  FREE,BUS/ATRIB(8);
TR08  TERM;
FR49  FREE,BUS/ATRIB(8);
      ACT,,,AS25;
;
;     CARGO SUBNETWORK
;
GN05  GOON;
      ACT,,ATRIB(7).EQ.2.OR.ATRIB(7).EQ.4,AW15;
      ACT,,ATRIB(7).EQ.3,AW28;
      ACT,,ATRIB(7).EQ.5,GN06;
;
;     URC BRANCH
AW15  AWAIT(16),CARGAGNT/1;
      ACT,USERF(19);
FR46  FREE,CARGAGNT/1;
      ACT,XX(56),ATRIB(4).GT.0,AS18;
      ACT,,ATRIB(5).GT.0,AW21;
;
;     VEHICLE PROCESSING BRANCH
AS18  ASSIGN,ATRIB(7)=USERF(15),ATRIB(8)=USERF(26);
      ACT,XX(56),ATRIB(7).GT.0,AW16;
      ACT,ATRIB(9),ATRIB(8).GT.0,AW17;
;
;     WASHRACK
AW16  AWAIT(17),ALLOC(6);
      ACT,,ATRIB(7).GT.0,AW16;
      ACT,USERF(33);
FR47  FREE,WASHRACK/1;
      ACT,XX(57);
```

```
3190=;
3200=;      OTHER VEHICLE PROCESSING
3210=AW17  AWAIT(18),ALLOC(7);
3220=      ACT,,ATRIB(8).GT.0,AW17;
3230=      ACT,USERF(34);
3240=FR48  FREE,VEHPROCS/1;
3250=      ACT,XX(65);
3260=;
3270=;      PARKING LOT
3280=AW18  AWAIT(19),VEHPARK/1;
3290=;
3300=;      JOINT INSPECTION
3310=AW19  AWAIT(20),JITEAM/1;
3320=      ACT,USERF(22);
3330=FR27  FREE,JITEAM/1;
3340=AS22  ASSIGN,ATRIB(7)=USERF(23);
3350=;
3360=;      VEHICLES PASSING INSPECTION
3370=      ACT,USERF(24),ATRIB(7).EQ.0,FR28;
3380=;
3390=;      FRUSTRATED VEHICLES
3400=      ACT,XX(63),ATRIB(7).EQ.1,AW20;
3410=      ACT,XX(65),ATRIB(7).EQ.2,AW17;
3420=AW20  AWAIT(21),WASHRACK/1;
3430=      ACT,USERF(33);
3440=FR29  FREE,WASHRACK/1;
3450=      ACT,XX(63),,AW19;
3460=FR28  FREE,VEHPARK/1;
3470=      ACT,USERF(7);
3480=TR15  TERM;
3490=;
3500=;      NON-VEHICULAR CARGO BRANCH
3510=AW21  AWAIT(22),MARSFORK/1;
3520=      ACT,USERF(35);
3530=AW22  AWAIT(23),ALLOC(10);
3540=      ACT,,ATRIB(5).GT.0,AW21;
3550=      ACT,,,FR30;
3560=FR30  FREE,MARSFORK/1,1;
3570=      ACT,,DRAND(3).LE.XX(32),AW23;
3580=      ACT,,,AW25;
3590=;
3600=;      AWAIT JOINT INSPECTION
3610=AW23  AWAIT(24),JITEAM/1;
3620=AS24  ASSIGN,ATRIB(3)=USERF(25),ATRIB(5)=1;
3630=      ACT,USERF(29);
3640=FR31  FREE,JITEAM/1;
3650=;
3660=;      AFTER INSPECTION COMPLETE
3670=;      SORT PASSES FROM FAILS
3680=      ACT,,ATRIB(3).EQ.1,AW25;
3690=      ACT,USERF(32),ATRIB(3).EQ.0,AW24;
3700=;
```

```
3710=;      FRUSTRATED CARGO BRANCH
3720=AW25  AWAIT(26),MARSFORK/1;
3730=      ACT,XX(72);
3740=FR34  FREE,MARSFORK/1;
3750=FR55  FREE,MARSAREA/ATRIB(8);
3760=AW26  AWAIT(27),FRUSTCAR/1;
3770=      ACT,USERF(30);
3780=FR35  FREE,FRUSTCAR/1;
3790=AW27  AWAIT(28),MARSFORK/1;
3800=      ACT,XX(72);
3810=FR36  FREE,MARSFORK/1;
3820=AW38  AWAIT(39),ALLOC(10);
3830=      ACT,,,AW23;
3840=;
3850=;     NON-FAILED PALLETS
3860=AW24  AWAIT(25),MARSFORK/1;
3870=      ACT,USERF(35);
3880=FR32  FREE,MARSFORK/1;
3890=FR33  FREE,MARSAREA/ATRIB(8);
3900=      ACT,USERF(38),,TR15;
3910=;
3920=;     OFFBASE NRC BRANCH
3930=GN06  GOON;
3940=      ACT,,XX(76).EQ.1,AW28;
3950=      ACT,,XX(76).EQ.0,AW30;
3960=AW28  AWAIT(29),ALLOC(8);
3970=      ACT,,ATRIB(5).GT.0,AW28;
3980=      ACT,,,AW29;
3990=AW29  AWAIT(30),NRCAGENT/1;
4000=      ACT,USERF(36);
4010=FR37  FREE,NRCAGENT/1;
4020=AS28  ASSIGN,ATRIB(5)=1;
4030=FR38  FREE,NRCRECPT/ATRIB(8);
4040=AW30  AWAIT(31),TERMFORK/1;
4050=      ACT,USERF(35);
4060=AW31  AWAIT(32),ALLOC(10);
4070=      ACT,,ATRIB(5).GT.0,AW30;
4080=      ACT,,,FR39;
4090=FR39  FREE,TERMFORK/1;
4100=AW32  AWAIT(33),PALTEAM/1;
4110=      ACT,USERF(18);
4120=FR40  FREE,PALTEAM/1;
4130=      ACT,USERF(32);
4140=AW33  AWAIT(34),TERMFORK/1;
4150=      ACT,USERF(35);
4160=FR41  FREE,TERMFORK/1;
4170=FR42  FREE,MARSAREA/ATRIB(8);
4180=      ACT,USERF(38);
4190=TR16  TERM;
4200=;
4210=;     EXPLOSIVES
4220=AW37  AWAIT(38),EXFORK/1;
```

```
4230=       ACT,USERF(37);
4240=AW34  AWAIT(35),ALLOC(11);
4250=       ACT,,ATRIB(6).GT.0,AW37;
4260=       ACT,,,FR43;
4270=FR43  FREE,EXFORK/1;
4280=AW35  AWAIT(36),PALTEAM/1;
4290=       ACT,USERF(31);
4300=FR44  FREE,PALTEAM/1;
4310=       ACT,USERF(27);
4320=AW36  AWAIT(37),EXFORK/1;
4330=       ACT,USERF(37);
4340=FR45  FREE,EXFORK/1;
4350=FR50  FREE,EXMARS/ATRIB(8);
4360        ACT,USERF(39);
4370=TR17  TERM;
4380=       END NETWORK
4390=INIT,0,720;
4400=FIN;
4410=*EOR
```

FORTRAN SUBROUTINES

```
      PROGRAM MAIN (INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE7)
C
C+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
C
C     MAIN PROGRAM IS USED TO INCREASE DIMENSION OF
C     NSET/ QSET TO 30000
C
C
      DIMENSION NSET(70000)
      COMMON/SCOM1/ ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,MSTOP,NCLNR
     +,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,SS(100),SSL(100),TNEXT,TNOW,XX(100)
      COMMON QSET(70000)
      EQUIVALENCE (NSET(1),QSET(1))
      NNSET=70000
      NCRDR=5
      NPRNT=6
      NTAPE=7
      CALL SLAM
      STOP
      END
C
C+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
C
C
      SUBROUTINE EVENT(I)
      DIMENSION NSET(70000)
      COMMON /SCOM1/ ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,
     +MSTOP,NCLNR,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,
     +SS(100),SSL(100),TNEXT,TNOW,XX(100)
      COMMON QSET(70000)
      EQUIVALENCE (NSET(1),QSET(1))
      INTEGER NPAX,ALD,EAD,LAD,TYPE,N
      INTEGER VEHSTON,BULSTON,OVRSTON,OUTSTON,EXPSTON
      REAL A(9)
C
C
      GO TO (1,2,3,4,5,6),I
C+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
1     CONTINUE
C     **EVENT 1 TAKES THE INPUT FROM TPFDD DATA CARDS AND AFTER THE
C       NEEDED MANIPULATIONS ARE DONE INSERTS THE ENTITIES INTO
C       SLAM FILE #1 FOR SORTING. FILE #1 IS THEN EMPTIED ONTO
C       DISC STORAGE AS FILE 'TAPE80' AND READ IN PERIODICALLY BY
C     EVENT(2).
C
C     **THE PROCESS WILL CONTINUE UNTIL ALL RECORDS HAVE BEEN READ.
C
C
C     N IS INITIALIZED HERE, IS USED AS A COUNTER IN EVENT(2)
```

```
      N = 0
C
100   READ(60,50,END=200) BULSTON,OVRSTON,OUTSTON,NPAX,EXPSTON,
     +     ALD,EAD,LAD,TYPE
      IF(XX(99).EQ.1)PRINT50,BULSTON,OVRSTON,OUTSTON,NPAX,EXPSTON,
     +   ALD,EAD,LAD,TYPE
50    FORMAT(1X,I4,4(1X,I4),3(1X,I2),1X,I1)
C
C     **ATRIB(1) IS THE ARRIVAL TIME AT THE APOE.
      XX(1) = ALD * 24
      XX(2) = XX(1) + 24
      A(1) = UNFRM(XX(1),XX(2),1)
C
C     **ATRIB(2) IS THE EXPECTED DEPARTURE TIME.
      XX(1) = A(1) + XX(10)
      XX(4) = (BULSTON+OVRSTON+OUTSTON+EXPSTON) * .03
      XX(5) = (EAD * 24) - XX(10)
      XX(1) = MAX(XX(1),XX(4),XX(5))
      XX(2) = (LAD * 24)+24 - XX(3)
      A(2) = UNFRM(XX(1),XX(2),1)
C
C     **ATRIB(3) IS THE NUMBER OF PASSENGERS
      A(3) = NPAX
C
C     **ATRIB(7) IS THE TYPE OF UNIT
      A(7) = TYPE
C
C     **XX(23) IS NON-EXPLOSIVE CARGO TONS.
      XX(23) = BULSTON + OVRSTON + OUTSTON
C
C     **XX(21) IS THE VEHICULAR STON ESTIMATE
C       THE USER DETERMINES BY XX(52) WHICH ESTIMATION METHOD TO USE.
      IF (XX(52).EQ.0) THEN
            IF(A(7).EQ.2.OR.A(7).EQ.4) XX(21) = .75 * XX(23)
            IF(A(7).EQ.3.OR.A(7).EQ.5) XX(21) = .1 * XX(23)
            IF(A(7).EQ.1) XX(21) = 0.0
         ELSE IF (XX(52).EQ.1) THEN
            XX(21) = OVRSTON + OUTSTON
         ELSE
      END IF
C
C     **XX(22) IS THE NON-VEHICULAR, NON-EXPLOSIVE STON ESTIMATE
      XX(22) = XX(23) - XX(21)
C
C     **ATRIB(4) IS THE NUMBER OF VEHICLES
      A(4) = NINT(XX(21)/XX(53))
C
C     **ATRIB(5) IS THE NUMBER OF PALLETS
      A(5) = NINT(XX(22)/XX(54))
C
C     **ATRIB(6) IS THE NUMBER OF EXPLOSIVE PALLETS
      A(6) = NINT(EXPSTON/XX(80))
```

```
C
C       **THE TRACE, IS ACTIVATED BY XX(99) =1, WILL PRINT THE ARRAY
         IF(XX(99).EQ.1)PRINT 170,A(1),A(2),A(3),A(4),A(5),A(6),A(7)
170     FORMAT(1X,7(1X,F7.2))
C
C
C       **WITH ALL ATRIBUTES DEFINED, THE ENTITY IS FILED AWAY
        CALL FILEM(1,A)
C
C       **RETURN TO DO THE NEXT ENTITY
        GO TO 100
C
C       **END OF FILE TRIGGERS 200
200     CALL RMOVE(1,1,A)
        DO 77 I=1,7
           WRITE (80,*) A(I)
77      CONTINUE
        IF (NNQ(1).GE.1) GO TO 200
        REWIND 80
        RETURN
C
C
C
C*************************************************************************
C       **EVENT 2 PULLS THE ENTITIES OUT OF FILE 1 AS THEIR ARRIVAL TIMES
          APPROACH. FILE 1 IS RANKED LVF ON ATRIB(1), THE ARRIVAL TIME,
          AND IS REPLENISHED WITH FRNS PULLED FROM THE INCOMING
          FRN LIST PREVIOUSLY WRITTEN TO TAPE80 BY EVENT(1). THE
          IDEA IS TO KEEP AT LEAST FIVE BUT NO MORE THAN 50 FRNS
          IN FILE 1 AT ALL TIMES, UNTIL THERE ARE NO MORE COMING.
C
2       IF (NNQ(1).LE.5.AND.XX(95).EQ.0) THEN
           DO 78 K=1,50
              DO 79 I=1,7
                 XX(95) = 1
                 READ (80,*,END=210) A(I)
                 XX(95) = 0
79            CONTINUE
              CALL FILEM(1,A)
              N = N + 1
78         CONTINUE
210        IF(XX(95).EQ.1) THEN
              PRINT*,N,' FRNS LOADED INTO FILE 1 AT',TNOW
           END IF
        END IF
        IF(NNQ(1).EQ.0) RETURN
        CALL RMOVE(1,1,ATRIB)
C
C       **THE TIME REMAINING TO ARRIVAL IS COMPUTED AND PLACED INTO
          ATRIB(1), AND USED AS THE DURATION OF THE LEAD IN ACTIVIT Y
        ATRIB(1) = ATRIB(1) - TNOW
        RETURN
```

```
C
C++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
C     **THE NEW FIRST ENTITY'S ATRIBUTES ARE COPIED INTO ATRIB
C       SO WE CAN DETERMINE WHEN IT WILL ARRIVE
3     IF(NNQ(1).EQ.0) RETURN
      CALL COPY(1,1,ATRIB)
      ATRIB(1) = ATRIB(1) - TNOW
      RETURN
C
C++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
C     EVENT 4  FREES THE RECEPTION POINT
4     II=MAX(ATRIB(4),ATRIB(5),ATRIB(6))
      CALL FREE(2,II)
      RETURN
C
C++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
C     EVENT 5  FREES THE APPROPRIATE BILLET AREA FEEDING RESOURCE, AND
C     CALCULATES THE NUMBER OF BUSES THIS GROUP NEEDS (ATRIB(7)).
5     II=ATRIB(8)
      IF(ATRIB(4).GT.0) CALL FREE(7,II)
      IF(ATRIB(5).GT.0) CALL FREE(8,II)
      IF(ATRIB(6).GT.0) CALL FREE(9,II)
      ATRIB(7) = USERF(11)
      ATRIB(8) = 0
      RETURN
C
C++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
C     EVENT 6  FREES THE BILLETING AREAS, USING THE SAME LOOPING
C     EMPLOYED TO ALLOCATE IT IN ALLOC(1)
6     II=MAX(ATRIB(4),ATRIB(5),ATRIB(6))
      DO 15 J=4,6
         IF(ATRIB(J).GT.0) CALL FREE(J+6,II)
15    CONTINUE
      RETURN
C
      END
C
C++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
C
C
C     SUBROUTINE INTLC INITIALIZES THE XX(.) ARRAY
C     TO 0.0, THEN SETS CERTAIN VARIABLES TO USER-
C     DEFINED VALUES
C     ALL TIMES ARE IN HOURS.
C
      SUBROUTINE INTLC
      DIMENSION NSET(70000)
      COMMON /SCOM1/ ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,
     +MSTOP,NCLNR,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,
     +SS(100),SSL(100),TNEXT,TNOW,XX(100)
      COMMON QSET(70000)
      EQUIVALENCE (NSET(1),QSET(1))
```

```
C
C
C     **THE ENTIRE XX(.) ARRAY IS FIRST SET TO 0.0**
      DO 10 I=1,100
         XX(I) = 0.0
C
C     **THEN CERTAIN VARIABLES ARE SET TO USER- DEFINED VALUES**
C
C     ** XX(1) THRU XX(2) INTERNAL USE
C
C     ** XX(3) = FLIGHT TIME TO THE COMBAT THEATER
      XX(3) = 12.0
C
C     ** XX(4) THRU XX(5) INTERNAL USE
C
C     ** XX(6) = THE EARLIEST TIME PRIOR TO DEPARTURE THAT
C        BILLETED FRNS MAY REPORT TO PAX STAGING
      XX(6) = 8.0
C
C     ** XX(7) NOT USED
C
C     ** XX(8) IS THE MINIMUM TIME BEFORE DEPARTURE TO
C       JUSTIFY ALLOCATION OF BILLETING
      XX(8) = 18.0
C
C     ** XX(9) NOT USED
C
C     ** XX(10) = MINIMUM TIME TO PREPARE AN FRN
      XX(10) = 8.0
C
C     ** XX(11) = PERCENTAGE OF VEHCILES NEEDING WASHING UPON ARRIVAL
      XX(11) = .75
C
C     ** XX(12) = TIME BEFORE DEPARTURE TO TURN VEHICLES INTO PROCESSING
      XX(12) = 8.0
C
C     ** XX(13) = TRANSIT TIME FROM RECEPTION TO VEHICLE PROCESSING
      XX(13) = .3
C
C     ** XX(14) INTERNAL USE
C
C     ** XX(15) = PERCENTAGE OF VEHICLES PASSING JOINT INSPECTION.
      XX(15) = .95
C
C     ** XX(16) = PERCENTAGE OF FAILED VEHICLES FAILING FOR WASHING
      XX(16) = .75
C
C     ** XX(17) = PERCENTAGE OF PALLETS PASSING JOINT INSPECTION
      XX(17) = .96
C
C     **XX(18) = TIME BEFORE DEPARTURE TO LOAD EXPLOSIVES ON K-LOADER
      XX(18) = 1.0
```

```
C
C     ** XX(19) TIME BEFORE AIRCRAFT LOADING TO PUT CARGO ON K-LOADER
      XX(19) = 1.0
C
C     ** XX(20) = PERCENTAGE OF FRNS WHICH HAVE THEIR OWN TRANSPORTATION
      XX(20) = .5
C
C     ** XX(21) THRU XX(23) INTERNAL USE
C
C     ** XX(24) THRU XX(25) NOT USED
C
C     ** XX(26) = DURATION RECPOINT TO TRABIL1
      XX(26) = .17
C
C     ** XX(27) = DURATION RECPOINT TO TRABIL2
      XX(27) = .2
C
C     ** XX(28) = DURATION RECPOINT TO TRABIL3
      XX(28) = .33
C
C     ** XX(29) THRU XX(30) NOT USED
C
C     ** XX(31) = TRANSPORTATION TIME TO EXPLOSIVE AREA
      XX(31) = 1.0
C
C     ** XX(32) = PERCENTAGE OF UNIT PALLETS PASSING INITIAL INSPECTION.
      XX(32) = .5
C
C     ** XX(33) THRU XX(35) NOT USED
C
C     ** XX(36) = DURATION TRABIL1 TO PAX STAGING
      XX(36) = .22
C
C     ** XX(37) = DURATION TRABIL2 TO PAX STAGING
      XX(37) = .25
C
C     ** XX(38) = DURATION TRABIL3 TO PAX STAGING
      XX(38) = .33
C
C     **(39) THRU XX(41) NOT USED
C
C     ** XX(42) = DURATION RECPOINT TO PAX STAGING
      XX(42) = .25
C
C     ** XX(43) = TYPE TRANSPORT PAX STAGING TO TERMINAL
      XX(43) = 0
C
C     ** XX(44) = DURATION PAX STAGING TO TERMINAL
      XX(44) = .03
C
C     ** XX(45) = EARLIEST TIME BEFORE DEPARTURE FRNS WILL
```

```
C         MOVE TO TERMINAL
          XX(45) = 4.0
C
C         ** XX(46) = PERCENT OF AIRCRAFT PARKING SPOTS WITHIN WALKING
C            DISTANCE OF THE TERMINAL
          XX(46) = .60
C
C         ** XX(47) = ROUND TRIP TRANSPORT TIME TO AIRCRAFT VIA BUS
          XX(47) = .33
C
C         ** XX(48) NOT USED
C
C         ** XX(49) = DURATION TERMINAL TO AIRCRAFT BY FOOT
          XX(49) = .25
C
C         ** XX(50) = TYPE TRANSPORT MOBILITY LINE TO PAX STAGING
C            (FOR ONBASE DEPLOYING PERSONNEL)
          XX(50) = 1
C
C         ** XX(51) = DURATION MOBILITY LINE TO PAX STAGING
          XX(51) = .5
C
C         XX(52) IS A SWITCH. IF SET TO 0, THE MAC % ARE USED IN ESTIMATING
C         THE VEHICULAR CARGO (80% OF URC, 10% OF NRC). IF SET TO 1, THE
C         TOTAL OF OVERSIZE AND OUTSIZE CARGO IS CONSIDERED TO BE VEHICULAR.
          XX(52) = 0
C
C         ** XX(53) = AVERAGE VEHICLE WEIGHT IN SHORT TONS
          XX(53) = 3.25
C
C         ** XX(54) = AVERAGE PALLET WEIGHT IN SHORT TONS
          XX(54) = 1.7
C
C         ** XX(55) NOT USED
C
C         ** XX(56) = VEHICLE TRANSIT TIME FROM THE RECEPTION POINT
C           TO THE WASHRACK
          XX(56) = .05
C
C         ** XX(57) = VEHICLE TRANSIT TIME FROM WASHRACK TO VEHICLE
C            PROCESSING AREA
          XX(57) = .05
C
C         ** XX(58) THRU XX(62) NOT USED
C
C         ** XX(63) = TRANSIT TIME FROM JOINT INSPECTION (JI) TO WASHRACK
          XX(63) = .03
C
C         ** XX(64) NOT USED
C
          XX(65) = .05
C         ** XX(65) = TRANSIT TIME FROM VEHPROC TO VEHPARK
```

```
C
C     ** XX(66) THRU XX(71) NOT USED
C
C     ** XX(72) = TRANSIT TIME JI TO FRUSTRATED PALLET PROCESSING
      XX(72) = .05
C
C     ** XX(73) THRU XX(74) NOT USED
C
C     ** XX(75) = TRANSIT TIME NRC RECEPTION PT TO NRC TERMINAL
      XX(75) = .25
C
C     ** XX(76) IS A SWITCH- 1= ONBASE NRC IS PROCESSED BY SURFAC E
C        FREIGHT SECTION, 0= NOT
      XX(76) = 1
C
C     ** XX(77) THRU XX(79) NOT USED
C
C     ** XX(80) IS THE AVERAGE EXPLOSIVE PALLET WEIGHT
      XX(80) = 4.0
C
C     ** XX(81) THRU XX(86) STATISTICS COLLECTION
C
C     ** XX(87) THRU XX(94) NOT USED
C
C     ** XX(95) IS USED IN EVENT(2), MUST BE LEFT EQUAL TO ZERO.
C
C     ** XX(96) THRU XX(97) NOT USED
C
C     ** XX(98) INTERNAL USE
C
C     ** XX(99) IS THE TRACE SWITCH: 0=OFF, 1=ON
      XX(99) = 0
      RETURN
      END
C
C
C
C*************************************************************************
      FUNCTION USERF(I)
C
C     USER FUNCTIONS DETERMINE VARIOUS PROCESSING
C     TIMES AND FRN CHARACTERISTICS, BASED ON
C     TRANSIT TIMES, RANDOM SELECTIONS, AND USER
C     PROVIDED PROBABILITY ESTIMATES.  ALL TIMES
C     ARE EXPRESSED IN HOURS AND DISTRIBUTIONS
C     USED FOR RANDOM SELECTIONS ARE INDICATED
C     IN THE CODE.
C
C
      DIMENSION NSET(70000)
      COMMON /SCOM1/ ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,
     +MSTOP,NCLNR,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,
```

```
     +SS(100),SSL(100),TNEXT,TNOW,XX(100)
      COMMON QSET(70000)
      EQUIVALENCE (NSET(1),QSET(1))
C
      GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,
     +22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40),I
C
C     THESE ALGORITHMS, PREPARED FOR DEMONSTRATION OF THE MODEL,  CAN BE
C     ALTERED TO REFLECT THE USER'S SYSTEM OPERATION. THE VARIOUS
C     USERFS SHOWN HERE DEMONSTRATE SEVERAL APPROACHES APPLICABLE TO
C     A TYPICAL RECEPTION SYSTEM.
C
C*********************************************************************
C     USERF(1) IS THE INPROCESSING TIME FOR OFFBASE DEPLOYING
C     PERSONNEL.
C
1     USERF = TRIAG(.25,.5,1.0,2)
      IF (XX(99).EQ.1) PRINT*,'USERF(1) = ',USERF,' AT TNOW = ',TNOW
      RETURN
C
C*********************************************************************
C
C     USERF(2) CALCULATES THE TIME REMAINING BEFORE THE FRN IS
C     SCHEDULED TO ENTER THE PAX STAGING AREA. THIS IS DRIVEN BY THE
C     SCHEDULED DEPARTURE TIME, THE EARLIEST TIME BILLETED FRNS MAY
C     REPORT TO THE PAX STAGING AREA, THE TRANSIT TIME FROM THE
C     RECEPTION POINT TO THE PAX STAGING AREA, AND THE CURRENT TIME.
C
C
2     USERF = ATRIB(2) - TNOW - XX(6) - XX(42)
      IF (USERF.LT.0) THEN
         USERF = 0
      END IF
      IF (XX(99).EQ.1) PRINT*,'USERF(2) = ',USERF,' AT TNOW = ',TNOW
      RETURN
C
C*********************************************************************
C
C     USERF(3) THRU (5) CALCULATE THE NUMBER OF BUSES NEEDED. THESE
C     CALCULATIONS ARE DRIVEN BY THE NUMBER OF PERSONS BEING SENT TO
C     EACH OF THE BILLETING AREAS, AS REFLECTED BY ATRIBUTES 4-6.
C     THE ALGORITHM ASSUMES THAT EACH UNIT OF 'BUS' RESOURCE IS A
C     40 PAX BUS. ANY FRACTION OF A SINGLE BUSLOAD WILL BE GIVEN A BUS.
C
C     THE ALGORITHM USES INTEGER DIVISION, KEYING ON THE APPROPRIATE
C     ATRIBUTE VALUE AND THE ASSUMPTION THAT EACH BUS HAS A NORMAL
C     CAPACITY OF 40. AFTER DIVIDING THE ATRIBUTE BY 40, IT ADDS 1
C     TO PUSH THE FIGURE OVER THE NEXT INTEGER IF THERE IS LESS THAN
C     A FULL BUSLOAD. IT THEN TRUNCATES THE DECIMAL PART,
C     RETURNING THE INTEGER VALUE.
C
C
```

```
3     USERF = INT(ATRIB(4)/40 + 1)
      IF (XX(99).EQ.1) PRINT*,'ATRIB(4) = ',ATRIB(4),' USERF =',USERF
      RETURN
C
C
4     USERF = INT(ATRIB(5)/40 + 1)
      IF (XX(99).EQ.1) PRINT*,'ATRIB(5) = ',ATRIB(5),' USERF =',USERF
      RETURN
C
C
5     USERF = INT(ATRIB(6)/40 + 1)
      IF (XX(99).EQ.1) PRINT*,'ATRIB(6) = ',ATRIB(6),' USERF =',USERF
      RETURN
C
C*******************************************************************
C     USERF(6) COLLECTS PASSENGER STATISTIC
6     IF(ATRIB(2).LT.TNOW)XX(81) = XX(81) + ATRIB(3)
      IF(ATRIB(2).GE.TNOW)XX(82) = XX(82) + ATRIB(3)
      USERF = 0
      RETURN
C
C
C     USERF(7) COLLECTS VEHICLE ON TIME PERCENTAGE
C
7     IF(ATRIB(2).LT.TNOW)XX(84) = XX(84) + XX(53)
      IF(ATRIB(2).GE.TNOW)XX(85) = XX(85) + XX(53)
      USERF = 0
C
      RETURN
C
C*********************************************************************
C
C     USERF(8) CALCULATES THE TIME THAT THE FRN HAS REMAINING IN THE
C     TRANSIENT BILLETING AREA. THIS FIGURE IS DRIVEN BY THE SCHEDULED
C     DEPARTURE TIME, THE CURRENT TIME, THE EARLIEST TIME TO
C     ENTER PAX STAGING, AND THE TRANSIT TIME FROM EACH
C     BILLETING AREA TO THE PAX STAGING AREA.
C     NOTE THAT WHEN AN FRN IS SPLIT AMONG SEVERAL AREAS BY ALLOC(1),
C     IT IN EFFECT BECOMES SEVERAL FRNS. EACH HAS THE SAME
C     CHARACTERISTICS (DEPARTURE TIME,ETC), BUT FROM THIS POINT
C     ON THE TOTAL PAX FIGURE (ATRIB(3)) IS MEANINGLESS UNLESS
C     THE FRN DID NOT GO THROUGH BILLETING.
C
8     IF (ATRIB(4).GT.0) THEN
            USERF = ATRIB(2) - TNOW - XX(6) - XX(36)
         ELSE IF (ATRIB(5).GT.0) THEN
            USERF = ATRIB(2) - TNOW - XX(6) - XX(37)
         ELSE IF (ATRIB(6).GT.0) THEN
            USERF = ATRIB(2) - TNOW - XX(6) - XX(38)
      ELSE
         USERF = ATRIB(2) - TNOW - XX(6)
      END IF
```

```
               IF (USERF.LT.0) THEN
                  USERF = 0.0
               END IF
         IF (XX(99).EQ.1) PRINT*,'TIME LEFT IN BILLETING = ',USERF
         RETURN
C
C**********************************************************************
C
C        USERF(9) CALCULATES THE PROCESSING TIME NEEDED IN PASSENGER
C        STAGING.
C
9        USERF = ATRIB(3) * .008 + .15
         IF(XX(99).EQ.1)PRINT*,'USERF(9) = ',USERF,' AT ',TNOW
         RETURN
C
C**********************************************************************
C
C        USERF(10) CALCULATES THE TIME REMAINING IN PAX STAGING UPON
C        COMPLETION OF PROCESSING. THIS IS DRIVEN BY THE SCHEDULED
C        DEPARTURE TIME, THE EARLIEST TIME FRNS MAY REPORT TO THE PAX
C        TERMINAL, AND THE TRANSIT TIME FROM PAX STAGING TO THE TERMINAL.
C
C        NOTE THAT THIS IS A FUNCTION OF THE PARAMETER ESTABLISHED BY THE
C        USER IN XX(45), THE EARLIEST TIME AN FRN MAY GO TO THE TERMINAL.
C        THEREFORE, IF XX(45) IS SET VERY LARGE, THE FRNS WILL BE MOVED TO
C        TERMINAL SOONER THAN IF IT IS SMALL. AS A CONSEQUENCE, MORE OF
C        THEM WILL BE UNABLE TO MAKE THIS MOVE ON SCHEDULE, DUE TO EARLIER
C        DELAYS. HOWEVER, BY SETTING XX(45) TO A LARGE VALUE, THERE IS A
C        GREATER AMOUNT OF SLACK IN THE TERMINAL AREA, AND IT IS VERY
C        LIKELY THAT AN FRN COULD SHOW UP AS 'LATE' GETTING TO THE
C        TERMINAL, BUT STILL MAKE ITS SCHEDULED DEPARTURE.
C
10       USERF = ATRIB(2) - TNOW - XX(45) - XX(44)
         IF (USERF.LT.0) THEN
            USERF = 0
         END IF
         IF(XX(99).EQ.1) PRINT*,'USERF(10) = ',USERF
         RETURN
C
C**********************************************************************
C
C        USERF(11) CALCULATES THE NUMBER OF BUSES NEEDED BY THIS GROUP.
C
11       II = MAX(ATRIB(4),ATRIB(5),ATRIB(6))
         IF(II.EQ.0) II = ATRIB(3)
         USERF = INT(II/40.0 + 1)
         IF (XX(99).EQ.1) PRINT*,'II = ',II,', USERF(11) = ',USERF
         RETURN
C
C**********************************************************************
C
C        USERF(12) CALCULATES THE PROCESSING TIME NEEDED IN THE PASSENGER
```

```
C     TERMINAL.
C
12    XX(7) = ATRIB(3) * .008 + .15
      USERF = MIN(2.0,XX(7))
      IF(XX(99).EQ.1) PRINT*,'USERF(12) = ',USERF,' AT ',TNOW
      RETURN
C
C*************************************************************************
C
C     USERF(13) CHECKS TO SEE WHERE AN FRN IS GOING AND
C     ASSIGNS THE APPROPRIATE TRANSIT TIME FROM THOSE PREVIOUSLY
C     ESTABLISHED BY THE USER IN THE XX(.) ARRAY.
C
13    IF (ATRIB(4).GT.0) USERF = XX(26)
      IF (ATRIB(5).GT.0) USERF = XX(27)
      IF (ATRIB(6).GT.0) USERF = XX(28)
      IF (XX(99).EQ.1) PRINT*,'USERF(13) = ',USERF
      RETURN
C
C*************************************************************************
C
C     USERF(14) CHECKS TO SEE FROM WHICH AREA AN FRN IS COMING, AND
C     ASSIGNS THE APPROPRIATE TRANSIT TIME ESTABLISHED BY THE
C     USER IN THE XX(.) ARRAY.
C
14    IF (ATRIB(4).GT.0) USERF = XX(36)
      IF (ATRIB(5).GT.0) USERF = XX(37)
      IF (ATRIB(6).GT.0) USERF = XX(38)
      IF (XX(99).EQ.1) PRINT*,'USERF(14) = ',USERF
      RETURN
C
C*************************************************************************
C
C     USERF(15) DETERMINES THE NUMBER OF VEHICLES IN AN FRN
C     WHICH WILL NEED WASHING UPON ARRIVAL.
C
15    USERF = NINT(ATRIB(4) * XX(11))
      IF(XX(99).EQ.1)PRINT*,'USERF(15) = ',USERF,' AT ',TNOW
      RETURN
C
C*************************************************************************
C
C     USERF(16) AND (17) CALCULATE THE TIME REMAINING IN THE TERMINAL
C     FOLLOWING THE COMPLETION OF FINAL PROCESSING. THE FIRST IS USED
C     FOR THOSE FRNS WHO WILL BE WALKING TO THEIR AIRCRAFT, AND THE
C     SECOND FOR THOSE WHO WILL REQUIRE BUS TRANSPORT. NOTE THAT THESE
C     FACTORS ARE SET BY THE USER AS PERCENTAGES IN XX(46).
C     THIS IS INCLUDED TO ALLOW FOR DIFFERENT AIRFIELD LAYOUTS, IN
C     WHICH SOME PARKING SPOTS MAY BE CLOSE TO THE TERMINAL AND OTHERS
C     ARE FAR AWAY. ALSO, POLICY CHANGES MAY BE MODELED. FOR INSTANCE,
C     BASE X MAY DECIDE THAT IN GOOD WEATHER ALL AIRCRAFT WILL BE
C     WITHIN WALKING DISTANCE, WHILE IN BAD WEATHER (SUCH AS WINTER)
```

```
C     ONLY 2 OUT OF 10 (20%) AIRCRAFT WILL BE PARKED WITHIN WALKING
C     DISTANCE. EACH OF THESE POLICIES COULD BE EXAMINED FOR THE IMPACT
C     ON THE BUS RESOURCE, AND WHETHER THE RESOURCES AVAILABLE WILL BE
C     ENOUGH.
C
C      IT IS POSSIBLE THAT ALL FRNS COULD BE ON SCHEDULE UP
C     TO THIS POINT, AND STILL BE LATE REACHING THEIR AIRCRAFT DUE TO
C     THE STRUCTURE OF THE MODEL. AN FRN WHICH IS TO BE BUSED TO THE
C     AIRCRAFT WILL NOT PRESENT ITSELF FOR BUS ALLOCATION UNTIL XX(47)
C     HOURS PRIOR TO ITS SCHEDULED DEPARTURE FROM THE SYSTEM, WHERE
C     XX(47) IS SET BY THE USER TO BE THE AVERAGE TRANSIT TIME BY BUS
C     TO THE AIRCRAFT. THEREFORE, IF THE FRN NEEDS MORE BUSES THAN ARE
C     AVAILABLE AT THAT MOMENT, IT WILL BE SOMEWHAT LATE IN GETTING TO
C     THE AIRCRAFT. SINCE THE 'SCHEDULED DEPARTURE TIME' USED THROUGH-
C     OUT THIS MODEL REFERS TO DEPARTURE FROM THE RECEPTION SYSTEM,
C     (WHICH IS ACTUALLY THE FRN'S ARRIVAL AT THE AIRCRAFT), SOME DELAY
C     IS ACCEPTABLE SINCE THEY SHOULD BE LOADING SOME 1-2 HOURS PRIOR
C     TO TAKE-OFF.
C
16    USERF = ATRIB(2) - XX(49) - TNOW
      IF (USERF.LT.0) THEN
         USERF=0
      END IF
      IF (XX(99).EQ.1) PRINT*,'USERF(16) = ',USERF,', TNOW = ',TNOW
      RETURN
C
C
17    USERF = ATRIB(2) - XX(47) - TNOW - (.4*ATRIB(7))
      IF (USERF.LT.0) THEN
         USERF = 0
      END IF
      IF (XX(99).EQ.1) PRINT*,'USERF(17) = ',USERF,', TNOW = ',TNOW
      RETURN
C
C**********************************************************************
C
C     USERF(18) IS THE TIME TO BUILD AND INSPECT ONE PALLET.
18    USERF = TRIAG(.5,.75,1.0,2)
      IF(XX(99).EQ.1)PRINT*,'USERF(18) = ',USERF,' AT ',TNOW
      RETURN
C
C**********************************************************************
C
C     USERF(19) CALCULATES THE CARGO INPROCESSING TIME, BASED ON THE
C     TOTAL AMOUNT OF CARGO (ATRIB(4)). THE TIME IS EXPRESSED IN HOURS.
C
19    USERF = TRIAG(.1,.6,1.25,2)
      IF (XX(99).EQ.1) PRINT*,'USERF(19) = ',USERF,' TIME = ',TNOW
      RETURN
C
C**********************************************************************
C
```

```
C USERF(20) DETERMINES IF UNIT RELATED PAX WILL HAVE THEIR OWN TRANSPORT
C
20    XX(98) = DRAND(4)
         IF(XX(98).LE.XX(20)) USERF = 0
         IF(XX(98).GT.XX(20)) USERF = 1
      IF(XX(99).EQ.1)PRINT*,'USERF(20) = ',USERF,' AT ',TNOW
      RETURN
C
C*********************************************************************
C
C     USERF(21) DETERMINES HOW LONG UNITS  MAY KEEP
C     THEIR OWN VEHICLES BEFORE TURNING THEM OVER TO VEHICLE PROCESSING.
C
21    USERF = ATRIB(2) - TNOW - XX(12)
         IF(USERF.LT.0)THEN
            USERF = 0
         ENDIF
      IF(XX(99).EQ.1)PRINT*,'USERF(21) = ',USERF,' AT ',TNOW
      RETURN
C
C*********************************************************************
C
C     USERF(22) IS THE VEHICLE INSPECTION TIME.
C
22    USERF = TRIAG(.06,.25,.33,2)
      IF (XX(99).EQ.1) PRINT*,'USERF(22) = ',USERF,' TIME = ',TNOW
      RETURN
C
C*********************************************************************
C
C     USERF(23) DETERMINES IF VEHICLES PASS JOINT INSPECTION AND THE
C     REASON FOR FAILURE.
C
23    XX(98)=DRAND(4)
         IF(XX(98).LE.XX(15))THEN
            USERF = 0
         ELSE
            XX(98) = DRAND(4)
            IF(XX(98).LE.XX(16)) USERF = 1
            IF(XX(98).GT.XX(16)) USERF = 2
         ENDIF
      IF(XX(99).EQ.1)PRINT*,'USERF(23) = ',USERF,' AT ',TNOW
      RETURN
C
C*********************************************************************
C
C     USERF(24) CALCULATES THE TIME LEFT IN THE PARKING AREA AFTER
C     JI IS FINISHED. IF THIS TIME IS NEGATIVE THE TIME IS SET TO
ZERO.
C
24    USERF = ATRIB(2) - TNOW
      IF (USERF.LT.0) THEN
```

```
         USERF=0
      END IF
      IF (XX(99).EQ.1) PRINT*,'USERF(24) = ',USERF,' TIME = ',TNOW
      RETURN
C
C**********************************************************************
C
C     USERF(25) DETERMINES IF A PALLET PASSES JOINT INSPECTION.
C
25    XX(98) = DRAND(4)
         IF(XX(98).LE.XX(17))USERF = 0
         IF(XX(98).GT.XX(17))USERF = 1
      IF(XX(99).EQ.1)PRINT*,'USERF(25) = ',USERF,' AT ',TNOW
      RETURN
C
C**********************************************************************
C
C     USERF(26) DETERMINES THE NUMBER OF VEHICLES IN AN FRN WHICH WILL
C     NOT NEED WASHING.
C
26    USERF = NINT(ATRIB(4) * (1-XX(11)))
      IF(XX(99).EQ.1)PRINT*,'USERF(26) = ',USERF,' AT ',TNOW
      RETURN
C
C**********************************************************************
C
C     USERF(27) DETERMINES THE TIME UNTIL PALETIZED EXPLOSIVES WILL BE
C     LOADED ON A K-LOADER. THE DRAND(4) FACTOR STAGGERS THE PALLET
C     LOADING SCHEDULE FOR LARGE FRNS.
C
27    USERF = ATRIB(2) - TNOW - XX(18) - DRAND(4)
          IF(USERF.LT.0) THEN
             USERF = 0
          END IF
      IF (XX(99).EQ.1)PRINT*,'USERF(27) = ',USERF,' AT ',TNOW
      RETURN
C
C**********************************************************************
C
C     USERF(28) DETERMINES THE BUS DISPATCH TIME TO PICK UP PASSENGERS.
C
28    USERF = TRIAG(0.0,.17,.33,2)
      IF(XX(99).EQ.1) PRINT*,'USERF(28) = ',USERF,' AT ',TNOW
      RETURN
C
C**********************************************************************
C
C     USERF(29) IS THE PALLET INSPECTION TIME.
C
29    USERF=TRIAG(.08,.165,.25,2)
      IF (XX(99).EQ.1) PRINT*,'USERF(29) = ',USERF,' TIME = ',TNOW
      RETURN
```

```
C
C*******************************************************************
C
C     USERF(30) IS THE TIME NEEDED TO REWORK FRUSTRATED PALLETS.
C
30    USERF=TRIAG(.25,1.0,2.0,2)
      IF (XX(99).EQ.1) PRINT*,'USERF(30) = ',USERF,' TIME = ',TNOW
      RETURN
C
C*******************************************************************
C
C     USERF(31) DETERMINES THE TIME TO BUILD AN EXPLOSIVE PALLET.
C
31    USERF = TRIAG(.75,1.0,1.5,2)
      IF (XX(99).EQ.1) PRINT*,'USERF(31) =',USERF,' AT ',TNOW
      RETURN
C
C*******************************************************************
C
C     USERF(32) CALCULATES THE TIME REMAINING  IN MARSHALLING.
C
32    USERF = ATRIB(2) - TNOW - XX(19) - DRAND(4)
      IF (USERF.LT.0) THEN
         USERF = 0.0
      END IF
      IF (XX(99).EQ.1) PRINT*,'USERF(32) = ',USERF,' TIME = ',TNOW
      RETURN
C
C*******************************************************************
C
C     USERF(33) IS THE VEHICLE WASH TIME.
33    USERF = TRIAG(.06,.25,.5,2)
      IF(XX(99).EQ.1)PRINT*,'USERF(33) = ',USERF,' AT ',TNOW
      RETURN
C
C*******************************************************************
C
C     USERF(34) IS THE VEHICLE PROCESSING TIME.
34    USERF = TRIAG(.06,.25,.33,2)
      IF(XX(99).EQ.1)PRINT*,'USERF(34) = ',USERF,' AT ',TNOW
      RETURN
C
C*******************************************************************
C
C     USERF(35) IS THE TIME TO LOAD/UNLOAD ONE PALLET OF GENERAL CARGO.
35    USERF = TRIAG(.01,.0165,.06,2)
      IF(XX(99).EQ.1)PRINT*,'USERF(35) = ',USERF,' AT ',TNOW
      RETURN
C
C*******************************************************************
C
C     USERF(36) IS THE TIME TO RECEIVE ONE PALLET OF CARGO IN THE
```

```
C     FREIGHT SECTION.
C
36    USERF = TRIAG(.01,.02,.03,2)
      IF(XX(99).EQ.1)PRINT*,'USERF(36) = ',USERF,' AT ',TNOW
      RETURN
C
C*****************************************************************************
C
C     USERF(37) IS THE TIME TO LOAD/UNLOAD ONE PALLET OF EXPLOSIVES.
C
37    USERF = TRIAG(.15,.2,.25,2)
      IF(XX(99).EQ.1)PRINT*,'USERF(37) = ',USERF,' AT ',TNOW
      RETURN
C
C*****************************************************************************
C
C     USERF(38) COLLECTS GENERAL CARGO PALLET ON-TIME PERCENTAGE.
C
38    IF(ATRIB(2).LT.TNOW)XX(84) = XX(84) + XX(54)
      IF(ATRIB(2).GE.TNOW)XX(85) = XX(85) + XX(54)
      USERF = 0
      RETURN
C
C*****************************************************************************
C
C     USERF(39) COLLECTS EXPLOSIVE PALLET ON-TIME PERCENTAGE.
C
39    IF(ATRIB(2).LT.TNOW)XX(84)=XX(84) + XX(80)
      IF(ATRIB(2).GE.TNOW)XX(85) = XX(85) + XX(80)
      USERF = 0
      RETURN
C
C*****************************************************************************
C
      USERF(40) DETERMINES THE NUMBER OF PEOPLE IN A GROUP COMING
C     FROM VARIOUS AREAS.
C
40    II = MAX(ATRIB(4),ATRIB(5),ATRIB(6))
      IF(II.GT.0)USERF = II
      IF(II.EQ.0)USERF = ATRIB(3)
      RETURN
      END
C*****************************************************************************
      SUBROUTINE ALLOC(IAC,IFLAG)
      DIMENSION NSET(70000)
      COMMON /SCOM1/ ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,
     +MSTOP,NCLNR,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,
     +SS(100),SSL(100),TNEXT,TNOW,XX(100)
      COMMON QSET(70000)
      EQUIVALENCE (NSET(1),QSET(1))
C
      GO TO (1,2,3,4,5,6,7,8,9,10,11),IAC
```

```
C
C***********************************************************************
C
C     ALLOC(1) ALLOCATES TRANSIENT BILLETING. BILLETING IS IN 3
C     AREAS, LABELLED TRABIL1- TRABIL3. THE LABELS CORRESPOND TO THE
C     PREFERENCE THAT THE MANAGERS WILL GIVE TO THE AREAS. IN OTHER
C     WORDS, AREA 1 WOULD NORMALLY BE USED BEFORE AREA 2, AND SO ON. IT
C     IS NOT NECESSARY THAT ALL THREE AREAS BE USED. IF A PARTICULAR BASE
C     ONLY ESTABLISHES TWO AREAS, THEN THE USER NEED ONLY SET THE
C     AVAILABILITY OF AREA 3 TO ZERO ON THE 'RESOURCE' CARD IN
C     THE NETWORK PORTION OF THE INPUT. THIS WILL PREVENT THE MODEL FROM
C     EVER ASSIGNING ANY FRN TO THAT AREA.
C
C     IN DEFINING THE AVAILABILITY OF BILLETING, THE 'UNIT OF ISSUE' IS
C     ONE SLEEPING SPACE. THIS ASSUMES THAT THE ASSOCIATED SERVICES ARE
C     PROVIDED AS WELL (SANITARY FACILITIES, TRASH REMOVAL, ETC.).
C
C     THE FIRST STEP IN THE ALLOCATION IS A RE-EXAMINATION OF THE TIME
C     REMAINING BEFORE DEPARTURE. IF THE FRN HAS BEEN WAITING TOO LONG,
C     THERE IS NO LONGER ANY POINT IN SENDING THEM TO BILLETING. THEY
C     ARE INSTEAD ROUTED BACK TO THE NETWORK, WHICH SENDS THEM TO PAX
C     STAGING.
1     ATRIB(1) = ATRIB(2) - TNOW
      IF (ATRIB(1).LT.XX(8)) THEN
         IFLAG = 1
         RETURN
      END IF
C
C     IF THERE IS STILL ENOUGH TIME TO BILLET THEM, WE FIRST TRY TO PUT
C     THE ENTIRE FRN IN ONE AREA.
C
      II=ATRIB(3)
      DO 25 J=4,6
         IF (NNRSC(J+6).GE.II) THEN
            CALL SEIZE(J+6,II)
            ATRIB(J) = II
            IFLAG = 1
            RETURN
         END IF
25    CONTINUE
C
C     FAILING TO PUT THEM INTO ONE AREA, WE NEXT CHECK TO SEE IF THERE
C     ARE ENOUGH SPACES IN ALL AREAS COMBINED.
C     IF THERE ARE NOT, THE FRN IS TOLD TO WAIT IN THE QUEUE. IF THERE
C     ARE ENOUGH SLOTS SCATTERED AROUND, WE START BY ALLOCATING THE
C     LARGEST CHUNK FIRST. THIS CONTINUES UNTIL THE ENTIRE FRN HAS BEEN
C     BILLETED.
C
      II=NNRSC(10) + NNRSC(11) + NNRSC(12)
      IF (II.LT.ATRIB(3)) THEN
         IFLAG = 0
         RETURN
```

```
         ELSE
            NNEED = ATRIB(3)
100         II=MAX(NNRSC(10),NNRSC(11),NNRSC(12))
            DO 20 K=4,6
            IF(II.EQ.NNRSC(K+6)) THEN
               IF (II.LE.NNEED) THEN
                  CALL SEIZE(K+6,II)
                  ATRIB(K) = II
                  NNEED=NNEED-II
               ELSE
                  CALL SEIZE(K+6,NNEED)
                  ATRIB(K)=NNEED
                  NNEED=0
                  IFLAG=1
                  RETURN
               END IF
            END IF
20          CONTINUE
      GO TO 100
      END IF
C
C
C***********************************************************************
C
C     ALLOC(2) IS THE BUS ALLOCATION ROUTINE, AND IS USED IN SEVERAL
C     LOCATIONS. IN EVERY CASE, WHEN AN FRN ARRIVES AT A NODE TO RECEIVE
C     BUSES, IT CARRIES WITH IT ATRIBUTE 7, WHICH IS THE NUMBER OF
C     BUSES IT NEEDS, AND ATRIBUTE 8, WHICH IS THE NUMBER OF BUSE SIT
C     HAS AT THE MOMENT (0 TO START WITH). THE ROUTINE FIRST ATTEMPTS TO
C     GIVE THE FRN ALL THE BUSES IT NEEDS AT ONE TIME. FAILING THIS, IT
C     GIVES ALL THE BUSES THAT ARE AVAILABLE. IF NONE ARE AVAILABLE, THE
C     FRN IS TOLD TO WAIT.
C
C     AS BUSES ARE ALLOCATED, ATRIBUTE 7 IS DECREMENTED BY THAT NUMBER
C     AND REPRESENTS THE NUMBER OF BUSLOADS OF PEOPLE STILL WAITING FOR
C     TRANSPORTATION. AS SHOWN BY THE NETWORK DIAGRAM IN CHAPTER FOUR,
C     AS LONG AS ATRIBUTE 7 IS GREATER THAN 0, THE FRN WILL CONTINUE TO
C     LOOP BACK TO THE AWAIT NODE TO RECEIVE THE BUSES IT STILL NEEDS.
C
C     THESE BUSES MAY COME FROM EITHER THE ONES IN USE BY THIS FRN,
C     COMING BACK FOR A SECOND LOAD, OR FROM BUSES BEING RELEASED FROM
C     OTHER PARTS OF THE NETWORK. WHICHEVER THE CASE, THEY ARE AL LOCATED
C     AND ATRIB(8) SHOWS HOW MANY THE FRN CURRENTLY HAS. THIS IS THE
C     NUMBER WHICH WILL BE RELEASED AFTER THE DURATION OF THE TRIP HAS
C     ELAPSED.
C
C
2     II=ATRIB(7)
      IF (NNRSC(4).GE.II) THEN
            CALL SEIZE(4,II)
            ATRIB(7) = 0
            ATRIB(8) = II
```

```
            IFLAG = 1
         ELSE IF (NNRSC(4).GT.0) THEN
            ATRIB(7) = ATRIB(7) - NNRSC(4)
            ATRIB(8) = NNRSC(4)
            CALL SEIZE(4,NNRSC(4))
            IFLAG = 1
         ELSE
            IFLAG = 0
      END IF
C
      RETURN
C*********************************************************************
C
C     ALLOC(3) ALLOCATES BILLET AREA FEEDING CAPABILITY. IN DEFINING
C     THIS RESOURCE, THE MANAGERS MUST TAKE INTO ACCOUNT THE CAPABILITY
C     OF SOME TRANSIENT FRNS TO FEED THEMSELVES. AS THIS THESIS IS BEING
C     PREPARED, THIS CAPABILITY IS LARGELY A MYSTERY. WHEN IT BECOMES
C     KNOWN THAT A GIVEN UNIT WILL ARRIVE ON A CERTAIN DAY AND WILL SET
C     UP A FIELD KITCHEN FOR 15 DAYS, THE MODEL CAN BE MODIFIED TO TAKE
C     INTO ACCOUNT THE INCREASED LEVEL OF FEEDING RESOURCE THAT SUCH A
C     KITCHEN WOULD PROVIDE FOR THOSE 15 DAYS. AT THIS TIME, HOWEVER,
C     THAT LEVEL OF DETAIL IS NOT ATTEMPTED. THE MANAGERS SHOULD MERELY
C     ATTEMPT TO DEFINE THE NUMBER OF MEALS THEY COULD SERVE AT EACH
C     AREA. FOR THIS RESOURCE, EACH AREA IS CONSIDERED SEPERATE, EVEN
C     THOUGH A SINGLE SOURCE MIGHT PROVIDE MEALS FOR ALL BILLETING
C     AREAS. IN SUCH A CASE, THE AVAILABILITY SHOULD BE DIVIDED AMONG
C     THE SEVERAL AREAS. FURTHERMORE, THE AVAILABILITY OF MEALS IS
C     MEASURED IN SERVINGS PER SIX HOURS, ON THE ASSUMPTION THAT A 24-
C     HOUR SCHEDULE IS IN EFFECT. THIS MEANS THAT IF A KITCHEN CAN SERVE
C     600 MEALS PER HOUR, 24 HOURS PER DAY, THEY HAVE AN AVAILABILITY OF
C     600 X 6 = 3600 UNITS PER CYCLE.
C
C     ON THIS BASIS, AN FRN OF 200 PERSONS WILL BE ALLOCATED 200 UNITS
C     OF THAT 3600, AND WILL KEEP THEM UNTIL THEY DEPART THE BILLETING
C     AREA. SHOULD THE MANAGERS WISH TO PROVIDE ONE MEAL EVERY 12
C     HOURS, THEY SIMPLY MULTIPLY THE HOURLY CAPABILITY BY 12 INSTEAD OF
C     BY 6.
C
C     THE ALGORITHM USED CONSIDERS EACH OF THE ATRIBUTES (4-6) IN TURN
C     TO SEE IF THE FRN HAS PEOPLE IN THAT AREA. IF SO, IT ATTEMPTS TO
C     ALLOCATE THE FEEDING RESOURCE. IF THERE IS INSUFFICIENT RESOURCE
C     AVAILABLE, THIS WILL NOT PREVENT THE FRN FROM LEAVING ON TIME.
C     THEREFORE, THE ROUTINE MERELY PRINTS AN ADVISORY NOTICE AND ALLOWS
C     THE FRN TO MOVE ON. TO KEEP THE MODEL SIMPLE, NO ATTEMPT IS MADE
C     AT ANY LATER DATE TO ALLOCATE FEEDING WHICH BECOMES AVAILABLE TO
C     THOSE FRNS WHICH DID NOT RECEIVE IT AT THIS POINT.
C
3     CONTINUE
      IF(ATRIB(4).GT.0) THEN
         IF(NNRSC(7).GE.ATRIB(4))THEN
              II=ATRIB(4)
              ATRIB(8)=II
```

```
               CALL SEIZE(7,II)
            ELSE IF (NNRSC(7).GT.0) THEN
               II=ATRIB(4)-NNRSC(7)
               ATRIB(8)=NNRSC(7)
               CALL SEIZE(7,NNRSC(7))
            ELSE
               II=ATRIB(4)
               ATRIB(8) = 0
         END IF
      END IF
C
      IF(ATRIB(5).GT.0) THEN
         IF(NNRSC(8).GE.ATRIB(5))THEN
               II=ATRIB(5)
               ATRIB(8)=II
               CALL SEIZE(8,II)
            ELSE IF (NNRSC(8).GT.0) THEN
               II=ATRIB(5)-NNRSC(8)
               ATRIB(8)=NNRSC(8)
               CALL SEIZE(8,NNRSC(8))
            ELSE
               II=ATRIB(5)
               ATRIB(8) = 0
         END IF
      END IF
C
      IF(ATRIB(6).GT.0) THEN
         IF(NNRSC(9).GE.ATRIB(6))THEN
               II=ATRIB(6)
               ATRIB(8)=II
               CALL SEIZE(9,II)
            ELSE IF (NNRSC(9).GT.0) THEN
               II=ATRIB(6)-NNRSC(9)
               ATRIB(8)=NNRSC(9)
               CALL SEIZE(9,NNRSC(9))
            ELSE
               II=ATRIB(6)
               ATRIB(8) = 0
         END IF
      END IF
      IFLAG=1
      RETURN
C
C****************************************************************************
C     EVENT 4 AND 5 NOT USED
4     RETURN
5     RETURN
C
C****************************************************************************
C
C     ALLOC(6) ALLOCATES WASHRACKS TO THE VEHICLES, ONE AT A TIME.
C
```

```
6      IF (NNRSC(16).GT.0) THEN
           ATRIB(7) = ATRIB(7) - 1
           ATRIB(8) = 1
           CALL SEIZE(16,1)
           IFLAG = 1
        ELSE
           IFLAG = 0
      END IF
      RETURN
C
C**********************************************************************
C
C     ALLOC(7) ALLOCATES VEHICLE PROCESSING SPACE. EACH SLOT
C     REPRESENTS SPACE FOR ONE VEHICLE TO BE DEFUELED, WEIGHED, AND
C     OTHERWISE PREPARED FOR SHIPMENT. THE LOGIC USED HERE IS IDENTICAL
C     TO THAT USED FOR THE WASHRACKS.
C
C
7     IF (NNRSC(17).GT.0) THEN
           ATRIB(8) = ATRIB(8) - 1
           CALL SEIZE(17,1)
           IFLAG = 1
        ELSE
           IFLAG = 0
      END IF
      RETURN
C
C**********************************************************************
C
C     ALLOC(8) ALLOCATES NON-UNIT RECEPTION AREA. ATRIB(8) IS THE NUMBER
C     OF PALLETS IN THIS FRN. RESOURCE 30 IS DEFINED AS PALLET CAPACITY.
C     AN OVERFLOW WILL NOT STOP THE FRN.
C
8     IF(NNRSC(26).EQ.0)THEN
        ATRIB(8) = 0
      ELSE
        ATRIB(8) = 1
        CALL SEIZE(26,1)
      END IF
      ATRIB(5) = ATRIB(5) - 1
      IFLAG = 1
      RETURN
C
C**********************************************************************
C     EVENT 9 NOT USED
9     RETURN
C**********************************************************************
C
C     ALLOC(10) ALLOCATES PALLET SPACE IN THE MARSHALLING AREA.
C     ATTRIB(8) WAS REDEFINED AS THE NUMBER OF PALLETS IN THIS
C     GROUP.  RESOURCE 24 IS THE PALLET CAPACITY.  IT IS ASSUMED
C     THAT AN OVERFLOW OF THE ALLOCATED AREA WILL NOT PREVENT
```

```
C     TIMELY DEPARTURES.
C
10    IF (NNRSC(20).EQ.0) THEN
      ATRIB(8) = 0
          ELSE
            CALL SEIZE(20,1)
             ATRIB(8) = 1
      END IF
      ATRIB(5) = ATRIB(5) - 1
      IFLAG = 1
      RETURN
C*****************************************************************************
C     ALLOC(11) ALLOCATES EXPLOSIVE MARSHALLING AREA.
C     AN OVERFLOW WILL NOT STOP THE FRN FROM BEING PROCESSED.
C
11    IF(NNRSC(23).EQ.0)THEN
      ATRIB(8) = 0
      ELSE
        ATRIB(8) = 1
        CALL SEIZE(23,1)
      END IF
      IFLAG = 1
      ATRIB(6) = ATRIB(6) - 1
      RETURN
      END
C
C*****************************************************************************
C
      SUBROUTINE OTPUT
      DIMENSION NSET(70000)
      COMMON/SCOM1/ ATRIB(100),DD(100),DDL(100),DTNOW,II,MFA,MSTO P,NCLNR
     +,NCRDR,NPRNT,NNRUN,NNSET,NTAPE,SS(100),SSL(100),TNEXT,TNOW, XX(100)
      COMMON QSET(70000)
      EQUIVALENCE (NSET(1),QSET(1))
C
      XX(83) = XX(82)/(XX(81)+XX(82))
      XX(86) = XX(85)/(XX(84)+XX(85))
      PRINT*,'PASSENGER PERCENTAGE = ',XX(83)
      PRINT*,'CARGO PERCENTAGE = ',XX(86)
      RETURN
      END
*EOR
```

APPENDIX F

SIMULATED TPFDD INPUT

FORTRAN PROGRAM TO GENERATE SIMULATED TPFDD

```
      PROGRAM FILE
      INTEGER BULSTON,OUTSTON,OVRSTON,NPAX,EXPSTON,ALD,EAD,LAD,TY PE
      DO 50 J=1,700
      R=RANF()
      ALD=NINT(R*30)
      EAD=NINT(ALD+R*2)
      IF(EAD.EQ.ALD)EAD=ALD+1
      LAD=NINT(EAD+R*10)
      IF(LAD.LT.EAD)LAD=EAD
      IF(R.LE..4)TYPE=2
      IF(R.GT..4.AND.R.LE..6)TYPE=3
      IF(R.GT..6.AND.R.LE..9)TYPE=4
      IF(R.GT..9)TYPE=5
      IF(TYPE.EQ.2)THEN
         EXPSTON=0
         Z=RANF()
         IF(Z.LT..5)THEN
            BULSTON=0
         ELSE
            R=RANF()
            BULSTON=R*120
         ENDIF
         Z=RANF()
         IF(Z.LT..6)THEN
            OVRSTON=0
         ELSE
            R=RANF()
            BULSTON=R*33
         ENDIF
         Z=RANF()
         IF(Z.LT..7)THEN
            OUTSTON=0
         ELSE
            R=RANF()
            OUTSTON=R*35
         ENDIF
         Z=RANF()
         IF(Z.LT..2)THEN
            NPAX=0
         ELSE
            R=RANF()
            NPAX=R*50
         ENDIF
      ELSEIF(TYPE.EQ.3)THEN
         NPAX=0
         Z=RANF()
         IF(Z.LT.5)THEN
            BULSTON=0
```

```
         ELSE
            R=RANF()
            BULSTON=R*66
         ENDIF
         Z=RANF()
         IF(Z.LT..6)THEN
            OVRSTON=0
            OUTSTON=0
         ELSE
            R=RANF()
            OVRSTON=R*42
            R=RANF()
            OUTSTON=R*42
         ENDIF
         Z=RANF()
         IF(Z.LT..7)THEN
            EXPSTON=0
         ELSE
            R=RANF()
            EXPSTON=R*225
         ENDIF
      ELSEIF(TYPE.EQ.4)THEN
         EXPSTON=0
         OVRSTON=0
         OUTSTON=0
         Z=RANF()
         IF(Z.LT..8)THEN
            NPAX=0
         ELSE
            R=RANF()
            NPAX=R*250
         ENDIF
         Z=RANF()
         IF(Z.LT..1)THEN
            BULSTON=0
         ELSE
            R=RANF()
            BULSTON=R*17
         ENDIF
      ELSEIF(TYPE.EQ.5)THEN
         EXPSTON=0
         Z=RANF()
         IF(Z.LT..3)THEN
            NPAX=0
         ELSE
            R=RANF()
            NPAX=R*50
         ENDIF
         Z=RANF()
         IF(Z.LT..4)THEN
            BULSTON=0
            OVRSTON=0
```

```
                 OUTSTON=0
              ELSE
                 R=RANF()
                 BULSTON=R*30
                 OVRSTON=R*20
                 OUTSTON=R*10
              ENDIF
           ENDIF
           IF(J.LT.5)PRINT5,BULSTON,OVRSTON,OUTSTON,NPAX,EXPSTON,ALD,E AD,
          +LAD,TYPE
           S=BULSTON+OVRSTON+OUTSTON+NPAX
           IF(S.GT.0)WRITE(80,5)BULSTON,OVRSTON,OUTSTON,NPAX,EXPSTON,
          +ALD,EAD,LAD,TYPE
5          FORMAT(1X,A4,5(1X,I4),3(1X,I2),1X,I1)
50         CONTINUE
           STOP
           END
*EOR ..
```

SIMULATED TPFDD

100=	0	12	19	0	0	17	18	24	3
110=	12	12	0	29	0	8	9	12	2
120=	2	12	34	46	0	3	4	5	2
130=	27	12	0	0	0	6	7	9	2
140=	112	0	0	44	0	9	10	13	2
150=	0	39	25	0	0	15	16	21	3
160=	7	0	0	0	0	27	29	38	4
170=	0	24	18	0	0	14	15	20	3
180=	4	3	1	0	0	28	30	39	5
190=	6	0	0	0	0	25	27	35	4
200=	0	0	0	33	0	8	9	12	2
210=	6	0	0	0	0	20	21	28	4
220=	21	0	0	0	0	3	4	5	2
230=	26	17	8	19	0	29	31	41	5
240=	108	0	0	29	0	2	3	4	2
250=	0	0	0	6	0	8	9	12	2
260=	0	29	21	0	126	15	16	21	3
270=	26	29	0	42	0	9	10	13	2
280=	3	0	0	0	0	26	28	37	4
290=	4	0	0	47	0	6	7	9	2
300=	0	15	27	0	0	16	17	22	3
310=	14	0	0	0	0	27	29	38	4
320=	30	0	17	47	0	4	5	6	2
330=	0	0	0	37	0	29	31	41	5
340=	13	0	0	209	0	24	26	34	4
350=	0	14	12	0	10	14	15	20	3
360=	0	0	18	5	0	6	7	9	2
370=	0	0	24	47	0	11	12	16	2
380=	0	0	0	26	0	29	31	41	5
390=	75	0	0	9	0	7	8	10	2
400=	[illegible]	0	0	0	0	18	19	25	4
410=	5	0	0	0	0	26	28	37	4
420=	0	0	10	0	0	11	12	16	2
430=	0	1	2	0	0	16	17	22	3
440=	0	16	31	0	0	12	13	17	3
450=	15	0	0	0	0	20	21	28	4
460=	9	0	0	9	0	10	11	14	2
470=	114	0	0	0	0	5	6	8	2
480=	9	0	0	0	0	20	21	28	4
490=	11	0	0	0	0	5	6	8	2
500=	0	0	8	12	0	2	3	4	2
510=	27	0	0	26	0	2	3	4	2
520=	17	11	5	15	0	27	29	38	5
530=	0	39	25	0	203	16	17	22	3
540=	14	0	0	0	0	19	20	26	4
550=	0	0	0	16	0	12	13	17	2
560=	43	0	18	18	0	9	10	13	2
570=	0	0	0	3	0	10	11	14	2

580=	10	0	0	15	0	4	5	6	2
590=	5	0	0	227	0	23	25	33	4
600=	0	12	30	0	0	15	16	21	3
610=	8	5	2	0	0	30	32	42	5
620=	26	17	8	0	0	29	31	41	5
630=	0	40	1	0	163	15	16	21	3
640=	10	40	0	0	0	1	2	2	2
650=	3	0	0	49	0	9	10	13	2
660=	0	14	25	0	0	17	18	24	3
670=	17	14	0	47	0	11	12	16	2
680=	0	31	40	0	0	13	14	18	3
690=	15	0	0	0	0	24	26	34	4
700=	0	0	0	47	0	27	29	38	5
710=	7	0	0	3	0	8	9	12	2
720=	16	0	0	12	0	4	5	6	2
730=	0	0	0	46	0	1	2	2	2
740=	0	13	31	0	0	15	16	21	3
750=	11	13	0	24	0	9	10	13	2
760=	8	0	0	0	0	21	22	29	4
770=	6	4	2	49	0	29	31	41	5
780=	3	4	0	26	0	8	9	12	2
790=	0	0	0	40	0	3	4	5	2
800=	10	0	0	0	0	20	21	28	4
810=	0	0	0	34	0	30	32	42	5
820=	0	0	20	10	0	0	1	1	2
830=	0	0	0	18	0	4	5	6	2
840=	8	0	0	0	0	11	12	16	2
850=	13	0	0	0	0	19	20	26	4
860=	1	0	0	6	0	29	31	41	5
870=	0	0	0	43	0	8	9	12	2
880=	10	0	0	0	0	23	25	33	4
890=	0	0	10	0	0	4	5	6	2
900=	0	0	7	14	0	4	5	6	2
910=	0	[illegible]	7	0	0	12	13	17	3
920=	0	14	26	0	0	17	18	24	3
930=	25	0	11	10	0	1	2	2	2
940=	0	5	23	0	0	15	16	21	3
950=	15	0	0	0	0	19	20	26	4
960=	92	0	27	0	0	1	2	2	2
970=	38	0	0	41	0	7	8	10	2
980=	8	0	0	0	0	24	26	34	4
990=	21	0	0	0	0	2	3	4	2
1000=	105	0	0	16	0	6	7	9	2
1010=	22	0	0	0	0	0	1	1	2
1020=	16	0	0	47	0	1	2	2	2
1030=	8	0	0	0	0	18	19	25	4
1040=	12	0	0	[illegible]	0	25	27	35	4
1050=	31	0	0	14	0	4	5	6	2
1060=	8	0	0	10	0	27	29	38	4
1070=	4	0	0	5	0	23	25	33	4
1080=	30	0	0	24	0	12	13	17	2
1090=	7	0	0	41	0	9	10	13	2

1100=	9	0	0	0	0	20	21	28	4
1110=	25	0	0	7	0	4	5	6	2
1120=	11	0	0	225	0	21	22	29	4
1130=	20	13	6	0	0	28	30	39	5
1140=	2	0	0	0	0	19	20	26	4
1150=	0	30	20	0	0	13	14	18	3
1160=	108	0	0	35	0	7	8	10	2
1170=	3	0	0	0	0	20	21	28	4
1180=	12	0	0	0	0	23	25	33	4
1190=	8	0	0	146	0	23	25	33	4
1200=	12	8	4	9	0	29	31	41	5
1210=	37	0	0	16	0	1	2	2	2
1220=	18	12	6	28	0	29	31	41	5
1230=	8	0	0	0	0	26	28	37	4
1240=	16	0	0	0	0	27	29	38	4
1250=	3	0	0	0	0	22	23	30	4
1260=	33	0	0	42	0	4	5	6	2
1270=	8	0	0	0	0	22	23	30	4
1280=	8	0	0	0	0	20	21	28	4
1290=	4	0	0	0	0	27	29	38	4
1300=	27	18	9	0	0	29	31	41	5
1310=	26	17	8	49	0	29	31	41	5
1320=	16	0	0	0	0	20	21	28	4
1330=	24	0	0	19	0	8	9	12	2
1340=	6	0	0	38	0	12	13	17	2
1350=	0	0	0	37	0	30	32	42	5
1360=	29	0	19	48	0	11	12	16	2
1370=	0	0	0	12	0	8	9	12	2
1380=	9	0	0	186	0	27	29	38	4
1390=	38	0	0	0	0	3	4	5	2
1400=	31	0	0	0	0	4	5	6	2
1410=	11	0	0	0	0	21	22	29	4
1420=	2	0	0	0	0	24	26	34	4
1430=	9	0	0	0	0	21	22	29	4
1440=	32	0	10	37	0	10	11	14	2
1450=	13	0	0	5	0	8	9	12	2
1460=	9	0	0	0	0	21	22	29	4
1470=	4	0	0	0	0	24	26	34	4
1480=	10	0	0	7	0	12	13	17	2
1490=	0	0	0	36	0	9	10	13	2
1500=	1	0	0	0	0	30	32	42	5
1510=	66	0	0	0	0	5	6	8	2
1520=	0	10	38	0	0	15	16	21	3
1530=	6	0	0	95	0	21	22	29	4
1540=	0	0	0	5	0	30	32	42	5
1550=	11	0	0	0	0	26	28	37	4
1560=	13	0	0	0	0	25	27	35	4
1570=	0	3	13	0	0	17	18	24	3
1580=	0	0	14	0	0	9	10	13	2
1590=	26	17	8	43	0	29	31	41	5
1600=	0	0	0	15	0	30	32	42	5
1610=	3	0	0	0	0	26	28	37	4

1620=	11	0	11	23	0	3	4	5	2
1630=	11	0	0	16	0	2	3	4	2
1640=	0	20	17	0	0	13	14	18	3
1650=	7	0	0	0	0	20	21	28	4
1660=	15	0	0	0	0	21	22	29	4
1670=	0	0	0	7	0	5	6	8	2
1680=	10	0	0	0	0	21	22	29	4
1690=	6	0	14	13	0	4	5	6	2
1700=	9	0	0	0	0	20	21	28	4
1710=	3	0	0	0	0	20	21	28	4
1720=	0	38	33	0	0	15	16	21	3
1730=	9	0	0	0	0	20	21	28	4
1740=	0	0	34	0	0	3	4	5	2
1750=	3	0	0	0	0	23	25	33	4
1760=	22	0	0	10	0	7	8	10	2
1770=	20	0	0	35	0	1	2	2	2
1780=	8	0	0	14	0	6	7	9	2
1790=	15	0	0	1	0	8	9	12	2
1800=	74	0	0	37	0	8	9	12	2
1810=	14	0	0	0	0	23	25	33	4
1820=	3	0	0	0	0	25	27	35	4
1830=	0	0	0	42	0	30	32	42	5
1840=	12	8	4	0	0	28	30	39	5
1850=	6	0	0	26	0	21	22	29	4
1860=	0	0	11	10	0	6	7	9	2
1870=	1	0	0	0	0	22	23	30	4
1880=	16	0	0	36	0	8	9	12	2
1890=	0	36	41	0	0	17	18	24	3
1900=	30	36	0	13	0	6	7	9	2
1910=	0	12	9	0	0	16	17	22	3
1920=	0	22	32	0	0	17	18	24	3
1930=	4	0	0	0	0	25	27	35	4
1940=	8	0	0	3	0	7	8	10	2
1950=	11	0	0	0	0	25	27	35	4
1960=	18	0	0	4	0	6	7	9	2
1970=	15	0	0	0	0	25	27	35	4
1980=	2	0	0	0	0	23	25	33	4
1990=	19	13	6	0	0	29	31	41	5
2000=	7	0	0	100	0	25	27	35	4
2010=	15	0	2	0	0	6	7	9	2
2020=	27	0	0	23	0	6	7	9	2
2030=	1	0	18	49	0	6	7	9	2
2040=	0	0	0	2	0	10	11	14	2
2050=	61	0	0	38	0	3	4	5	2
2060=	0	0	0	1	0	6	7	9	2
2070=	14	0	0	0	0	18	19	25	4
2080=	0	0	14	25	0	9	10	13	2
2090=	0	20	0	0	49	12	13	17	3
2100=	0	18	8	0	0	13	14	18	3
2110=	32	18	0	31	0	8	9	12	2
2120=	0	0	1	0	0	6	7	9	2
2130=	0	0	28	23	0	11	12	16	2

2140=	0	0	0	45	0	11	12	16	2
2150=	17	11	5	14	0	28	30	39	5
2160=	25	11	0	1	0	9	10	13	2
2170=	2	0	0	21	0	10	11	14	2
2180=	0	0	0	29	0	12	13	17	2
2190=	23	0	0	30	0	2	3	4	2
2200=	0	22	28	0	0	13	14	18	3
2210=	31	22	15	26	0	11	12	16	2
2220=	80	0	0	7	0	7	8	10	2
2230=	0	30	36	0	103	13	14	18	3
2240=	13	0	0	0	0	21	22	29	4
2250=	0	0	0	41	0	2	3	4	2
2260=	21	0	24	10	0	4	5	6	2
2270=	26	0	0	25	0	11	12	16	2
2280=	0	35	39	0	0	17	18	24	3
2290=	8	35	33	31	0	1	2	2	2
2300=	19	35	0	43	0	3	4	5	2
2310=	7	0	0	0	0	22	23	30	4
2320=	0	5	31	0	0	17	18	24	3
2330=	0	0	0	15	0	11	12	16	2
2340=	0	0	21	0	0	12	13	17	2
2350=	13	0	0	25	0	11	12	16	2
2360=	11	0	0	0	0	19	20	26	4
2370=	32	0	17	15	0	1	2	2	2
2380=	0	0	0	32	0	28	30	39	5
2390=	3	0	0	0	0	19	20	26	4
2400=	0	0	0	17	0	7	8	10	2
2410=	3	0	0	0	0	24	26	34	4
2420=	0	0	0	21	0	28	30	39	5
2430=	0	0	0	41	0	30	32	42	5
2440=	8	0	0	0	0	23	25	33	4
2450=	2	0	0	0	0	21	22	29	4
2460=	8	0	0	49	0	9	10	13	2
2470=	110	0	0	0	0	9	10	13	2
2480=	0	0	27	0	0	6	7	9	2
2490=	0	20	0	0	0	18	19	25	3
2500=	0	0	0	4	0	3	4	5	2
2510=	1	1	0	22	0	30	32	42	5
2520=	13	0	0	22	0	26	28	37	4
2530=	0	0	0	26	0	28	30	39	5
2540=	16	0	0	22	0	11	12	16	2
2550=	88	0	5	17	0	6	7	9	2
2560=	5	0	0	0	0	18	19	25	4
2570=	8	0	0	0	0	24	26	34	4
2580=	9	0	0	0	0	22	23	30	4
2590=	8	0	0	0	0	24	26	34	4
2600=	0	0	27	12	0	1	2	2	2
2610=	0	41	2	0	0	15	16	21	3
2620=	8	0	16	6	0	8	9	12	2
2630=	13	0	0	0	0	26	28	37	4
2640=	4	0	0	10	0	26	28	37	4
2650=	0	0	0	29	0	4	5	6	2

2660=	9	0	0	0	0	26	28	37	4
2670=	10	0	0	238	0	21	22	29	4
2680=	10	0	0	0	0	27	29	38	4
2690=	109	0	0	4	0	1	2	2	2
2700=	31	0	0	0	0	7	8	10	2
2710=	0	0	4	26	0	5	6	8	2
2720=	0	10	40	0	0	14	15	20	3
2730=	12	0	0	0	0	19	20	26	4
2740=	15	10	5	0	0	27	29	38	5
2750=	20	0	0	49	0	0	1	1	2
2760=	3	0	0	0	0	25	27	35	4
2770=	0	0	0	3	0	7	8	10	2
2780=	0	0	34	0	0	11	12	16	2
2790=	0	0	0	32	0	11	12	16	2
2800=	6	0	0	0	0	24	26	34	4
2810=	0	19	23	0	0	16	17	22	3
2820=	16	0	0	64	0	24	26	34	4
2830=	59	0	0	0	0	10	11	14	2
2840=	81	0	0	15	0	2	3	4	2
2850=	11	0	0	168	0	21	22	29	4
2860=	16	0	0	0	0	22	23	30	4
2870=	88	0	0	0	0	2	3	4	2
2880=	15	0	0	115	0	21	22	29	4
2890=	0	0	25	12	0	11	12	16	2
2900=	5	0	0	110	0	23	25	33	4
2910=	13	0	0	0	0	22	23	30	4
2920=	6	0	0	1	0	1	2	2	2
2930=	15	10	5	0	0	27	29	38	5
2940=	4	0	0	0	0	20	21	28	4
2950=	8	0	0	0	0	22	23	30	4
2960=	3	0	0	0	0	22	23	30	4
2970=	0	0	20	41	0	6	7	9	2
2980=	3	0	0	0	0	25	27	35	4
2990=	9	0	0	0	0	23	25	33	4
3000=	5	0	0	14	0	8	9	12	2
3010=	9	0	19	17	0	1	2	2	2
3020=	1	0	0	11	0	10	11	14	2
3030=	15	0	14	49	0	10	11	14	2
3040=	23	15	7	41	0	27	29	38	5
3050=	0	0	0	39	0	8	9	12	2
3060=	0	0	0	5	0	2	3	4	2
3070=	7	0	0	140	0	26	28	37	4
3080=	41	0	25	40	0	5	6	8	2
3090=	14	0	19	0	0	4	5	6	2
3100=	101	0	0	43	0	0	1	1	2
3110=	0	30	31	0	64	16	17	22	3
3120=	0	0	0	8	0	3	4	5	2
3130=	21	0	19	0	0	0	1	1	2
3140=	1	0	0	0	0	27	29	38	4
3150=	6	0	0	104	0	26	28	37	4
3160=	9	0	0	0	0	26	28	37	4
3170=	9	0	0	0	0	23	25	33	4

3180=	17	0	0	12	0	10	11	14	2
3190=	23	15	7	49	0	28	30	39	5
3200=	6	4	2	19	0	29	31	41	5
3210=	0	0	0	42	0	4	5	6	2
3220=	6	0	0	0	0	27	29	38	4
3230=	20	0	0	24	0	10	11	14	2
3240=	27	0	17	0	0	3	4	5	2
3250=	0	0	0	26	0	11	12	16	2
3260=	1	0	0	0	0	26	28	37	4
3270=	9	0	0	0	0	22	23	30	4
3280=	14	0	0	0	0	3	4	5	2
3290=	11	0	0	0	0	22	23	30	4
3300=	7	4	2	7	0	27	29	38	5
3310=	0	19	37	0	87	14	15	20	3
3320=	21	14	7	0	0	29	31	41	5
3330=	116	0	6	42	0	3	4	5	2
3340=	2	0	0	173	0	27	29	38	4
3350=	0	0	0	9	0	0	1	1	2
3360=	30	0	0	0	0	9	10	13	2
3370=	2	0	0	0	0	19	20	26	4
3380=	20	0	31	0	0	1	2	2	2
3390=	5	0	0	21	0	3	4	5	2
3400=	6	0	0	0	0	18	19	25	4
3410=	13	0	0	0	0	21	22	29	4
3420=	31	0	0	12	0	2	3	4	2
3430=	85	0	0	17	0	7	8	10	2
3440=	6	0	0	0	0	19	20	26	4
3450=	0	0	0	11	0	8	9	12	2
3460=	8	0	0	0	0	26	28	37	4
3470=	8	0	0	0	0	21	22	29	4
3480=	23	15	7	19	0	29	31	41	5
3490=	7	0	0	0	0	23	25	33	4
3500=	25	0	34	32	0	2	3	4	2
3510=	11	0	0	0	0	21	22	29	4
3520=	20	0	0	0	0	3	4	5	2
3530=	15	0	0	0	0	18	19	25	4
3540=	3	0	0	0	0	23	25	33	4
3550=	27	0	0	48	0	2	3	4	2
3560=	20	0	0	0	0	6	7	9	2
3570=	0	0	0	234	0	25	27	35	4
3580=	8	0	0	0	0	20	21	28	4
3590=	67	0	12	29	0	10	11	14	2
3600=	31	0	19	24	0	5	6	8	2
3610=	5	0	0	48	0	12	13	17	2
3620=	92	0	0	0	0	8	9	12	2
3630=	0	0	0	1	0	11	12	16	2
3640=	31	0	0	14	0	7	8	10	2
3650=	6	0	0	0	0	26	28	37	4
3660=	45	0	0	34	0	11	12	16	2
3670=	5	0	0	39	0	4	5	6	2
3680=	0	14	23	0	0	17	18	24	3
3690=	0	16	15	0	0	17	18	24	3

3700=	9	0	0	119	0	24	26	34	4
3710=	0	0	0	27	0	1	2	2	2
3720=	14	9	4	0	0	30	32	42	5
3730=	20	0	0	0	0	6	7	9	2
3740=	14	0	0	0	0	24	26	34	4
3750=	19	12	6	34	0	29	31	41	5
3760=	3	0	0	0	0	25	27	35	4
3770=	77	0	0	41	0	7	8	10	2
3780=	4	2	1	46	0	28	30	39	5
3790=	14	2	0	35	0	6	7	9	2
3800=	22	2	0	0	0	4	5	6	2
3810=	0	33	37	0	217	17	18	24	3
3820=	31	33	34	38	0	1	2	2	2
3830=	95	0	0	8	0	1	2	2	2
3840=	3	0	0	0	0	20	21	28	4
3850=	6	0	0	0	0	21	22	29	4
3860=	0	0	6	12	0	7	8	10	2
3870=	0	0	0	35	0	2	3	4	2
3880=	57	0	0	25	0	12	13	17	2
3890=	14	0	0	0	0	22	23	30	4
3900=	0	0	0	3	0	25	27	35	4
3910=	26	0	0	9	0	4	5	6	2
3920=	0	0	0	36	0	11	12	16	2
3930=	1	0	0	36	0	12	13	17	2
3940=	51	0	0	0	0	1	2	2	2
3950=	1	0	0	127	0	24	26	34	4
3960=	6	0	0	6	0	6	7	9	2
3970=	0	0	0	15	0	27	29	38	5
3980=	3	0	0	0	0	2	3	4	2
3990=	86	0	22	41	0	10	11	14	2
4000=	0	0	5	40	0	7	8	10	2
4010=	9	0	0	110	0	22	23	30	4
4020=	9	0	0	0	0	24	26	34	4
4030=	20	0	0	31	0	8	9	12	2
4040=	13	0	0	0	0	24	26	34	4
4050=	12	0	0	0	0	18	19	25	4
4060=	2	0	0	193	0	21	22	29	4
4070=	12	0	0	205	0	19	20	26	4
4080=	112	0	0	0	0	10	11	14	2
4090=	20	0	0	5	0	5	6	8	2
4100=	16	0	0	0	0	25	27	35	4
4110=	14	0	0	0	0	19	20	26	4
4120=	0	33	34	0	0	16	17	22	3
4130=	24	33	28	0	0	9	10	13	2
4140=	12	8	4	0	0	30	32	42	5
4150=	0	0	0	7	0	3	4	5	2
4160=	27	0	0	26	0	1	2	2	2
4170=	18	0	0	29	0	3	4	5	2
4180=	23	0	0	19	0	1	2	2	2
4190=	0	0	0	31	0	11	12	16	2
4200=	0	15	40	0	0	13	14	18	3
4210=	60	0	0	5	0	11	12	16	2

4220=	3	0	0	0	0	20	21	28	4
4230=	2	0	0	32	0	4	5	6	2
4240=	3	0	0	0	0	23	25	33	4
4250=	6	0	6	14	0	6	7	9	2
4260=	0	8	5	0	0	13	14	18	3
4270=	7	0	0	0	0	25	27	35	4
4280=	6	0	19	21	0	10	11	14	2
4290=	10	0	0	0	0	26	28	37	4
4300=	0	34	26	0	176	13	14	18	3
4310=	113	0	21	25	0	12	13	17	2
4320=	0	0	0	5	0	28	30	39	5
4330=	83	0	10	8	0	4	5	6	2
4340=	16	0	0	0	0	20	21	28	4
4350=	0	0	0	35	0	29	31	41	5
4360=	0	0	0	10	0	11	12	16	2
4370=	7	0	19	42	0	3	4	5	2
4380=	0	33	3	0	0	16	17	22	3
4390=	0	28	16	0	0	16	17	22	3
4400=	10	0	0	0	0	20	21	28	4
4410=	14	0	0	0	0	20	21	28	4
4420=	14	0	0	0	0	26	28	37	4
4430=	6	0	0	0	0	24	26	34	4
4440=	20	0	0	40	0	9	10	13	2
4450=	100	0	0	13	0	2	3	4	2
4460=	6	0	0	0	0	19	20	26	4
4470=	0	13	28	0	39	16	17	22	3
4480=	0	13	19	0	0	7	8	10	2
4490=	0	0	0	42	0	2	3	4	2
4500=	81	0	28	15	0	12	13	17	2
4510=	21	0	13	11	0	12	13	17	2
4520=	9	0	0	0	0	22	23	30	4
4530=	4	0	0	23	0	7	8	10	2
4540=	8	0	30	15	0	7	8	10	2
4550=	1	0	0	92	0	24	26	34	4
4560=	115	0	21	21	0	10	11	14	2
4570=	8	0	0	0	0	19	20	26	4
4580=	115	0	0	6	0	9	10	13	2
4590=	0	0	11	0	0	12	13	17	2
4600=	13	0	0	52	0	27	29	38	4
4610=	0	0	0	33	0	2	3	4	2
4620=	0	0	22	0	0	16	17	22	3
4630=	3	0	34	40	0	5	6	8	2
4640=	11	7	3	18	0	30	32	42	5
4650=	0	0	25	0	0	2	3	4	2
4660=	7	0	28	1	0	10	11	14	2
4670=	12	0	0	156	0	27	29	38	4
4680=	0	0	0	40	0	11	12	16	2
4690=	0	0	0	10	0	12	13	17	2
4700=	34	0	11	20	0	8	9	12	2
4710=	25	0	0	30	0	4	5	6	2
4720=	25	0	0	0	0	6	7	9	2
4730=	4	0	0	0	0	20	21	28	4

4740=	0	39	35	0	0	14	15	20	3
4750=	4	0	0	0	0	19	20	26	4
4760=	0	13	33	0	128	13	14	18	3
4770=	25	13	0	47	0	7	8	10	2
4780=	5	3	1	0	0	30	32	42	5
4790=	0	17	8	0	0	14	15	20	3
4800=	18	17	0	0	0	10	11	14	2
4810=	11	17	0	16	0	6	7	9	2
4820=	24	17	0	8	0	11	12	16	2
4830=	10	0	5	9	0	4	5	6	2
4840=	30	0	0	2	0	7	8	10	2
4850=	60	0	0	5	0	5	6	8	2
4860=	0	0	0	41	0	6	7	9	2
4870=	0	0	0	18	0	2	3	4	2
4880=	0	7	26	0	0	18	19	25	3
4890=	0	39	34	0	0	18	19	25	3
4900=	1	0	0	0	0	3	4	5	2
4910=	14	0	0	0	0	9	10	13	2
4920=	0	0	0	43	0	29	31	41	5
4930=	11	0	0	0	0	24	26	34	4
4940=	0	0	41	0	161	13	14	18	3
4950=	0	0	13	1	0	8	9	12	2
4960=	0	5	31	0	208	15	16	21	3
4970=	0	18	21	0	150	14	15	20	3
4980=	2	0	0	233	0	24	26	34	4
4990=	6	4	2	39	0	30	32	42	5
5000=	7	0	0	0	0	24	26	34	4

5010=*EOR

APPENDIX G

SLAM SUMMARY REPORTS

FILE NUMBER	ASSOCIATED RESOURCE	ASSOCIATED ACTIVITY
1	NONE	SLAM event file.
2	NODEPBIL	Permanent Billeting for non-deploying augmentees.
3	RECPOINT	Personnel reception location.
4	INCHECKER	Initial personnel reception and direction.
5	TRABIL	Temporary billeting for deploying personnel.
6	BUS	Transportation to billeting from reception.
7	BILFEED	Feeding capacity in billeting.
8	BUS	Transportation to passenger staging from billeting.
9	PAXSTG	Passenger staging.
10	BUS	Bus to passenger terminal from staging.
11	PAXTERM	Passenger Terminal.
12	PAXAGENT	Passenger Agent.
13	BUS	Transportation to aircraft from passenger terminal.
14	BUS	Transportation to passenger staging from reception point.
15	BUS	Transportation from mobility line to passenger staging.
16	CARGAGNT	Agent to receive, initially inspect unit related cargo.
17	WASHRACK	Vehicle washing location.
18	VEHPROS	Vehicle processing crew/location.
19	VEHPARK	Vehicle marshalling.

FILE NUMBER	ASSOCIATED RESOURCE	ASSOCIATED ACTIVITY
20	JITEAM	Unit related vehicle inspection.
21	WASHRACK	Frustrated vehicle washing.
22	MARSFORK	Forklift to unload unit related cargo from truck.
23	MARSAREA	Pallet marshalling area.
24	JITEAM	Unit related pallet inspection.
25	MARSFORK	Forklift to load unit related cargo on K-loader.
26	MARSFORK	Forklift to move unit related cargo to frustrated cargo area.
27	FRUSTCAR	Frustrated cargo rework area.
28	MARSFORK	Forklift to move unit related cargo from frustrated area to marshallling area.
29	NRCRECPT	Non-unit cargo reception area.
30	NRCAGENT	Non-unit cargo receiving agent.
31	TERMFORK	Forklift to unload non-unit cargo from truck.
32	MARSAREA	Pallet marshalling area.
33	PALTEAM	Palletizing crew for non-unit cargo.
34	TERMFORK	Forklift to load non-unit cargo on K-loader.
35	EXMARS	Explosives marshalling area.
36	PALTEAM	Palletizing crew for explosives.

FILE NUMBER	ASSOCIATED RESOURCE	ASSOCIATED ACTIVITY
37	EXFORK	Forklift to load explosives on K-loader.
38	EXFORK	Forklift to unload explosives from truck.
39	MARSAREA	Pallet marshalling area.
40	BOXLUN	Box lunches for staging and flight.

ESTIMATED RESOURCES

```
100= PASSENGER PERCENTAGE = 1.
110= CARGO PERCENTAGE = .8505873201089
120=
140=                    S L A M   S U M M A R Y   R E P O R T
170=                          SIMULATION PROJECT RECEPTION MODE L          BY G. L. WHITE
190=                          DATE  1/ 7/1983                     RUN NUMBER    1 OF    1
220=                           CURRENT TIME    .7200E+03
230=                           STATISTICAL ARRAYS CLEARED AT TIME  0.
270=                           **FILE STATISTICS**
280=
```

	FILE NUMBER	ASSOCIATED NODE TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAITING TIME
290= / 300=							
320=	1		29.6001	14.4642	491	14	21.7027
330=	2	AWAIT	0.0000	0.0000	0	0	0.0000
340=	3	AWAIT	0.0000	0.0000	1	0	0.0000
350=	4	AWAIT	.0003	.0171	1	0	.0011
360=	5	AWAIT	0.0000	0.0000	1	0	0.0000
370=	6	AWAIT	0.0000	0.0000	1	0	0.0000
380=	7	AWAIT	0.0000	0.0000	1	0	0.0000
390=	8	AWAIT	0.0000	0.0000	1	0	0.0000
400=	9	AWAIT	0.0000	0.0000	1	0	0.0000
410=	10	AWAIT	0.0000	0.0000	0	0	0.0000
420=	11	AWAIT	0.0000	0.0000	1	0	0.0000
430=	12	AWAIT	0.0000	0.0000	1	0	0.0000
440=	13	AWAIT	0.0000	0.0000	1	0	0.0000
450=	14	AWAIT	0.0000	0.0000	1	0	0.0000
460=	15	AWAIT	0.0000	0.0000	1	0	0.0000
470=	16	AWAIT	.0007	.0262	1	0	.0015
480=	17	AWAIT	4.4479	5.8474	20	0	1.3071
490=	18	AWAIT	.0605	.3866	6	0	.0132
500=	19	AWAIT	0.0000	0.0000	1	0	0.0000
510=	20	AWAIT	.7358	2.3717	28	0	.1533
520=	21	AWAIT	.0172	.1311	2	0	.0779
530=	22	AWAIT	0.0000	0.0000	1	0	0.0000
540=	23	AWAIT	0.0000	0.0000	1	0	0.0000
550=	24	AWAIT	5.9007	16.2826	97	0	3.2959
560=	25	AWAIT	0.0000	0.0000	1	0	0.0000
570=	26	AWAIT	0.0000	0.0000	1	0	0.0000
580=	27	AWAIT	0.0000	0.0000	1	0	0.0000
590=	28	AWAIT	0.0000	0.0000	1	0	0.0000
600=	29	AWAIT	0.0000	0.0000	1	0	0.0000
610=	30	AWAIT	.1284	1.4982	37	0	.0535
620=	31	AWAIT	.0006	.0416	6	0	.0003
630=	32	AWAIT	0.0000	0.0000	1	0	0.0000
640=	33	AWAIT	.8554	6.1092	92	0	.3560
650=	34	AWAIT	.0001	.0074	2	0	.0000
660=	35	AWAIT	0.0000	0.0000	1	0	0.0000
670=	36	AWAIT	.0192	.2186	7	0	.0292
680=	37	AWAIT	.1513	1.4856	31	0	.2303
690=	38	AWAIT	.0045	.0667	1	0	.0068
700=	39	AWAIT	0.0000	0.0000	1	0	0.0000
710=	40	AWAIT	0.0000	0.0000	1	0	0.0000

RESOURCE STATISTICS

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTILIZATION	CURRENT UTILIZATION
1	NODEPBIL	1376	0.0000	0.0000	0	0
2	RECPOINT	2000	24.3571	39.7535	243	0
3	INCHECKR	3	.1493	.4215	3	0
4	BUS	26	.2683	.8431	6	0
5	PAXSTG	2000	33.5558	52.4915	459	15
6	BOXLUN	1000	18.6122	40.9107	459	15
7	BILFEED1	1000	138.8771	169.5237	490	0
8	BILFEED2	1000	38.9491	69.6135	222	0
9	BILFEED3	3000	18.8704	47.5186	201	0
10	TRABIL1	490	139.9279	170.5427	490	0
11	TRABIL2	227	39.1255	69.8213	222	0
12	TRABIL3	3000	19.0028	47.7500	201	0
13	PAXTERM	2000	30.0309	48.2698	353	0
14	PAXAGENT	3	.1166	.3557	3	0
15	CARGAGNT	3	.3012	.5761	3	0
16	WASHRACK	2	.9714	.9837	2	0
17	VEHPROCS	5	.9823	1.3016	5	0
18	VEHPARK	2000	153.2746	82.5240	363	183
19	JITEAM	3	1.3258	1.3517	3	0
20	MARSAREA	3000	240.3058	218.4783	835	473
21	PALTEAM	26	2.5043	6.6114	26	22
22	EXFORK	6	.2621	.9475	6	0
23	EXMARS	2000	64.9889	108.5464	342	0
24	FRUSTCAR	500	.973	2.0793	16	0
25	MARSFORK	8	.1874	.5544	8	0
26	NRCRECPT	2000	.1767	1.8560	41	0
27	NRCAGENT	4	.0483	.4299	4	0
28	TERMFORK	8	.1211	.6774	8	0

RESOURCE STATISTICS

RESOURCE NUMBER	RESOURCE LABEL	CURRENT AVAILABLE	AVERAGE AVAILABLE	MINIMUM AVAILABLE	MAXIMUM AVAILABLE
1	NODEPBIL	1376	1376.0000	1376	1376
2	RECPOINT	2000	1975.6429	1757	2000
3	INCHECKR	3	2.8507	0	3
4	BUS	26	25.7317	20	26
5	PAXSTG	1985	1966.4442	1541	2000
6	BOXLUN	985	981.3878	541	1000
7	BILFEED1	1000	861.1229	510	1000
8	BILFEED2	1000	961.0509	778	1000
9	BILFEED3	3000	2981.1296	2799	3000
10	TRABIL1	490	350.0721	0	490
11	TRABIL2	227	187.8745	5	227
12	TRABIL3	3000	2980.9972	2799	3000
13	PAXTERM	2000	1969.9691	1647	2000
14	PAXAGENT	3	2.8834	0	3
15	CARGAGNT	3	2.6988	0	3
16	WASHRACK	2	1.0286	0	2
17	VEHPROCS	5	4.0177	0	5
18	VEHPARK	1817	1846.7254	1637	2000
19	JITEAM	3	1.6742	0	3
20	MARSAREA	2527	2759.6942	2165	3000
21	PALTEAM	4	23.4957	0	26
22	EXFORK	6	5.7379	0	6
23	EXMARS	2000	1935.0111	1658	2000
24	FRUSTCAR	500	499.0262	484	500
25	MARSFORK	8	7.8126	0	8
26	NRCRECPT	2000	1999.8233	1959	2000
27	NRCAGENT	4	3.9517	0	4
28	TERMFORK	8	7.8789	0	8

*EOR

AD-A134 433   AERIAL PORT OF EMBARKATION CAPABILITY PLANNING VOLUME 1   3/3
(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH
SCHOOL OF SYSTEMS AND LOGISTICS T W CHRISTENSEN ET AL.
UNCLASSIFIED   SEP 83 AFIT-LSSR-62-83   F/G 15/5   NL

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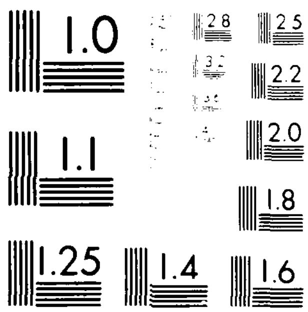
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2.8
2.5
3.2
2.2
3.6
2.0
1.1
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1.4
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UNLIMITED RESOURCES

```
100= PASSENGER PERCENTAGE = 1.
110= CARGO PERCENTAGE = 1.
120=
140=                    S L A M   S U M M A R Y   R E P O R T
170=                          SIMULATION PROJECT RECEPTION MODEL          BY G. L. WHITE
190=                          DATE  1/ 7/1983                        RUN NUMBER    1 OF    1
220=                          CURRENT TIME    .7200E+03
230=                          STATISTICAL ARRAYS CLEARED AT TIM E  0.
270=                          **FILE STATISTICS**
280=
```

	FILE NUMBER	ASSOCIATED NODE TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAITING TIME
290= / 300=							
320=	1		29.6001	14.4642	491	14	21.7027
330=	2	AWAIT	0.0000	0.0000	0	0	0.0000
340=	3	AWAIT	0.0000	0.0000	1	0	0.0000
350=	4	AWAIT	0.0000	0.0000	1	0	0.0000
360=	5	AWAIT	0.0000	0.0000	1	0	0.0000
370=	6	AWAIT	0.0000	0.0000	1	0	0.0000
380=	7	AWAIT	0.0000	0.0000	1	0	0.0000
390=	8	AWAIT	0.0000	0.0000	1	0	0.0000
400=	9	AWAIT	0.0000	0.0000	1	0	0.0000
410=	10	AWAIT	0.0000	0.0000	0	0	0.0000
420=	11	AWAIT	0.0000	0.0000	1	0	0.0000
430=	12	AWAIT	0.0000	0.0000	1	0	0.0000
440=	13	AWAIT	0.0000	0.0000	1	0	0.0000
450=	14	AWAIT	0.0000	0.0000	1	0	0.0000
460=	15	AWAIT	0.0000	0.0000	1	0	0.0000
470=	16	AWAIT	0.0000	0.0000	1	0	0.0000
480=	17	AWAIT	0.0000	0.0000	1	0	0.0000
490=	18	AWAIT	0.0000	0.0000	1	0	0.0000
500=	19	AWAIT	0.0000	0.0000	1	0	0.0000
510=	20	AWAIT	0.0000	0.0000	1	0	0.0000
520=	21	AWAIT	0.0000	0.0000	1	0	0.0000
530=	22	AWAIT	0.0000	0.0000	1	0	0.0000
540=	23	AWAIT	0.0000	0.0000	1	0	0.0000
550=	24	AWAIT	0.0000	0.0000	1	0	0.0000
560=	25	AWAIT	0.0000	0.0000	1	0	0.0000
570=	26	AWAIT	0.0000	0.0000	1	0	0.0000
580=	27	AWAIT	0.0000	0.0000	1	0	0.0000
590=	28	AWAIT	0.0000	0.0000	1	0	0.0000
600=	29	AWAIT	0.0000	0.0000	1	0	0.0000
610=	30	AWAIT	0.0000	0.0000	1	0	0.0000
620=	31	AWAIT	0.0000	0.0000	1	0	0.0000
630=	32	AWAIT	0.0000	0.0000	1	0	0.0000
640=	33	AWAIT	0.0000	0.0000	1	0	0.0000
650=	34	AWAIT	0.0000	0.0000	1	0	0.0000
660=	35	AWAIT	0.0000	0.0000	1	0	0.0000
670=	36	AWAIT	0.0000	0.0000	1	0	0.0000
680=	37	AWAIT	0.0000	0.0000	1	0	0.0000
690=	38	AWAIT	0.0000	0.0000	1	0	0.0000
700=	39	AWAIT	0.0000	0.0000	1	0	0.0000
710=	40	AWAIT	0.0000	0.0000	1	0	0.0000

RESOURCE STATISTICS

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTILIZATION	CURRENT UTILIZATION
1	NODEPBIL	1376	0.0000	0.0000	0	0
2	RECPOINT	2000	23.7874	39.6374	243	0
3	INCHECKR	100	.1525	.4201	4	0
4	BUS	100	.2607	.8115	6	0
5	PAXSTG	2000	33.6367	52.5933	459	15
6	BOXLUN	1000	18.6116	40.8823	459	15
7	BILFEED1	1000	138.8099	169.4668	490	0
8	BILFEED2	1000	39.6712	70.3036	222	0
9	BILFEED3	3000	18.8157	47.4355	201	0
10	TRABIL1	490	139.7623	170.3784	490	0
11	TRABIL2	227	39.8651	70.5784	222	0
12	TRABIL3	3000	18.9676	47.6909	201	0
13	PAXTERM	2000	30.2391	48.2487	353	0
14	PAXAGENT	100	.1166	.3557	3	0
15	CARGAGNT	100	.2950	.5804	4	0
16	WASHRACK	100	.9823	3.6235	49	0
17	VEHPROCS	100	.9914	2.9047	41	0
18	VEHPARK	2000	201.0457	103.0331	479	187
19	JITEAM	100	1.3308	3.1045	40	0
20	MARSAREA	3000	240.1031	218.9295	835	473
21	PALTEAM	100	2.4948	7.7273	81	22
22	EXFORK	100	.2629	1.1654	20	0
23	EXMARS	2000	64.8864	108.5441	342	0
24	FRUSTCAR	500	.9706	2.0779	18	0
25	MARSFORK	100	.1893	.5569	7	0
26	NRCRECPT	2000	.0480	1.0392	41	0
27	NRCAGENT	100	.0480	1.0392	41	0
28	TERMFORK	100	.1219	1.1529	41	0

1100= **RESOURCE STATISTICS**

	RESOURCE NUMBER	RESOURCE LABEL	CURRENT AVAILABLE	AVERAGE AVAILABLE	MINIMUM AVAILABLE	MAXIMUM AVAILABLE
1150=	1	NODEPBIL	1376	1376.0000	1376	1376
1160=	2	RECPOINT	2000	1976.2126	1757	2000
1170=	3	INCHECKR	100	99.8475	96	100
1180=	4	BUS	100	99.7393	94	100
1190=	5	PAXSTG	1985	1966.3633	1541	2000
1200=	6	BOXLUN	985	981.3884	541	1000
1210=	7	BILFEED1	1000	861.1901	510	1000
1220=	8	BILFEED2	1000	960.3288	778	1000
1230=	9	BILFEED3	3000	2981.1843	2799	3000
1240=	10	TRABIL1	490	350.2377	0	490
1250=	11	TRABIL2	227	187.1349	5	227
1260=	12	TRABIL3	3000	2981.0324	2799	3000
1270=	13	PAXTERM	2000	1969.7609	1647	2000
1280=	14	PAXAGENT	100	99.8834	97	100
1290=	15	CARGAGNT	100	99.7050	96	100
1300=	16	WASHRACK	100	99.0177	51	100
1310=	17	VEHPROCS	100	99.0086	59	100
1320=	18	VEHPARK	1813	1798.9543	1521	2000
1330=	19	JITEAM	100	98.6692	60	100
1340=	20	MARSAREA	2527	2759.8969	2165	3000
1350=	21	PALTEAM	78	97.5052	19	100
1360=	22	EXFORK	100	99.7371	80	100
1370=	23	EXMARS	2000	1935.1136	1658	2000
1380=	24	FRUSTCAR	500	499.0294	482	500
1390=	25	MARSFORK	100	99.8107	93	100
1400=	26	NRCRECPT	2000	1999.9520	1959	2000
1410=	27	NRCAGENT	100	99.9520	59	100
1420=	28	TERMFORK	100	99.8781	59	100

1430=*EOR

RECOMMENDED RESOURCES

100= PASSENGER PERCENTAGE = 1.
110= CARGO PERCENTAGE = .9557821485527
120=
140= S L A M   S U M M A R Y   R E P O R T
170= SIMULATION PROJECT RECEPTION MODEL   BY G. L. WHITE
190= DATE 1/ 7/1983   RUN NUMBER 1 OF 1
220= CURRENT TIME .7200E+03
230= STATISTICAL ARRAYS CLEARED AT TIME 0.
270= **FILE STATISTICS**
280=

	FILE NUMBER	ASSOCIATED NODE TYPE	AVERAGE LENGTH	STANDARD DEVIATION	MAXIMUM LENGTH	CURRENT LENGTH	AVERAGE WAITING TIME
290=/300=							
320=	1		29.6001	14.4642	491	14	21.7027
330=	2	AWAIT	0.0000	0.0000	0	0	0.0000
340=	3	AWAIT	0.0000	0.0000	1	0	0.0000
350=	4	AWAIT	.0003	.0169	1	0	.0011
360=	5	AWAIT	0.0000	0.0000	1	0	0.0000
370=	6	AWAIT	0.0000	0.0000	1	0	0.0000
380=	7	AWAIT	0.0000	0.0000	1	0	0.0000
390=	8	AWAIT	0.0000	0.0000	1	0	0.0000
400=	9	AWAIT	0.0000	0.0000	1	0	0.0000
410=	10	AWAIT	0.0000	0.0000	0	0	0.0000
420=	11	AWAIT	0.0000	0.0000	1	0	0.0000
430=	12	AWAIT	0.0000	0.0000	1	0	0.0000
440=	13	AWAIT	0.0000	0.0000	1	0	0.0000
450=	14	AWAIT	0.0000	0.0000	1	0	0.0000
460=	15	AWAIT	0.0000	0.0000	1	0	0.0000
470=	16	AWAIT	.0002	.0145	1	0	.0005
480=	17	AWAIT	4.4145	5.8218	20	0	1.2973
490=	18	AWAIT	.0623	.3977	6	0	.0135
500=	19	AWAIT	0.0000	0.0000	1	0	0.0000
510=	20	AWAIT	.2188	.9767	13	0	.0455
520=	21	AWAIT	.0143	.1211	2	0	.0703
530=	22	AWAIT	0.0000	0.0000	1	0	0.0000
540=	23	AWAIT	0.0000	0.0000	1	0	0.0000
550=	24	AWAIT	1.1375	5.8984	58	0	.6305
560=	25	AWAIT	0.0000	0.0000	1	0	0.0000
570=	26	AWAIT	0.0000	0.0000	1	0	0.0000
580=	27	AWAIT	0.0000	0.0000	1	0	0.0000
590=	28	AWAIT	0.0000	0.0000	1	0	0.0000
600=	29	AWAIT	0.0000	0.0000	1	0	0.0000
610=	30	AWAIT	.1288	1.5008	37	0	.0536
620=	31	AWAIT	.0004	.0250	3	0	.0002
630=	32	AWAIT	0.0000	0.0000	1	0	0.0000
640=	33	AWAIT	2.8602	13.0750	145	4	1.1904
650=	34	AWAIT	.0000	.0067	1	0	.0000
660=	35	AWAIT	0.0000	0.0000	1	0	0.0000
670=	36	AWAIT	.0377	.2674	5	0	.0574
680=	37	AWAIT	.1492	1.4226	26	0	.2271
690=	38	AWAIT	.0045	.0669	1	0	.0068
700=	39	AWAIT	0.0000	0.0000	1	0	0.0000
710=	40	AWAIT	0.0000	0.0000	1	0	0.0000

RESOURCE STATISTICS

RESOURCE NUMBER	RESOURCE LABEL	CURRENT AVAILABLE	AVERAGE AVAILABLE	MINIMUM AVAILABLE	MAXIMUM AVAILABL E
1	NODEPBIL	1376	1376.0000	1376	1376
2	RECPOINT	2000	1976.3246	1757	2000
3	INCHECKR	3	2.8486	0	3
4	BUS	26	25.7242	20	26
5	PAXSTG	1985	1966.4389	1647	2000
6	BOXLUN	985	981.3889	541	1000
7	BILFEED1	1000	861.1564	510	1000
8	BILFEED2	1000	960.3324	778	1000
9	BILFEED3	3000	2981.1154	2799	3000
10	TRABIL1	490	350.1176	0	490
11	TRABIL2	227	187.0985	5	227
12	TRABIL3	3000	2980.9993	2799	3000
13	PAXTERM	2000	1970.0601	1647	2000
14	PAXAGENT	3	2.8834	0	3
15	CARGAGNT	3	2.7009	0	3
16	WASHRACK	2	1.0357	0	2
17	VEHPROCS	5	4.0201	0	5
18	VEHPARK	1825	1849.7923	1632	2000
19	JITEAM	4	2.6743	0	4
20	MARSAREA	2527	2760.1609	2165	3000
21	PALTEAM	0	15.4997	0	22
22	EXFORK	6	5.7367	0	6
23	EXMARS	2000	1935.0292	1658	2000
24	FRUSTCAR	500	498.9841	482	500
25	MARSFORK	8	7.8091	2	8
26	NRCRECPT	2000	1999.8230	1959	2000
27	NRCAGENT	4	3.9518	0	4
28	TERMFORK	8	7.8789	0	8

*EOR

RESOURCE STATISTICS

RESOURCE NUMBER	RESOURCE LABEL	CURRENT CAPACITY	AVERAGE UTILIZATION	STANDARD DEVIATION	MAXIMUM UTILIZATION	CURRENT UTILIZATION
1	NODEPBIL	1376	0.0000	0.0000	0	0
2	RECPOINT	2000	23.6754	39.3922	243	0
3	INCHECKR	3	.1514	.4233	3	0
4	BUS	26	.2758	.8383	6	0
5	PAXSTG	2000	33.5611	52.3836	353	15
6	BOXLUN	1000	18.6111	40.9763	459	15
7	BILFEED1	1000	138.8436	169.5595	490	0
8	BILFEED2	1000	39.6676	70.3313	222	0
9	BILFEED3	3000	18.8846	47.5921	201	0
10	TRABIL1	490	139.8824	170.5502	490	0
11	TRABIL2	227	39.9015	70.6245	222	0
12	TRABIL3	3000	19.0007	47.7996	201	0
13	PAXTERM	2000	29.9399	48.1793	353	0
14	PAXAGENT	3	.1166	.3557	3	0
15	CARGAGNT	3	.2991	.5704	3	0
16	WASHRACK	2	.9643	.9832	2	0
17	VEHPROCS	5	.9799	1.3065	5	0
18	VEHPARK	2000	150.2077	82.1195	368	175
19	JITEAM	4	1.3257	1.5284	4	0
20	MARSAREA	3000	239.8391	218.8314	835	473
21	PALTEAM	22	2.5003	5.8080	22	22
22	EXFORK	6	.2633	.9479	6	0
23	EXMARS	2000	64.9708	108.4994	342	0
24	FRUSTCAR	500	1.0159	2.1335	18	0
25	MARSFORK	8	.1909	.5561	7	0
26	NRCRECPT	2000	.1770	1.8586	41	0
27	NRCAGENT	4	.0482	.4293	4	0
28	TERMFORK	8	.1211	.6781	8	0

APPENDIX H

STATISTICAL ANALYSIS

RATIOS OF CARGO PREPARED ON TIME

GROUP 1: AVERAGE .9580
JOINT INSPECTION TEAMS: 4
PALLETIZING CREWS: 26

GROUP 1 RUN 1 = .9744
GROUP 1 RUN 2 = .9718
GROUP 1 RUN 3 = .9434
GROUP 1 RUN 4 = .9751
GROUP 1 RUN 5 = .9452
GROUP 1 RUN 6 = .9698
GROUP 1 RUN 7 = .9328
GROUP 1 RUN 8 = .9516
GROUP 1 RUN 9 = .9655
GROUP 1 RUN 10 = .9508

GROUP 2: AVERAGE .9841
JOINT INSPECTION TEAMS: 5
PALLETIZING CREWS: 26

GROUP 2 RUN 1 = .9801
GROUP 2 RUN 2 = .9846
GROUP 2 RUN 3 = .9899
GROUP 2 RUN 4 = .9894
GROUP 2 RUN 5 = .984
GROUP 2 RUN 6 = .9851
GROUP 2 RUN 7 = .9786
GROUP 2 RUN 8 = .9884
GROUP 2 RUN 9 = .9825
GROUP 2 RUN 10 = .9789

GROUP 3: AVERAGE .8342
JOINT INSPECTION TEAMS: 3
PALLETIZING CREWS: 26

GROUP 3 RUN 1 = .6841
GROUP 3 RUN 2 = .8858
GROUP 3 RUN 3 = .8718
GROUP 3 RUN 4 = .8424
GROUP 3 RUN 5 = .9049
GROUP 3 RUN 6 = .8326
GROUP 3 RUN 7 = .8464
GROUP 3 RUN 8 = .8533
GROUP 3 RUN 9 = .8369
GROUP 3 RUN 10 = .7839

GROUP 4: AVERAGE .1959
JOINT INSPECTION TEAMS: 2
PALLETIZING CREWS: 26

GROUP 4 RUN 1 = .2654
GROUP 4 RUN 2 = .1854
GROUP 4 RUN 3 = .1839
GROUP 4 RUN 4 = .1949
GROUP 4 RUN 5 = .2234
GROUP 4 RUN 6 = .1718
GROUP 4 RUN 7 = .1485
GROUP 4 RUN 8 = .2093
GROUP 4 RUN 9 = .1665
GROUP 4 RUN 10 = .2097

GROUP 5: AVERAGE .9644
JOINT INSPECTION TEAMS: 4
PALLETIZING CREWS: 22

GROUP 5 RUN 1 = .9577
GROUP 5 RUN 2 = .9617
GROUP 5 RUN 3 = .9698
GROUP 5 RUN 4 = .9605
GROUP 5 RUN 5 = .9746
GROUP 5 RUN 6 = .9792
GROUP 5 RUN 7 = .9491
GROUP 5 RUN 8 = .9708
GROUP 5 RUN 9 = .9472
GROUP 5 RUN 10 = .9547

GROUP 6: AVERAGE .9602
JOINT INSPECTION TEAMS: 4
PALLETIZING CREWS: 18

GROUP 6 RUN 1 = .9517
GROUP 6 RUN 2 = .9636
GROUP 6 RUN 3 = .9774
GROUP 6 RUN 4 = .9561
GROUP 6 RUN 5 = .933
GROUP 6 RUN 6 = .963
GROUP 6 RUN 7 = .9593
GROUP 6 RUN 8 = .9718
GROUP 6 RUN 9 = .9716
GROUP 6 RUN 10 = .9545

GROUP 7: AVERAGE .9482
JOINT INSPECTION TEAMS: 4
PALLETIZING CREWS: 14

GROUP 7 RUN 1 = .9515
GROUP 7 RUN 2 = .9546
GROUP 7 RUN 3 = .9635
GROUP 7 RUN 4 = .9562
GROUP 7 RUN 5 = .9567
GROUP 7 RUN 6 = .9664
GROUP 7 RUN 7 = .933
GROUP 7 RUN 8 = .9345
GROUP 7 RUN 9 = .9437
GROUP 7 RUN 10 = .9216

GROUP 8: AVERAGE .9095
JOINT INSPECTION TEAMS: 4
PALLETIZING CREWS: 10

GROUP 8 RUN 1 = .9271
GROUP 8 RUN 2 = .9118
GROUP 8 RUN 3 = .9211
GROUP 8 RUN 4 = .9086
GROUP 8 RUN 5 = .9074
GROUP 8 RUN 6 = .8869
GROUP 8 RUN 7 = .9135
GROUP 8 RUN 8 = .901
GROUP 8 RUN 9 = .9214
GROUP 8 RUN 10 = .8944

GROUP 9: AVERAGE .5082
SENSITIVITY ANALYSIS
JOINT INSPECTION TEAMS: 4
PALLETIZING CREWS: 18

GROUP 9 RUN 1 = .5375
GROUP 9 RUN 2 = .6495
GROUP 9 RUN 3 = .3194
GROUP 9 RUN 4 = .51
GROUP 9 RUN 5 = .5111
GROUP 9 RUN 6 = .3374
GROUP 9 RUN 7 = .642
GROUP 9 RUN 8 = .5947
GROUP 9 RUN 9 = .3885
GROUP 9 RUN 10 = .5914

NONPARAMETRIC RANKINGS BY GROUP

GROUP 1 RUN 1 = 76
GROUP 1 RUN 2 = 74.5
GROUP 1 RUN 3 = 46
GROUP 1 RUN 4 = 78
GROUP 1 RUN 5 = 48
GROUP 1 RUN 6 = 70.5
GROUP 1 RUN 7 = 42
GROUP 1 RUN 8 = 53
GROUP 1 RUN 9 = 68
GROUP 1 RUN 10 = 51
GROUP 1 MEAN = 60.7

GROUP 2 RUN 1 = 83
GROUP 2 RUN 2 = 86
GROUP 2 RUN 3 = 90
GROUP 2 RUN 4 = 89
GROUP 2 RUN 5 = 85
GROUP 2 RUN 6 = 87
GROUP 2 RUN 7 = 80
GROUP 2 RUN 8 = 88
GROUP 2 RUN 9 = 84
GROUP 2 RUN 10 = 81
GROUP 2 MEAN = 85.3

GROUP 3 RUN 1 = 21
GROUP 3 RUN 2 = 29
GROUP 3 RUN 3 = 28
GROUP 3 RUN 4 = 25
GROUP 3 RUN 5 = 33
GROUP 3 RUN 6 = 23
GROUP 3 RUN 7 = 26
GROUP 3 RUN 8 = 27
GROUP 3 RUN 9 = 24
GROUP 3 RUN 10 = 22
GROUP 3 MEAN = 25.8

GROUP 4 RUN 1 = 10
GROUP 4 RUN 2 = 5
GROUP 4 RUN 3 = 4
GROUP 4 RUN 4 = 6
GROUP 4 RUN 5 = 9
GROUP 4 RUN 6 = 3
GROUP 4 RUN 7 = 1
GROUP 4 RUN 8 = 7
GROUP 4 RUN 9 = 2
GROUP 4 RUN 10 = 8
GROUP 4 MEAN = 5.5

GROUP 5 RUN 1 = 61
GROUP 5 RUN 2 = 64
GROUP 5 RUN 3 = 70.5
GROUP 5 RUN 4 = 63
GROUP 5 RUN 5 = 77
GROUP 5 RUN 6 = 82
GROUP 5 RUN 7 = 50
GROUP 5 RUN 8 = 72
GROUP 5 RUN 9 = 49
GROUP 5 RUN 10 = 57
GROUP 5 MEAN = 64.55

GROUP 6 RUN 1 = 54
GROUP 6 RUN 2 = 67
GROUP 6 RUN 3 = 79
GROUP 6 RUN 4 = 58
GROUP 6 RUN 5 = 43.5
GROUP 6 RUN 6 = 65
GROUP 6 RUN 7 = 62
GROUP 6 RUN 8 = 74.5
GROUP 6 RUN 9 = 73
GROUP 6 RUN 10 = 55
GROUP 6 MEAN = 63.1

GROUP 7 RUN 1 = 52
GROUP 7 RUN 2 = 56
GROUP 7 RUN 3 = 66
GROUP 7 RUN 4 = 59
GROUP 7 RUN 5 = 60
GROUP 7 RUN 6 = 69
GROUP 7 RUN 7 = 43.5
GROUP 7 RUN 8 = 45
GROUP 7 RUN 9 = 47
GROUP 7 RUN 10 = 40
GROUP 7 MEAN = 53.75

GROUP 8 RUN 1 = 41
GROUP 8 RUN 2 = 36
GROUP 8 RUN 3 = 38
GROUP 8 RUN 4 = 35
GROUP 8 RUN 5 = 34
GROUP 8 RUN 6 = 30
GROUP 8 RUN 7 = 37
GROUP 8 RUN 8 = 32
GROUP 8 RUN 9 = 39
GROUP 8 RUN 10 = 31
GROUP 8 MEAN = 35.3

GROUP 9 RUN 1 = 16
GROUP 9 RUN 2 = 20
GROUP 9 RUN 3 = 11
GROUP 9 RUN 4 = 14
GROUP 9 RUN 5 = 15
GROUP 9 RUN 6 = 12
GROUP 9 RUN 7 = 19
GROUP 9 RUN 8 = 18
GROUP 9 RUN 9 = 13
GROUP 9 RUN 10 = 17
GROUP 9 MEAN = 15.5

HYPOTHESIS TEST USING KRUSKAL-WALLIS TEST STATISTIC

H_o: The means of group A and B are the same.
H_a: The means of group A and B are different.

Reject H_o if $T_H > H$.

= .10
H = 29.66395

T_H values between groups

Group	1	2	3	4	5	6	7	8	9
1		24.6	34.9*	55.2*	3.8	2.4	7.0	25.4	45.2*
2			59.5*	79.8*	20.8	22.2	31.6*	50.0*	69.8*
3				20.3	38.8*	37.3*	28.0	9.5	10.3
4					59.0*	57.6*	48.2*	29.8*	10.0
5						1.4	10.8	29.2	49.1*
6							9.4	27.8	47.6*
7								18.4	38.2*
8									19.2

* indicates the null hypothesis is rejected and there is significant difference between the means of groups A and B.

COMPUTER CODE TO DETERMINE KRUSKAL-WALLIS TEST STATISTIC

```
10 DIM D(10,10):DIM M(10):DIM F(10):DIM G(10)
20 N=9
30 FOR A=1TON
40 FOR B=1TO10
50 READ D(A,B)
60 PRINT#-2,"GROUP";A;"RUN"B;"=";D(A,B)
70 IF B=10 THEN PRINT#-2
80 NEXT B
90 NEXT A
100 FOR R=1TO90
110 X=1
120 FOR C=1TON
130 FOR E=1TO10
140 IF D(C,E)=X THEN GOTO 170
150 IF D(C,E)<X THEN GOTO 160ELSE180
160 RP=1:X=D(C,E):F(RP)=C:G(RP)=E:GOTO180
170 RP=RP+1:F(RP)=C:G(RP)=E
180 NEXT E
190 NEXT C
200 FOR Q=1TORP
210 Z=Z+1
220 ZT=ZT+Z
230 NEXT Q
240 ZM=ZT/RP
250 FOR Q=1TORP
260 D(F(Q),G(Q))=ZM
270 NEXT Q
280 ZT=0
290 IF Z=90 THEN GOTO 310
300 NEXTR
310 FOR A=1TON
320 FOR B=1TO10
330 S=D(A,B)+S
340 PRINT#-2,"GROUP";A;"RUN";B;"=";D(A,B)
350 IF B=10 THEN 360 ELSE 380
360 PRINT#-2,"GROUP";A;"MEAN = ";S/10:PRINT#-2
370 M(A)=S/10:S=0
380 NEXT B
```

```
390 NEXT A
400 H=2.539*(N*(N*10+1)/6)^.5
410 PRINT#-2:PRINT#-2,"H = ";H:PRINT#-2
420 PRINT#-2,"GOUPING TESTS"
430 FOR A=1TON
440 FOR B=1TON
450 IF B<=A THEN 510
460 S=ABS(M(A)-M(B))
470 PRINT#-2,"TEST STATISTIC FOR GROUP";A;" - ";B" = ";S
480 IF S>H THEN PRINT#-2,"GROUP";B;"DIFFERS SIGNIFICANTLY
 FROM GROUP";A
490 IF S<=H THEN PRINT#-2,"GROUP"B;"DOES NOT DIFFER FROM
GROUP";A
500 PRINT#-2
510 NEXTB
520 NEXTA
530 DATA .9744,.9718,.9434,.9751,.9452,.9698,.9328,.9516,
.9655,.9508
540 DATA .9801,.9846,.9899,.9894,.9840,.9851,.9786,.9884,
.9825,.9789
550 DATA .6841,.8858,.8718,.8424,.9049,.8326,.8464,.8533,
.8369,.7839
560 DATA .2654,.1854,.1839,.1949,.2234,.1718,.1485,.2093,
.1665,.2097
570 DATA .9577,.9617,.9698,.9605,.9746,.9792,.9491,.9708,
.9472,.9547
530 DATA .9517,.9636,.9774,.9561,.9330,.9630,.9593,.9718,
.9716,.9545
590 DATA .9515,.9546,.9635,.9562,.9567,.9664,.9330,.9345,
.9437,.9216
600 DATA .9271,.9118,.9211,.9086,.9074,.8869,.9135,.9010,
.9214,.8944
610 DATA .5375,.6495,.3194,.5100,.5111,.3374,.6420,.5947,
.3885,.5914
```

APPENDIX I

USER'S MANUAL

USER'S MANUAL

This manual provides a summary of APOE reception model concepts and the program development. The following line by line analysis of the programed system parameters and resources should help mobility planners who are unfamiliar with SLAM and FORTRAN languages to experiment with the model.

MODEL CONCEPTS

The SLAM model inputs entities into the system, which flow through various activities. Entity attributes identify particular entities and direct their course through the system activities. Activities represent various time delays such as transportation or servicing times. Most activities require resources, such as buses, forklifts, or palletization crews. If an entitiy is scheduled for an activity and the required resource is not available, the entity enters a queue until the resource becomes available. Entities within a queue may be prioritized to receive the next available resource. Additionally, separate queues drawing upon the same resource may be prioritized. A planner may desire to experiment with the system by changing priorities within or between queues.

For this model, a personnel entity represents the total group of people associated with a particular FRN. The number of people in the group is maintained in Attribute 3. A cargo entity represents one pallet of cargo or one vehicle. The average weight of a pallet or a vehicle may be modified by the modeler. Adjusting the average vehicle or pallet weight will change the number of entities entering the system and subsuquent demand of resources since the number of pallets or vehicles is determined by dividing the total weight by the average weight.

In addition to server resources, this model considers space resources such as billeting, marshalling area, vehicle parking area, and others. For this simulation area resources were set artificially high to indicate maximum entity demand for a particular area. This approach provides a planner with sizing figures. If the modeler elects to use space resources which are less than the demand, personnel or cargo will queue, preventing them from flowing onto subsequent activities until the required resource is available.

Activity duration may be determined by two means, global XX(.) variables or user function distribution subroutines. A global variable represents a set, predetermined or calculated value which can be referenced or used throughout the system. For example, XX(3) = 12, (Line 2260) means that every time XX(3) is referenced or called in the simulation, the number 12 is used. A user function, however, will return different numbers conforming to a defined distribution or arithmetic operation each time it is referenced or called. For this simulation, activities which are generally base-specific such as transportation times between different locations are represented with global variables. More universal type activities such as the time to build a pallet or inspect a vehicle are represented with distribtuions. This allows a planner to easily modify this model to different APOEs. Planners can experiment with the system by changing either global or user function activity times.

Finally, when the entity departs the system, SLAM collects statistics. The departing personnel and cargo are totalled and the final average ratio of on-time to total departing personnel and cargo is returned at the end of the selected simulation period. Additionally, SLAM collects resource and queue statistics and summarizes this information. Appendix G contains a 30 day SLAM summary for the simulated TPFDD. Volume II contains actual classified 30 day summaries. The resource usage graphs in Volume II are obtained from 30 daily SLAM summaries. SLAM also allows the flexibilty in collecting statistics so that the planner may experiment with the system by collecting data over various specific periods of time (eg. from day 7 to day 12).

PROGRAM DEVELOPMENT

The simulation program consists of a SLAM network and user written FORTRAN subroutines. The SLAM network identifies the time duration for the simulation, desired SLAM statistic collection, queue prioritization, resource definition, and the actual activity network. The FORTRAN subroutines are divided into event routines, initialization routines, user functions, and allocation routines. The event routines read the input data, generate entities with appropriate attributes, and schedule entity arrivals. The initialization routine allows the user to set desired values for the XX(.) global variables. The user function subroutines define distribtuions or arithmetic operations and return the resulting values. The allocation subroutine is used to assign billeting, buses, or break bulk cargo into single pallet or vehicle entities. System experimentation should be limited to adjusting arrival or departure concepts in the event subroutine, changing global variable initial values, or changing distribution parameters in the user functions since further changes require an in depth understanding of SLAM and FORTRAN.

PROGRAM ANALYSIS

DATA PREPARATION

The program requires nine data entries for each FRN. The data cards must be generated with the data entered as integers in the following order: bulk tons, over-size tons, out-size tons, number of passengers, explosive tons, ALD, EAD, LAD, type. The tons should be indicated in short tons, and the ALD, EAD, and LAD expressed as C+0 day. The type codes are: 1 for non-deploying, 2 for unit related off-base, 3 for non-unit related off-base, 4 for unit related on-base, and 5 for non-unit related on-base. The Fortran data read statements are formated so the data must be in the exact format as the data presented in Volume II. A single space must preceed the bulk tons entry on each card. The data cards may be generated by hand-punching information extracted from the TPFDD or by a WWMCCS generated tape.

SLAM NETWORK

All line number and value references relate to the SLAM network listed in Appendix E.

Line 100 and 110 should not be changed.

To collect daily summaries rather than a 30 day summary add lines:

114= MONTR,SUMRY,24.0,24.0;

118= MONTR,CLEAR,24.0,24.0;

Lines 130 through 180 establish entitiy priority within the queues. For example, for 18,LVF(2)/, on Line 140 the 18 represents the await file number, LVF indicates lowest value first, and the (2) means look at attribute 2 for the lowest value. For the 18,LVF(2)/ example, for all the queued entities in file 18 (awaiting washrack) the vehicle with the lowest attribute 2 value (scheduled departure time) would be selected first for the next available washrack. The file number associated with a queue can be obtained from the small number in the await node in the SLAM flowchart (Figure I-1), or from the network resource

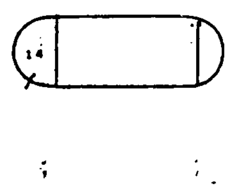

Figure I-1

lines (Lines 200 through 750), or from the await node glossary in Appendix G or Volume II. In this program, await files 2 through 8 default to a first-in-first-out priority. All other queues are prioritized to select the entity with the nearest departure time. The user may change the priority to last-in-first-out by changing LVF to LIFO. A highest value priority is designated with the letters HVF rather than LVF. To change the prioritizing attribute, change the number in the parenthesis to correspond to the desired attribute number.

Lines 200 through 750 define resource levels. The number in parenthesis indicates the defined resource levels initially available. The number following the parenthesis identifies which await files or queues are associated with this resource. Where more than one queue is associated with a resource, the order of the queue numbers determines the priority between the queues. For example, line 260 represents the bus resources. Three buses are initially available. Await queues 13, 10, 8, 6, 15, and 14 all require buses. If only one bus is available and all the queues have entities needing a bus those in queue 13 would have priority and the particular entity with the lowest value in attribute 2 would get the bus. If await file 13 is empty then await file 10 would have the next highest priority. The general philosophy in this model assigns queue priority to the queues associated with activities closest to departure.

In this model, resources are designated essential or non-essential. Essential resources will force the entity to enter a queue and wait for the resource to become available. For non-essential resources such as feeding in billeting a shortage will not prevent the entity from progressing through the system. For billeting shortages entities would queue until receiving billeting, or until time to proceed to passenger staging. At this time they would depart the billeting queue and proceed through the network.

An explanation of the composition of each resource by line further defines this model.

200= NODEPBIL, represents permanent billeting for non-deploying personnel. Each number represents a bed for one person.

220= RECPOINT, is a general area to initially receive personnel and direct them to the appropriate area.

240= INCHECKER, is a person who initially receives personnel, checks their unit identification and directs them to the appropriate area.

260= BUS, is base supplied transportation to billeting, passenger staging, the aircraft etc. All buses in this model will carry 40 passengers.

280= PAXSTG, is a location where units can assemble for briefings before proceeding to the passenger terminal. Each number represents space for one person.

300= BOXLUN, is a box lunch which each passenger will receive in passenger staging and upon leaving the passenger terminal. The simulation collects the number of lunches required each hour.

320 through 360 represents feeding while in billeting. This could be additional box lunches, or hot meals.

Each number represents one meal and each person will require three meals per day. These requirements do not use BOXLUN resources from line 300.

380 and 400 represent on base temporary billeting. Each number represents a bed for one person. TRABIL1 has priority over and will be filled before using TRABIL2.

420 represents billeting overflow. TRABIL3 will not be used unless TRABIL1 and TRABIL2 are full. TRABIL3 may be off-base contract quarters or tents.

440= PAXTERM, represents space for one person in the passenger terminal.

460= PAXAGENT, is an individual who will perform final passenger briefings, anti-hijacking and other final terminal responsibilities. One passenger agent will brief an entire FRN.

480= CARGAGNT, is a person who initially receives and examines the cargo paperwork and directs the cargo to the appropriate unloading area.

500= WASHRACK is a location to wash vehicles. Each vehicle needs one washrack if washing is required.

520= VEHPROCS, is the area and personnel who inspect, weigh, stencil, drain and purge vehicles if required.

540= VEHPARK, is parking space for vehicle awaiting departure. Each number represents space for one vehicle.

560= JITEAM, is a team representing the shipper, APOE, and the aircrew. For this simultion Phase II loading is assumed, so each joint inspection team will include a qualified loadmaster. This allows cargo inspection as soon as the team is ready, rather than the shipper and APOE waiting for the aircrew to arrive before beginning inspection.

580= MARSAREA is the marshalling area for unit and non-unit related cargo. Cargo requires marshalling area as soon as it is unloaded from the truck. Each number represents space for one pallet.

600= PALTEAM, is a palletizing team. For this simulation a palletizing team represents qualified loaders with a forklift and a rotating inspector to correct deficiencies on the spot. After the pallet is built the inspector insures it is airworthy and the team then moves it to final marshalling.

620= EXFORK, are forklifts in the explosive marshalling area to unload trucks and load K-loaders.

640= EXMARS, is the explosive marshalling area. Each number is space for one pallet.

660= FRUSTCAR, is a location where unit-related pallets can be broken down and reworked. Each number represents space for one pallet.

680= MARSFORK, is a forklift to unload trucks and load K-Loaders in the marshalling area.

700= NRCECPT, is an area to receive non-unit related cargo. All this cargo will require palletization. Each number represents one pallet's worth of cargo.

720= NRCAGENT, is an individual who receives non-unit cargo, inspects accompanying paperwork, and directs the cargo to its processing area.

740= TERMFORK, is a forklift in the cargo terminal area used to unload non-unit related cargo.

Lines 770 through 4370 are the system network. Without an understanding of SLAM do not change these lines.

Line 4390 determines the simulation duration. The first number is the start time and the second number is the finish time. For this simulation the simulation ran from hour 0 to hour 720 (30 days).

FORTRAN SUBROUTINES

Do not change any line in the main program, line 100 through 290.

The event subroutine (line 340 through 1980) should be changed only to modify the FRN arrival or departure scheduling. The arrival time, stored in attribute 1 is calculated in line 680 through 700. For this simulation the arrivals are determined from the TPFDD ALD. A 24 hour arrival window defined by 0000 hours to 2400 hours is established. From this window the arrival time is drawn from an uniform distribution. The departure time is calculated in lines 730 through 780. More factors are involved in establishing a realistic departure time than in determining the arrival time. First the departure time must be at least the arrival time plus a minimum time for APOE processing (Line 730). For a very large FRN the APOE will require more time to process it, so this preparation time is considered in Line 740. The cargo should not depart the APOE to arrive at the POD prior to the EAD so this situation is accounted for in Line 760. Line 770 selects the highest of these three values which represents the very earliest the FRN could depart. The latest departure parameter is the latest the FRN could depart the APOE and still arrive at the POD by 2400 hours on the LAD. These two values define a window of time from the earliest possible to the latest allowable departure time. From this window the actual departure time is drawn from a uniform distribution.

Lines 780 through 910 assign attributes and manipulate SLAM files.

Another modification a user might consider is the vehicle/pallet mixture. Lines 920 through 960 are two switched vehicle computation methods. If XX(52) = 1, 75% of unit related and 10% of non-unit related cargo is considered vehicular. The user may change these percentages in Lines 920 and 930. If XX(52) = 0, all outsized and oversized cargo are considered vehicles and all bulk cargo is considered pallets.

The initialization subroutine (Lines 2030 through 4030) sets the values for all the global variables. In this section each variable is explained in the code followed by the value. The user may change any of the XX(.) values as desired.

The user function subroutines (Lines 4100 through 8780) return various values to the SLAM network. Each user function is documented in the code. The user may change any arithmetic operation or distribtuion as desired. All the distributions are triangular distributions, with three parameters. The triangular distributions are identified TRIAG(X1,X2,X3,X4), where X1 is the shortest time to accomplish an activity, X2 the most likely time, and X3 the longest time. X4 identifies the random number stream and should be left at 2. X1, X2, X3 must be real numbers. The program will not run if integer values are used as distribtuion parameters.

User functions 6, 7, (Lines 4900 through 5020) 38, and 39 (Lines 8550 through 8670) collect on-time statistics as personnel and cargo depart. The functions collect an average rate over the entire simulation run. To collect on-time rates for specific days these functions must be modified. Specific modifications depend on the user's desired statistic to be collected and require an understanding of FORTRAN programing, so will not be detailed in this manual.

The allocation subroutines (Line 8800 through 11730) assigns buses, assigns billeting and separates the FRN cargo into individual pallets and vehicles. Subroutine "otput" (Line 11770 through 11900) prints the on-time percentages at the simulation conclusion. The user should not modify the the allocation or "otput" subroutines.

COMPUTER REQUIREMENTS

To input this program to the computer the user must generate three separate files. The first file is the FORTRAN code, the second file is the SLAM network, and the third file is the data. The SLAM computer language must be attached and the FORTRAN code compiled before initiating the simulation. Local ADP personnel should provide appropriate job control cards.

At Wright-Patterson on the ASD Cyber computer, with the data set indicated in Volume II, the simulation required approximately 340,000 core memory and 400 CPU seconds for execution.

ASSISTANCE

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