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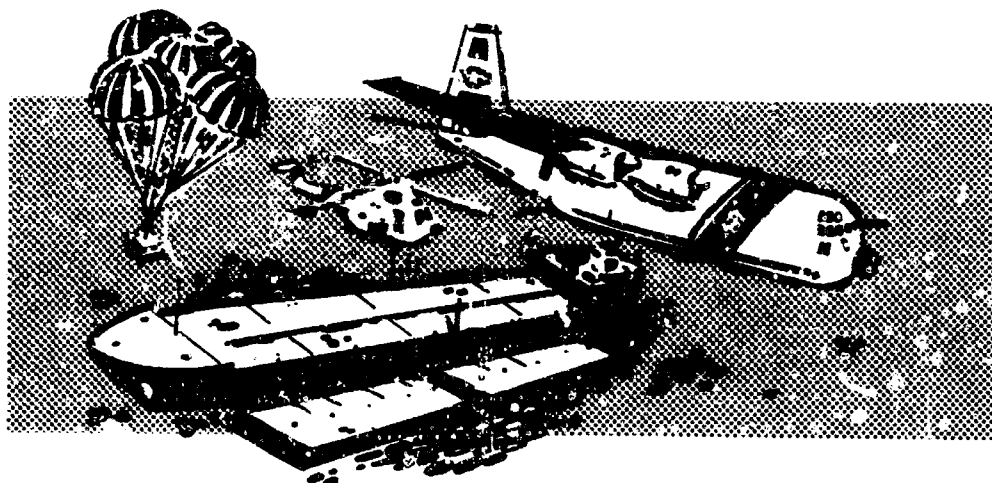
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AD 731807



COAST GUARD

THE OPERATIONAL CAPABILITIES OF THE PROPOSED



Air Deliverable Anti-Pollution Transfer System (ADAPTS)

Vol. 1 = AD 731806

VOLUME 2

VOL. 1 - AD 731

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
Springfield, Va. 22151

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Department of Transportation
United States Coast Guard

A Report on the Operational Capabilities of
the Proposed Air Deliverable Anti-Pollution Transfer System

Volume 2: Documentation of the Simulation
Model, BAGSIM

Plans Staff
Office of Operations
May 1971

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CHAPTER 1.

BACKGROUND INFORMATION

Description of ADAPTS

The equipment that the Air Deliverable Anti-Pollution Transfer System requires on scene is comprised of 500 ton capacity rubber tanks (hereafter called bags or bag pkgs) which are packaged to be air delivered and dropped by C-130 aircraft and of 1,000 gallon per minute pump and prime mover sets (hereafter called pumps or E pkgs) which also are packaged to be air delivered and dropped by C-130 aircraft. These packages are used at the scene of an oil pollution incident before a major spill can occur or during the spill to minimize the spill. While the system is not designed for use after a spill, the development of adequate boom and sweeping equipment may allow application of ADAPTS in those instances.

The personnel that the system requires on scene varies with the amount of equipment and the duration of the incident. For purposes of this study the assumption was made that a four man salvage team was needed for each pump used on scene when the deployment is a period of twenty four hours or less. Also there is personnel support equipment delivered to the scene by any means to provide food, bedding, lighting, and communications for these personnel.

Transportation of the equipment and personnel is provided by C-130 aircraft from Elizabeth City Air Station (ECAS) and by HH-52A or HH-3F

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helicopters from the air stations nearest the incident. The system is designed for use with the current inventory of Coast Guard aircraft but, should the workload warrant, aid from the Air Force could be obtained or additional aircraft may need to be purchased.

The concept of ADAPTS and its use places additional requirements upon the aircraft, the air stations, and the personnel stationed there. One hopes there will be no need for additional aircraft and personnel but there will be a definite need to improve cargo handling capability at the air stations. In order for ADAPTS to be deployed in a timely manner, i.e., first units on scene within four hours, the C-130's must be configured for loading and dropping the heavy packages rapidly. Means for bringing the packages to the C-130's must be improved for safety and speed. Likewise the HH-3F's are expected to deliver in slings the prepositioned E pkgs. Additional slings are needed and the time that sling installation requires must be reduced.

The System consists of several categories of equipment and personnel. The categories are broken down for purposes of description¹ into four sub-systems:

- a. ECAS with C-130 aircraft and ground support.
- b. Two other air stations (HP1 nearest to the incident and HP2 next)
- c. The aircraft delivered pumps and tanks which are the ADAPTS peculiar equipment.
- d. The salvage teams with life support equipment.

The manner in which these interact during deployment is shown in Figure 1.

¹ These are described in detail in Volume 1.

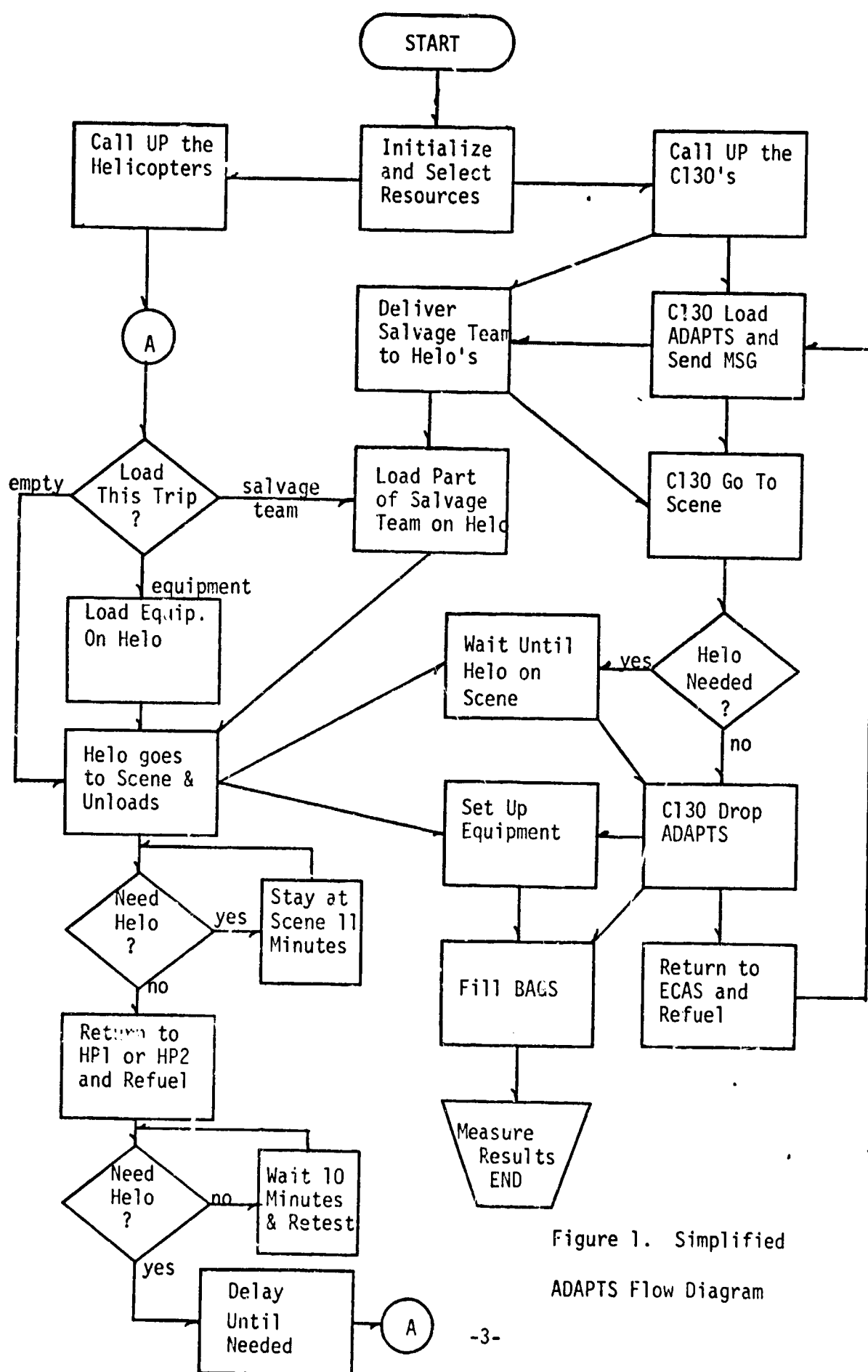


Figure 1. Simplified
ADAPTS Flow Diagram

Assumptions

The study was conducted to discover the upper bound on the capability of the system. This allowed the assumptions of good weather, a 20,000 ton tanker cargo in danger of spill in a location where ADAPTS can be delivered, and no machinery or material failures. An adverse condition in any one of these basic assumptions reveals the lower bound of the problem: no bags filled. The actual results will lie between these bounds. For a given set of resources and distances, the manager can determine the upper bound with the model and from that and the extent to which the assumptions are violated he can estimate the actual capability of the system in any given instance.

At least one C-130 and means of loading it are needed. The assumption used in the model was that these were available for use immediately. That is, the C-130 was fueled, had a rail system installed, and was positioned for ease of loading and taking off. An air crew for the C-130 was assumed to be either ready immediately or to be ready before the C-130 was loaded. Loading was assumed to start immediately for the first trip of the first C-130. The standby and availability of following C-130's is variable; however, for all C-130's the assumption was made initially that once they become available, they remain available for the duration of the incident regardless of crew endurance and scheduled maintenance (We will see later the effect of changing this assumption). Naturally the prior assumption of no material failures holds here.

At least one helicopter is needed. All helicopters were assumed to have slings either installed or immediately attachable; that is, there was no time delay for installing slings but an allowance was made for loading and

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unloading the helicopters. The fuel consumption of the C-130's and helicopters is assumed constant for the speeds used and loads carried. See Table 1. The helicopter endurance per trip was derived by computing the amount of fuel it can carry with the load (people, E pkg, or empty) and converting this into time. The time required to go to the scene, return from the scene, and a half hour reserve were subtracted to form time on scene. It must be greater than 10 minutes for the helo to be useful with the load it is carrying. If not the problem is stopped. It is assumed that an HH-3F carries a complete E pkg in one trip while an HH-52A carries 1/3 E pkg per trip for three trips. These assumptions were made to compare HH-3F's with HH-52A's, to allow HH-52A's to be considered for carrying E pkgs, and to limit the times involved. While an HH-3F could carry 1/3 E pkgs a great distance, the distances involved and the time required for three trips would reduce output drastically. Such a combination is of academic interest only; it is not practical, hence it was not incorporated into BAGSIM.

The results reported herein are based upon the assumption that the size, weight, and capacity of the prototype pump and bag remain unchanged when ADAPTS is purchased in quantity. This means that only two packages can be carried by a C-130 per trip. The model will require extensive minor changes to accommodate changes in the pumps and bags but these changes are easily entered.

The tanker was assumed to be a dead ship, none of its equipment usable, and its crew unable to help the salvage team. No commercial salvage undertaken and no supporting Coast Guard ships were two more assumptions for the purpose of deploying up ADAPTS within a 24 hour limit.

TABLE 1
AIRCRAFT PARAMETERS

PLANE	SPEED IN KNOTS		CAPACITY f=fuel c=Psngrs & Cargo	RESERVE FUEL	REFUELING RATE IN MINUTES			FUEL CONSUMPTION RATE #/hr.
	OUT	BACK			LOW	MEAN	HIGH	
HH-52A	85	95	2000# f&c	1/2 hr-200#	15	20	35	400
HH-3	115	125	7000# f&c	1/2 hr=600#	20	30	50	1100
C-130	270	290	17000# c @ 45000# f	1 hr=4000#	30	40	60	4000

Each bag delivered was assumed to drop and anchor about 100 yards from the tanker and the bags once filled were assumed to be out of the problem. This latter assumption is based upon the consideration that, by the time enough bags are filled to be a problem, surface vessels capable of moving them will be available. Hence, this final part of the problem is not considered. For the former assumption, 100 yards was picked from the results of the April 1970 test of the prototype. The distance could have been made a probabilistic variable with mean value of 100 yards but was fixed for purposes of comparability of results for the upper bounds.

Food, water, clothing, shelter, and communications equipment for the salvage team were ignored in the model under the assumption that they can be delivered piecemeal to the scene by helicopters without materially affecting on scene endurance. Such support could also be delivered by parachuted packages from HU-16E's or C-130's or by cutter depending upon circumstances.

The good weather assumption * was further defined as:

- wind less than 25 knots
- visibility more than 8 miles
- chop less than 5 feet
- clouds at or above 1000 feet (if any).

The final assumption used to formulate the model was that the available resources in aircraft were not diverted for any other use. That is, if a problem run of the model started with eight C-130's, it ended with the same eight C-130's.

* The Specific Operational Requirement (SOR) for ADAPTS is more demanding. Restricting the study to good weather allows us to ignore weather as a variable.

During the construction of the model some additional assumptions were made on the sequencing and priority of helicopter operations etc. These strategies will be described with the model in the following chapters since they are modeling assumptions.

The Simulation Language

GPSS-360/Version 2 is the language used for the computer simulation of ADAPTS. It is a block command oriented language with special blocks for queuing problems. The deployment of ADAPTS is a queuing problem since the following queues can and do form as the resources are varied:

- a. C-130's waiting for loaders
- b. C-130's waiting for drop zone
- c. C-130's waiting for helicopters
- d. Bags waiting for HLD's
- e. Bags waiting for pumps
- f. Bags waiting for helicopters

A queuing or waiting line problem has several parameters which GPSS automatically stores, tabulates, computes, and displays. Among the more useful are for each queue:

- a. the number that wait
- b. the number that do not wait
- c. the average wait for all
- d. the average wait for those who wait
- e. the maximum length of the waiting line
- f. the average number in the waiting line
- g. the current number in the waiting line

The model is constructed so that these values are displayed after 10 bags and 40 bags have been filled to provide data during and after a run.

A program is built in GPSS by defining storages and facilities (single capacity storages) for which the language computes usage statistics. For example a storage could be assigned the capacity of 2 and be named pier 1. The program could be written to have ships arrive at pier 1 every 4 ± 3 days

for stays of 5, 10, 15, 37 hours and the questions of how many ships have to wait per week and how many hours of the week the pier is idle are to be answered automatically. Ships too large for pier 1 are rejected or can be sent to pier 2 depending upon priority of cargo.

The blocks of the GPSS language define what is being done including: time delays, conditional routing, computations and value saving, and reassigning values amongst others. Values can be initially set, computed during computer run, or placed into the program as constants. This is a representative list; not an exhaustive list of the block capabilities.

The blocks to be used are given descriptive values which describe the action of the block. For example the block ADVANCE can be given the values ADVANCE p12, FN5 which means the transactions reaching that block stays there for the average time it has stored in its twelfth parameter plus or minus time given by function 5.

The GENERATE and the SPLIT blocks create transactions which are numbered areas of computer storage. The transactions can be assigned identities such as first C-130, helo 1 or message 37. The GPSS compiler has an internal clock routine built into it which asks what happens at this time and when nothing else is due to happen at this time in the simulation it asks what happens next in the simulation and advances to that time. Things happen to (or are done by the) transactions by figuratively routing the transaction through the sequence of block commands. This is done by having the transaction storage area in the computer contain the current block number, the block departure time, and the next block number as well as the other values which define the transaction. When the action

required at the current block is completed by (on) the transaction, the next block is approached by the transaction; if it enters, the action required is taken. This process continues for that transaction and only that transaction until the transaction is refused by a block or the block requires a time delay. Then the GPSS clock routine goes on to the next transaction. This point is important, if two transactions are to take action at the same time, regardless of priority, the first one encountered by the GPSS clock routine moves first. The ADAPTS simulation model (EAGSIM) has extra blocks added to it for the sole purpose of defining the priority of simultaneous events should they ever arise.

A more complete description of GPSS may be found in reference 1 and the relative merits of computer simulation are discussed in reference 3.

CHAPTER 2

MODELING ADAPTS

Model Requirements

The prime requirements placed upon BAGSIM are that it accurately portray the ADAPTS deployment process and that the model be clear and easily understood. A secondary requirement is that the input for a simulation run be easily identified and entered. To meet these requirements extra detail was added to the model. Comment cards were added and comments were placed on the same card as the command to help interpret the effect of that command. For example:

```
SPLIT 1, HHG82  UNLOAD HELO2
```

Here the block SPLIT caused one duplicate transaction to be created in CPU. It is sent to the program address HHG82 and represents an E pkg that has been unloaded from HELO2 which is the parent transaction. The parent transaction continues along its sequence of blocks until it encounters a delay and then the GPSS clock goes to the next transaction that can move during that time; it may be the E pkg. Sometimes the comment on a card indicates what will happen next, this is done when unconditionally transferring to a routine. A single asterisk on a comment indicates that that card was used on an initial simplified version of BAGSIM and remained unchanged through the development of the model. Three asterisks on a comment indicate that that card contains an input value such as number of C-130's;

thus, the variables and parameters which represent inputs for a simulation run are flagged. They also are placed at the beginning of the simulation model in groups for further ease in locating and changing. This is done by using INITIAL commands (they are not blocks) which in some cases added extra length to BAGSIM.

When a symbolic address name was used, an attempt was made to have it describe the routine it represented. Examples include:

HLSC2 the initial H means a helo action
the final 2 means Helo2

GTS1 to to scene (in Helo1 routine)

IHLD initialize the amount of HLD's available

WAIT wait

CCREW change C-130 aircrew

BFILL bag filling routine

SMSG send a message

and so forth. In some instances there seemed little value to having the symbolic name mean anything so multiple letters such as AAA1 were used. This happened most often within a routine for which the symbolic name had sufficiently identified the routine (AAA1 follows HGSC1 for example).

Restrictions on BAGSIM

Certain of the input variables and parameters were constrained in the range of values they could take to meet the following limitations:

- GPSS required a fixed constant
- ADAPTS fixed the possible range
- A large amount of computer space would be required but it would be normally unused.

The amount of E pkgs was limited to twenty (from all sources) to meet the first limitation. That there can be only two types of Helos is an illustration of the second type of limitation. That there can be only fifteen C-130's is an example of the third limitation. These will be considered at length in the detailed description of the model in Chapter 3.

BAGSIM will show extra time consumed in delivering the salvage team from New York City to an incident at NYC. This results from having a C-130, the EC-130 for example, go to NYC to pick up the salvage team and then deliver the team to the air station (HPI) nearest to the scene. This C-130 serves no other function and while it would be necessary for delivery of the team to a location distant from NYC, it is redundant in this case. The time for the C-130 to travel from ECAS to NYC can be changed to zero and the C-130 is then effectively removed from the problem.

The standard GPSS report generator was used in lieu of developing a specific and more descriptive report generator. As a result the user must interpret the results of a simulation run. The reader is referred to Chapter 3 for specific information. This is done since the GPSS report generator presents all the desired data without requiring a single card for control of output while the GPSS commands required for a full but better formatted and more descriptive output requires over 1,000 cards. This

disadvantage clearly outweighs the advantage of a more legible output. So while the input for BAGSII was made easier, the output must be interpreted. Particular care must be taken when looking at the STORAGE statistics since some storages are defined empty initially and others are defined full initially while the standard output is based upon all being defined empty initially; e.g., STORAGE HLD is defined full initially so a utilization of 1.0 means it was never used in lieu of meaning it was always used!

Verification of BAGSIM

Any model must be verified in order that its output can be used with confidence. In the case of BAGSIM verification was done by making comparative runs against the ADAPTS problem solutions by PERT/CPM techniques. The results of these comparisons verified the model; see table 2 through 5. The PERT/CPM techniques used a sequencing of events and time required for each event based upon prototype tests and were themselves edited and changed to prevent such occurrences as helicopters arriving on scene two hours before they were needed.

These four verification runs were done for an incident postulated at the Delaware Bay Entrance and with different resources. Verification runs were not done for other locations but the results from the different methods agreed when the differences in resources are considered. For example on the Florida Straits, run FSA was a BAGSIM run with five C-130's, two C-130 loaders and four E pkgs while run DA9 was a PERT run with five C-130's, five C-130 loaders and three E pkgs. The result of the former was 22 bags filled in 24 hours while the result of the latter was 21 bags filled in 24 hours. For Norfolk, runs AA5 by PERT and NFA by BAGSIM ended with 35 and 36 bags filled in 24 hours. Both used five C-130's and four E pkgs but the number of loaders varied and the method of delivering the E pkgs varied.

Although BAGSIM is verified, it should be updated when new parameters are established for ADAPTS equipment. For example, if subsequent experience shows that the time to drop a package out of a C-130 is 15 minutes plus or minus five minutes instead of the flat ten minutes given in the model, the model should be changed and run several times with different random number seeds comparing its results to the actual ADAPTS deployment. Such a change

TABLE 2

Comparison of Run BET Results
Using BAGSIM with PERT/CPM Method

<u>EVENT</u>	<u>BAGSIM TIME</u>	<u>PERT TIME</u>	<u>% DIFF.*</u>
last E pkg set up	557	539	3.34
1st C-130 returns ECAS	241	239	0.84
1st Bag Dropped	204	202	0.99
1st Bag Filled	395	380	3.95
2nd Bag Filled	555	553	0.36
3rd Bag Filled	676	671	0.74
4th Bag Filled	678	674	0.59
5th Bag Filled	797	792	0.63
10th Bag Filled	1041	1037	0.38
11th Bag Filled	1160	1155	0.43
12th Bag Filled	1162	1158	0.34
18th Bag Filled	1525	1521	0.26
19th Bag Filled	1644	1639	0.30
20th Bag Filled	1646	1642	0.24

*Computed from 100 times (larger minus smaller time)
PERT time

TABLE 3

Comparison of Run 3P3 Results
Using BAGSIM with PERT/CPM Method

<u>EVENT</u>	<u>BAGSIM TIME</u>	<u>PERT TIME</u>	<u>% DIFF.</u>
Last E pkg Set up	605	604	0.16
1st C-130 returns to ECAS	241	239	0.84
1st Bag Dropped	204	202	0.99
1st Bag Filled	416	408	1.96
2nd Bag Filled	582	581	0.17
3rd Bag Filled	726	725	0.14
4th Bag Filled	737	746	1.21
5th Bag Filled	870	869	0.12
10th Bag Filled	1169	1178	0.76
11th Bag Filled	1302	1301	0.08
12th Bag Filled	1313	1322	0.68
18th Bag Filled	1745	1754	0.51
19th Bag Filled	1878	1877	0.05
20th Bag Filled	1889	1898	0.47

TABLE 4

Comparison of Run AAF Results
Using BAGSIM with PERT/CPM Method

<u>EVENT</u>	<u>BAGSIM TIME</u>	<u>PERT TIME</u>	<u>% DIFF.</u>
Last E pkg Set up	845	858	1.52
1st C-130 returns to ECAS	241	239	0.84
1st Bag Dropped	204	202	0.99
1st Bag Filled	416	408	1.96
2nd Bag Filled	582	581	0.17
3rd Bag Filled	726	725	0.14
4th Bag Filled	737	736	0.14
5th Bag Filled	870	869	0.12
10th Bag Filled	1182	1181	0.08
11th Bag Filled	1205	1205	0.08
12th Bag Filled	1302	1301	0.08
13th Bag Filled	1326	1325	0.08
14th Bag Filled	1422	1421	0.07
15th Bag Filled	1446	1445	0.07

TABLE 5

Comparison of Run DBE Results *
Using BAGSIM with PERT/CPM Method

<u>EVENT</u>	<u>BAGSIM TIME</u>	<u>PERT TIME</u>	<u>% DIFF.</u>
List E Pkg Set up	485	490	1.02
1st C-130 Returns to ECAS	241	239	0.84
1st Bag Dropped	204	202	0.99
1st Bag Filled	416	403	3.22
2nd Bag Filled	602	601	0.17
3rd Bag Filled	798	798	zero
4th Bag Filled	808	808	zero
5th Bag Filled	1019	1015	0.39
10th Bag Filled	1461	1459*	0.14
11th Bag Filled	1662	1666*	0.24
12th Bag Filled	1672	1676*	0.24
13th Bag Filled	1883	1883*	zero
14th Bag Filled	1893	1893*	zero

*Adjusted to correct for difference in C-130 refueling.

may require an adjustment to the time a helo stays on scene (in BAGSIM)
before asking what work is there for a helo.

CHAPTER 3

DETAILED DESCRIPTION OF BAGSIM

Inputs Required

The following are the input numbers needed to run the model. They are discussed here in the same order they appear in the computer card deck.

●LDROO is the number of C-130 loaders, this storage value can be any integer from 1 to 4,294,967,295. For practical reasons it should be less than or equal to the number of C-130's.

●Halfword Matrix 1, MHI, describes the C-130 delivered E pkgs. There must be an initial value card for each C-130 delivered E pkg. See Appendix E for a description of this matrix. A sample initial value card would be: INITIAL MHI(2,1),3 which means place 3 (trip number) into halfword matrix 1 in position row 2 (second E pkg delivered by this C-130) column 1 (first C-130). These must all be positive integers greater than zero. The row number cannot exceed 3, the column number cannot exceed 15.

●Halfword Savevalue 22, XH22, contains the number of extra C-130 aircrews. If there are three C-130's and five aircrews, place $5-3=2$ into XH22. This must be a positive integer or zero. (Halfword save values can be any number within ± 32767 in GPSS/360 but BAGSIM places further restrictions.)

●XH23 contains the C-130 aircrew endurance in minutes, that is, the length of time a crew is allowed to use a C-130 before it must rest. This must be a positive integer.

●XH3 contains the number of C-130's in this run. It must be an integer from 1 to 15 inclusive.

●XH2 contains the number of four man salvage teams used in the run. It is generally set equal to the total number of pumps used in the run. The only effect of salvage teams in BAGSIM is to tie up C-130's and Helos for delivery of the teams to the scene. The actual need for a given number of men is not determined. This number must be a positive integer.

●XH40 contains the distance in nautical miles from Brooklyn Air Station, BAS, to the air station nearest to the scene, HPI. It must be greater than or equal to zero (but less than 32,767).

●XH20 contains the distance in nautical miles from HP2 to HP1 where HP1 is the air station nearest to the scene and HP2 is the next nearest air station. This distance is greater than or equal to zero.

●The distances to the scene are in the next four initializing cards:

<u>Halfword</u> <u>Savevalue</u>	<u>Distance Involved</u>
XH5	from ECAS to scene
XH6	from ECAS to HP1
XH7	from HP1 to scene
XH8	from HP2 to scene

Each of these distances must be greater than or equal to zero.

●XH16 and XH17 contain the prepositioned E pkgs at HP1 and HP2 respectively. These are integers greater than or equal to zero.

●XH41, XH42, and XH43 are the helicopter type designators. They must contain either a 3 or a 52 to specify the type of helicopter. XH41 represents the first helicopter, it is the helo immediately available at HP1. XH42 represents the second helicopter, it is the helo immediately available at HP2. XH43 represents the third helicopter, it is the backup helo at HP1. Any combination of the helo types (3 or 52) with helo availability (Helo1 used or not, Helo2 used or not, Helo3 used with variable standby or not used) is allowed.

●XH50 is the call up time for the backup helo at HP1; it is a positive integer or zero. BAGSIM assumes that, after HP1 has been notified to provide helos, one minute is used to call the helo on immediate standby and then XH50 is the time lapse before Helo3 is ready to do work.

●XH51 through XH55 are the standby times for the first through fifteenth C-130 respectively. All these times are measured from the time ECAS is first notified and they are generally set to:

<u>Halfword</u> <u>Savevalue</u>	<u>Value</u>
XH51	0
XH52-XH55	60 minutes
XH56-XH65	300 minutes

These are changeable to any realistic standby time subject to the following restrictions:

- greater than or equal to zero
- integers representing minutes
- Sorted by size with the smallest first to the largest last. This is necessary since the C-130's are identified in the order they come off standby.

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●XH14 represents the time needed to install rails on the C-130 if rails are not installed. It is generally set to 15 minutes to represent the final sections of -4A rails but it can be any positive integer.

●XH15 represents the time needed to load a C-130. It can be any positive integer greater than zero. It is assumed to be constant for all loads and C-130's (after the rails are installed). With the 25K loader, this value is expected to be 90 minutes. (The point made earlier that any constant value time delay, such as this 90 minute delay, can be represented as a mean \pm a curve applies, should experience warrant using probabilities or variables, the change is simple to make.)

The preceding inputs are all grouped before the GPSS block statements in a section of definition statements. Following them are the mathematical statements that define the variables and then the model. Some input values are more efficiently placed at the head of the model after the GENERATE block.

●Logic switches 1, 2, 3, 4, 5, and 10 are used to denote either-or situations:

Logic Switch	Meanings S=set; R=reset*
1	S = Helo1 available and used R = Helo1 not used
2	S = Helo2 is used at HP2 then HP1 R = Helo2 is not used at HP1 but it can be used at HP2 if XH17 is greater than zero
3	S = Helo3 available and used R = Helo3 not used
4	S = Manifolds are placed on the pump discharges R = No manifolds
5	S = Helos tow packages in the water R = Helos do not tow packages but they deliver the end of the tow line
10	S = Salvage teams at NYC R = Salvage teams at ECAS

*All logic switches are initially reset.

These commands are placed in the first 10 blocks.

●The final input is the TEST G block (block 25) between symbolic addresses PLANE and DTEAM. It is flagged with three asterisks and is the number of C-130's that have rails installed. The assumption is that the C-130's with rails installed are used first. It can be any positive integer; it is presently set equal to one since the present plans are that only the immediately available C-130 at ECAS will have rails installed at all times.

Outputs

BAGSIM is designed to give an extended output when 10 bags have been filled and a standard output when 40 bags have been filled. Some conditions that can occur, such as insufficient flight time for the crews will terminate the problem early with standard output. These considerations have been placed into the model with indicators to aid in determining the reason for early termination.

Halfword matrix 7 is used to log messages sent by the C-130's to HP1 and HP2 and Helos at the scene. This matrix is defined to hold thirty messages; once it is filled, it is printed and zeroed for the next thirty messages.

The extended output that is printed after 10 bags are filled includes first, the current time in minutes and the block status. For each block the current contents (number of transactions) and the total entries are tabulated. This is useful in determining the location of aircraft at that time.

Second, the current events chain is printed. It lists the transactions and their parameters that at this time are being moved by the simulation. This is an extended output used in debugging and determining values of variables. It is interpreted using reference 1.

Third, the Future Events Chain is printed. This is similar to the current events chain but it lists the transactions that are waiting a future time before they are moved by the simulation.

Fourth, the facility statistics are printed. There are four facilities used and they are:

Facility Name	Represents
1	Helol usage
2	Helo2 usage
3	Helo3 usage
LOADI	A throttling device to prevent loading more than helo at a time with E pkgs.

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If a numbered facility is seized, that means the helo is doing work for the seizing transaction; if it is preempted by a C-130, it means that an E pkg is being delivered; and if it is preempted by the helo, it means that the helo has left the scene. (1- Average utilization) represents the % time helos are available for work and are not working. The average time per transaction is the average of time at scene and working plus time away from scene. It is relatively meaningless. The preempting transaction is the transaction that represents the helo or a C-130 delivering an E pkg. The priorities for seizing or preempting are:

<u>Priority Number</u>	<u>Transaction Representing</u>	<u>Action</u>
1	Bags	Can seize only
3	C-130's	Can preempt bags
5	Helos	Preempts C-130's and bags

By using the number of the preempting or seizing transaction, the current events chain and the future event chain, the reader can determine exactly what is happening at the time of the printout.

Fifth, the logic switch status printing is given. It is a listing of logic switches that are set. The meaning of having a particular logic switch set or reset is given in Appendix F. The logic switches in the 200's are used to flag time delays that are computed to a negative value. Most of these terminate the problem early.

Sixth, the storage statistics are printed. These are:

<u>Name</u>	<u>Use</u>
DZONE	to limit the number of C-130's in the drop zone to two since more than two C-130's dropping packages at a given time would interfere with each other and present a risk of collision.
HAUL	to define the number of HLD's at the scene in this run. Its statistics are useful for debugging only since it is filled initially.

EPKG to define the number of pumps at the scene in this run regardless of source. Its statistics are useful for debugging only since it is filled initially, emptied as pumps are set up, and refilled when pumps are in use.

LDROO the number of C-130 loaders in this run. Its statistics are particularly valuable since loaders are so costly and necessary.

Seventh, the Halfword Savevalues, XH_n , (the contents of which are not equal to zero) are printed along with the value of the contents. The definitions of these halfword savevalues are given in Appendix D. Since fullword savevalues are not used by BAGSIM, they are not printed.

Eighth, the queue statistics are printed. These are standard queueing (waiting line) parameters and are useful in determining the causes of delays and their remedies. Six queues have been defined, they are:

<u>Name</u>	<u>Server</u>	<u>Description</u>
WLDR	C-130 loaders	This is the queue for C-130's waiting to be loaded.
WDZ	Scene	This is the queue for C-130's waiting <u>near</u> the scene to drop their load.
WHELO	Helos	This is the queue for C-130's waiting <u>at</u> the scene for a helo when an E pkg is in its load.
WCPTR	Helos	This is the queue for bags in the water waiting for a helo to deliver messenger (or to tow).
WEPKG	Pumps	This is the queue for bags after positioning by HLD (or helo) waiting for a pump to become available.

Other queues could have been defined (such as waits for HLD's) but they are considered to be minor so while the wait actually occurs in BAGSIM it is not recorded.

Ninth, a tabular presentation of helo on scene time is printed. For 15 minute intervals, the number of helo stays on scene is tabulated along with percentages of total, cumulative percentages, the mean, standard deviation, and sum. It is labeled OSTMH.

Tenth, tables are presented for four of the queues, they are:

<u>Table</u>	<u>Queue</u>	<u>Size of Interval</u>
WTLDR	WLDR	15
WTDZ	WDZ	10
WTHH	WHELO	5
WTCP	WCPTIR	5

These tables are identical in format to the table previously described.

Eleventh, the Matrices are printed out. These are printed one to a page, and are identified by number only. The rows and columns are numbered. The meanings assigned to the matrices and their rows and columns are described in Appendix E. Matrix 6 was not entered into BACSIM.

<u>Number</u>	<u>Use</u>
1	to input the C-130 delivery schedule for pumps.
2	to record each time each C-130 returns to ECAS
3	to record when a pump first is ready to pump and which aircraft delivered it.
4	information on filled bags
5	to record each time each C-130 begins loading
7	to record the messages and the action taken
8	to record the helicopter trips.

The standard output that is printed at the end of the simulation run is the same as the extended output except the current events chain and the future events chain are not printed.

Whenever an early termination is necessary a TRACE block is passed which causes the terminating transaction to be printed just before the final output. This helps in determining more of the facts of the problem.

Far more output could be specified but in normal simulation runs it is unnecessary. For example standard output could be specified when each

bag is filled or it could be specified when any specific event occurs.

It may be necessary to know where every C-130 and helicopter is after 9 1/2 hours. Standard output can be called by a simple clock routine at 9 1/2 hours or every 9 1/2 hours instead of, or in addition to, output after 10 and 40 bags are filled. It may be desirable to know where all helos are when a C-130 carrying a pump in its load is 5 minutes from a drop. This can be specified as an extended output or by printing only the current event chain end the future event chain. Additional queues could be defined for more waiting time information. Practically any question about the operational deployment of ADAPTS can be asked except what is the best number of _____.

GPSS does not seek an optimal. It is similar to an equation. For given inputs, an output is presented. In a deterministic situation the same output is given each time the same inputs are used. In a stochastic situation different possible outputs are given each time the same inputs are used with different random number seeds. In BAGSIM there are 60 blocks that could have been defined with stochastic parameters but were defined with average values. Any of all of them can be changed to stochastic variables should experience warrant. If many of them are, a large number of runs would be needed to define:

- a. the most likely results and
- b. the possible range of results.

Program Description

BAGSIM is listed in Appendix A. The computer listing breaks down readily into:

1. the Job Control Language for the IBM 360 computer. These cards have // in the first two columns. They specify the use of GPSS-360V2 and the file sizes and allocations. The total region needed is near 170K of main core and the problem runs for 90 seconds on an IBM 360/65.
2. definitions; between the SIMULATE card and the GENERATE card are the cards that define the storages, tables, matrices, variables, and boolean variables. Included in this section are the cards that assign initial values to the matrices and Savevalues which require initial values. Some of the initial values are for counters and others are inputs.
3. the model which begins with the GENERATE card and ends with the last block which is the TRANSFER, GOHPl card.
4. three GPSS control cards which specify starting the simulation run, the desired output, and the ending of the run.

The model consists of many well defined portions. The first portion from the comment card "AIRCRAFT CALL UP ROUTINE" includes the GENERATE card which makes the first transaction. This transaction initializes the storages HAUL and EPKG. It splits to form the C-130's used in the run and places them through the delays of call up and rail installation before sending them to the Delivery Routine. If the Salvage teams are at NYC, this transaction splits off an aircraft to go from ECAS to BAS, pick up the teams, and deliver them to HPl. It also determines which helos are used and splits transactions to the Helo Routines. The "HELO #1 ROUTINE" is next in sequence. It assigns to the transaction that represents Helol the trip

times and maximum permissible on scene times. This transaction will now be called Helol. It waits for the Salvage Teams (S.T.) unless the S.T. will be delivered after Helo3 is ready. In this latter case Helo3 waits for the salvage team and Helol makes one pump trip and then waits for salvage teams.

The normal sequence for Helol is:

1. deliver one S.T.,
2. deliver an E pkg if there are any pumps at HP1,
3. deliver the remaining S.T.,
4. deliver the remaining pumps,
5. make empty trips for the rest of the on scene work.

Whenever Helol goes to the scene it stays for a minimum of eleven minutes and then asks:

1. Is my endurance ended?
2. Is work in progress?
3. What work is coming?

If work is not in progress and a C-130 is coming the helo either waits for it or goes back to HP1 and refuels and then comes back to scene in time for its arrival. Whenever Helol returns from the scene it asks:

1. Has an E pkg been delivered? If no, deliver one E pkg from HP1.
2. Have all salvage teams been delivered? If no, deliver them.
3. Are there any more E pkgs at HP1? If yes, deliver them.
4. Can this helo wait before leaving for the scene? If yes, wait and check messages; if no, go to scene.

The messages sent by C-130's are checked either at the scene or at HP1. When the helo takes a message it computes when it is needed and schedules itself to be at the scene when the C-130 arrives. It also indicates on the message file (MH7) that it received the message.

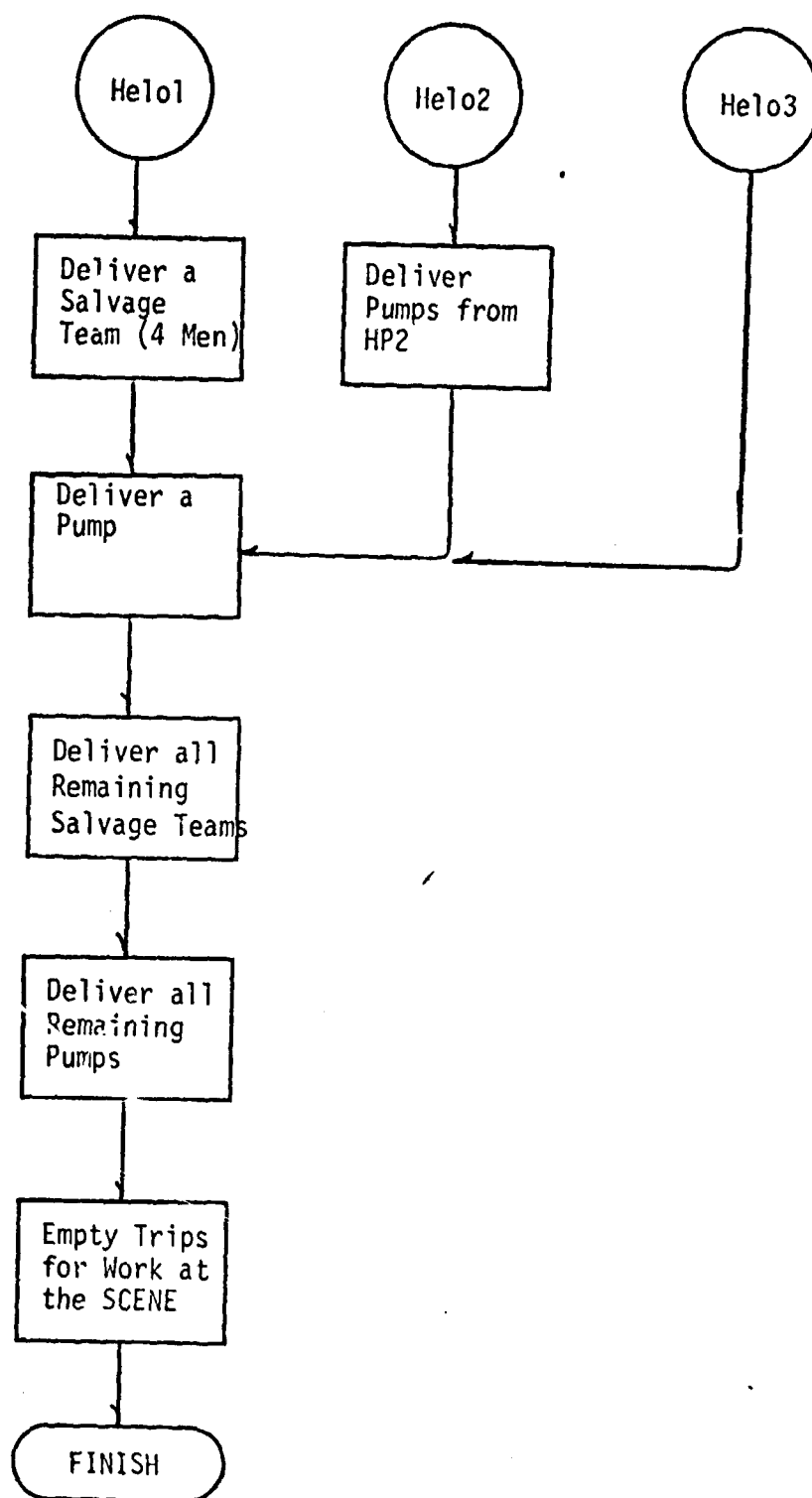


Figure 2. Work Strategy Followed by Helicopters in BAGSIM.

The situation that a C-130 delivering an E pkg has an available helo but the helo has to leave to refuel before the HLD has been delivered can arise. The need to refuel was given preemptive priority over all tasks performed by helo's. Whenever such a preemption occurs, the C-130 is removed by GPSS from its normal delivery routine and placed into the RES2 subroutine. There the status of the load is determined. If no packages have been dropped, the C-130 is reset into the drop zone waiting for any helo. If the E pkg had been dropped but not the bag pkg, the bag pkg is dropped and the C-130 returns to ECAS. If both pkgs were dropped, the C-130 had already begun its return trip and the preempted transaction actually represented the time needed to tow in an E pkg. It is no longer needed since it can be hauled in when no helo is available so it is terminated.

The E Package Set Up Routine describes the process of setting up E pkgs from the time they hit the water until they are ready for use. The HLD is delivered by the same helo that stood by during the drop, then this routine tells the delivery routine to release the helo. The HLD is set up and the count in storage HAUL is decreased by one to signify an unused HLD. If there is an unused HLD, it is used to haul in the E pkg. (When helo's can tow, the HLD is used to finish the hauling and lifting.) If no HLD is free, the E pkg queues for HLD's but at the head of the line before bags (priority queue without preemption). The E pkg is hauled in, lifted aboard, and the HLD is released. Helo delivered E pkgs are inserted into the routine at this point. E pkgs are then set up and test run. The time each E pkg becomes ready is logged and the count in storage EFG is decreased by one to allow the use of the ready E pkg.

The Bag Filling Routine begins when the bag pkgs hit the water. They are assumed to anchor and open as planned. The bags wait for helos to

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deliver their messengers (or to tow if that option is picked). If a bag is preempted by a C-130 for the use of a helo, the bag is reset into the routine at a point and time where it would be if it had not been preempted. This recognizes the fact that a helo can standby for a C-130 and continue other work. Whenever a bag is preempted by the refueling needs of a helo, the work done by a helo is lost and the bag is reset into the helo waiting queue titled WCPTTR. Once the hauling process is completed, it queues for E pkgs. When an E pkg is available, it is connected and the bag is filled. After filling, the bag data is logged into MH4 and the bag drops from the problem.

The balance of the model includes the message subroutine, the preemption resetting subroutines, and the bomb-out subroutines. Their purposes have already been described.

Limitations of the Model

The model is currently limited to three helicopters. Each may be an HH-3F or an HH-52A; no other type is allowed.

Only C-130 aircraft are considered for air delivery of bags and they come from only one air station. The C-130's can carry two bag packages or one bag package and one equipment package. When an equipment package is carried, it is dropped first. C-130 refueling is assumed to be done as necessary during loading operations.

The greatest limitation on the use of the model is that it is based upon the prototype ADAPTS equipment and bag. If these are changed, the model must be changed. The prototype characteristics are listed in Table 6. Any changes in these must be evaluated for the effect of the change on the numbers that can be delivered by C-130 and helicopter, for the effect of the change upon the duration of the tasks, and for the effect of the change upon the salvage team composition.

Helo2 is the ready helicopter (on immediate standby) at HP2. Since it has to go farther to reach the scene there will be occasions that, when Helo2 is used, an HH-52A cannot be used but an HH-3F can be used. Whenever Helo2 is called up, it checks to see if it has enough on scene endurance (carrying E pkgs from HP2). If it does, the problem continues, if it does not, and it is an HH-52A, it is changed to an HH-3F and the check is made again. If it is an HH-3F and it does not have enough endurance, it sets logic switch 236, prints the status of logic switches and checks whether or not it is supposed to go to HP1. If it is to go to HP1 (logic switch 2 is set), it goes there, stopping to refuel at arbitrary points on the way. The arbitrary points represent commercial airports that undoubtedly exist but may not be in the desired minimum time path between HP1 and HP2. This approximation may introduce some error in the time Helo2 arrives at HP1; generally the error will have little or no affect on bag filling time, hence, it is ignored for all purposes except for scheduling that trip. When Helo2 arrives at HP1, it follows the normal sequence given above for Helo1 starting at step 2.

If Helo2 has sufficient endurance to deliver E pkgs from HP2 to the scene and if there are E pkgs for it to deliver, it delivers them; it does work at the scene if and only if:

1. A C-130 or a Bag is waiting for a helo (BV4 = 1) and
2. It can stay on scene for 30 minutes.

If these conditions are not met, it delivers the E pkg and returns to HP2. When all E pkgs from HP2 have been delivered, Helo2 checks whether or not it is to go to HP1 as just described. If Helo2 is to continue working at the scene, it is logical for it to use HP1 as its support base since HP1 is by definition closer to the scene.

Helo3 is the helicopter that backs up Helo1 at HP1. It's call up period is initially set into XH50 at 60 minutes and it is identified as an input. When Helo3 comes up from standby, it either waits for the S.T. in lieu of Helo1 and then follows the normal sequence given above for Helo1 or it follows the normal sequence given above for Helo1 starting at step 2. Figure 2 is a simple diagram of the strategy followed by the three helicopters.

The Delivery Routine describes the C-130 operations during the deployment of ADAPTS. The C-130's queue at the loaders, load and send a message giving ETA at scene, and go the scene. The C-130's carrying two bag pkgs drop them once they can enter the drop zone and return to ECAS. The C-130's carrying an E pkg and a bag pkg queue for a helicopter. Once a helicopter is available, they drop their loads and return to ECAS. Each time the C-130's return to ECAS the question: "can this crew make another trip?" is asked. If the answer is yes, they continue; if not, they either take another crew and continue or are grounded. When the last C-130 available is grounded, the problem is terminated.

When C-130's are delivering E pkgs, they must have a helo at the scene to pick up the free floating HLD: when bag pkgs are delivered, the C-130's can work independently of the helos. So when a C-130 arrives with E pkgs it either waits for a helo to arrive or preempts the use of a helo at the scene. "Preempt" means that it stops the work the helo was doing and the helo picks up the HLD before continuing with the other work. Actual stoppage is not necessary for ten minutes so the situation is approximated by having the helo preempted immediately when the C-130 arrives but by sending the preempted bag to the RES4 subroutine where the work is finished concurrently with the helo waiting for the E pkg to enter the water.

TABLE 6

PROTOTYPE ADAPTS EQUIPMENT

	<u>DIMENSIONS</u>	<u>WEIGHT</u>
Oil Storage Container with Hose and Fittings	Folded 5'8" x 7'0" x 6'2"	8,583 lbs.
Capacity 140,000 gallons	Filled 140' x 30' x 6'	500 tons
Oil Storage Container Module (including flotation, side plates, and bindings)	7'0" x 7'4" x 8'0"	10,512 lbs.
Diesel Engine Module (including enclosure and flotation)	3'4" x 3'7" x 4'0"	1,150 lbs.
Pump Module, rated 1000 gpm @ 60 ft. head (including enclosures, pump, flotation, and hydraulic hoses)	2'4" x 2'4" x 6'10"	946 lbs.
Pump alone	8" diameter x 6'10"	455 lbs.
Flexible Seal Drum Fuel Container (55 gallons)	Filled 2' diameter x 2'10"	450 lbs.
HLD Module (including flotation and adjustable strap)	2'1" diameter x 10' 3"	278 lbs.

APPENDIX A

PROGRAM LISTING

```

*****
*                               GPSS/'360 ADAPTS PROBLEM          *
*                               BAG SIM                          *
*****

```

```

* SCENE IS FLORIDA STRAITS
*** MEANS INPUT
* 1ST HELO PORT(HP1) IS MAS
* 2ND HELO PORT'HP2) IS SPAS

```

* ASSUMPTIONS:

```

*   1. IF THE SALVAGE TEAM IS BASED IN NYC, A SPARE C130 IS USED
*       TO DELIVER IT TO HP1. NOTE THIS ASSUMPTION IS IMPROPER
*       FOR ANY SCENE NEAR NYC!
*   2. CMAS AND THE MUNICIPAL AIRPORT ARE CLOSE ENOUGH TO EACH
*       OTHER THAT THEY CAN BE CONSIDERED IDENTICAL FOR THE
*       PURPOSES OF THIS PROBLEM!
* THIS SIMULATION RUNS UNDER THE ASSUMPTION THAT THE 1ST HELO IS READY
* IN 1 MINUTE AND THAT THE 3RD HELO IS READY 60 MINUTES AFTER THE FIRE
* IS CALLED; THE 2ND HELO COMES FROM A NEARBY AIR STATION IF USED.

```

```

DZONE STORAGE      2      CAN HAVE 2 C130'S DROPPING PKGS AT A TIME
HAUL  STORAGE      20      CAN HAVE UP TO 20 HLD'S
EPG  STORAGE       20      CAN HAVE UP TO 20 E PKGS
OSTMH TABLE       M1,15,15,25  * ON SCENE TIME OF HELO'S
WTLDR QTABLE       WLDR,0,15,13
WTDZ  QTABLE       WDZ,0,10,7
WTHH  QTABLE       WHELO,0,5,8
WTCP  QTABLE       WCPTR,0,5,8

```

```

1  MATRIX  H,3,15      * INPUT MATRIX DELIVER E PKG'S
2  MATRIX  H,30,15     * OUTPUT C130 RETURN TIMES
3  MATRIX  H,20,3      * OUTPUT E PKG'S READY FOR USE
4  MATRIX  H,40,9      * OUTPUT BAG PKG DATA
5  MATRIX  H,30,15     * OUTPUT TIME C130 LOADING BGNS
7  MATRIX  H,30,6      * OUTPUT MESSAGE INFORMATION
8  MATRIX  H,50,6      * OUTPUT HELO DATA

```

***** INPUT DATA

```

*
LDR00 STORAGE      5      *** NUMBER OF C130 LDRS THIS RI

```

INITIAL	MH1(1,1),1	*** NEED ONE CARD PER E PKG
INITIAL	MH1(1,2),1	
INITIAL	MH1(2,1),3	
INITIAL	MH1(1,4),2	
INITIAL	XH28,1	
INITIAL	XH29,K1	
INITIAL	XH22,5	*** NUMBER OF EXTRA C130 CREWS
INITIAL	XH23,480	*** C130 CREW ENDURANCE
INITIAL	XH3,5	*** NUMBER OF C130'S THIS RUN
INITIAL	XH2,6	*** NUMBER OF 4 MAN SALVAGE TEAMS
INITIAL	XH40,949	*** DISTANCE FM BAS TO HP1
INITIAL	XH20,174	*** DISTANCE FM HP2 TO HP1
INITIAL	XH5,772	*** DISTANCE FM ECAS TO SCENE
INITIAL	XH6,656	*** DISTANCE FM ECAS TO HP1
INITIAL	XH7,118	*** DISTANCE FM HP1 TO SCENE
INITIAL	XH8,242	*** DISTANCE FM HP2 TO SCENE
INITIAL	XH16,2	*** # PREPOSITIONED E PKG HP1
INITIAL	XH17,2	*** # PREPOSITIONED E PKG HP2
INITIAL	XH19,1	COUNTER , HELOS SELECT MSG
INITIAL	XH41,3	*** 52=HH52 3=HH3
INITIAL	XH42,3	*** 52=HH52 3=HH3
INITIAL	XH43,3	*** 52=HH52 3=HH3
INITIAL	XH50,60	*** STANDBY TIME HELO3
INITIAL	XH51,0	*** STANDBY TIME 1ST C130
INITIAL	XH52,60	*** STANDBY TIME 2ND C130
INITIAL	XH53,60	*** STANDBY TIME 3RD C130
INITIAL	XH54,60	*** STANDBY TIME 4TH C130
INITIAL	XH55,60	*** STANDBY TIME 5TH C130
INITIAL	XH56,300	*** STANDBY TIME 6TH C130
INITIAL	XH57,300	*** STANDBY TIME 7TH C130
INITIAL	XH58,300	*** STANDBY TIME 8TH C130
INITIAL	XH59,300	*** STANDBY TIME 9TH C130
INITIAL	XH60,300	*** STANDBY TIME 10TH C130
INITIAL	XH61,300	*** STANDBY TIME 11TH C130
INITIAL	XH62,300	*** STANDBY TIME 12TH C130
INITIAL	XH63,300	*** STANDBY TIME 13TH C130
INITIAL	XH64,300	*** STANDBY TIME 14TH C130
INITIAL	XH65,300	*** STANDBY TIME 15TH C130
INITIAL	XH9,1	ROW COUNTER FOR MSG MATRIX
INITIAL	XH14,15	TIME TO INSTALL RAILS
INITIAL	XH15,90	TIME TO LOAD C130
1 VARIABLE	C1-XH21	LAPSED TIME SINCE C130 ARRIVED
2 VARIABLE	XH23+P16-C1-V6-V7-20	CREW TIME LEFT AFTER NEXT TP
3 VARIABLE	60*XH40/270	* C130 TIME, BAS TO HP1
4 VARIABLE	60*XH6/270	* C130 TIME,ECAS TO HP1
5 VARIABLE	10+60*XH7/270	* C130 TIME,HP1 TO SCENE
6 VARIABLE	60*XH5/270	* C130 TIME,ECAS TO SCENE
7 VARIABLE	60*XH5/290	* C130 TIME,SCENE TO ECAS
8 VARIABLE	XH15+V6+C1	TIME C130 ARRIVES AT SCENE
9 VARIABLE	60*(1-BV1)*XH7/85+60*BV1*XH7/115	* HP1 TO SCENE

10	VARIABLE	60*(1-BV1)*XH7/95+60*Bv1*XH7/125	* SCENE TO HP1
11	VARIABLE	60*(1-BV2)*XH8/85+60*Bv2*XH8/115	* HP2 TO SCENE
12	VARIABLE	60*(1-BV2)*XH8/95+60*Bv2*XH8/125	* SCENE TO HP2
13	VARIABLE	60*(1-BV3)*XH7/85+60*Bv3*XH7/115	* HP1 TO SCENE
14	VARIABLE	60*(1-BV3)*XH7/95+60*Bv3*XH7/125	* SCENE TO HP1
15	VARIABLE	50+P2	FOR ADDRESSING XH*10
16	VARIABLE	C1+P7-11	TIME WHEN C130 MUST REACH SCENE IF
17	VARIABLE	C1+P8-11	HELO IS TO SERVE IT
18	VARIABLE	C1+P9-11	"
19	VARIABLE	60*(1-BV2)*XH7/85+60*Bv2*XH7/115	HP1 TO SCENE
20	VARIABLE	60*(1-BV2)*XH7/95+60*Bv2*XH7/125	SCENE TO HP1
21	VARIABLE	60*(1-BV2)*XH20/85+60*Bv2*XH20/115	HP2 TO HP1
22	VARIABLE	150+158*Bv1-V9-V10	TIME ON SCENE IF S TEAM CRD
23	VARIABLE	P5+P6+P10	TIME FOR HELO TO RETURN, REFUEL, & SORTEE
24	VARIABLE	3*XH16	0 = NO E PKGS TO CARRY HP1
25	VARIABLE	3*XH17	0 = NO E PKG TO CARRY FM HP2
26	VARIABLE	270+82*Bv1-V9-V10	TIME ON SCENE IF EMPTY
27	VARIABLE	120+62*Bv1-V9-V10	TIME ON SCENE IF E PKG CRD
28	VARIABLE	150+158*Bv3-V13-V14	HELO3 ON SCENE TIME IF SAL. T.
29	VARIABLE	270+82*Bv3-V13-V14	HELO3 ON SCENE TIME IF EMPTY
30	VARIABLE	120+62*Bv3-V13-V14	HELO3 ON SCENE TIME IF E PKG
31	VARIABLE	20+10*Bv1	* TIME TO REFUEL HELO #1
32	VARIABLE	20+10*Bv2	* TIME TO REFUEL HELO #2
33	VARIABLE	20+10*Bv3	* TIME TO REFUEL HELO #3
34	VARIABLE	150+158*Bv2-V19-V20	HELO2 ON SCENE TIME IF S.T, HP1
35	VARIABLE	270+82*Bv2-V19-V20	HELO2 ON SCENE TIME, EMPTY, HP1
36	VARIABLE	120+62*Bv2-V11-V12	HELO2 ON SCENE TIME IF E PKG, HP
37	VARIABLE	120+62*Bv2-V19-V20	HELO2 ON SCENE TIME IF E PKG, HP
38	VARIABLE	270+82*Bv2	ENDURANCE OF HELO2

1	BVARIABLE	XH41'L'4	HELO1: 0 = HH52, 1 = HH3
2	BVARIABLE	XH42'L'4	HELO2: 0 = HH52, 1 = HH3
3	BVARIABLE	XH43'L'4	HELO3: 0 = HH52, 1 = HH3
4	BVARIABLE	Q\$WCPTR+Q\$WHELO	=1 IF SOMETHING IS AWAITING HEL
5	BVARIABLE	FU*12+Bv4	=1 HELO IN USE
6	BVARIABLE	P2'G'0*P2'L'4*P2'NE'P12	1=OTHER HELO

*

AIRCRAFT CALL UP ROUTINE

GENERATE	11,,,1,5,16,H	* START PROBLEM;CG NOTIFIED
SAVEVALUE	24,XH3,H	
SAVEVALUE	26,V24,H	
SAVEVALUE	27,V25,H	
LOGIC S	1	*** S = HELO #1 AVAILABLE
LOGIC S	2	*** R = HELO #2 NOT USED AT HP1
LOGIC S	3	*** R = HELO #3 NOT USED
LOGIC S	4	*** S = MANIFOLDS; R = NO MANIFOLDS
LOGIC R	5	*** S = HELOS TOW; R = TOWING NOT ALLOWED
LOGIC R	10	*** S=SALVAGE TEAMS BASED @ NYC

SPLIT 20,JEPKG
 SPLIT 20,IHLD
 ADVANCE 2
 SPLIT 1,IHCFT
 GATE LR 10,DTEAM
 CCAC TEST G XH3,15,PLANE
 SAVEVALUE 3,15,H
 PLANE SAVEVALUE 11+,K1,H
 ASSIGN 2,XH11
 TEST LE P2,XH3,FINIS
 ASSIGN 10,V15
 PRIORITY 3
 SPLIT 1,PLANE
 ADVANCE XH*10
 SAVEVALUE P10,1,H
 TEST G P2,1,TWOP
 ADVANCE XH14
 TWOP ASSIGN 16,C1
 TRANSFER ,ONEP
 DTEAM SPLIT 1,CCAC
 ADVANCE 80
 ADVANCE V3
 LOGIC S 52
 SAVEVALUE 18,C1,H
 FINIS TERMINATE 0
 IEPKG ENTER EPG
 GATE LS 35
 LOGIC R 35
 LEAVE EPG
 TERMINATE 0
 IHLD ENTER HAUL
 GATE LS 34
 LOGIC R 34
 LEAVE HAUL
 TERMINATE 0
 IHCFT PREEMPT 1
 ASSIGN 16,1
 SPLIT 1,HELO2
 ADVANCE 1
 SPLIT 1,HELO3

*

GATE LS 1,FINIS
 ASSIGN 5,V9
 ASSIGN 6,V10
 ASSIGN 7,V22
 ASSIGN 8,V26

* DECIDE TO RESP.

IS TEAM IN NYC?

15 IS MAX # C130'S ALLOWED
 INCREMENT FOR C130
 LOG C130 NUMBER
 REACHED # C130'S IN PROBLEM
 LABEL WHICH XH TO USE
 C130 PRIORITY
 PREPARE NEXT C130
 STANDBY TIME

INITIALIZE FOR EPG1 ROUTINE
 *** NUMBER OF C130'S WITH RAILS INSTALL
 INSTALL RAILS
 LOG TIME C130 BECOMES AVAILABLE
 C130 READY TO LOAD
 SALVAGE TEAM AT NYC SUBROUTINE
 GO TO BAS & LOAD TEAM
 GO TO HP1
 TRANSFER TEAM TO HELO
 LOG TIME

* INITIALIZE,NO E PKG AV.
 * E PKG SET UP YET?

* ONE E PKG HAS BEEN SET UP

* INITIALIZE,NO HLD AVA.
 * HLD SET UP YET?

* ONE HLD HAS BEEN SET UP

MSG TO TEST

* START 2ND HELO SUBROUTINE
 * CALL UP 1ST HELO
 * START 3RD HELO SUBROUTINE

HELO #1 ROUTINE

* IF R, 1ST HELO NOT USED
 HELO1, HP1 TO SCENE TIME
 HELO1, SCENE TO HP1 TIME
 HELO1, ON SCENE ENDURANCE, S T
 HELO1, ON SCENE ENDURANCE, EMP

	ASSIGN	9,V27	HELO1, ON SCENE ENDURANCE, E PI
	ASSIGN	10,V31	HELO1, REFUEL TIME
	ASSIGN	12,1	THIS IS HELO1
	TEST LE	MH7(1,3),XH50,GOERL	IF C130 ARRIVES AFTER HELO3,GO
WAIT	GATE LS	52	* WAIT FOR SALVAGE TEAM
HELO1	ADVANCE	2	* SALVAGE TEAM BOARD HELO1
	TEST G	P7,11,BOV22	IF V22<11 BOMBOUT
	ASSIGN	11,1	LOG HELO CARRIED SALVAGE TEAM
	SAVEVALUE	2-,1,H	ONE TEAM LESS TO LOAD
	ASSIGN	13,V16	LOG TIME C130 MUST ARRIVE SO HELO CAN WORK
HGSC1	SAVEVALUE	31+,1,H	LOG HELO TAKE OFF
	ASSIGN	1,XH31	
	MSAVEVALUE	8,P1,2,C1,H	LOG LOAD CARRIED BY HELO
	MSAVEVALUE	8,P1,6,P11,H	LOG WHICH HELO
	MSAVEVALUE	8,P1,1,P12,H	GO TO SCENE
	ADVANCE	P5	LOG TIME ARRIVE AT SCENE
	MSAVEVALUE	8,P1,3,C1,H	RESET MARK TIME, HELO AT SCENE
	MARK		LOG TIME WHEN
	ASSIGN	14,P13	HELO MUST LEAVE SCENE
	ASSIGN	14+,11	IS A C130 WAITING FOR A HELO?
	TEST E	Q\$WHELO,0,FFF1	IS HELO MAKING AN EMPTY TRIP?
	TEST NE	P11,0,FFF1	UNLOAD HELO
	ADVANCE	6	IS A C130 WAITING FOR A HELO?
	TEST E	Q\$WHELO,0,FFF1	
	ADVANCE	4	HELO READY FOR OTHER WORK
FFF1	RETURN	P12	
	LOGIC R	6	
	LOGIC R	7	
AAA1	ADVANCE	11	WORK 11 MINUTES
	TEST G	P14,C1,HLSC1	HAS HELO REACHED END OF ENDURANCE
	TEST E	BV5,0,AAA1	IS HELO IN USE?
	TEST G	V1,20,AAA1	WAS A C130 HERE IN THE LAST 20 MIN?
AAA2	ASSIGN	15,MH7(P16,3)	TAKE MSG IF
	TEST G	P15,0,HLSC1	IT EXISTS
	TEST G	P15,C1,AAA3	HAS THIS MSG EXPIRED?
	ASSIGN	2,MH7(P16,5)	TAKE STATUS OF MSG
	TEST E	BV6,0,BBB1	DID OTHER HELO TAKE MSG?
	TEST L	P15,P13,BBB1	WAIT ON SCENE FOR C130?
	TEST L	P15,V23,BBB1	REFUEL BEFORE C130 COMES?
	ASSIGN	15-,C1	COMPUTE WAIT FOR C130
	MSAVEVALUE	7,P16,4,C1,H	LOG TIME HELO TOOK MSG
	MSAVEVALUE	7,P16,5,P12,H	LOG # OF HELO
	ADVANCE	P15	HELO WAIT FOR C130
	TRANSFER	,AAA1	TEST HELO ON SCENE
AAA3	TEST GE	P16,30,AAA4	AT MATRIX CAPACITY?
	ASSIGN	16,0	ZERO MATRIX ROW COUNTER

AAA4	ASSIGN	16+,1	INCREMENT TO NEXT MSG
	TRANSFER	,AAA2	
BBB1	TEST NE	P16,1,HLSC1	DON'T RESET IF = 1
	TEST L	P16,1,BBB2	
	ASSIGN	16,30	RESET COUNTER
BBB2	ASSIGN	16-,1	REJECT MSG
HLSC1	TABULATE	OSTMH	TABULATE ON SCENE TIME FOR HELO
	MSAVEVALUE	8,P1,4,M1,H	LOG ON SCENE TIME
	PREEMPT	P12,PR,RES2,7,RE	ALLOW NO ONE TO USE HELO
	ADVANCE	P6	RETURN TO HP1
	MSAVEVALUE	8,P1,5,C1,H	LOG RETURN TIME
	ADVANCE	P10	REFUEL
	GATE LS	36,HHT01	* HAS AN E PKG BEEN DELIVERED?
HHT11	TEST G	XH2,0,HHG01	* TEST IF MORE SAL. TMS TO DL
	TRANSFER	,WAIT	PICK UP SALVAGE TEAM
GOERL	LOGIC S	12	TELL HELO3 TO WAIT FOR SAL. TEA
HHT01	TEST G	XH16,0,HHT11	* THIS HELO HAVE PP E PKG TO DELIVER
HHG01	TEST LE	XH26,0,HHG41	IS E PKG WAITING DLVR FM HP1?
HHG21	TEST NE	BV4,0,HHG30	IF WAIT FOR HELO, GO TO SCENE
HHG11	TEST G	P8,11,BOV26	IF V26<11, BOMBOUT
	ASSIGN	11,0	NOTE HELO EMPTY THIS TRIP
	ASSIGN	13,V17	LOG TIME C130 MUST ARRIVE FOR HELO TO WORK
	TRANSFER	,HGSC1	GO TO SCENE
HHT21	RELEASE	LOADH	THRU LOADING E PKG'S AT HP1
	TRANSFER	,HHG21	RESUME
HHG31	TEST G	MH7(P16,3),0,HHT71	HAS NEXT MSG BEEN SENT?
	TEST E	MH7(P16,5),0,HHT81	DID ANY HELO RECEIVE MSG?
HHT41	TEST GE	MH7(P16,3),C1,HHT61	WAS MSG SENT LONG BEFORE HELO A
	ASSIGN	4,C1	LOG PRESENT TIME
	ASSIGN	4+,P5	LOG TIME ARRIVE SCENE IF LEAVE
	ASSIGN	3,0	
	TEST G	MH7(P16,3),P4,HHT51	CAN HELO DELAY BEFORE TAKING OFF
	ASSIGN	3,MH7(P16,3)	COMPUTE WAITING TIME BEFORE
	ASSIGN	3-P4	TAKING OFF
HHT51	MSAVEVALUE	7,P16,5,P12,H	LOG THIS HELO TOOK MSG
	MSAVEVALUE	7,P16,4,C1,H	AT THIS TIME
	ASSIGN	15,MH7(P16,3)	TAKE MESSAGE
	ADVANCE	P3	WAIT BEFORE TAKING OFF
	TRANSFER	HHG11	PREPARE TO GO TO SCENE
HHT61	MSAVEVALUE	P16,5,10,H	LOG MSG RECEIVED TOO LATE
HHT81	TEST NE	P12,MH7(P16,5),HHT41	WAS MSG RECEIVED BY THIS HELO
HHG30	TEST GE	XH19,K30,HHT31	HAS ROW 30 BEEN REACHED?
	SAVEVALUE	19,0,H	RESET TO ZERO
HHT31	SAVEVALUE	19+,1,H	INCREMENT MSG COUNTER

ASSIGN 16,XH19
 TRANSFER ,HHG31
 HHT71 ADVANCE 10
 TRANSFER ,HHG21
 HHG41 SEIZE LOADH
 TEST G XH26,0,HHT21
 TEST E BV*12,0,HHG61
 SAVEVALUE 26-.1,H
 TRANSFER ,HHG71
 HHG61 SAVEVALUE 26-,3,H
 HHG71 RELEASE LOADH
 ADVANCE 30
 SPLIT 1,HHG81
 TEST G P9,11,BOV27
 ASSIGN 11,2
 ASSIGN 13,V18
 TRANSFER ,HGSC1
 HHG81 TEST E BV*12,0,GTS1
 TEST E XH28,3,HHG91
 SAVEVALUE 28,1,H
 GTS1 ADVANCE P5
 ADVANCE 5
 ASSIGN 2,0
 SPLIT 1,REPKG
 ADVANCE 15
 LOGIC S 34
 TERMINATE 0
 HHG91 SAVEVALUE 28+,1,H
 TERMINATE 0
 HELO2 PREEMPT 2,PR
 TEST G XH17,0,CPTR2
 ASSGN ADVANCE 5
 ASSIGN 5,V11
 ASSIGN 6,V12
 ASSIGN 7,V34
 ASSIGN 8,V35
 ASSIGN 9,V36
 ASSIGN 10,V32
 ASSIGN 12,2
 TEST G K10,P9,HHG42
 TEST G XH42,4,BOV36
 SAVEVALUE 42,3,H
 PRINT 42,42,XH
 TRANSFER ,ASSGN
 HHG42 TEST NE XH17,0,HHG32
 HHT42 ADVANCE 30

TELL HELO WHICH MSG TO TEST

WAIT 10 MINUTES AND RETEST

IF HERE BY MISTAKE, GO TO HHT21
WHICH HELO,WHAT TYPE?

* LOAD 1/3 E PKG INTO HH52

* LOAD E PKG INTO HH3

LOADING TIME

* START E PKG COUNTER

IF V27<11, BOMBOUT

LOG HELO CARRIED E PKG

LOG TIME C130 MUST ARRIVE SO

* RESET XH28 FOR NEXT 3 PARTS

* E PKG DELIVERED

* SET UP HLD

* AN HLD SET UP

* E PKG DELIVERED

* INCREASE COUNT

ALLOW NO ONE TO USE HELO2
HELO2 HAS PREPOSITIONED E PKG?
CALL UP HELO2

REFUELING TIME

HELO # 2

IS HELO2 AN HH3?

OUTPUT THAT HELO2 MUST BE AN HH3
REASSIGN VALUES

IS HELO2 IN THIS PROBLEM SOLELY FOR H
LOAD HELO2 WITH E PKG

	TEST E	BV*12,0,HHG62	
	SAVEVALUE	27-,1,H	LOAD 1/3RD E PKG INTO HH52
	TRANSFER	,HHG72	
HHG62	SAVEVALUE	27-,3,H	LOAD E PKG INTO HH3
HHG72	ASSIGN	11,2	LOG CARRIED AN E PKG
	SAVEVALUE	31+,1,H	
	ASSIGN	1,XH31	
	MSAVEVALUE	8,P1,1,P12,H	
	MSAVEVALUE	8,P1,2,C1,H	
	MSAVEVALUE	8,P1,6,P11,H	
	ADVANCE	P5	GO TO SCENE
	MSAVEVALUE	8,P1,3,C1,H	LOG TIME ARRIVE AT SCENE
	MARK		RESET MARK TIME, HELO AT SCENE
	ADVANCE	10	
	SPLIT	1,HHG82	UNLOAD HELO2
	SAVEVALUE	33,P9,H	
	SAVEVALUE	33-,K10,H	LOG HOW LONG HELO2 CAN STAY ON SCENE
	TEST E	BV4,1,HLSC2	IS ANYTHING WAITING FOR A HELO?
	TEST GE	XH33,30,HLSC2	CAN HELO2 STAY ON SCENE 30 MIN?
	SAVEVALUE	32-,K30,H	
	RETURN	2	HELO2 AVAILABLE FOR OTHER WORK
	ADVANCE	30	HELO2 AVAILABLE FOR OTHER WORK
	PREEMPT	2,PR,RES2,7,RE	FOR 30 MINUTES ONLY
HLSC2	TABULATE	OSTMH	LOG HELO2 LEAVE SCENE &
	MSAVEVALUE	8,P1,4,M1,H	TABULATE ON SCENE TIME
	TEST G	XH27,0,HHT02	ARE THERE ANY MORE E PKGS AT HP?
	ADVANCE	P6	RETURN TO HP2
	MSAVEVALUE	8,P1,5,C1,H	LOG TIME OF RETURN
	ADVANCE	P10	REFUEL HELO2
	TRANSFER	,HHT42	NEXT TRIP
HHT02	GATE LS	2,FINIS	ARE WE THRU WITH HELO2?
	SAVEVALUE	33+,P6,H	LOG REMAINING ENDURANCE OF HELO2 TO HP1,2
	TEST GE	XH33,V20,HHG02	CAN HELO2 GO TO HP1 DIRECTLY?
	ASSIGN	5,V19	
	ASSIGN	6,V20	TIMES TO & FM SCENE -HP1
	ASSIGN	9,V37	
	ADVANCE	P6	GO TO HP1
	MSAVEVALUE	8,P1,5,39,H	LOG ARRIVAL IS IN XH39
	SAVEVALUE	39,C1,H	LOG TIME OF ARRIVAL AT HP1
	ADVANCE	P10	REFUEL
	TRANSFER	,HHG01	USE HELO2 AT HP1
CPTR2	GATE LS	2,FINIS	FINISH DETERMINING IF HELO2 IS IN THIS
	TRANSFER	,ASSGN	PROBLEM
HHG02	ADVANCE	P6	RETURN TO HP2
	MSAVEVALUE	8,P1,5,C1,H	LOG TIME OF RETURN

ADVANCE P10
 GOHP1 ASSIGN 5,V19
 ASSIGN 6,V20
 ASSIGN 9,V37
 TEST GE V38,V21,HHG52
 ADVANCE V21
 SAVEVALUE 39,C1,H
 MSAVEVALUE 8,P1,5,K39,H
 ADVANCE P10
 TRANSFER ,HHG01
 HHG52 SAVEVALUE 33,V21,H
 HHT52 ADVANCE V38
 ADVANCE P10
 SAVEVALUE 33-,V38,H
 TEST LE XH33,0,HHT52
 SAVEVALUE 39,C1,H
 MSAVEVALUE 8,P1,5,K39,H
 TRANSFER ,HHG01
 HHG82 TEST E BV*12,0,GTS1
 TEST E XH29,3,HHG92
 SAVEVALUE 29,1,H
 TRANSFER ,GTS1
 HHG92 SAVEVALUE 29+,1,H
 TERMINATE 0
 HELO3 PREEMPT 3,PR
 GATE LS 3,FINIS
 ADVANCE XH50
 ASSIGN 5,V13
 ASSIGN 6,V14
 ASSIGN 7,V28
 ASSIGN 8,V29
 ASSIGN 9,V30
 ASSIGN 10,V33
 ASSIGN 12,3
 GATE LR 12,WAIT
 TRANSFER ,HHG01

 *
 ONEP SAVEVALUE 10+,K1,H
 ASSIGN 1,XH10
 ASSIGN 3+,K1
 QUEUE WLDR
 ENTER LDR00
 DEPART WLDR
 MSAVEVALUE 5,P3,P2,C1,H

REFUEL

TIMES TO & FM SCENE - HP1

CAN HELO2 REACH HP1 W/O FUELING
 GO TO HP1
 LOG TIME ARRIVE AT HP1

REFUEL

USE HELO2 AT HP1

GO TO HP1, REFUELING ON WAY

* RESET XH29 FOR NEXT 3 PARTS

INCREASE COUNT PARTS E PKG DLVD

ALLOW NO ONE TO USE HELO

CALL UP HELO3 AND CREW

HELO3 TIME TO SCENE

HELO3 TIME TO HP1 FM SCENE

HELO3 ON SCENE ENDURANCE, S T

HELO3 ON SCENE ENDURANCE, EMPTY

HELO3 ON SCENE ENDURANCE, EPKG

HELO3 REFUEL TIME

THIS IS HELO3

WAIT FOR S T IF HELO1 DIDN'T

HELO3 READY TO WORK

DELIVERY SUBROUTINE

* ADD 1 TO XH10

* ASSIGN TO P1 THE # IN XH10

LABEL TRIP

* QUEUE C130 FOR LDR

* LOADER NOW BUSY

LOG TIME START LOADING

	SPLIT	1,SMMSG	TELL HELO WHEN C130 WILL ARRIVE
	ADVANCE	XH15	LOAD 2 PKG'S ON C130
	LEAVE	LDR00	* LDR READY FOR NEXT C130
	ASSIGN	8,C1	* LOG TIME C130 TAKES OFF
	GATE LR	52,GTSC	
	GATE LR	10,GTSC	
	GATE LR	8,GTSC	IF TEAM ALREADY DLVD, GTSC
	LOGIC S	8	TEAM DLVD
	ADVANCE	V4	
	LOGIC S	52	* TRNF PERS. TO WAITING HELO
	SAVEVALUE	18,C1,H	LOG TIME SALVAGE TEAM ARRIVE HP
	ADVANCE	V5	* GO TO SCENE FM HELOPORT
	TRANSFER	,ATSC	
GTSC	ADVANCE	V6	* GO TO SCENE
ATSC	QUEUE	WDZ	* WAIT FOR DROP ZONE
	ENTER	DZONE	* C130 RDY DROP, ZONE CLEAR
	DEPART	WDZ	
	SAVEVALUE	21,C1,H	TEMPORARILY LOG TIME C130 ARRIVES AT
	TEST NE	P3,MH1(XH*10,P2),EPKG1	IS EPKG ON C130?
	ADVANCE	10	* DROP BAG PKG
	SPLIT	1,BFILL	1ST BAG PKG NOW IN WATER
	ADVANCE	10	* DROP BAG PKG
	LEAVE	DZONE	* C130 LEAVE DROP ZONE
	SPLIT	1,BFILL	* 2ND BAG PKG NOW IN WATER
ACFTR	ADVANCE	V7	C130 RETURN TO ECAS
	MSAVEVALUE	2,P3,P2,C1,H	LOG TIME OF RETURN
	TEST GE	V2,0,CCREW	CAN THIS CREW MAKE ANOTHER TRIP?
	TRANSFER	,ONEP	C130 NOW READY FOR RELOADING
CCREW	TEST G	XH22,0,NCREW	ANY SPARE CREWS?
	SAVEVALUE	22-,1,H	TAKE NEW CREW
	ASSIGN	16,C1	LOG TIME NEW CREW ASSIGNED
	TRANSFER	,ONEP	
NCREW	SAVEVALUE	24-,1,H	ONE LESS C130
	TEST C	XH24,0,BOUT	END RUN IF NO C130'S LEFT
	TRACE		
	PRINT	22,24,XH	
	TERMINATE	0	REMOVE C130
EPKG1	SAVEVALUE	P10+,1,H	* RESET TEST FOP NEXT E PKG
RES7	QUEUE	WHELO	
FSTH1	GATE LR	6	IS ANY HELO AVAILABLE?
	GATE NU	1,SECH1	IS HELO1 AVAILABLE?
	PREEMPT	1,PR,RES4,7,RE	* HELO1 IN USE
	ASSIGN	9,1	* LOG HELO1 USED
	TRANSFER	,RES1	
SECH1	GATE NU	2,TRDH1	IS HELO2 AVAILABLE?

	PREEMPT	2,PR,RES4,7,RE		* HELO2 IN USE
	A3SIGN	9,2		* LOG HELO2 USED
	TRANSFER	,RES1		
TRDH1	GATE NU	3,NOHH1		IS HELO3 AVAILABLE?
	PREEMPT	3,PR,RES4,7,RE		HELO3 IN USE
	ASSIGN	9,3		* LOG HELO3 USED
	TRANSFER	,RES1		
NOHH1	LOGIC S	6		
	TRANSFER	,FSTH1		
RES1	DEPART	WHELO		
	MARK		TEMPORARILY	LOG TIME HELO SEIZED
	ADVANCE	10		* DROP E PKG
	SPLIT	1,EPKG		* E PKG NOW IN WATER
	ADVANCE	10		* DROP BAG PKG
	LEAVE	DZONE		* C130 LEAVE DROP ZONE
	SPLIT	1,ACFTR		* RETURN C130
	SPLIT	1,BFILL		* B PKG NOW IN WATER
	GATE LS	9		* THRU WITH HELO?
	RETURN	P9		* RELEASE HELO
RES6	LOGIC R	9		*
	TERMINATE	0		

*				E PACKAGE SET UP ROUTINE
EPKG	ASSIGN	4,C1		
	ADVANCE	10		* DELIVER HLD
	ADVANCE	10		* DELIVER MSGR OR TOW
	LOGIC S	9		* RELEASE HELO
	LOGIC R	6		
	LOGIC R	7		
	SPLIT	1,UHLD	SPLIT E PKG F HLD AND SET UP BOTH	
	ADVANCE	5		* FINISH SETTING UP HLD
	LOGIC S	34		* HLD READY
	TERMINATE	0		
UHLD	LOGIC S	11		GIVE EPKG PRIORITY OVER BAGS
	ENTER	HAUL		* DECREASE # AV. HLD BY 1
	LOGIC R	11		
	GATE LR	2,TEPKG		* CAN HELO'S TOW?
	ADVANCE	35		* HLD HAUL IN E PKG
HLDF	LEAVE	HAUL		* HLD FREE
REPKG	LOGIC S	36		* S = 1ST E PKG DELIVERED
	ADVANCE	20		* SET UP & TEST E PKG
	LOGIC S	35		* E PKG READY
	SAVEVALUE	1+,K1,H		
	MSAVEVALUE	3,XH1,1,C1,H		* LOG TIME E PKG READY
	MSAVEVALUE	3,XH1,2,P12,H		LOG HELO NUMBER
	MSAVEVALUE	3,XH1,3,P2,H		LOG C130 NUMBER

TERMINATE 0
 TEPKG ADVANCE 17
 TRANSFER ,HLDF

 *
 BFILL ASSIGN 4,C1
 PRIORITY 1
 RES3 QUEUE WCPTR
 FSTH9 GATE LR 7
 GATE NU 1,SECH9
 SEIZE 1
 ASSIGN 9,1
 TRANSFER ,RES9
 SECH9 GATE NU 2,TRDH9
 SEIZE 2
 ASSIGN 9,2
 TRANSFER ,RES9
 TRDH9 GATE NU 3,NOHH9
 SEIZE 3
 ASSIGN 9,3
 TRANSFER ,RES9
 NOHH9 LOGIC S 7
 TRANSFER ,FSTH9
 RES9 DEPART WCPTR
 ADVANCE 10
 RELEASE P9
 RES5 LOGIC R 7
 LOGIC R 6
 QUEUE WHLD
 GATE SNF HAUL
 GATE LR 11
 ENTER HAUL
 DEPART WHLD
 GATE LR 5,TOW
 ADVANCE 30
 LHAUL LEAVE HAUL
 QUEUE WEPKG
 GATE LR 4,MFD
 ENTER EPG
 DEPART WEPKG
 ADVANCE 12
 ASSIGN 5,C1
 ADVANCE 120
 ASSIGN 6,C1
 ADVANCE 12

* HLD FINISH HAULING,LIFTING

BAG FILLING ROUTINE

* LOG TIME BAG DROPPED

* IS HELO AVAILABLE?

* HELO1 IN USE

* LOG HELO1 USED

* HELO2 IN USE

* LOG HELO2 USED

* HELO3 IN USE

* LOG HELO3 USED

* DELIVER MSGR(OR TOW)

* THRU WITH HELO

* IS HLD AVAILABLE?

WAIT IF EPKG NEEDS HLD

* DECREASE # OF AVAIL. HLD'S BY 1

* CAN HELO'S TOW?

* HAUL BAG IN

* THRU W/HLD, AVAIL. HLD +1

* IS E PKG AVAIL.?

* ARE THERE MANIFOLD?

DECREASE # OF AVAILABLE

* E PKG'S BY 1

* HOOK UP BAG

* LOG TIME START FILLING BAG

* FILL BAG

* LOG TIME FINISHED FILLING BAG

* DISCONN BAG, MOVE OUT OF WAY

	LEAVE	EPG		* INCREASE # AVAIL. E PKG'S +1
BFULL	SAVEVALUE	4+,K1,H		* STORE INFO ON BAGS
	ASSIGN	7,XH4		* (P7 IS ROW)
	MSAVEVALUE	4,P7,1,P1,H		
	MSAVEVALUE	4,P7,2,P2,H		
	MSAVEVALUE	4,P7,3,P3,H		
	MSAVEVALUE	4,P7,5,P4,H		
	MSAVEVALUE	4,P7,6,P5,H		* LOG BAG DATA
	MSAVEVALUE	4,P7,7,P6,H		
	MSAVEVALUE	4,P7,8,P7,H		
	MSAVEVALUE	4,P7,4,P8,H		
	MSAVEVALUE	4,P7,9,P9,H		
	TERMINATE	1		* REDUCE START COUNT BY 1
TOW	ADVANCE	2		* FINISH POSITIONING BAG
	TRANSFER	,LHAUL		* GO TO LHAUL
MFD	ADVANCE	12		* HOOK UP BAG TO MFD
	ENTER	EPG		* DECREASE # AVA. E PKG -1
	ADVANCE	1		* SWITCH BAGS
	DEPART	WEPKG		
	ASSIGN	5,C1		* LOG TIME START FILLING BAG
	ADVANCE	120		* FILL BAG
	ASSIGN	6,C1		* LOG TIME BAG FULL
	LEAVE	EPG		
	ADVANCE	12		* DISCONN BAG
	TRANSFER	,BFULL		
MSG	ASSIGN	16,V8	LOG ONLY THOSE MSGS WITH	
	ASSIGN	16-,15	INTERARRIVALS GREATER THAN	
	ASSIGN	4,XH9	ASSIGN ROW # TO MESSAGE	
	TEST G	P16,MH7(P4,3),FINIS	FIFTEEN MINUTES.	
	SAVEVALUE	9+,1,H	SET ROW COUNTER FOR MH7	
	TEST E	P4,8,MSG3		
	SPLIT	1,MSG3		
	SAVEVALUE	12,P4,H		
	TRANSFER	,MSG1		
MSG3	MSAVEVALUE	7,P4,6,P1,H	LOG MSG NUMBER	
	MSAVEVALUE	7,P4,3,V8,H	LOG TIME C130 EXPECTS TO ARRIVE	
	MSAVEVALUE	7,P4,1,P2,H	LOG WHICH C130	
	MSAVEVALUE	7,P4,2,P3,H	LOG WHICH C130 TRIP	
	TEST E	XH9,31,FINIS	MATRIX CAPACITY = 30 ROWS	
	SAVEVALUE	9,1,H	RESET ROW COUNTER	
	PRINT	7,7,MH	PRINT PRESENT MH7	
	SAVEVALUE	12,1,H	RESET	
MSG1	TEST LE	XH12,30,FINIS	HAVE WE FINISHED RESETTING?	
	TEST L	MH7(XH12,3),C1,MSG2	IS MSG STILL VALID?	
	MSAVEVALUE	7,XH12,3,0,H		
	MSAVEVALUE	7,XH12,4,0,H		
	MSAVEVALUE	7,XH12,5,0,H	CLEAR COLUMNS 3 THRU 5	

MSG2 SAVEVALUE 12+,1,H
 TRANSFER ,MSG1
 RES4 ADVANCE P7
 TRANSFER ,RES5
 RES2 TEST E PR,3,RES3
 TEST GE M1,10,RES7
 TEST L M1,20,RES6
 ADVANCE 10
 LEAVE DZONE
 SPLIT 1,ACFTR
 TRANSFER ,BFILL

*

BOV22 LOGIC S 222
 BOUT TRACE
 TERMINATE 48
 BOV26 LOGIC S 226
 TRANSFER ,BOUT
 BOV27 LOGIC S 227
 TRANSFER ,BOUT
 BOV36 LOGIC S 236
 PRINT 1,236,LG
 GATE LS 2,FINIS
 HHG32 SAVEVALUE 31+,1,H
 ASSIGN 1,XH31
 TRANSFER ,GOHP1
 START 10,,,1
 START 30
 END

INCREMENT

ADVANCE REMAINING TIME, HELO
 CONTINUES WORK & STDBY FOR AC
 SEND BAGS BACK TO THEIR ROUTINE
 DID C130 DROP E PKG?
 DID C130 DROP BAG PKG?
 C130 NO LONGER NEEDS HELO, DROP
 BAG PKG & LEAVE DROP ZONE
 RETURN C130
 BAG PKG NOW IN WATER
 BOMB-OUT SUBROUTINES

BOMBOUT V22<10

* SHUT DOWN BAGSIM DUE TO BOMBOUT
 BOMBOUT V26<10

BOMBOUT V27<10

BOMBOUT V36<10

IS HELO2 WANTED AT HP1?

APPENDIX B

DEFINITIONS OF ACRONYMS AND ABBREVIATIONS

ADAPTS	The acronym for the Air Deliverable Anti-Pollution Transfer System. It is described in Chapter 1.
BAGSIM	The acronym for the ADAPTS simulation model; it comes from Bag and Simulation.
BVn	Boolean Variable n (n is the serial number of the boolean variable). These variables can have a value of one or zero only.
ECAS	U. S. Coast Guard Air Station, Elizabeth City, North Carolina.
E pkg	Equipment package; it consists of a Diesel - hydraulic power supply fuel, a submersible pump, connecting hoses, and HLD.
GPSS	General Purpose Simulation System. A block oriented computer language for simulation models.
HLD	Hauling and Lifting Device. An aircraft deliver A-frame complete with rigging tackle and manual winch. It is a component of an E pkg.
HPl	Helo Port 1. The helicopter equipped CG Air Station nearest to the scene.
Hl2	Helo Port 2. The backup helicopter equipped CG Air Station. It is the next nearest to the scene.
MHn	Halfword Matrix n (n is the serial number of the matrix).
NYC	New York City.
PERT/CPM	Program Evaluation and Review Technique/Critical Path Method which as used for network analysis. The specific method use in this report was the Integrated Civil Engineering System program called PROJECT 1 released by the Massachusetts Institute of Technology.
Vn	Variable n (n is the serial number of the variable). It is a defined formula used for computation during a computer run of BAGSIM.
XHn	Halfword Savevalue n (n is the serial number of the halfword save-value). A save number, either initially set into the computer run or computed during the run.

APPENDIX C

BOOLEAN VARIABLES, BVn

<u>Number</u>	<u>Equation</u>	<u>Meaning</u>
BV1	XH41'L'4	Helo 1 is 1 = HH3F 0 = HH52A
BV2	XH42'L'4	Helo 2 is 1 = HH3F 0 = HH52A
BV3	XH43'L'4	Helo 3 is 1 = HH3F 0 = HH52A
BV4	Q\$WCPT+Q\$WHELO	0 = no waits for helo 1 = a helo queue is formed
BV5	FU*12+BV4	0 = helo not in use 1 = helo being used
BV6	P2'G'O*P2'L'4*P2'NE'P12	1 = a message has been taken and message was not late and the asking helo did not take the message. 0 = at least one of the conditions was not met.

FLOATING POINT VARIABLES, FVn

Floating point variables are not used by BAGSIM although they are available in GPSS/360.

ARITHMETIC VARIABLES, Vn

<u>Number</u>	<u>Equation</u>	<u>Meaning</u>
V1	C1-XH21	Lapsed time since last C-130 arrive scene.
V2	XH23+P16-C1-V6-V7-20	Crew time available after next trip
V3	60*XH40/270	C-130 time to HP1 fm BAS
V4	60*XH6/270	C-130 time to HP1 fm ECAS
V5	10+60*XH7/270	C-130 time to scene fm HP1
V6	60*XH5/270	C-130 time to scene fm ECAS
V7	60*XH5/290	C-130 time to return to ECAS

<u>Number</u>	<u>Equation</u>	<u>Meaning</u>
V8	$XH15+V6+C1$	Time C-130 arrives at scene
V9	$60*(1-BV1)*XH7/85+60*Bv1*XH7/115$	1st Helo time to scene fm HP1
V10	$60*(1-BV1)*XH7/95+60*Bv1*XH7/125$	1st Helo time to HP1 fm scene
V11	$60*(1-BV2)*XH8/85+60*Bv2*XH8/115$	2nd Helo time to scene fm HP2
V12	$60*(1-BV2)*XH8/95+60*Bv2*XH8/125$	2nd Helo time to HP2 fm scene
V13	$60*(1-BV3)*XH7/85+60*Bv3*XH7/115$	3rd Helo time to scene fm HP1
V14	$60*(1-BV3)*XH7/95+60*Bv3*XH7/125$	3rd Helo time to HP1 fm scene
V15	$50+P2$	for addressing HX_j where j equals the C-130 number plus 50.
V16	$C1+P7-11$	time by which C-130 must reach scene if Helo1 is to serve it.
V17	$C1+P8-11$	
V18	$C1+P9-11$	
V19	$60*(1-BV2)*XH7/85+60*Bv2*XH7/115$	Helo2 time to scene fm HP1
V20	$60*(1-BV2)*XH7/95+60*Bv2*XH7/125$	Helo2 time to HP1 fm scene
V21	$60*(1-BV2)*XH20/85+60*Bv2*XH20/115$	Helo2 time from HP2 to HP1
V22	$150+158*Bv1-V9-V10$	On scene endurance with transit time accounted.
V23	$P5+56+P10$	time for helo to return, refuel & go back out
V24	$3*XH16$	0 if no E pkgs to be carried fm HP1
V25	$3*XH17$	0 if no E pkgs to be carried fm HP2
V26	$270+82*Bv1-V9-V10$	time that Helo1 stays on scene if unloaded

<u>Number</u>	<u>Equation</u>	<u>Meaning</u>
V27	$120+62*BV1-V9-V10$	time Helo1 stays on scene if carrying E pkg
V28	$150+158*BV3-V13-V14$	Helos on scene endurance if a salvage team is carried
V29	$270+82*BV3-V13-V14$	Helos on scene endurance if no load is carried
V30	$120+62*BV3-V13-V14$	Helos on scene endurance if an E pkg is carried
V31	$20+10*BV1$	Average time to refuel 1st helo
V32	$20+10*BV2$	Average time to refuel 2nd helo
V33	$20+10*BV3$	Average time to refuel 3rd helo
V34	$150+158*BV2-V19-V20$	Helos on scene endurance S.T. carried from HP1
V35	$270+82*BV2-V19-V20$	Helos on scene endurance empty from HP1
V36	$120+62*BV2-V19-V20$	Helos on scene endurance pkg carried from HP2
V37	$120+62*BV2-V19-V20$	Helos on scene endurance E pkg carried from HP1
V38	$270+82*BV2$	total endurance HP1 Helos

APPENDIX D

FULLWORD SAVEVALUES, Xn

Fullword savevalues are not used by BAGSIM although they are available in GPSS/360.

HALFWORD SAVEVALUES, XHn

<u>Number</u>	<u>Allowable Range</u>	<u>Meaning</u>
1	1 - 20	number of E pkg's set up (used as row for MH3)
2	1 up	# of 4 man salvage teams
3	1 - 15	# of C-130's
4	1 up	Bag # assigned after bag is filled (used as row for MH4)
5	0 up	Distance in nautical miles from ECAS to scene
6	0 up	Distance in nautical miles from ECAS TO HP1
7	0 up	Distance in nautical miles from HP1 to scene
8	0 up	Distance in nautical miles from HP2 to scene
9	1 up	Message #
10	1 up	Counter to serially number the plane loads
11	1 - 15	Serial number of C-130
12	1 - 30	Row counter for resetting MH7 contents to zero
13	<u>Not Used</u>	
14	0 up	Average time needed to install rails in C-130
15	0 up	Average time needed to load a C-130 with two packages

<u>Number</u>	<u>Allowable Range</u>	<u>Meaning</u>
16	0 - 20	# of E pkgs at HP2
17	logged time	time C-130 leaves salvage teams at HP1
19	1 - 30	Counter used by helos to select message
20	0 up	Distance in nautical miles from HP1 to HP2
21	logged time	The most recent time any C-130 arrived at scene, used by helos when deciding to leave scene
22	0 up	number of <u>extra</u> (spare) air crews for C-130's
23	0 - 15	number of C-130's left
24	0 up	C-130 crew endurance in minutes, see CG-333 for the standards
25	<u>Not Used</u>	
26	0 - V24	Counter for # of 1/3 E pkgs left to be delivered from HP1
27	0 - v25	Counter for # of 1/3 E pkgs left to be delivered from HP2
28	1 - 60	Initially = 1, Counter for Helo deliver of 1/3 E pkgs
29	1 - 60	Initially = 1, Counter Helo2 delivery of 1/3 E pkgs
30	<u>Not Used</u>	

<u>Number</u>	<u>Allowable Range</u>	<u>Meaning</u>
31	1 up	Helo trip number
32	<u>Not Used</u>	
33	Initially time Helo2 stays on scene when carrying E pkgs from HP2 and then used in refueling Helo2 when enroute HP1 from HP2	
34 - 38	<u>Not Used</u>	
39	Logged time	Time Helo2 arrives at HP1 for work
40	0 up	Distance in nautical miles from BAS to HP1
41	3, 52	Type of helicopter, Helo1
42	3, 52	Type of helicopter, Helo2
43	3, 52	Type of helicopter, Helo3
44	0 up	Standby time for Helo3
51 - 65	0 up	First used for standby of jth C-130 ($50+j=XIn$) then used for E pkg subroutine

APPENDIX E

FULLWORD MATRICES, MXn

Fullword matrices are not used by BAGSIM although they are available in GPSS/360.

HALFWORD MATRICES, MHn

I. MH1 is the only input matrix; it is for the E pkgs to be delivered by the C-130's. The i-th row represents the i-th E pkg delivered by a given C-130. The j-th column represents the j-th C-130. Hence MH(1,3),4 (the number 4 is in position row 1, column 3 of MH1) means that the 3rd C-130 makes its 1st E pkg delivery on its 4th trip. MH1 is limited to 3 rows and 15 columns. The numbers in a column must be zero or positive integers with increasing value going down a column except that zero may be after the last positive number.

Sample of MH1:

MATRIX HALFWORD SAVEVALUE 1
(C-130 Numbers)

	Col.	1	2	3	4	5
Row 1		1	1	0	2	0
(E PKG)2		2	3	0	0	0
3		3	0	0	0	0

II. In MH2 the times that C-130's return to ECAS are logged in the column with the same number as the C-130. There can be up to 30 returns (rows) by each of the 15 C-130's (columns).

(C-130 Number)

	Col.	1	2	3	15
Row 1		186	251	253						0
(Trip 2		331	time of return							
No.) :										
30		0	0							0

III. In MH3 the time when each E pkg is set up is logged in column 1. The helo that delivered it is numbered in column 2 with zero meaning no helo. The C-130 that delivered it is numbered in column 3 with zero meaning no C-130. If column 2 has a zero in it, column 3 must have a positive number in it for each row that has a set up time in column 1. There can be up to 20 E pkgs (rows) for this three column matrix.

		(Time set up)	(Delivered by helo)	(Delivered by C-130)
Col.		1	2	3
Row	1	113	1	0
(E pkg)	2	216	0	1
	3	239	2	0
	20	0	0	0

IV. In MH4 the information on the filled bags is logged. It is defined for 40 bags (rows) with 9 columns of information. The bags are logged in the same order they are filled with the columns containing:

<u>COLUMN</u>	<u>ALLOWABLE RANGE OF CONTENTS</u>	<u>MEANING</u>
1	1 - 40	order in which left storage at ECAS
2	1 - 15	which C-130 carried bag
3	1 - 20	C-130 trip number
4	logged time	time left ECAS
5	logged time	time bag dropped by C-130
6	logged time	time bag is ready for filling
7	logged time	time bag is full
8	1 - 10	order in which filled (repeats row number)
9	1 - 3	Helo used to deliver bag pkg messenger.

If a bag was filled, all spaces in its row must have numbers greater than zero.

Sample of MH4 in which 10 bags have been filled:

MATRIX HALFWORD SAVEVALUE 4

	COL.	1	2	3	4	5	6	7	8	9
Row	1	1	1	1	103	169	232	352	1	3
	2	3	3	1	178	206	288	408	2	1
	3	5	5	1	178	244	297	417	3	2
	4	3	3	1	178	216	298	418	4	1
	5	4	4	1	178	226	353	473	5	2
	6	2	2	1	178	234	409	529	6	1
	7	5	5	1	178	254	418	538	7	1
	8	4	4	1	178	236	419	539	8	1
	9	6	1	2	276	304	453	573	9	3
	10	6	1	2	276	314	474	594	10	3
	11	0	0	0	0	0	0	0	0	0
	12	0	0	0	0	0	0	0	0	0

V. In MH5 the time that C-130's begin loading for each trip is logged; these can be up to 30 loadings (rows) for each C-130 (column). This matrix resembles MH2.

VI. MH6 is not used.

VII. In MH7 the C-130 messages and their status is logged. Since each C-130 can make up to 30 trips, there are $30 \times 15 = 450$ possible messages, but to save room, this matrix is defined for 30 rows only. This means it can hold 30 messages so when 30 messages are placed into it, it is printed and partially zeroed to allow room for the next 30 messages. The columns represent:

<u>Column</u>	<u>Allowable Range Of Contents</u>	<u>Meaning</u>
1	1 - 15	Identifies which C-130 sent message
2	1 - 30	C-130 trip number
3	time	expected time for C-130 to arrive at scene
4	logged time	time message received by helo
5	0 - 3	which helo received this message; 0 = ignored by helo at scene 10 = received too late
6	1 up	message number

A sample of MH7 in which over 30 messages have been logged is:

MATRIX HALFWORD SAVEVALUE 7

	Col.	1	2	3	4	5	6
Row	1	1	7	1025	0	0	31
	2	3	7	1066	0	10	32
	3	2	7	1084	0	10	33
	4	5	7	1104	0	10	34
	5	4	7	1110	0	10	35
	6	1	8	1170	1151	1	36
	7	3	8	1211	0	0	37
	8	2	8	1229	0	0	38

VIII. In MH8 the information on the helicopter trips to the scene is logged. There can be up to 50 trips in total by the helos including the special trip by Helo2 when it shifts from HP2 to HP1 for its base of operations. The special trip is logged with zero in each column except 39 in column 5. The 39 refers to XH39 which then contains the time of HELO2's arrival at HP1. Otherwise each row of MH7 contains the information on a round trip by a helo to the scene. The columns represent:

<u>Column</u>	<u>Allowable Range Of Contents</u>	<u>Meaning</u>
1	1 - 3	Which helo made this trip
2	logged time	Time departed for scene
3	logged time	Time arrived at scene
4	duration	Time stayed on scene
5	logged time	Time arrived back at HP1 or HP2
6	0 = no load 1 = salvage team 2 = E pkg (1/3 pkg if helo is HH-52A)	Type of load carried on this trip

A sample of the beginning of MH8 is:

MATRIX HALFWORD SAVEVALUE 8

	<u>Col.</u>	1	2	3	4	5	6
<u>Row</u>	1	0	0	0	0	39	0
	2	1	44	88	21	149	2
	3	3	105	149	44	233	1
	4	2	170	214	55	309	1

APPENDIX F

LOGIC SWITCHES, LSn or LRn

<u>NUMBER</u>	<u>MEANING</u>
1	R = Helo1 is not used, S = Helo1 available and used
2	R = Helo2 is not used at HP1, S = used at HP2 then HP1
3	R = Helo3 is not used, S = Helo3 available and used
4	R = No manifolds, S = manifolds
5	R = No helo towing, S = Helo tow packages in the water
6	Normally R; S means no helo available for C-130 (at E pkg routine)
7	R = Helo available; S = no helo available (after tested for helo)
8	S = 1st C-130 went to HP1
9	Normally R; S releases helo that waited for E pkg drop by C-130
10	S = Salvage teams at New York City and R = Salvage teams at ECAS
11	Normally R; S by E pkg to delay bags when E pkg needs HLD. This helps to establish priority of queue.
12	Normally R; S means Helo1 went to scene early and that Helo3 waited at HP1 for the salvage teams to arrive by C-130
13-33	<u>Not Used</u>
34	R = HLD not set up; S = HLD set up
35	R = E pkg not set up; S = E pkg set up
36	R until at least 1 E pkg has been set up then S
37-50	<u>Not Used</u>

NUMBERMEANING

51

52

R until C-130 delivers salvage teams to
HP1, then S

53-199

Not Used

The 200 number series is used for logging model failures; that is,
conditions which cause this model to be unuseable.

NUMBERMEANING OF SET

222

S only if Helo1 on scene time, V22, will
exceed endurance; causes model to terminate
computer run

226

S only if Helo1 on scene time, V26, will
exceed endurance; causes model to terminate

227

S only if Helo1 on scene time, V27, will
exceed endurance; causes model to terminate

236

S only if HP2 is too far from scene for
Helo2 to deliver E pkgs from HP2

APPENDIX G

FACILITIES AND STORAGES

Facilities have a capacity of one user only while the size of storages must be defined. In BAGSIM four facilities and four storages are used as described in Chapter 3. They are:

<u>Name</u>	<u>Size</u>	<u>Meaning</u>
1	1	Helo1
2	1	Helo2
3	1	Helo3
LOADH	1	Only one helo can be loaded at a time
DZONE	2	Only two C-130's can be at the scene at a time
HAUL	2	Can have up to 20 HLD's
EPG	2	Can have up to 20 E pkgs
LDROO	1 or more*	Amount of C-130 loaders, hence, number of C-130's that can be loaded simultaneously

LOADH is now extraneous, it originally was needed to prevent simultaneous loading of the same pump into different helicopters. This can not happen with the present program.

* Defined as an input for each use of BAGSIM.

APPENDIX H

PARAMETER DEFINITIONS FOR TRANSACTIONS

When interpreting the meaning of a number stored in a parameter of a transaction, the position and priority of the transaction in the model are important. They help to define what the transaction represents. Transactions are initially given a priority of 5; they have 16 parameters. Those transactions that preload storages HAUL and EPG retain a priority of 5 and their 16 parameters each contain zero; any change in these conditions indicates that a bag of E pkg has entered the storage.

1. Helicopters. The helicopters have a priority of 5. The parameter values based upon the helo being at program location HLSC1 are:

<u>PARAMETER</u>	<u>MEANING</u>
1	helo trip number (serially assigned to all helo)
2	status of message
3	waiting time at HPl before taking this trip
4	projected arrival time at scene before taking this trip
5	HPl to scene trip time
6	scene to HPl trip time
7	On scene endurance carrying salvage team
8	On scene endurance carrying nothing
9	On scene endurance carrying E pkg
10	average refueling time
11	load carried this trip
12	Helo number (1, 2, or 3)

<u>PARAMETER</u>	<u>MEANING</u>
13	last time this Helo trip that a C-130 can arrive at scene with enough helo endurance to deliver messenger.
14	time helo must leave scene
15	time a C-130 is expected at scene or time helo must wait for C-130
16	next message to check in MH7

2. C-130 aircraft. The C-130's have a priority of 3. The parameter values are based upon the C-130's being at program location ACFTR are:

<u>PARAMETER</u>	<u>MEANING</u>
1	serial number of bag load
2	C-130#
3	C-130 trip # (serially assigned per C-130)
4 - 7	<u>Not Used</u>
8	time C-130 took off @ ECAS
9	which helo was used last time delivered E pkg
10	XH51 - XH65 C-130 standby address then used for EPKG1 routine
11 - 15	<u>Not Used</u>
16	logged time that C-130 became available for use.

3. Equipment Packages (Epkg). The helo delivered E pkgs have a priority of 5 while the C-130 delivered E pkgs have a priority of 3. Since these transactions are used only in the delivery of E pkgs, the difference in priority is immaterial except for debugging. The following parameter values are based upon the E pkg being at program location REPKG:

<u>PARAMETER</u>	<u>C-130 DELIVERY MEANING</u>	<u>HELO DELIVERY MEANING</u>
1	order in which left storage at ECAS	Helo trip number (for all helos)

<u>PARAMETER</u>	<u>C-130 DELIVERY MEANING</u>	<u>HELO DELIVERY MEANING</u>
2	which C-130 carried it	zero
3	which C-130 trip	zero
4	time dropped by C-130	zero
5		HP1 to scene trip time
6		Scene to HP1 trip time
7		On scene endurance carrying salvage team
8	time C-130 took off fm ECAS	On scene endurance carrying nothing
9	which helo was used	On scene endurance carrying E pkg
10	which E pkg delivery by this C-130	average refueling time
11		two
12	zero	helo number
13		V16, V17, or V18
14		time when helo must leave scene
15		message time for testing
16	logged time C-130 became available for use	# of message being tested

4. Bags. The bags have a priority of 1. The parameter values are based upon the bag being at program location BFULL:

<u>PARAMETER</u>	<u>MEANING</u>
1	order in which bags leave storage @ ECAS
2	which C-130 carried bag
3	C-130 trip number
4	time bag dropped
5	time bag ready for filling

<u>PARAMETER</u>	<u>MEANING</u>
6	time bag filled
7	order in which bags filled
8	time C-130 took off fm ECAS
9	Helo which towed bag msgr
10	used for E pkg delivery by C-130
11 - 15	<u>Not Used</u>
16	logged time C-130 became available for use

5. Messages. The messages sent by the C-130's to the helo's and HP1 have a priority of 3. The parameter values based upon the messages being at program location SMSG3 are:

<u>PARAMETER</u>	<u>MEANING</u>
1	order in which messages sent
2	which C-130 sent the message
3	C-130 trip number
4	matrix row for message
5 - 15	zero (<u>Not Used</u>)
16	used for interarrival test.

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REFERENCES

1. International Business Machines Corp. General Purpose Simulation System/360 OS Version 2 Introductory User's Manual H20-0693-0. White Plains: IBM, 1969
2. International Business Machines Corp. General Purpose Simulation System/360 OS Version 2 User's Manual SH20-0694-0. White Plains: IBM, 1969
3. Naylor, Balintfy, Burdick, Chu. Computer Simulation Techniques. New York; John Wiley & Sons, 1966