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NATIONAL BUREAU OF STANDARDS REPORT

10 433

A SEARCH AND RESCUE SIMULATION MODEL FOR THE UNITED STATES COAST GUARD

VOLUME IV

PROGRAMMER LEVEL DOCUMENTATION FOR
"OPSIM"

Sponsored by
U. S. Coast Guard



U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

NATIONAL BUREAU OF STANDARDS

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by

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PREFACE

This volume is one of a series which documents a Search and Rescue Simulation Model for the United States Coast Guard. The material reported in this documentation was developed by an interdisciplinary team at the National Bureau of Standards with representation from the U.S. Coast Guard under MPR Z-70099-0-01935.

The complete documentation is comprised of the following:

- Volume I Executive Level Documentation
- Volume II Analyst Level Documentation
- Volume III Programmer Level Documentation for "PREPROCESSOR"
- Volume IV Programmer Level Documentation for "OPSIM"
- Volume V Programmer Level Documentation for "POSTPROCESSOR"
- Appendix A Flow Charts for Programmer Level Documentation
- Appendix B Program Listings for Programmer Level Documentation

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I. Computer Program Listing for OPSIM

Computer listings for OPSIM are found
in Appendix B (NBS Report No. 10436).

II. Definition Deck

Every Temporary Entity, Event Notice, Permanent Entity, Attribute, and Set must be described in the Definition Deck. A sample coding form for the Definition Deck is shown in Figure II-1. A listing of the Definition Deck used for OPSIM is included with the program listing. For a detailed description of the Definition Deck preparation, the reader is referred to SIMSCRIPT A Simulation Programming Language by Markowitz, Hausner and Karr, Prentice-Hall, Inc., 1963.

Special mention should be made of the manner in which attributes are stored and packed. Packing allows more than one attribute to occupy a single word of computer storage. This is necessary in order to accommodate in core storage the large amount of information utilized by the simulation. Care must be taken, however, that the size of the stored attribute does not exceed the maximum allowable size for the packing code. It should be further noted that time information must be stored as floating point days. For maximum possible accuracy, all attributes which contain specific times (not durations) and other critical values should be stored in full words. The maximum size for several packing codes is shown in Figure II-2 below. This is an amended version of Table 2 found on page 107 of the above references. It should be noted that one-sixth ($1/6$) packing is also allowed for the UNIVAC 1108 system, but since it is not universally available, it has not been used for OPSIM.

For attributes of Permanent Entities the packing code is in column 44 of the Definition Card. For example the listing of the

PROGRAMMER _____
PROBLEM _____
DATE _____

* NOT AVAILABLE TO
EVENT NOTICES



Fig. II-1-SIMSCRIPT Definition Form (actual size)

Maximum Size For Various Packing Codes

Packing Code	Position In Word	Maximum Integer Value		Approximate Maximum Floating Point Value	
		Unsigned	Signed	Unsigned	Signed
Blank or 1/1	full word	$2^{35} - 1$	$2^{35} - 1$	2^{-128} to 2^{127}	2^{-128} to 2^{127}
1/2	first half	131,071	131,071	2^{-32} to 2^{31}	2^{-16} to 2^{15}
2/2	second half	131,071	131,071	2^{-32} to 2^{31}	2^{-16} to 2^{15}
1/3	first third	4,095	2,047	Not Permitted	
2/3	second third	4,095	2,047		
3/3	last third	4,095	2,047		
1/4	first quarter	511	255	Not Permitted	
2/4	second quarter	511	255		
3/4	third quarter	511	255		
4/4	fourth quarter	511	255		

FIGURE II - 2

definition deck in the computer program listings shows the attribute COST being packed two to a word and the attribute STN being packed four to a word.

The attributes of temporary entities are stored in a different manner. Associated with each temporary entity are a 'Master Record' and possibly several 'Satellite Records'. The number of words in the Master Record is found in column 9 and the number of words in each succeeding Satellite Record follows in columns 10 through 17. There can be at most eight words per record. A particular word of any record may contain more than one different attribute. The storage code appears in columns 25 and 26 with the packing in columns 27-29. For example, the computer listing of the definition deck shows the CASE attribute COUNT with code 123/4 indicating that it is stored in the third quarter of the second word in the first satellite record. A zero or blank in column 25 indicates the master record. Two or more temporary entities and event notices may have attributes of the same name if that attribute occupies the same relative storage position. In this case the attribute name appears in the Definition Deck with only one of the temporary entities or event notices. A pictorial map of the storage layout for CASE, NOTE, NOTIF, and FLT is given below. The other event notices have short records and will not be mapped herein.

It should be noted that storage and retrieval times are somewhat greater for packed attributes than for unpacked ones, and also greater for attributes stored in Satellite Records than those in the Master Record.

Storage Layout

A. The Temporary Entity CASE

RECORD WORD

0 1

2

3

4

5

6

7

8

1 1

2

3

4

5

6

7

8

2 1

2

3

4

5

6

7

8

3 1

2

SYTAG	ITOL	Reserved for linkage to Satellite Records		
MMM	NNN			
XC				
POB		UTYPE		L
SIS	S2S	STATN	AIR	
OST		RESA	SWELL	
NEED	PRI	FLG	SIGNL	
PCQUE		SQQUE		
FPRI	REA	IDLOC	WIND	
NOINT	LOC	COUNT	IWAIT	
VIS	IS2	TQUE		
NOCAS		OFSHR		
FNSET		LNSET		
FSRHS		LSRHS		
GAMMA		SEXCS		
XCX		YCY		
NQUE	CNRES	TSVC		
TSM		TQUE1		
COSTC		TWAIT		
STINQ				
TINQ				
VALUE				
OCCUR				
YC		TINT		
ITOW	BOX		OPFAC	
DMERT				

B. The Event Notice NOTIF

RECORD WORD

0 1
2
3
4
5
6
7
8

The first two words are used by Simsript timing routines.			
COMP	NUMBR	DELTA	
CAS		SNSSET	
XHAND		YHAND	
OST		RESA	KRES
NEED	PRI	FLG	SIGNL
PCQUE		SCQUE	

C. The Event Notice NOTE

RECORD WORD

0 1
2
3
4
5
6
7
8

The first two words are used by Simsript timing routines.			
TS		SSRHS	
SM		ESAC	
SDAY	SFLAG	RSRC	
SLIST		RESA	SASG
blank	PRI	FLG	SIGNL
PCQUE		SCQUE	

D. The Temporary Entity FLT

RECORD WORD

0 1

2

3

4

5

6

7

8

1

1

2

HCREW	linkage to satellite record.	
XDEST	YDEST	
IDEV	ACASE	
TARVL	FITON	
XI	YI	
DEP		
TFLT		
RLS		
TOW	MFLG	TOWSP
ROS		

- INCOMING CASE TO OPERATIONAL SIMULATOR FROM
 EXOGENOUS EVENT TAPE; TEMPORARY ENTITY
 - AIR TEMPERATURE AT TIME OF CASE
 - CTEMP(CASE)
 - NUMBER OF RESOURCES INVOLVED IN SERVING CASE
 - COSTC(CASE)
 - TOTAL COST FOR CASE
 - COUNT(CASE)
 - NUMBER OF NOTIFS THAT HAVE BEEN COMPLETELY SERVED
 - DMERT(CASE)
 - CASE DEMERIT
 - FLG(CASE)
 - = 1: FLAG TO INDICATE SINGLE RESOURCE CASE IN QUEUE
 - FNSSET(CASE)
 - FIRST NOTIF IN NSET(CASE)
 - FPRIC(CASE)
 - INITIAL PRIORITY OF CASE
 - FSRHS(CASE)
 - FIRST NOTE IN SRHS(CASE)
 - GAMMA(CASE)
 - DEGREE OF NON-PARALLELISM FOR MULTI-RESOURCE CASES
 - ILOC(CASE)
 - DISTRICT LOCATION OF CASE
 - ISA(CASE)
 - THE ADDITIONAL RESOURCE NEEDED FOR A SHORT SEARCH
 - (I.E. WHEN S2S(CASE) = 2)
 - ITOL(CASE)
 - = 0 IF CASE WAS NOT SERVED WITHIN TOLERANCE
 - = 1 IF CASE WAS SERVED WITHIN TOLERANCE
 - = 2 FIRST ARVSN OR ARSCH HAS NOT YET OCCURRED
 - = 3 NO CAPABLE RESOURCE TYPES IN SYSTEM
 - = 4 NO CAPABLE RESOURCE TYPES AT PRIMARY AND
 - ADJACENT STATIONS
 - = 5 NO CAPABLE RESOURCE AVAILABLE TO SERVE AIR ESCORT
 - = 6 IMPOSSIBLE SET OF INPUT PARAMETERS; CASE PLACED
 - IN EXCS
 - = 7 FAILSAFE SWITCH IN THE EVENT A CASE TAKES AN
 - IMPOSSIBLE ROUTE IN PROGRAM
 - ITOW(CASE)
 - IF THE CASE IS A MULTI-RESOURCE CASE WITH A TOW OR
 - ESCORT NEED, EXOGENOUS EVENT OPSIM STORES THE TYPE OF
 - TOW OR ESCORT NEED IN ITOW(CASE)
 - IWAIT(CASE)
 - = 0 NO RESOURCE IS RESPONSIBLE FOR COVERING
 - = NUMBER OF THE RESPONSIBLE RESOURCE COVERING
 - L(CASE)
 - LENGTH OF DISTRESSED UNIT
 - LNSSET(CASE)
 - LAST NOTIF IN NSET(CASE)
 - LOC(CASE)
 - = 0 CASE HAS NOT BEEN FOUND
 - = 1 CASE HAS BEEN FOUND
 - LSRHS(CASE)
 - LAST NOTE IN SRHS(CASE)
 - MMM(CASE)
 - NUMBER OF TOWS
 - NEED(CASE)
 - NEED OF SINGLE RESOURCE CASE
 - NNN(CASE)
 - NUMBER OF NEEDS EXCEPT LONG SEARCH AND TOW
 - NOCAS(CASE)
 - HISTORICAL CASE NUMBER
 - NOINT(CASE)
 - CASE INTERRUPT COUNT
 - NQUE(CASE)
 - TOTAL NUMBER OF TIMES THE CASE VISITED A QUEUE
 - NSET(CASE)
 - SET OF EVENT NOTICE ENTITIES CALLED NOTIF WHICH
 - ARE CREATED FOR EACH NEED OF A MULTI-RESOURCE CASE
 - OCCUR(CASE)
 - TIME THAT CASE OCCURS
 - OFSHR(CASE)
 - DISTANCE OFFSHORE
 - OPFAC(CASE)
 - ORIGINAL STATION NUMBER OF CASE READ FROM INPUT TAPE
 - OST(CASE)
 - ON-SCENE-TIME FOR SINGLE RESOURCE CASE
 - PCQUE(CASE)
 - PREDECESSOR IN QUEUE
 - POB(CASE)
 - NUMBER OF PEOPLE ON BOARD DISTRESSED UNIT
 - PRI(CASE)
 - FINAL PRIORITY OF CASE
 - REA(CASE)
 - FIRST REASON CASE GOES INTO QUEUE
 - = 0 IF CASE WAS INTERRUPTED
 - = 1 IF NO AVAILABLE RESOURCES


```

C      PRI(NOTIF) - PRIORITY OF NOTIF
C      RESA(NOTIF) - FIRST RESOURCE TO SERVL NEED
C      SQUE(NOTIF) - SUCCESSOR IN QUEUE
C      SIGNL(NOTIF) - INDICATES REASON FOR NOTIF BEING QUEUED
C      = 0 QUEUED DUE TO NO AVAILABLE RESOURCES
C      = 1 QUEUED DUE TO INTERRUPT
C      = 2 NOTIF IS NOT IN THE QUEUE
C      SMCSET(NOTIF) - SUCCESSOR IN SET
C      XHAND(NOTIF) - X COORDINATE OF TOW HAND-OFF
C      YHAND(NOTIF) - Y COORDINATE OF TOW HAND-OFF
C
C      ENT--NOTE - EVENT NOTICE ENTITY CREATED FOR EACH OF SIS SEARCH
C                  RESOURCES ON A LONG SEARCH CASE; EACH ENTITY--NOTE--
C                  IS PLACED INTO A FIFO SET--SRHS(CASE)
C                  CASE NUMBER OF NOTE
C                  = 3; FLAG TO INDICATE A SEARCH NEED IN QUEUE
C                  PREDECESSOR IN QUEUE
C                  PRI(NOTIF) - PRIORITY OF NOTE
C                  RESA(NOTIF) - FIRST RESOURCE TO SERVE SEARCH NEED
C                  RSKC(NOTIF) - RESOURCE SERVING SEARCH NEED
C                  SASG(NOTIF) - = 0 IF NO RESOURCE IS ASSIGNED TO THE SEARCH NEED
C                                  DURING THE DAY
C                                  = 1 IF A RESOURCE WAS ASSIGNED TO THE SEARCH NEED
C                                  DURING THE DAY
C                                  SUCCESSOR IN QUEUE
C                  SQUE(NOTIF) - SUCCESSOR IN QUEUE
C                  SDAY(NOTIF) - DAY OF SEARCH
C                  SFLAG(NOTIF) - FLAG TO INDICATE THAT THIS SEARCH NEED WAS SERVICED
C                                  BY THE FIRST RESOURCE TO BE ASSIGNED TO THE CASE
C                  SIGNL(NOTIF) - INDICATES REASON FOR NOTE BEING QUEUED
C                                  = 0 QUEUED DUE TO NO AVAILABLE RESOURCES
C                                  = 1 QUEUED DUE TO INTERRUPT
C                                  = 2 NOTE IS NOT IN QUEUE
C                  SMCSET(NOTIF) - SUCCESSOR IN SLIST
C                  SMCN(NOTIF) - SEARCH MILES A SEARCH RESOURCE ATTEMPTS TO COMPLETE
C                  TS(NOTIF) - TIME SPENT ON SCENE SEARCHING
C
C      ENT--FLT - TEMPORARY ENTITY CREATED WHEN A RESOURCE WITH
C                  EIAT = 0.0 IS ASSIGNED TO A CASE
C                  ACASE(FLT) - CASE THAT RESOURCE IS SERVICING
C                  DEP(FLT) - TIME RESOURCE LEFT LAST POINT TO HEAD IN IT'S
C                                  PRESENT DIRECTION
C                  FITON(FLT) - NOTIF OR NOTE IDENTIFICATION NUMBER
C                  HCREW(FLT) - SET EQUAL TO 1 WHEN IDLE RES MUST RETURN TO
C                                  IT'S HOME STATION DUE TO CREW AVAILABILITY STATUS
C                                  SET EQUAL TO 2 WHEN AN IDLE RESOURCE MUST RETURN
C                                  TO ITS HOME STATION TO REFUEL
C                  IDEV(FLT) - IDENTIFICATION NUMBER OF UPCOMING ENDOGENOUS EVENT
C                                  --ONSCN,ARSCN,ARVSN,COMPL,SSET,FUEL,HOMEF,HOMEF,
C                                  SNOBK
C                  MFLG(FLT) - FLAG TO INDICATE TYPE OF UPCOMING EVENT
C                                  = 1 ARVSN
C                                  = 2 ONSCN
C                                  = 3 ARSCH
C                                  = 4 COMPL
C                                  = 5 SSET
C                                  = 6 FUEL
C                                  = 7 HOMEF
C                                  = 8 HOMEF

```

```

= 9  NOTHING IS SCHEDULED
=10  SNOCK
=11  DELAY
=12  READY
=13  CHECK
- EXPECTED LEAVE TIME
- ARRIVE ON SCENE TIME
- TIME RESOURCE ARRIVES AT HOME STATION
- TIME RESOURCE LEAVES HOME STATION
- TAG TO INDICATE RES IS PRESENTLY TOWING
- TOWING SPEED OF RES ON A PARTICULAR CASE
- X' COORDINATE -- DESTINATION OF RES ON ASSIGNMENT
- Y COORDINATE -- DESTINATION OF RES ON ASSIGNMENT
- X COORDINATE -- INTERRUPT LOCATION
- Y COORDINATE -- INTERRUPT LOCATION

- PERMANENT ENTITY WHERE NRES = NUMBER OF RESOURCES
- COST OF RESOURCE K ON A GIVEN CASE
- TIME IT TAKES RESOURCE K TO VECTOR TO THE CASE
  LOCATION PLUS THE DELAY TIME IT TAKES TO READY
  RESOURCE K
- EXPECTED IDLE ALPHA TIME OF RESOURCE K
- =0 IF RESOURCE K IS IDLE
- =1 IF RESOURCE K IS BUSY
- =2 IF RESOURCE K IS COVERING
- IDENTIFICATION NUMBER OF TEMPORARY ENTITY--FLT--
  CREATED WHEN RESOURCE K IS ASSIGNED
- TOTAL NUMBER OF CASES SERVED BY RESOURCE K
- PERCENTAGE OF SEARCH MILES COMPLETED BEFORE SUNSET
  OR TOLRS BY RESOURCE K
- PRIORITY OF CASE TO WHICH RESOURCE K IS ASSIGNED
- STATION TO WHICH RESOURCE K IS ASSIGNED
- TOTAL TIME RESOURCE K HAS (E1AT)NE(0.0) DURING THE
  PRESENT SHIFT
- TIME IT TAKES RESOURCE K TO VECTOR TO CASE LOCATION
- TYPE OF RESOURCE K
- UTILIZATION OF RESOURCE
- X COORDINATE -- LOCATION OF RESOURCE K
- Y COORDINATE -- LOCATION OF RESOURCE K

- PERMANENT ENTITY WHERE NRST = NUMBER OF RESOURCE TYPES
- AVERAGE UTILIZATION OF RESOURCE TYPE I IN DISTRICT
- COST/DAY OF OPERATING RESOURCE TYPE I
- DELAY TIME NECESSARY TO READY RESOURCE TYPE I AT
  IT'S HOME STATION
- ENDURANCE IN HOURS FOR RESOURCE TYPE I
- MAINTAINABILITY/RELIABILITY OF RESOURCE TYPE I
- RELATIVE COST RANKING OF RESOURCE TYPE I
- SWELL LIMIT FOR SOA1(I) OF RESOURCE TYPE I
- SPEED OF ADVANCE(WC1) OF RESOURCE TYPE I
- SPEED OF ADVANCE(WC2) OF RESOURCE TYPE I
- SEARCH SPEED OF ADVANCE OF RESOURCE TYPE I
- TAG TO DISTINGUISH SMALL SURFACE CRAFT, CUTTERS,
  C-130'S, AND OTHER AIRCRAFT
- = 0 IF TYPE IS A SMALL SURFACE CRAFT
- = 1 IF TYPE IS A CUTTER
- = 2 IF TYPE IS A C-130
- = 3 IF TYPE IS AN AIRCRAFT OTHER THAN A C-130

```

- REFUEL TIME FOR RESOURCE TYPE I
 - TAG TO INDICATE IF THE TYPE IS A BOAT OR AIRPLANE
 = 0 IF TYPE IS A BOAT
 = 1 IF TYPE IS AN AIRPLANE
 C ENT--STA
 - PERMANENT ENTITY WHERE NSTA = NUMBER OF STATIONS
 IN THE DISTRICT
 - COVERING AIR STATIONS OF STATION J - RAGGED TABLE
 - ADJACENT STATIONS OF STATION J - RAGGED TABLE
 - AVERAGE TWAIT(CASE) OF STATION J
 - NUMBER OF BUSY CREWS AT STATION J
 - AVERAGE FAILURE TYPE C (TWAIT-TOL) AT STATION J
 - RESPONSIBLE CUTTERS OF STATION J - RAGGED TABLE
 - NORMALIZED DEMERIT AT STATION J
 - NUMBER OF FAILURE TYPE A'S AT STATION J
 - NUMBER OF FAILURE TYPE B'S AT STATION J
 - NUMBER OF FAILURE TYPE C'S AT STATION J
 - GROUP NUMBER TO WHICH STATION J BELONGS
 - NUMBER OF COVERING AIR STATIONS OF STATION J
 - NUMBER OF ADJ. STATIONS OF STATION J
 - NUMBER OF CASES SERVED BY STATION J
 - NUMBER OF RESPONSIBLE CUTTERS OF STATION J
 - NUMBER OF NEEDS SERVED BY STATION J
 - NUMBER OF INTERRUPTIONS AT STATION J
 - SUM OF ALL NQUE(CASE) WHERE STAIN(CASE) = J
 - TOTAL NUMBER OF TIMES A STANDBY IS CALLED
 - TAG TO INDICATE IF STATION J CAN/CANNOT BE A
 PRIMARY STATION OF A CASE
 = 0 STATION CANNOT BE A PRIMARY STATION
 = 1 STATION CAN BE A PRIMARY STATION
 - NUMBER OF RESOURCES OF TYPE I AT STATION J
 - RAGGED TABLE
 - CREW MANNING LEVEL DURING SHIFT I AT STATION J
 - RAGGED TABLE
 - AVERAGE POSITIVE (TWAIT-TOL) AT STATION J
 - TOTAL NUMBER OF TIMES A STANDBY IS CALLED AND NOT
 USED (I.E., UNPRODUCTIVE CALL)
 - AVERAGE UTILIZATION OF RESOURCES AT STATION J
 - UTILIZATION OF RESOURCES DURING SHIFT I AT STATION
 J; USHF(J,I) IS AN ATTRIBUTE OF BOTH STA AND WEWDS
 - AVERAGE TIME-TO-VECTOR AT STATION J
 - X COORDINATE -- STATION LOCATION
 - Y COORDINATE -- STATION LOCATION
 C ENT--WEDS
 - PERMANENT ENTITY WHERE NWEWDS = NUMBER OF WEEKEND
 SHIFTS + NUMBER OF WEEKDAY SHIFTS
 - AVERAGE UTILIZATION OVERALL (IN DISTRICT) DURING
 SHIFT I
 - TIME THAT SHIFT I ENDS
 - TOTAL SIMULATED TIME OF SHIFT I
 C ENT--TOLER
 - PERMANENT ENTITY WHERE NTOLER = NUMBER OF SEVERITY
 LEVELS
 - TOLERANCE TIME AT SEVERITY LEVEL I
 - SEARCH TOLERANCE TIME AT SEVERITY LEVEL I
 C ENT--CPBL
 - PERMANENT ENTITY WHERE NCPBL = NUMBER OF CAPABILITIES
 - SOCIAL NUMBER REPRESENTING ONE ROW OF THE RESOURCE

CAPABILITY MATRIX

C ENT--PRM - PERMANENT ENTITY WHERE NPRTM = MAXIMUM VALUE OF
 C ANY SIS(CASE)
 C PRISM(I,J) - RAGGED TABLE; FRACTIONAL SPLIT OF TSM(CASE) AS A
 C FUNCTION OF SIS(CASE)
 C
 C ENT--PATRL - PERMANENT ENTITY WHERE NPATRL = NUMBER OF PATROLLING
 C CUTTERS
 C IPAT(I) - STATION NUMBER OF PATROLLING CUTTER
 C
 C ENT--SCNVT - PERMANENT ENTITY (STATION CONVERSION TABLE)
 C NSN(I) - CONVERTED STATION NUMBER FOR STATION I
 C
 C ENT--GROUP - PERMANENT ENTITY WHERE NGROUP = NUMBER OF GROUPS
 C ADVRT(I) - NORMALIZED DEMERIT OF GROUP(I)
 C CS(I) - NUMBER OF CASES SERVED BY GROUP(I)
 C FL1(I) - NUMBER OF FAILURE TYPE A'S IN GROUP(I)
 C FL2(I) - NUMBER OF FAILURE TYPE B'S IN GROUP(I)
 C FL3(I) - NUMBER OF FAILURE TYPE C'S IN GROUP(I)
 C INTRP(I) - NUMBER OF INTERRUPTS IN GROUP(I)
 C NDS(I) - NUMBER OF NEEDS SERVED BY GROUP(I)
 C NUNPR(I) - TOTAL NUMBER OF UNPRODUCTIVE STANDBY CALL-UPS IN GROUP(I)
 C NOSB(I) - TOTAL NUMBER OF TIMES A STANDBY WAS CALLED IN GROUP(I)
 C TMTAV(I) - AVERAGE POSITIVE (TWAIT-TOL) OF GROUP(I)
 C TVAVG(I) - AVERAGE TIME-TO-VECTOR OF GROUP(I)
 C TWAVG(I) - AVERAGE TWAIT(CASE) OF GROUP(I)
 C USEAV(I) - AVERAGE UTILIZATION OF RESOURCES IN GROUP(I)
 C
 C ENT--DSTRB - PERMANENT ENTITY WHERE NDSTRB = NUMBER OF
 C DISTRIBUTIONS OUTPUT IN REPORT GENERATORS
 C MEEN(DSTRB) - MEAN
 C CNTR(DSTRB) - COUNTER
 C STDDEV(DSTRB) - STANDARD DEVIATION
 C CATG1(DSTRB) - FREQUENCY OF EXPRESSION BEING IN A RANGE
 C > OR = 0.0 AND < OR = 0.5
 C CATG2(DSTRB) - FREQUENCY OF EXPRESSION BEING IN A RANGE
 C > 0.5 AND < OR = 1.0
 C CATG3(DSTRB) - FREQUENCY OF EXPRESSION BEING IN A RANGE
 C > 1.0 AND < OR = 2.0
 C CATG4(DSTRB) - FREQUENCY OF EXPRESSION BEING IN A RANGE
 C > 2.0 AND < OR = 3.0
 C CATG5(DSTRB) - FREQUENCY OF EXPRESSION BEING IN A RANGE
 C > 3.0 AND < OR = 4.0
 C CATG6(DSTRB) - FREQUENCY OF EXPRESSION BEING IN A RANGE
 C > 4.0 AND < OR = 5.0
 C CATG7(DSTRB) - FREQUENCY OF EXPRESSION BEING IN A RANGE
 C > 5.0 AND < OR = 10.0
 C CATG8(DSTRB) - FREQUENCY OF EXPRESSION BEING IN A RANGE
 C > 10.0
 C
 C ENT--HLDY - PERMANENT ENTITY WHERE NHLDY = NUMBER OF HOLIDAYS
 C HOLID(I) - DAY OF HOLIDAY I
 C
 C NOTE: THE OPERATIONAL SIMULATOR CONSIDERS THE FIRST
 C DAY AS DAY ZERO. THEREFORE, IF THE MONTH OF JULY WAS
 C BEING SIMULATED, JULY 4 WOULD BE INPUT AS DAY 3.
 C IF THE TWO MONTHS OF JUNE AND JULY WERE BEING
 C SIMULATED, JULY 4 WOULD BE INPUT AS DAY 33.

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C ENT--AKSCH - EVENT NOTICE ENTITY OCCURRING WHEN A RESOURCE
C ARRIVES ON SCENE TO SEARCH
C LNOTE(ARSKCH)- NOTE IDENTIFICATION NUMBER
C LKES(ARSKCH) - RES IDENTIFICATION NUMBER
C LFLG(ARSKCH) - = 1 IF ARSCH WAS CAUSED FOR THE FIRST RESOURCE TO
C SEARCH
C = 2 IF ARSCH WAS CAUSED FOR ANY RESOURCE EXCEPT
C THE FIRST
C
C ENT--ARVSN - EVENT NOTICE ENTITY OCCURRING WHEN A RESOURCE
C ARRIVES ON SCENE
C CASNO(ARVSN)- CASE IDENTIFICATION NUMBER
C RESNO(ARVSN)- RESOURCE IDENTIFICATION NUMBER
C
C ENT--CHEKN - EVENT NOTICE ENTITY OCCURRING WHEN A 'COVERING'
C RESOURCE EXAMINES THE QUEUE; THE RESOURCE WILL EITHER
C SERVE A NEED IN THE QUEUE IF CAPABLE OR REMAIN
C 'COVERING' ON HIS PRESENTLY ASSIGNED CASE
C CASNO(CHEKN)- CASE IDENTIFICATION NUMBER
C RESNO(CHEKN)- RESOURCE IDENTIFICATION NUMBER
C
C ENT--COMPL - EVENT NOTICE ENTITY OCCURRING WHEN A RESOURCE
C COMPLETES A SEARCH NEED
C NCMP(LCOMPL)- NOTE IDENTIFICATION NUMBER
C RCMP(LCOMPL)- RESOURCE IDENTIFICATION NUMBER
C
C ENT--DELAY - EVENT NOTICE ENTITY OCCURRING WHEN A RESOURCE STARTS
C TO VECTOR TO THE SCENE OF A CASE (LONG SEARCH NEEDS
C EXCLUDED) AFTER HAVING BEEN DELAYED FOR READING
C CASNO(DELAY)- CASE IDENTIFICATION NUMBER
C RESNO(DELAY)- RESOURCE IDENTIFICATION NUMBER
C
C ENT--FUEL - EVENT NOTICE ENTITY OCCURRING WHEN A RESOURCE
C MUST LEAVE CASE TO REFUEL
C NFUEL(FUEL) - NOTE IDENTIFICATION NUMBER
C RFUEL(FUEL) - RESOURCE IDENTIFICATION NUMBER
C
C ENT--HOME - EVENT NOTICE ENTITY OCCURRING WHEN A RESOURCE
C ARRIVES AT HIS HOME STATION
C RESNO(HOME) - RESOURCE IDENTIFICATION NUMBER
C
C ENT--HOMEF - EVENT NOTICE ENTITY OCCURRING WHEN A RESOURCE
C ARRIVES AT HIS HOME STATION TO REFUEL
C NHOM(HOMEF) - NOTE IDENTIFICATION NUMBER
C RHOM(HOMEF) - RESOURCE IDENTIFICATION NUMBER
C
C ENT--NUCRU - EVENT NOTICE ENTITY OCCURRING AT THE SHIFT CHANGE
C
C ENT--ONSCN - EVENT NOTICE ENTITY OCCURRING AT PRIORITY
C REEVALUATION TIME
C CASNO(ONSCN)- CASE IDENTIFICATION NUMBER
C RESNO(ONSCN)- RESOURCE IDENTIFICATION NUMBER
C
C ENT--READY - EVENT NOTICE ENTITY OCCURRING WHEN A RESOURCE STARTS
C TO VECTOR TO THE SCENE OF A LONG SEARCH NEED AFTER
C HAVING BEEN DELAYED FOR READING
C NREAD(READY)- NOTE IDENTIFICATION NUMBER

```


C		INFORMATION WILL BE WRITTEN
C	S2PRI	- SEVERITY LEVEL TO WHICH CASE IS RAISED WHILE
C		A SHORT SEARCH IS BEING SERVED
C	TCHK	- THE HOURS BETWEEN CHECK-IN TIMES WHEN A 'COVERING'
C		RESOURCE EXAMINES THE QUEUE; USER INPUT
C	THOOK	- USER INPUT; HOOK-UP TIME ON A TOW CASE
C	TIME	- CURRENT SIMULATED CLOCK TIME
C	TLAST	- TIME AT WHICH THE PRESENT SHIFT BEGAN
C	TOSBY	- TOTAL NUMBER OF TIMES A STANDBY CREW WAS CALLED IN
C		THE DISTRICT
C	TOTIN	- TOTAL NUMBER OF INTERRUPTED CASES IN DISTRICT
C	TPRI	- MINIMUM PRIORITY AT WHICH A QUEUED NEED OR CASE
C		IS SERVED BY AN IDLE 'CAPABLE' RESOURCE REGARDLESS
C		OF THE RESOURCE'S TYPE; USER INPUT
C	TSET	- SET OF RESOURCES RANKED BY TVEC
C	TSP1	- TOW SPEED OF RESOURCES IF L(CASE) IS LESS THAN OR
C		EQUAL TO 26 FEET
C	TSP2	- TOW SPEED OF RESOURCES IF L(CASE) > 26 FEET
C	TUNPR	- TOTAL NUMBER OF TIMES A STANDBY CREW WAS CALLED
C		BUT NOT USED IN THE DISTRICT
C		THE HOURS BEFORE SUNRISE WHEN HELD OVER SEARCH
C	XRK	- CASES ARE EXAMINED FOR RESOURCE ASSIGNMENT (USER
C		INPUT)

III. OPSIM Subroutines and Event Routines

A. Brief description of each routine:

1. Exogenous Event START occurs at TIME = 0.0. The system attribute LIMIT is calculated. The station, resource type, X coordinate and Y coordinate of all resources are set. A Saturday indicator, ISA, and a Monday indicator, IMO are calculated using IFDAY, the first day of the simulation. PSHFT, the present shift, is set after checking IFDAY and the possibility that the first day may be a holiday. The first crew change, the first sunrise and the first sunset are created and caused to occur at the appropriate future times.

2. Endogenous Event NUCRU occurs when there is a change of shift. Utilization data is accumulated for TUTIL, UTIL, USHF and CLLCT. If it is the last shift change of the day, weekend or weekday daily utilization statistics are also collected. PSHFT is updated and an event notice for another NUCRU is caused at the end of the next shift.

The case queue is examined in NUCRU for single resource cases, multi-resource needs and long search needs that can be served by idle resources.

3. Exogenous Event OPSIM creates a temporary entity, CASE, for the incoming case. Attributes of the case are read from the exogenous event tape. The primary station of the case, which is stored in STATN (CASE), is among the input data received from the preprocessor. Note that there is not necessarily a one-to-one correspondence between the preprocessor and operational simulator station numbers; therefore, STATN(CASE) is converted to the correct OPSIM station number. After

this initial conversion, STATN(CASE) may be changed again in an effort to determine the best primary station of the case. If STATN(CASE) was converted to a zero value (meaning that the preprocessor station did not exist as such in the operational simulator), STATN(CASE) is set equal to the nearest OPSIM station in the district that is capable of being a primary station. If STATN(CASE) was converted to an existing operational simulator station that is capable of being a primary, STATN(CASE) is set equal to the nearest station capable of being a primary in a set which includes the primary and all of its adjacents. If STATN(CASE) was converted to an existing operational simulator station that is not capable of being a primary, STATN(CASE) is set equal to the nearest OPSIM station in the district that can be a primary.

Impossible combinations of case attributes are checked for, and if any are found, the case is filed into the exceptional cases set, EXCS. Exogenous Event OPSIM calls Subroutine SRCH for cases with long searches, calls Subroutine SRAS for single resource cases and calls Subroutine MRAS for multi-resource cases.

4. Subroutine SRAS serves as a driver for single resource cases. That is, it calls all necessary subroutines to find an ordered set of resources, to select one of those resources and to serve the case.

5. Subroutine CRES determines all resources capable of serving a single resource case, a multi-resource need or a long search need. To obtain the resource types capable of serving a case, Subroutine CRES first determines six applicable rows of the Resource Capability Matrix from the values SWELL(CASE), WIND(CASE), VIS(CASE), AIR(CASE), OFSHR(CASE), and NEED(CASE). These six rows (The rows of the

Resource Capability Matrix are input as octal numbers in the Initialization Deck. See Section II, Part IV.) are "AND"ed using the FORTRAN AND function to yield a final answer giving all the capable resource types which are stored in IRAY1. Next, Subroutine CRES determines all stations that can serve a case and stores them in IRAY2. All resources that meet the resource type and station requirements are then filed into RQUE. Note that if the number of resource types is ever input greater than twenty, Subroutine CRES must be recompiled and reassembled to increase the dimension of IRAY1. In like manner, if it is ever anticipated that the number of stations capable of serving a case may exceed thirty, the dimension of IRAY2 must be increased.

6. Subroutine VEC calculates TVEC (time-to-vector to the incoming case) for each resource in RQUE. Note that time-to-vector (TVEC) is a function of the location of the resource and speed of the resource's type, which in turn is a function of swell(SWELL).

7. Subroutine OSET orders the capable resources in RQUE. DVEC is set equal to TVEC (time-to-vector) for each capable resource. However, if the resource is idle at it's home station, DVEC is redefined to be $TVEC + DLAY$ (a delay time necessary to ready the resource). Those resources with a DVEC less than or equal to the tolerance of the priority of the case are filed into the set, CSET, which is ranked on the attribute COST with low value considered best. Before the resource is filed into CSET, the attribute COST is set according to the cost option (COSTO). If the COSTO is equal to zero, COST of the resource is set equal to the relative cost ranking of the type

of the resource. If COSTO is equal to one, COST of the resource is set equal to the cost per day (COSTD) of the type of the resource times the time-to-vector (TVEC). Those resources that cannot vector to the case within tolerance are filed into the set, TSET, which is ranked on the attribute DVEC with low value considered best. The two sets are then merged; all resources in CSET are filed into RQUE and then all resources in TSET are filed into RQUE.

8. Subroutine RESAP searches for a resource in RQUE to serve a single resource case, a multi-resource need or a long search need. It is divided into eight main sections: (1) searching for an idle resource at the primary station, (2) searching for an idle resource in RQUE, (3) searching for an idle resource at an adjacent station, (4) searching for a resource that can be interrupted at the primary station, (5) searching for a resource that can be interrupted at an adjacent station, (6) searching for a resource that can be interrupted in RQUE, (7) setting JRS = 0 to indicate to the calling subroutine that no resource is immediately available, and (8) printing an error message for any impossible route. The sequence for exercising these sections is determined by the user input variable, RAP (Resource Assignment Policy.) As an example, if RAP = 2, sections 1, 4, 3, 5 and 7 are exercised in that order. If at any point a resource is found in sections 1, 4, 3 or 5, Subroutine RESAP returns the number of that resource to the calling subroutine and subsequent sections are not executed. Note that primary station in this explanation of RESAP includes the aircraft covering stations

of the primary and the covering cutters of the primary. Moreover, "adjacent station" includes the aircraft covering stations of the adjacent and the covering cutters of the adjacent.

9. Subroutine ROCA determines both if the resource, selected by Subroutine RESAP, is operational and if there is an available crew. A standby crew may be called if the number of crews at the station of the resource has decreased to the user input value of CL (crew level at which a standby crew is called) and if the case has not previously caused a standby to occur. Note that if CL is equal to -1, standby crews will never be called.

10. Subroutine MRAS is called for every multi-resource case. It establishes timing and causes an Event Notice NOTIF for non-tow needs. If the case requires a tow, Subroutine TOW is called.

11. Endogenous Event NOTIF calls the routines (CRES, VEC, OSET, and RESAP) necessary to locate a resource which can serve a single need of a multi-resource case. If no capable resource exists, Subroutine WRECK is called to destroy the case. If no capable resource is available, the need associated with the NOTIF is filed in the queue CQUE via a call to Subroutine QUEUE. If a capable resource is available, Subroutine SERVE is called.

12. Subroutine TOW creates an Event Notice NOTIF for each tow need of a multi-resource case. It determines the distance and destination of the tow via a call to Subroutine DTD. This information is used to establish hand-off coordinates. If there are no non-tow needs, the first tow NOTIF is caused. (If there are non-tow needs, the first tow NOTIF is caused in Endogenous Event ONSCN.)

13. Subroutine DTD determines the final destination for tow cases. The destination is the primary station of the case unless the primary station is a patrol. In this case the destination is the (first) adjacent station of the primary station. The total distance of the tow is also calculated.)

14. Subroutine SRCH creates an Event Notice NOTE for each long search need. If it is night time (i.e., the present time is greater than or equal to sunset and less than the time at which the sunrise list is examined), Subroutine SRCH attempts to serve the first search need. All remaining search needs are filed into LIST - the sunrise list. If it is daytime, Subroutine SRCH attempts to serve the first search need. All other search needs are caused to occur at $TIME + EPSLN$, where $EPSLN$, a user input, is a small time delay usually set to two minutes.

15. Endogenous Event NOTE occurs at $TIME + EPSLN$ for all but the first search need of a long search case that occurs during the daytime. An attempt is made to serve the need. If no resource is available, the search need is filed into CQUE.

16. Subroutine SASS orders the resources in RQUE for search needs only. A call is made to Subroutine CRES to gather all capable resources in the set RQUE. Subroutine VEC is called to calculate TVEC for each resource in RQUE. The local variable TOLRS is set equal to the search tolerance of the priority of the case. If, however, the present time plus the search tolerance of the case priority is greater than the next sunset, TOLRS is redefined to be sunset minus the present time. (Note that this redefinition of TOLRS is used only

in the calculation of PR for airplanes and not in the PR calculation for small boats and cutters,) PR (percentage of search miles that a resource is capable of completing before sunset or within the search tolerance time of the case priority) is then calculated for each resource in RQUE. Those resources that can complete the desired percentage of search miles are filed into CSET. Resources that cannot complete the desired percentage of search miles, but have a PR value greater than 0.0 are filed into PSET which is ranked on the attribute PR with high value considered best. The remaining resources with a PR value of 0.0 are filed into TSET if they meet an endurance check. The three sets are then merged into RQUE.

17. Subroutine SSS is the service routine for long search needs. RES and FLT attributes are updated. Any previously scheduled future event for the resource serving the long search need is cancelled and destroyed. If the resource was idle at its home station when chosen, an Endogenous Event READY is created and caused. If, however, the resource was not at its' home station, an Endogenous Event ARSCH is created and caused for the resource serving the long search need.

18. Endogenous Event READY occurs at the end of the delay time necessary to ready a resource at its home station before serving a long search need. TVEC (time-to-vector) is calculated, DEP (departure time) is set, XDEST (X coordinate of destination) is set, and YDEST (Y coordinate of destination) is set. An Endogenous Event ARSCH is created and caused to occur at $TIME + TVEC$.

19. Endogenous Event ARSCH occurs when a resource arrives on scene to serve a long search need. Depending on the endurance of the resource and the present time, one of three possible future events - FUEL, SSET or COMPL - is created and caused to occur.

20. Endogenous Event COMPL occurs when a long search need is completed. A check is made to determine if all long search needs of the case are completed. If this is true, Subroutine SRAS is called for single resource cases, Subroutine MRAS is called for multi-resource cases, and Subroutine TERM is called for cases that have no additional needs.

21. Endogenous Event SSET occurs at sunset when a resource serving a long search need is taken off the case because of darkness. The search need is placed in the sunrise list and a call is made to EXQ for the now idle resource.

22. Endogenous Event FUEL occurs when a resource serving a long search need must return home to refuel. Attributes are updated and Endogenous Event HOMEF is created and caused to occur.

23. Endogenous Event HOMEF occurs when a resource arrives at it's home station to refuel. Attributes are updated and Endogenous Event SNDBK is created and caused to occur.

24. Endogenous Event SNDBK occurs at the completion of refueling of a resource serving a long search need. At this point, the temporary entity FLT is destroyed for the refueled resource, and it is returned to an idle status. A call is made to Subroutine SASS to gather an ordered set of resources capable of serving the remaining portion of the

long search need. The set RQUE is then examined for the best idle resource to serve the need. If the best idle resource is the refueled resource that last served the search need, a new FLT is created, RES, FLT and NOTE attributes are updated, and an arrive-on-scene event (ARSCH) is created and caused to occur at $TIME + TVEC$. However, if the best idle resource is any other resource, Subroutine SSS is called.

25. Endogenous Event SRISE occurs at RISE-XXR. The sunrise list is examined and resources are vectored to arrive on the search scene at sunrise or soon thereafter. The next SRISE is caused at $TIME + 1.0$ (day).

26. Endogenous Event XSET occurs at sunset each day. All queued long search needs are removed from CQUE and filed into the sunrise list, LIST. The next XSET is caused at $TIME + 1.0$ (day).

27. Subroutine SERVE is called every time a resource is assigned to a case for reasons other than a long search. Data is accumulated for several statistics (COSTC, CNRES, NEEDS and NCASE). If the resource is at its home station, a temporary entity FLT is created to be associated with the resource until it returns home via Endogenous Event HOME. RES and FLT attributes are updated and an Event Notice DELAY is created and caused. If the resource is not at its home station, any event previously scheduled for the resource in connection with some other case is cancelled and destroyed. RES and FLT attributes are updated and an Endogenous Event ARVSN is created and caused.

28. Endogenous Event DELAY occurs at the end of the delay time necessary to ready a resource at its home station before vectoring to

the scene of any need other than a long search need. XDEST and YDEST (destination coordinates) are set; DEP (departure time) and TFLT (time that resource leaves its home station) are set equal to TIME. An Endogenous Event ARVSN is then created and caused to occur at TIME + ROS.

29. Endogenous Event ARVSN occurs when a resource arrives at the scene of a case for reasons other than a long search. If the resource is the first resource to arrive on scene, data is collected for the statistics RESA, TWAIT, NCAS, AVGTW, TQUE1, and FAIL3. Subroutine STATS is also called to collect other case, station and group statistics. If this is the first resource to arrive on scene there is a check to see if a short search is needed. If so, there is a call to Subroutine SRCHF which establishes the information needed for a short search. The priority of the case is increased to S2PRI until the short search is completed. ARVSN also determines the resource responsible for maintaining coverage. The resource responsible for coverage is chosen from among all resources at the scene of the case as that resource associated with the greatest value of RLS. RLS is equal to the time that the resource arrived on scene plus the on scene time during which the resource will actually serve the particular need. If a covering resource has fulfilled its on scene time, the next resource to arrive on scene will become responsible for coverage and the resource formerly covering will be relieved of duty via a call to Subroutine RETN.

Still another function of ARVSN is to determine the on scene time if the resource will be towing or providing an air escort. For single resource cases there is a call to Subroutine DTD to determine the destination and distance for the tow. (For multi-resource cases this information was previously determined and stored by a call to Subroutine TOW from MRAS.) The length of the case as well as the type of resource serving the tow or air escort determine the speed at which the tow proceeds and thus the on scene time.

30. Subroutine STATS, which can be called from Endogenous Event ARVSN or from Endogenous Event ARSCH, collects station, group and district statistics when the first resource arrives at the scene of a case. It also accumulates case statistics for both weekdays and weekends with holidays being included in the weekend statistics.

31. Subroutine SRCHF is called when the first ARVSN occurs for a case requiring a short search. If an additional resource is needed, Subroutine SASS and RESAP are called. If an additional resource is located, the associated on scene time is calculated. The on scene time of the resource having the first ARVSN is increased so that it remains on scene until the short search is completed. For multi-resources cases an Event Notice NOTIF is created to be associated with the short search. The additional resource is assigned to the case via a call to Subroutine SERVE. If the short search was originally to

be handled by the first arriving resource or if there is no additional resource available, the resource having the first ARVSN will also serve the short search. The on scene time for this resource is increased to include the time spent searching.

32. Endogenous Event ONSCN occurs differently for resources that are towing and resources serving non-tow needs. For non-towing resources there is an ONSCN when the resource first arrives on scene and thereafter at intervals of time equal to the on scene time divided by KKK. On all but the last ONSCN for a particular resource there is a reevaluation of the case priority. At the last ONSCN for the resource serving the last non-tow need of a case there is a check to see if a tow is needed. If so the first tow is initiated. A call to Subroutine CRES determines whether or not the resource serving the last non-tow need can also serve the tow. If so, it is assigned to serve the tow via a call to Subroutine SERVE. If not, an Event Notice NOTIF is caused for the first tow. If a resource is not responsible for coverage at the time of its last ONSCN, it is relieved of duty via a call to Subroutine RETN. For towing resources there is only one occurrence of ONSCN, that being when the tow is completed. There is no reevaluation of the case priority in this situation. If the resource is completing the first of a two part tow, an Event Notice NOTIF is created for the second tow. The attribute COUNT(CASE) keeps track of the number of needs and tows for the case which have been completed. This variable is increased by one whenever a resource has its last ONSCN

for a particular case. There is one exception to the above description which applies to short searches which are served by the first resource to arrive on the scene of the case. The first occurrence of ONSCN for such a resource is after the short search is completed. The priority of the case is immediately restored to the original case priority and the on scene time applicable for this resource is reduced to its original value. (Subroutine SRCHF increases on scene time). Thereafter the above description applies depending on whether the resource is towing or not.

33. Subroutine COVER is called when a resource responsible for coverage is interrupted to serve another case. It considers all other resources on the scene of the case being interrupted to determine another resource responsible for coverage. As explained in the description of ARVSN, the attribute RLS is used to establish coverage.

34. Endogenous Event CHEKN occurs every TCHEK hours for a covering resource. Subroutine EXQ is called to determine if the covering resource can serve any case in the queue. If it cannot serve any case in the queue, it remains as the covering resource on its present case and another CHERN is created and caused to occur at TIME + TCHEK. If it can serve a queued case or need, Subroutine EXQ updates all applicable attributes and calls the proper subroutine to serve the case or need.

35. Subroutine RETN is called when a resource serving other than a long search finishes an assignment. It relieves the resource of its current duty by setting IB = 0 and returns the resource to the system via a call to Subroutine EXQ. If the resource was an additional

resource serving only a short search, the priority of the case is reduced to its original level. If COUNT(CASE) indicates that all needs and tows of the case have been completed, the case is terminated via a call to Subroutine TERM.

36. Subroutine TERM occurs when all the needs and tows of a case have been completed. TSVC (time case spent in system) statistics are accumulated and the value of STAPE is tested. If STAPE is not equal to zero, all pertinent case attributes are output on logical unit STAPE for the post processor. There is no output for the post processor if STAPE is equal to zero. All temporary entities and event notices associated with the case as well as the case itself are destroyed.

37. Endogenous Event HOME occurs when a resource arrives at its home station after finishing an assignment. The temporary entity FLT is destroyed and expected idle alpha time (EIAT) is set to zero. The coordinates of the resource are set to the coordinates of the home station and the number of busy crews is reduced by one. Utilization data is collected in TUTIL.

38. Subroutine SAQ is called from RESAP when a single resource case, a multi-resource need or a long search need is interrupted. If a tow was interrupted, the location of the case and the location of the resource are updated to be the previously calculated interrupt location of the resource. Interrupt statistics (NOINT, TOTIN and NINTR) are accumulated. Subroutine COVER is called if the resource was covering on the interrupted case. If it's determined that the interrupted

resource was covering only, no attempt is made to vector an idle resource to the scene for coverage purposes.

If a single resource case or a search need has been interrupted, Subroutine SAQ attempts to find an idle resource to serve it. The case or need is queued if no capable resource is available. If a multi-resource need has been interrupted, Subroutine QUEUE is called.

39. Subroutine QUEUE is called when a resource is interrupted while serving a multi-resource need or when no capable resource is available to serve a multi-resource need. In the interrupt situation, an attempt is made to locate another resource to serve the need via calls to Subroutines CRES, VEC, OSET, and ROCA. The usual call to RESAP is replaced by a search through the ordered set of resources RQUE. The first non-busy resource with an available crew is assigned to serve the multi-resource need via a call to Subroutine SERVE. RESAP cannot be called since it created the interrupt situation and an infinite logical loop would be generated. If no capable resource is available to serve the need, the NOTIF associated with the need is filed in the queue CQUE. If there are no other NOTIF's of the case already in CQUE or if there are no other NOTIF's of the case in CQUE due to interrupts, and this NOTIF is queued because of an Interrupt, the attributes TINQ and/or STINQ are set to the current value of TIME. If an air escort is to be queued, Subroutine WRECK is called.

40. Subroutine EXQ examines the queue, CQUE, for a single resource case, a multi-resource need or a long search need that can be served by a resource becoming idle. If the resource is not capable of serving any case or need in the queue, an Endogenous Event HOME is created and caused for the resource.

41. Endogenous Event SINBY occurs when a standby crew arrives at it's station. The queue is examined for cases which that station is capable of serving. If the crew cannot be used to serve any CASE or need in the queue, the stand-by crew is not added to the available crews at the station. If the crew can be used, the appropriate subroutine is called to serve the case.

42. Subroutine SVQUE is called when a resource is assigned to serve a NOTIF in the queue CQUE. If there are no other NOTIF's of the case in CQUE, the time in queue TQUE is accumulated. If this NOTIF was queued because of an interrupt and if there are no other NOTIF's of the case in the queue due to interrupts, the attribute TINT is accumulated. The NOTIF is removed from CQUE and Subroutine SERVE is called.

43. Subroutine WRECK is called when a multi-resource case is being terminated for reasons other than completion. It cancels and destroys temporary entities and event notices associated with the case. Any resources serving the case are released via a call to Subroutine EXQ. The case is filed in a set of exceptional cases EXCS to be output at the end of the simulation.

44. Exogenous Event ENDSIM occurs when the simulation is to end. It is triggered by the last entry on the Exogenous Event Tape containing the case input data. Output data are averaged over time and DRIVE is called to control the report output. The statistics and

data of the report output will be described later in part VI of this section. All cases in the set of exceptional cases EXCS are output on logical unit STAPE, if STAPE is unequal to zero.

45. Subroutine DRIVE is called from ENDSIM at the end of the simulation. It serves as a driver to call the several report generators and the output subroutines, EXCASE and JUMPER. It also generates printed output for cases remaining in CQUE and for cases still being served at the end of the simulation.

46. Report SARSIM is the report generator for printing district statistics and station response.

47. Report GRPRES prints group response.

48. Report HEADER is the report generator for printing the heading of the resource utilization section.

49. Report TITLE is the report generator for printing resource utilization for each shift at each station.

50. Report RESULT, a report generator, prints the utilization of each resource.

51. Report HEAD, a report generator, prints the heading of the exceptional cases section.

52. Subroutine EXCASE prints all exceptional cases in the set EXCS.

53. Report DSTTRIB prints daily utilization distributions and certain case attribute distributions.

54. Subroutine JUMPER is an output routine printing all changes, additions and deletions to the initialization data base. It is coded in FORTRAN.

B. Note on Flowchart Nomenclature

It should be mentioned that attribute names shown in the flowcharts^{*} are sometimes abbreviated relative to the names in the computer programming code. This abbreviation is due to the lengthiness of the subscripts required to completely identify a particular entity or event notice of which the variable is an attribute. The context removes any possible ambiguity. For example, CUT(ADJS(STAN(CASE), I), J), which is the Jth cutter of the Ith adjacent station of the primary station of CASE, may be abbreviated at CUT(ADJS).

* All flowcharts for OPSIM are found in Appendix A (NBS Report No. 10435).

IV. OPSIM Input Data Deck

A. Composition of the data deck

The data deck is composed of the system specifications card, the initial conditions deck, a blank card, the exogenous events deck and input data for Subroutine JUMPER. The order of these is illustrated in figure IV - 1 below.

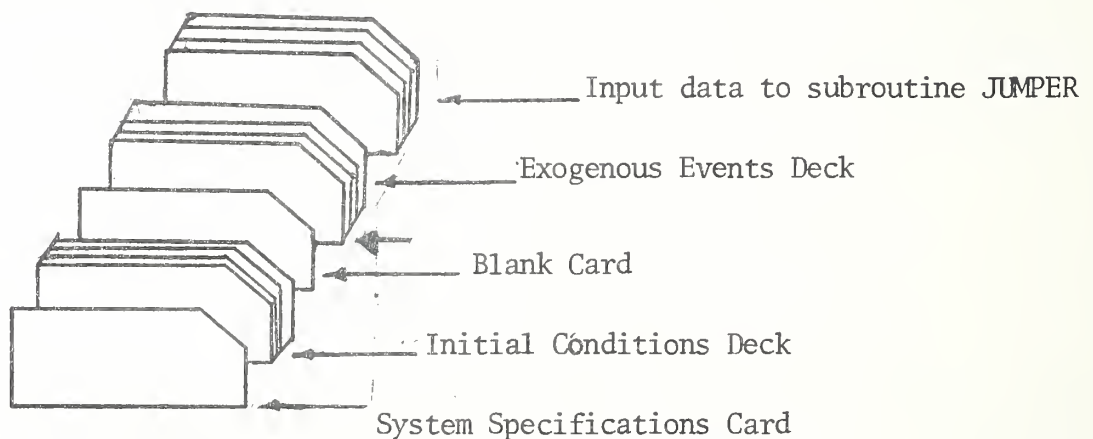


Figure IV - 1

B. System Specifications Card

The contents and format of the system specifications card follow;

Columns	Contents
1	The number one (1).
6	If this Column is non-blank, the initial conditions deck will output to the printer.
7-12	Maximum array number that appears in columns 32 through 34 of the Definition Form, (Section II, Part II). This integer is right-justified in the field and presently has the value of 175.

13-18	Right-justified integer number of minutes per hour of simulated time. If left blank, the number of minutes per hour is assumed to be 60. For OPSIM runs, it may be left blank.
19-24	Right-justified integer number of hours per day of simulated time. If left blank, the number of hours per day is assumed to be 24. For OPSIM runs, it may be left blank.
25-30	The initial value of the root to be used in generating random numbers. This is a right-justified integer and must be an odd number. If left blank, it is assumed to be 1. It is suggested that the user fill the field with an odd number.
31-36	Right-justified integer indicating the logical tape unit from which the initial conditions deck is read. If left blank, the initial conditions deck will be read from logical tape unit five - the card reader.
37-42	Right-justified integer indicating the logical tape unit from which the exogenous events deck is read. If left blank, logical tape unit five - the card reader - is assumed.
43-48	Right-justified integer indicating the logical tape unit on which reports are written. If left blank, logical tape unit six - the printer - is assumed.

Number of lines per page of printed output. This is a right-justified integer, the maximum value of which is 59. The number of lines will be 55 if this field is left blank.

C. Initial Conditions Deck

1. Composition of initial conditions deck

The initial conditions deck consists of initialization cards and data cards keypunched from the form shown in Figure IV-2. Every array number appearing in columns 32-34 of the definition deck must be accounted for in sequential order in the initialization cards. It is suggested that the user read Chapter 14 (Initial Conditions Deck) in SIMSCRIPT, A Simulation Programming Language by Markowitz, Hausner and Karr for farther explanations on procedures for preparing the initial conditions deck.

2. Explanation of format and content of OPSIM's initial conditions deck using the Thirteenth Coast Guard District, July 1968, as an example. Note that all data is right-justified unless otherwise specified.

PROBLEM	PROGRAMMER
1. The program is not working as expected.	John Doe
2. The program is running too slowly.	Jane Smith
3. The program is crashing frequently.	Bob Johnson
4. The program is not handling errors correctly.	Alice Brown
5. The program is not following the requirements.	Charlie White
6. The program is not compatible with the hardware.	Diana Green
7. The program is not secure.	Frank Black
8. The program is not user-friendly.	Grace Hall
9. The program is not scalable.	Henry King
10. The program is not maintainable.	Ivy Lee

DATE _____

[illegible][illegible]

SAMPLE INITIAL CONDITIONS DECK
DISTRICT 13

0	1	2	3	4	5	6	7	8	
12345678901234567890123456789012345678901234567890	1	175	0	0999999	0	77	RES	(1)	
1	0	0	0	0	0	0		(2)	
2	5	1	7	1	0	0	2	(3)	
6	7	1	7	1	0	0	4	(4)	
8	20	1	7	1	0	0	2	(5)	
21	22	1	7	1	0	0	4	(6)	
23	0	0	0	0	0	0	0	(7)	
24	0	1	7	1	0	0	0	(8)	
25	0	1	7	1	0	0	0		
30.0	14.0	5.0	16.0	16.0	13.0	14.0	120.0	120.0	336.0
12.0	12.0	4.5	6.5						
26	0	1	7	1	0	0	0		
384.00	355.44	288.00	413.28						
7872.00	4104.00	2400.00	5641.44						
3000.00	8889.12								
27	0	1	7	1	0	0	0		
4	2	1	5	6	3	7	8	10	9
28	0	1	7	1	0	0	0	2	
475.0	384.0	240.0	336.0	264.0	192.0	240.0	475.0	475.0	317.0
7656.04092.01800.03036.0									
29	0	1	7	1	0	0	0	2	
317.0	264.0	132.0	211.0	211.0	132.0	158.0	317.0	317.0	211.0
7656.04092.01800.03036.0									
30	0	1	7	1	0	0	0	2	
317.0	317.0	211.0	264.0	211.0	158.0	211.0	396.0	396.0	264.0
4752.03564.01980.03300.0									
31	0	1	7	1	0	0	0	4	
5	5	10	10	10	10	10	10	20	20
32	0	1	7	1	0	0	0	2	
.5	.5	.3	.5	.5	.5	.5	1.0	1.0	1.0
.5	.5	.3	.3						
33	0	1	7	1	0	0	0	2	
0.90	0.90	0.90	0.90	0.90	0.90	0.50	0.99	0.50	0.25
0.75	0.75	0.75							
34	0	0	0	0	0	0	0	0	
35	0	2	3	3	4	0	0	0	4
11	29	33							
11	29	33							
11	29	33							
11	29	33							
11	29	33							
29	33								
11	33								
12	33								
11	29	33							
11	29	33							
11	29	33							
12	33								
35									
11	29	33							
11	29	33							
11	29	33							
12	33								

[illegible]

	.180	.110	.110	.110	.110	.110	.110	.110	.110	.050		9	10	
.180	.110	.110	.110	.110	.110	.110	.110	.110	.110	.050				LLIST
.150	.100	.100	.100	.100	.100	.100	.100	.100	.100	.050				PATRL
67	0	0	Z	0	0	0	0	0	0	0				IPAT
68	0	0	R	0	0	0	0	0	0	0				
69	0	1	R	4	68	0	0	0	0	0				
35	36	37	38											
70	0	0	Z	0	0	0	0	0	0	0				AVUTO
71	0	0	R	0	0	0	0	0	0	0				CL
72	0	0	R	0	0	0	0	0	0	0				COSTO
73	0	0	R	0	0	0	0	0	0	0				DIST
74	0	0	R	0	0	0	0	0	0	0				EPSLN
75	80	0	Z	0	0	0	0	0	0	0				
81	0	0	R	0	0	0	0	0	0	0				HO
82	0	0	R	0	0	0	0	0	0	0				IDELT
83	0	0	R	0	0	0	0	0	0	0				IFDAY
84	85	0	Z	0	0	0	0	0	0	0				IWOISA
86	0	0	R	0	0	0	0	0	0	0				KKK
87	98	0	Z	0	0	0	0	0	0	0				
99	0	0	R	0	0	0	0	0	0	0				NWD
100	0	0	R	0	0	0	0	0	0	0				NWE
101	0	0	R	0	0	0	0	0	0	0				PDC1
102	0	0	R	0	0	0	0	0	0	0				PDC2
103	0	0	R	0	0	0	0	0	0	0				PRDN
104	0	0	R	0	0	0	0	0	0	0				PRUP
105	0	0	Z	0	0	0	0	0	0	0				PSHFT
106	0	0	R	0	0	0	0	0	0	0				RAP
107	0	0	R	0	0	0	0	0	0	0				RISE
108	0	0	R	0	0	0	0	0	0	0				SET
109	0	0	Z	0	0	0	0	0	0	0				SNEED
110	0	0	R	0	0	0	0	0	0	0				S2PRI
111	0	0	R	0	0	0	0	0	0	0				THOOK
112	114	0	Z	0	0	0	0	0	0	0				
115	0	0	R	0	0	0	0	0	0	0				TSP1
116	0	0	R	0	0	0	0	0	0	0				TSP2
117	0	0	Z	0	0	0	0	0	0	0				TUNPR
118	0	0	R	0	0	0	0	0	0	0				XRX
119	0	0	Z	0	0	0	0	0	0	0				FLIST
120	0	1	R	16	23	0	0	0	0	0				VOP
0	0	0	0	0	0	0	0	0	0	0				
121	0	0	Z	0	0	0	0	0	0	0				LIMIT
122	0	0	Z	0	0	0	0	0	0	0				KOUNT
123	0	0	R	0	0	0	0	0	0	0				SCNVT
124	0	1	R	62	123	0	0	0	0	0				NSN
1	1	2	3	4	5	6	7	8	9	10				
0	0	34	11	12	13	14	15	16	17	0				
25	26	35	0	30	27	0	0	0	0	0				
0	0	0	0	0	0	0	33	0	0	0				
125	0	0	R	0	0	0	0	0	0	0				STAPE
126	0	0	R	0	0	0	0	0	0	0				TPRI
127	0	1	Z	77	1	0	0	0	0	0				DVEC
128	0	1	R	16	23	0	0	0	0	0				SQTAG
0	0	0	0	0	0	0	0	0	0	0				
129	0	1	R	16	23	0	0	0	0	0				DLAY
.166666	.166666	.083333	.166666	.083333	.083333	.166666	.166666	.166666	.166666	.166666				.166666
.25	.083333	.333333	.333333	.333333	.333333	.166666	.166666	.166666	.166666	.166666				.166666
.083333	.083333	.083333	.083333	.083333	.083333	.083333	.083333	.083333	.083333	.083333				.083333
130	0	0	R	0	0	0	0	0	0	0				TCHK
131	0	1	Z	38	34	0	0	0	0	0				DWRT

[illegible]

EXPLANATION OF INITIAL CONDITIONS INPUT

INITIALIZATION CARD	COLUMNS	CONTENT
1	1-4	The number '1'.
	12	The letter 'R'.
	50-66	Left-justified integer giving the total number of resources in a run.
	67-80	Field for comment.
2	1-4	The number '2'.
	5-8	The number '5'.
	10	The number '1'.
	13	The letter 'Z'.
	15-18	Integer giving the total number of resources.
	19-22	The number '1'.
	34	The number '2'.
	67-80	Field for comment.
3	1-4	The number '6'.
	5-8	The number '7'.
	10	The number '1'.
	13	The letter 'Z'.
	15-18	Integer giving the total number of resources.
	19-22	The number '1'.
	34	The number '4'.
	67-80	Field for comment.
4	1-4	The number '8'.
	5-8	The number '20'.
	10	The number '1'.
	13	The letter 'Z'.
	15-18	Integer giving the total number of resources.
	19-22	The number '1'.
	34	The number '2'.
	67-80	Field for comment.
5	1-4	The number '21'.
	5-8	The number '22'.

INITIALIZATION CARD	COLUMNS	CONTENT
6	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the total number of resources.
	19-22	The number "1".
	34	The number "4".
	67-80	Field for comment.
	1-4	The number "23".
	12	The letter "R".
	50-66	Left-justified integer giving the number of resource types.
	67-80	Field for comment.
7	1-4	The number "24".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of resource types.
	19-22	The number "23".
	34	The number "2".
	67-80	Field for comment.
	1-4	The number "25".
8	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.
	19-22	The number "23".
	34	The number "2".
	50-66	Left-justified format - 12(H4.1)
	67-80	Field for comment

Data cards must follow initialization card number 8 to read in endurance times for each resource type. The format for these data cards is given in columns 50-66 of the initialization card. In this case, the format is 12(H4.1). The "12" gives the number of fields per card. The letter "H" indicates that the endurance times are to be read in decimal hours. The "4.1" indicates there will be four places to the left of the decimal point, the decimal point and one place after the decimal point making each field occupy six columns.

INITIALIZATION CARD	COLUMNS	CONTENT
9	1-4	The number "26".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.
	19-22	The number "23".
	34	The number "2".
	50-66	Left-justified format - 7(U7.2)
	67-80	Field for comment.

Data cards are required after initialization card 9 to read in the cost per day of each resource type. The format 7(U7.2), indicates seven floating point numbers per card each with seven places before the decimal point, the decimal point and two places after the decimal point. The 'U' means that "unsigned" floating point numbers are being read in.

10	1-4	The number "27".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.
	19-22	The number "23".
	34	The number "4".
	50-66	Left-justified format - 16(I4)
	67-80	Comment field.

Data cards to read the relative cost ranking of each resource type should follow initialization card 10. The format 16(I4) implies sixteen integers per card with four columns per field.

11	1-4	The number "28".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.
	19-22	The number "23".
	34	The number "2".

INITIALIZATION CARD	COLUMNS	CONTENT
	50-66	Left-justified format - 12(U4.1).
	67-80	Comment field.

Data cards to read speed-of-advance I for each resource type follow card 11. These are read in miles per day under the format 12(U4.1).

12	1-4	The number "29".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.
	19-22	The number "23".
	34	The number "2".
	50-66	Left-justified format - 12(U4.1).
	67-80	Comment field.

Following initialization card 12 are the data cards to read speed-of-advance II for each resource type. These are read in miles per day under the format 12(U4.1).

13	1-4	The number "30".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.
	19-22	The number "23".
	34	The number "2".
	50-66	Left-justified format - 12(U4.1).
	67-80	Comment field.

Data cards to read the search speed-of-advance for each resource type follow card 13. These are also input in miles per day under the format 12(U4.1).

14	1-4	The number "31".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.

INITIALIZATION CARD	COLUMNS	CONTENT
	19-22	The number "23".
	34	The number "4".
	50-66	Left-justified format - 16(I4).
	67-80	Comment field

Data cards follow to read in the swell limit on speed-of-advance I for each resource type. The swell limit is expressed in feet under the format 16(I4). Note that there is no swell limit for an aircraft resource type.

15	1-4	The number "32".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.
	19-22	The number "23".
	34	The number "2".
	50-66	Left-justified format - 12(H4.1).
	67-80	Comment field.

Data cards follow to read the time-to-refuel for each resource type. The format is 12(H4.1).

16	1-4	The number "33".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.
	19-22	The number "23".
	34	The number "2".
	50-66	Left-justified format - 13(U2.2).
	67-80	Comment field.

Data cards follow to input operational probabilities for each resource type under the format 13(U2.2).

17	1-4	The number "34".
	12	The letter "R".
	50-66	Left-justified integer giving the number of stations.
	67-80	Comment field
18	1-4	The number "35".
	10	The number "2".

INITIALIZATION CARD	COLUMNS	CONTENT
	12	The letter "R".
	15 - 18	Integer giving the number of stations.
	19 - 22	The number "34".
	40	The number "4".
	41	The letter "R".
	50 - 66	Left-justified format - 14(I5).
	67 - 80	Comment field

Following initialization card 18 is the ragged table (refer to Mar Markowitz for an explanation of ragged tables) to input the covering aircraft stations of each station. There is usually one input card per station in this set of data cards. Each card contains the aircraft covering stations of one station under the format 14(I5) and an integer right-justified in columns 71 and 72 giving the number of fields to be read from the card. If a station has more than 14 aircraft covering stations, the first card would contain the first 14 and the letter "C" keypunched in column 72. The next card would contain the remaining aircraft covering stations with the numbers of fields to be read keypunched in columns 71 and 72. Note that if a station has no aircraft covering station, a "0" should be keypunched in column 4 and a "1" should be keypunched in column 72 on the card for that station.

19	1-4	The number "36".
	10	The number "2".
	12	The letter "R".
	15-18	Integer giving the number of stations.
	19-22	The number "34".
	40	The number "4".
	41	The letter "R".
	50-66	Left-justified format - 14(I5).
	67-80	Comment field

Following initialization card 19 is the ragged table to input the adjacent stations of each station. The above discussion on the ragged table input of aircraft covering stations applies here also.

20	1-4	The number "37".
	10	The number "2".
	12	The letter "R".
	15-18	Integer giving the number of stations.
	19-22	The number "34".
	40	The number "4".
	41	The letter "R".

INITIALIZATION CARD	COLUMNS	CONTENT
	50-66	Left-justified format - 14(I5).
	67-80	Comment field.

Following card 20 is the ragged table to input the covering cutters of each station. The discussion of ragged table input above applies.

21	1-4	The number "38".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of stations.
	19-22	The number "34".
	34	The number "2".
	50-66	Left-justified format - 12(D4.1).
	67-80	Comment field.

Data cards to input the X coordinate of each station follow initialization card 21. The format 12(D4.1) calls for "12" fields per card. The "D4.1" means that signed floating point numbers with four places before the decimal point, the decimal point and one place after the decimal point are to be read.

22	1-4	The number "39".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of stations.
	19-22	The number "34".
	34	The number "2".
	50-66	Left-justified format - 12(D4.1).
	67-80	Comment field.

Data cards to input the Y coordinate of each station follow initialization card 22. The format, 12(D4.1), is explained above under initialization card 21.

23	1-4	The number "40".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of stations.

INITIALIZATION CARD	COLUMNS	CONTENT
24	19-22	The number "34".
	34	The number "2".
	67-80	Comment field
	1-4	The number "41".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of stations.
	19-22	The number "34".
25	34	The number "4".
	67-80	Comment field.
	1-4	The number "42".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of stations.
	19-22	The number "34".
	34	The number "4".
26	67-80	Comment field.
	1-4	The number "43".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of stations.
	19-22	The number "34".
	34	The number "4".
	67-80	Comment field.
27	1-4	The number "44".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of stations.
	19-22	The number "34".
	34	The number "2".
	67-80	Comment field.
	1-4	The number "45".
28	10	The number "1".

INITIALIZATION CARD	COLUMNS	CONTENT
29	13	The letter 'Z'.
	15-18	Integer giving the number of stations.
	19-22	The number '34'.
	34	The number '4'.
	67-80	Comment field.
	1-4	The number '46'.
	10	The number '1'.
	13	The letter 'Z'.
	15-18	Integer giving the number of stations.
	19-22	The number '34'.
30	34	The number '2'.
	67-80	Comment field.
	1-4	The number '47'.
	10	The number '1'.
	13	The letter 'Z'.
	15-18	Integer giving the number of stations.
	19-22	The number '34'.
	34	The number '4'.
	67-80	Comment field.
	1-4	The number '48'.
31	10	The number '1'.
	13	The letter 'Z'.
	15-18	Integer giving the number of stations.
	19-22	The number '34'.
	34	The number '4'.
	67-80	Comment field.
	1-4	The number '49'.
	10	The number '2'.
	12	The letter 'R'.
	15-18	Integer giving the number of stations.
32	19-22	The number '34'.
	40	The number '4'.

INITIALIZATION CARD	COLUMNS	CONTENT
	41	The letter 'R'.
	50-66	Left-justified format - 16(I4).
	67-80	Comment field.

The table to input the number of resources of each resource type at each station follows initialization card 32. There is usually one input card per station in this data set. Each card contains the number of resources of each resource type at a station read in under the format 16(I4) and an integer right-justified in columns 71 and 72 giving the number of resource. If there are more than 16 resource types, the first card for a station would contain the number of resources of the first 16 types and a C keypunched in column 72. The next card would contain the number of resources of the remaining types and the number of fields to be read keypunched in column 71 and 72.

33	1-4	The number "50".
	10	The number "2".
	12	The letter 'R'.
	15-18	Integer giving the number of stations.
	19-22	The number "34".
	40	The number "4".
	41	The letter 'R'.
	50-66	Left-justified format - 8(I4).
	67-80	Comment field.

The table to input the number of crews during each shift at each station follows initialization card 33. There is one input card per station in this data set. Each card contains the number of crews during each shift for a station under the format 8(I4) and an integer right-justified in columns 71 and 72 giving the number of shifts. The number of shifts cannot be greater than 8.

34	1-4	The number "51".
	10	The number "1".
	13	The letter 'Z'.
	15-18	Integer giving the number of stations.

INITIALIZATION CARD	COLUMNS	CONTENT
35	19-22	The number "34".
	34	The number "4".
	67-80	Comment field.
	1-4	The number "52".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of stations.
	19-22	The number "34".
36	34	The number "2".
	67-80	Comment field.
	1-4	The number "53".
	12	The letter "R".
	50-66	Left-justified integer giving the total number of weekend shifts and weekday shifts.
37	67-80	Comment field.
	1-4	The number "54".
	10	The number "2".
	13	The letter "Z".
	15-18	Integer giving the number of stations.
	19-22	The number "34".
	23-26	Integer giving the total number of shifts.
	27-30	The number "53".
38	40	The number "2".
	67-80	Comment field.
	1-4	The number "55".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of shifts.
	19-22	The number "53".
	34	The number "2".
	67-80	Comment field.

INITIALIZATION CARD	COLUMNS	CONTENT
39	1-4	The number "56".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of shifts.
	19-22	The number "53".
	34	The number "2".
	50-66	Left-justified format - 8(H2.2).
	67-80	Comment field.

One data card follows initialization card 39 to input the times that the shifts end. Times that weekday shifts end are keypunched first with the times that weekend shifts end keypunched last. The format, 8(H2.2) indicates a maximum of eight fields on the card with the times given in decimal hours.

40	1-4	The number "57".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of shifts.
	19-22	The number "53".
	34	The number "2".
41	67-80	Comment field.
	1-4	The number "58".
	12	The letter "R".
	50-66	The number "5", left-justified.
	67-80	Comment field.
42	1-4	The number "59".
	10	The number "1".
	12	The letter "R".
	15-18	The number "5".
	19-22	The number "58".
	34	The number "2".
	50-66	Left-justified format - 5(H2.2).
	67-80	Comment field.

INITIALIZATION CARD	COLUMNS	CONTENT
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One data card follows initialization card 42 to input tolerance times in decimal hours. Note that there are always 5 tolerance times. The first tolerance time will have the greatest value since severity level 1 is the lowest priority.

43	1-4	The number "60".
	10	The number "1".
	12	The letter "R".
	15-18	The number "5".
	19-22	The number "58".
	34	The number "2".
	50-66	Left-justified format - 5(H2.2).
	67-80	Comment field.

One data card follows to input search tolerance times in decimal hours. Again there are always 5 search tolerance times and the first will have the greatest value since severity level 1 is the lowest priority.

44	1-4	The number "61".
	12	The letter "R".
	50-66	Left-justified integer giving the number of rows in the Resource Capability Matrix (Figure IV-3).
	67-80	Comment field.
45	1-4	The number "62".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of rows in the Resource Capability Matrix
	19-22	The number "61".
	50-66	Left-justified format - 6(012).
	67-80	Comment field.

Data cards to input the Resource Capability Matrix follow initialization card 45. The format, 6(012) indicates 6 fields per card with 12 columns per field. Each row of the Resource Capability Matrix is represented by one octal number. (See Figure IV-3). The Resource Capability Matrix must be changed

1 - indicates capability
0 - indicates non-capability

FIGURE IV-3
SAMPLE RESOURCE CAPABILITY MATRIX

Row Number	For Attribute	RESOURCE TYPE																Right-justified Octal Number Representing Row
		40's	30's	17's	44's	52's	36's	MRB/MSB	82/95	82/95-P	WYTM/L	MEC	HEC	C-130	HU 16	H 52	HH-3	
1	NEED: Provide Equipment	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17777
2	NEED: Deliver Pump/ Equipment	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17777
3	NEED: Made repairs	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	17760
4	NEED: Fought fires	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	17760
5	NEED: Vector other unit	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17777
6	NEED: Dewatered	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	17760
7	NEED: Refloated	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	17760
8	NEED: Icebreaking	0	0	0	1	1	0	0	1	1	1	1	1	0	0	0	0	014760
9	NEED: Refueled and re-supplied	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	17760
10	NEED: Surface Escort	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	17760
11	NEED: Stoodby	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17777
12	NEED: Located property and owner advised	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17777
13	NEED: Freed from position of peril	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	17760
14	NEED: General assistance rendered - Surface	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	17760
15	NEED: Towed - 0 < L(CASE) < 30'	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	17760
16	NEED: Evacuate POB's - 0 < POB(CASE) < 5	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	17763
17	NEED: Air Escort	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	000017
18	NEED: General Assistance Rendered	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17777
19	NEED: Rescue and Tow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	17760
									-60-									

(continued)

FIGURE IV-3
SAMPLE RESOURCE CAPABILITY MATRIX

1 - indicates capability
0 - indicates non-capability

Row Number	For Attribute	RESOURCE TYPE													Right-justified Octal Number Representing Row			
		40's	30's	17's	44's	52's	36's	MRB/MSB	82/95	82/95-P	WYTM/L	MEC	HEC	C-130		HU 16	H 52	HH-3
20	NEED: Towed - 30 ≤ L(CASE) < 65'	1	1	0	1	1	1	1	1	1	1	1	1	0	0	0	0	157760
21	NEED: Towed - 65' ≤ L(CASE) < 100'	1	0	0	1	1	0	0	1	1	1	1	1	0	0	0	0	114760
22	NEED: Towed - 100' ≤ L(CASE) < 200'	1	0	0	1	1	0	0	1	1	1	1	1	0	0	0	0	114760
23	NEED: Towed - L(CASE) ≥ 200'	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	000160
24	NEED: Evacuate POB's 5 ≤ POB(CASE) < 10	1	1	0	1	1	1	1	1	1	1	1	1	0	0	0	1	157761
25	NEED: Evacuate POB's 10 ≤ POB(CASE) < 18	1	1	0	1	1	1	1	1	1	1	1	1	0	0	0	0	157760
26	NEED: Evacuate POB's 18 ≤ POB(CASE) < 25	0	0	0	1	1	1	0	1	1	1	1	1	0	0	0	0	016760
27	NEED: Evacuate POB's POB(CASE) ≥ 25	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	000760
28	0' ≤ SWELL(CASE) < 5'	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	177777
29	5' ≤ SWELL(CASE) < 10'	1	0	0	1	1	1	0	1	1	0	1	1	1	1	1	1	116677
30	10 ≤ SWELL(CASE) < 20'	0	0	0	1	1	1	0	1	1	0	1	1	1	1	1	1	016677
31	SWELL(CASE) ≥ 20'	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	000077
32	WIND(CASE) < 60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	177777
33	WIND(CASE) ≥ 60	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	177775
34	VIS(CASE) = 0	1	0	0	1	1	0	0	1	1	1	1	1	1	1	1	1	114777
35	VIS(CASE) > 0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	177777
36	AIR(CASE) < 20°	0	0	0	1	1	0	0	1	1	1	1	1	1	1	1	1	014777
37	AIR(CASE) ≥ 20°	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	177777
38	0 ≤ OFSHR(CASE) < 1/2	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	177017
									-61-									

-61-

(continued)

1 - indicates capability
0 - indicates non-capability

FIGURE IV-3
SAMPLE RESOURCE CAPABILITY MATRIX

Row Number	For Attribute	RESOURCE TYPE																	Right-justified Octal Number Representing Row		
		40's	30's	17's	44's	52's	36's	MRB/MSB	82/95	82/95-P	WYTM/L	MEC	HEC	C-130	HU	16	H	H		52	HH-3
39	$1/2 \leq \text{OFSHR}(\text{CASE}) < 5$	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17777
40	$5 \leq \text{OFSHR}(\text{CASE}) < 10$	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	15777
41	$10 \leq \text{OFSHR}(\text{CASE}) < 20$	1	0	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	11677
42	$20 \leq \text{OFSHR}(\text{CASE}) < 50$	0	0	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	01677
43	$\text{OFSHR}(\text{CASE}) > 50$	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	00077

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INITIALIZATION CARD	COLUMNS	CONTENT
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if there is a change in the number of resource types and if there is a change in the capable/non-capable status of any matrix element. Of course, it would also need to be changed if more rows were added, but this would also require a change in the computer programming code in Subroutine CRES.

46	1-4	The number "63".
	12	The letter "R".
	50-66	Left-justified integer giving the number of resource types.
	67-80	Comment field.
47	1-4	The number "64".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.
	19-22	The number "63".
	50-66	Left-justified format - 6(012).
	67-80	Comment field.

Data cards follow initialization card 47 to input the permanent attribute, 'MASK'. MASK(I), where I is the ordinal designation of a particular resource type, is used in Subroutine CRES in determining what resource types can serve a case. After "ANDing" the appropriate rows of the Resource Capability Matrix (see Subroutine CRES in Section II, Part III), each MASK(I) is "ANDed" with that product to determine if the Ith resource type can serve the case. From the above explanation of the function of 'MASK', the input of 'MASK' can be understood. (See Figure IV-4). For example, MASK(1) should have all bits of the 36-bit UNIVAC 1108 word zeroed out except the one representing the first resource type - thus the right justified octal number, 100000. If the number of resource types was increased to 17, MASK(1) would be input as 200000, MASK(2) would be input as 100000, etc.

48	1-4	The number "65".
	12	The letter "R".
	50-66	Left-justified integer giving to maximum number of SIS(CASE), number of resources operating in parallel on a long search case; the maximum number is presently 10.

FIGURE IV-4
SAMPLE 'MASK' INPUT FOR SIXTEEN RESOURCE TYPES

'MASK' Input For Resource Type No.	Binary Representation of 'MASK' Octal Number	Right-justified Octal Number (<i>'MASK' Input</i>)
1 - (40's)	Zero fill for first 20 bits of word → 1 000 000 000 000 000	100000
2 - (30's)	Zero fill → 0 100 000 000 000 000	040000
3 - (17's)	Zero fill → 0 010 000 000 000 000	020000
4 - (44's)	Zero fill → 0 001 000 000 000 000	010000
5 - (52's)	Zero fill → 0 000 100 000 000 000	004000
6 - (36's)	Zero fill → 0 000 010 000 000 000	002000
7 - (MRB/MSB)	Zero fill → 0 000 001 000 000 000	001000
8 - (82/95)	Zero fill → 0 000 000 100 000 000	000400
9 - (82/95-P)	Zero fill → 0 000 000 010 000 000	000200
10 - (WYTM/L)	Zero fill → 0 000 000 001 000 000	000100
11 - (MEC)	Zero fill → 0 000 000 000 100 000	000040
12 - (HEC)	Zero fill → 0 000 000 000 010 000	000020
13 - (C-130)	Zero fill → 0 000 000 000 001 000	000010
14 - (HU-16)	Zero fill → 0 000 000 000 000 100	000004
15 - (HH-52)	Zero fill → 0 000 000 000 000 010	000002
16 - (HH-3)	Zero fill → 0 000 000 000 000 001	000001

INITIALIZATION CARD	COLUMNS	CONTENT
49	67-80	Comment field.
	1-4	The number "66".
	10	The number "2".
	12	The letter "R".
	15-18	Integer giving the maximum SIS(CASE).
	19-22	The number "65".
	40	The number "2".
	41	The letter "R".
	50-66	Left-justified format - 10(U1.3).
	67-80	Comment field.

The ragged table to input the fractional split of the total search miles on a case as a function of SIS(CASE) follows initialization card 49. The format 10(U1.3) indicates 10 fields per card with 5 columns in each field. The U means unsigned numbers must be input. The first data card inputs the percentage of search miles assigned to the resource when SIS(CASE) = 1, the second data card inputs the fractional split of the total search miles when SIS(CASE) = 2, the third data card inputs the fractional split when SIS(CASE) = 3, etc. Each of the data cards must have an integer right-justified in columns 71 and 72 to indicate how many fields will be read from the card.

50	1-4	The number "67".
	13	The letter "Z".
	67-80	Comment field.
51	1-4	The number "68".
	12	The letter "R".
	50-66	Left-justified integer giving the number of patrolling cutters.
	67-80	Comment field.
52	1-4	The number "69".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of patrolling cutters.
	19-22	The number "68".

INITIALIZATION CARD	COLUMNS	CONTENT
	34	The number "4".
	50-66	Left-justified format - 18(I4).
	67-80	Comment field.

Data cards follow to input the ordinal designations of the patrolling cutters under the format 18(I4).

53	1-4	The number "70".
	13	The letter "Z".
	67-80	Comment field.
54	1-4	The number "71".
	12	The letter "R".
	50-66	Left-justified integer giving the option for CL (See OPSIM Definitions, Section II, Part II).
	67-80	Comment field.
55	1-4	The number "72".
	12	The letter "R".
	50-66	Left-justified integer giving the option of COSTO (See OPSIM Definitions, Section II, Part II).
	67-80	Comment field.
56	1-4	The number "73".
	12	The letter "R".
	50-66	Left-justified integer giving the district.
	67-80	Comment field.
57	1-4	The number "74".
	12	The letter "R".
	50-66	Left-justified floating point number expressed in decimal days giving EPSLN, a small time delay for causing the Endogeneous Event NOTE for all but the first long search resource.
	67-80	Comment field.
58	1-4	The number "75".
	5-8	The number "80".

INITIALIZATION CARD	COLUMN	CONTENT
59	13	The letter "Z".
	67-80	Comment field.
	1-4	The number "81".
	12	The letter "R".
	50-66	Left-justified floating point number expressed in nautical miles giving the distance offshore where the hand-off for a two-part tow takes place.
60	67-80	Comment field.
	1-4	The number "82".
	12	The letter "R".
	50-66	Left-justified integer giving the increment to the priority of an interrupted case.
61	67-80	Comment field.
	1-4	The number "83".
	12	The letter "R".
	50-66	Left-justified integer giving the day of the week on which the simulation begins (Monday = 1, Tuesday = 2, etc.)
62	67-80	Comment field.
	1-4	The number "84".
	5-8	The number "85".
	13	The letter "Z".
63	67-80	Comment field.
	1-4	The number "86".
	12	The letter "R".
	50-66	Left-justified floating point number giving the number of looks at priority reevaluation.
64	67-80	Comment field.
	1-4	The number "87".
	5-8	The number "98".

INITIALIZATION CARD	COLUMNS	CONTENT
65	13	The letter "Z".
	67-80	Comment field.
	1-4	The number "99".
	12	The letter "R".
	50-66	Left-justified integer giving the number of weekday shifts.
66	67-80	Comment field.
	1-4	The number "100".
	12	The letter "R".
	50-66	Left-justified integer giving the number of weekend shifts.
	67-80	Comment field.
67	1-4	The number "101".
	12	The letter "R".
	50-66	Left-justified floating point number giving the percentage of search miles desirable to achieve by each resource on the first day of a long search.
	67-80	Comment field.
	1-4	The number "102".
68	12	The letter "R".
	50-66	Left-justified floating point number giving the percentage of search miles desirable to achieve by each resource on any but the first day of a long search.
	67-80	Comment field.
	1-4	The number "103".
	12	The letter "R".
69	50-66	Left-justified floating point number giving the probability that the priority will decrease when reevaluated.
	67-80	Comment field.
	1-4	The number "104".
	12	The letter "R".
	50-66	Left-justified integer giving the number of weekday shifts.

INITIALIZATION CARD	COLUMNS	CONTENT
71	50-66	Left-justified floating point number giving the probability that the priority will increase when reevaluated.
	67-80	Comment field.
	1-4	The number "105".
	13	The letter "Z".
72	67-80	Comment field.
	1-4	The number "106".
	12	The letter "R".
	50-66	Left-justified integer giving the option for the resource assignment policy (See OPSIM Definitions, Section II, Part II).
73	67-80	Comment field.
	1-4	The number "107"
	12	The letter "R".
	50-66	Left-justified floating point number expressed in decimal days giving the time for sunrise.
74	67-80	Comment field.
	1-4	The number "108".
	12	The letter "R".
	50-66	Left-justified floating point number expressed in decimal days giving the time for sunset.
75	67-80	Comment field.
	1-4	The number "109".
	13	The letter "Z".
	67-80	Comment field.
76	1-4	The number "110".
	12	The letter "R".
	50-66	Left-justified integer giving the priority level to which a CASE is raised while a short search is being served.

INITIALIZATION CARD	COLUMNS	CONTENT
77	67-80	Comment field.
	1-4	The number "111".
	12	The letter "R".
	50-66	Left-justified floating point number expressed in decimal days giving the hook-up time on a tow case.
78	67-80	Comment field.
	1-4	The number "112".
	5-8	The number "114".
	13	The letter "Z".
79	67-80	Comment field.
	1-4	The number "115".
	12	The letter "R".
	50-66	Left-justified floating point number expressed in nautical miles per day giving the tow speed of resources if $L(\text{CASE}) \leq 26$ feet.
80	67-80	Comment field.
	1-4	The number "116".
	12	The letter "R".
	50-66	Left-justified floating point number expressed in nautical miles per day giving the tow speed of resources if $L(\text{CASE}) > 26$ feet.
81	67-80	Comment field.
	1-4	The number "117".
	13	The letter "Z".
	67-80	Comment field.
82	1-4	The number "118".
	12	The letter "R".
	50-66	Left-justified floating point number expressed in decimal days giving the hours before sunrise when held over long search cases are examined for resource assignment.

INITIALIZATION CARD	COLUMNS	CONTENT
	67-80	Comment field.
83	1-4	The number "119".
	13	The letter "Z".
	67-80	Comment field.
84	1-4	The number "120".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.
	19-22	The number "23".
	34	The number "4".
	50-66	Left-justified format - 16(I4).
	67-80	Comment field.

Data cards follow initialization card 84 to input indicators (0 if resource type is a boat; 1 if resource type is an airplane) for each resource type under the format 16(I4).

85	1-4	The number "121".
	13	The letter "Z".
	67-80	Comment field.
86	1-4	The number "122".
	13	The letter "Z".
	67-80	Comment field.
87	1-4	The number "123".
	12	The letter "R".
	50-66	Left-justified integer giving the maximum number of OPFAC(CASE), the station of the case input from the Exogenous Event Tape.
	67-80	Comment field.
88	1-4	The number "124".
	10	The number "1".
	12	The letter "R".

INITIALIZATION CARD	COLUMNS	CONTENT
	15-18	Integer giving the maximum number of OPFAC(CASE).
	19-22	The number "123".
	34	The number "4".
	50-66	Left-justified format - 18(I4).
	67-80	Comment field.
Data cards follow to input the station conversion table under the format 18(I4).		
89	1-4	The number "125".
	12	The letter "R".
	50-66	Left-justified integer giving the logical unit number on which the case attributes will be written for Quick Query.
	67-80	Comment field.
90	1-4	The number "126".
	12	The letter "R".
	50-66	Left-justified integer giving the minimum priority at which a queued need or case is served by an idle capable resource regardless of the resource's type.
	67-80	Comment field.
91	1-4	The number "127".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of resources.
	19-22	The number "1".
	34	The number "2".
	67-80	Comment field.
92	1-4	The number "128".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.

INITIALIZATION CARD	COLUMNS	CONTENT
	19-22	The number "23".
	34	The number "4".
	50-66	Left-justified format, 16(I4).
	67-80	Comment field.

Data cards follow to input indicators for each resource type under the format 16(I4). (0 for small vessels, 1 for cutters, 2 for C-130's and 3 for aircraft).

93	1-4	The number "129".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of resource types.
	19-22	The number "23".
	34	The number "2".
	50-66	Left-justified format, 7(H3.6).
	67-80	Comment field.

Following initialization card 93 are the data cards to input a delay time for each resource type under the format, 7(H3.6).'

94	1-4	The number "130".
	12	The letter "R".
	50-66	Left-justified floating point number giving the amount of time in decimal days between check-in times when a 'covering' resource examines the queue.
	67-80	Comment field.
95	1-4	The number "131".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of stations.
	19-22	The number "34".
	34	The number "2".
	67-80	Comment field.
96	1-4	The number "132".

INITIALIZATION CARD	COLUMNS	CONTENT
	10	The number '1'.
	12	The letter 'R'.
	15-18	Integer giving the number of stations.
	19-22	The number '34'.
	34	The number '4'.
	50-66	Left-justified format, 18(I4).
	67-80	Comment field.

Data cards follow initialization card 96 to input the group number of each station under the format, 18(I4).

97	1-4	The number '133'.
	10	The number '1'.
	13	The letter 'Z'.
	15-18	Integer giving the number of stations.
	19-22	The number '34'.
	34	The number '2'.
	67-80	Comment field.
98	1-4	The number '134'.
	10	The number '1'.
	13	The letter 'Z'.
	15-18	Integer giving the number of stations.
	19-22	The number '34'.
	34	The number '2'.
	67-80	Comment field.
99	1-4	The number '135'.
	13	The letter 'Z'.
	67-80	Comment field.
100	1-4	The number '136'.
	13	The letter 'Z'.
	67-80	Comment field.
101	1-4	The number '137'.
	13	The letter 'Z'.

INITIALIZATION CARD	COLUMNS	CONTENT
102	67-80	Comment field.
	1-4	The number "138".
	12	The letter "R".
	50-66	Left-justified integer giving the number of groups.
103	67-80	Comment field.
	1-4	The number "139".
	5-8	The number "151".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of groups.
	19-22	The number "138".
	34	The number "2".
104	67-80	Comment field.
	1-4	The number "152".
	5-8	The number "155".
	13	The letter "Z".
	67-80	Comment field.
105	1-4	The number "156".
	12	The letter "R".
	50-66	Left-justified integer giving the number of distributions output in REPORT DSTRIB.
	67-80	Comment field.
106	1-4	The number "157".
	5-8	The number "167".
	10	The number "1".
	13	The letter "Z".
	15-18	Integer giving the number of distributions output in REPORT DSTRIB.
	19-22	The number "156".
	34	The number "2".
	67-80	Comment field.

INITIALIZATION CARD	COLUMNS	CONTENT
107	1-4	The number "168".
	13	The letter "Z".
	67-80	Comment field.
108	1-4	The number "169".
	12	The letter "R".
	50-66	Left-justified integer giving the number of holidays to be read in. If there are no holidays, input the number "1" in this field.
109	67-80	Comment field.
	1-4	The number "170".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of holidays. If there are not holidays, read in the number "1" here.
	19-22	The number "169".
	34	The number "4".
	50-66	Left-justified format, 18(I4).
	67-80	Comment field.

Data cards follow initialization card 109 to read in holidays. A value of -1 should be read in here if there are no holidays.

110	1-4	The number "171".
	10	The number "1".
	12	The letter "R".
	15-18	Integer giving the number of stations.
	19-22	The number "34".
	34	The number "4".
	50-66	Left-justified format, 18(I4).

Following initialization card 110 are the data cards to input PSTN for each station under the format 18(I4). PSTN is a tag to indicate if the station can or cannot be a primary station.

INITIALIZATION CARD	COLUMNS	CONTENT
111	1-4	The number '172'.
	10	The number '1'.
	13	The letter 'Z'.
	15-18	Integer giving the number of stations.
	19-22	The number '34'.
	34	The number '4'.
	67-80	Comment field.
112	1-4	The number '173'.
	12	The letter 'R'.
	50-66	Left-justified integer giving the output option for printing/not printing the 'case created' and 'case terminated' information.
	67-80	Comment field.
113	1-4	The number '174'.
	10	The number '1'.
	13	The letter 'Z'.
	15-18	Integer giving the number of stations.
	19-22	The number '34'.
	34	The number '2'.
	67-80	Comment field.
114	1-4	The number '175'.
	13	The letter 'Z'.
	67-80	Comment field.

D. Blank Card

A blank card must follow the initial conditions deck.

E. Exogenous Event Deck

The exogenous events may be read from cards or from magnetic tape. For efficiency, OPSIM is reading exogenous events from magnetic tape.

There are three types of exogenous events in the operational simulator: (1) Exogenous Event START, (2) Exogenous Event OPSIM, and (3) Exogenous Event ENDSIM. START occurs only once and must be the first event to occur at TIME = 0.0. OPSIM occurs every time a case comes into the system. ENDSIM, an event to end the simulation, occurs only once and must be the last event on the tape. The contents and format of the exogenous tape event follow.

TYPE OF EVENT	CARD	COLUMNS	CONTENT
START	1	3	The number "3" to indicate Exogenous Event START.
(3)		7	A zero, "0", to give the day the event occurred.
		10	A zero, "0", to give the hour the event occurred.
		12	A zero, "0", to give the minute the event occurred.
OPSIM	1	3	The number "1" to indicate Exogenous Event OPSIM.
(1)		4-7	Right-justified integer giving the day the event occurred.
		8-10	Right-justified integer giving the hour the event occurred.
		11-12	Right-justified integer giving the minute the event occurred.
		13-15	IDLOC(CASE), right-justified integer.
		16-20	OPFAC(CASE), right-justified integer.
		21-25	NOCAS(CASE), right-justified integer.
		26-30	POB(CASE), right-justified integer.
		31-35	AIR(CASE), right-justified integer.
		36-40	WIND(CASE), right-justified integer.
		41-45	SWELL(CASE), right-justified integer.
		46-50	VIS(CASE), right-justified integer.
		51-55	UTYPE(CASE), right-justified integer.
		56-60	L(CASE), right-justified integer.
		61-65	FPRJ(CASE), right-justified integer.
		66-70	N, right-justified integer. N = NNN(CASE) if MMM(CASE) = 0, N = NNN(CASE) + 1 if MMM(CASE) > 0
	2	1-5	NNN(CASE), right-justified integer.
		6-10	MMM(CASE) right-justified integer.
		11-15	GAMMA(CASE), right-justified integer.
		16-20	SIS(CASE), right-justified integer.

TYPE OF EVENT	CARD	COLUMNS	CONTENT
		21-25	S2S(CASE), right-justified integer.
		26-30	TSM(CASE), right-justified integer.
		31-35	OFSHR(CASE), right-justified integer given in tenths of miles.
		36-40	XC(CASE), right-justified integer.
		41-45	YC(CASE), right-justified integer.
		46-50	BOX(CASE), right-justified integer.
		51-60	VALUE(CASE) right-justified integer.

If a single resource case is being input, card 3 is read under the format (I2, D1.4).

3	1-2	NEED(CASE), right-justified integer.
	3-8	OST(CASE), a floating point number expressed in decimal days input under the format D1.4.

If a multi-resource case is being input, card 3 is read under the format 6(I2, D1.4, D1.2).

3	1-2	NEED(NOTIF), right-justified integer.
	3-8	OST(NOTIF), a floating point number expressed in decimal days.
	9-12	DELTA(NOTIF), a floating point number.

Note that there are six sets of the above three fields on one input card. There is one set per need of a multi-resource case so that NEED (NOTIF), OST(NOTIF), and DELTA(NOTIF) are read repeatedly across the card for all NNN(CASE) needs. More than one card may be required to read in all needs.

	4	I2	ITOW(CASE), right-justified integer read in only for multi-resource cases with a tow or escort need.
ENDSIM	1	3	The number "2" to indicate Exogenous Event ENDSIM.
(2)		4-7	Right-justified integer giving the last day of the simulation.
		8-10	Right-justified integer giving the last hour of the simulation.
		11-12	Right-justified integer giving the last minute of the simulation.

F. Data to Subroutine JUMPER

The input data to Subroutine JUMPER immediately follows the Exogenous Event Deck. If the Exogenous Event Deck is read from magnetic tape, the data will follow the blank card.

Following is a description of the format and content of the JUMPER data set:

FORTRAN REPORT GENERATOR - INPUT DECK ORDER AND CARD FORMAT

CARD NUMBER	COLUMN NUMBERS	LINE REF.	VALUE IN SAMPLE OUTPUT	VARIABLE TYPE	DESCRIPTION OF VARIABLE
1	1&2			I2	District Number
2	3-14			2A6	Run Data
3	1-10			2A5	Peak or Now Peak Season
4	11&12			I2	Year
5	1&2			I2	Year from
6	3&4			I2	Year to
7	1-5			I2	Number of "Pct Change For"s to be entered
8	6-17			F5.1	Percent Age Change
9	1&2			3A6	Attribute of Run That is Being Changed
10	1-3			I2	Number of Added Stations
11	4-8			I3	Station Number
12	9-13			F8.1	X Coordinate
13	14-16			F8.1	Y Coordinate
14	17-19			I3	Covering Air Station
15	20-22			I3	Covering Air Station
16	23-25			I3	Covering Air Station
17	26-28			I3	Covering Adjacent Station
18	29-31			I3	Covering Adjacent Station
19	32-34			I3	Covering Adjacent Station
20	35-37			I3	Covering Adjacent Station
21	38-40			I3	Responsible Cutter
22	41-43			I3	Responsible Cutter
23	44-46			I3	Responsible Cutter
24	47-49			I3	Responsible Cutter
25	50-52			I2	Number of Deleted OFFACs
26	1&2			I2	Numbers of the deleted OFFACs
27	1-3			I3	Number of OFFACs with Attribute Changes
28	1&2			I3	OFFAC Number
29	1-3			I2A6	Changes in Attributes
30	4-75			I2	Number of New Resource Types
31	1&2			I2	Resource Type
32	3-9			F7.1	COSTD
33	10-16			F7.1	END
34	17-211			F5.2	MR
35	22-25			F4.1	Slim
36	26-30			F5.1	S0A1
37	31-35			F5.1	S0A2
38	36-40			F5.1	S0A3
39	41-46			F6.1	If
40	1&2			I2	Number of Attribute Changes
41	1&2			I2	Number of Resource Type
42	1-3			12A6	Changes in Attributes
43	1&2			I2	Number of Resource Types with Capability Changes
44	1-72			I3	Type Number with Capability Changes
45	1&2			I2	Number of New OFFACs
46	1-72			12A6	OFFAC Number and Changes
47	1&2			O2	Number of Existing OFFACs with Inventory Changes
48	1-72			12A6	OFFAC number and Changes
49	1&2			I2	Number of New OFFACs
50	1-3			D1	OFFAC Number

23	4-6 7-9 10-12 13-15 16-18 19-21 22-24 25-27	3 3 D1	3 3 3 4 4 3 3 3	I3 I3 I3 I3 I3 I3 I3 I3	Number of Crews in Shift 1 Number of Crews in Shift 2 Number of Crews in Shift 3 Number of Crews in Shift 4 Number of Crews in Shift 5 Number of Crews in Shift 6 Number of Crews in Shift 7 Number of Crews in Shift 8
24	1&2	D2	2	I2	Number of Existing OPFACs with Crew Changes
25	1-72	D2	OPFAC 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100	12A6	OPFAC Number and Crew Level Changes
26	1-5	E1	22	I2	Number of Demgen Tape
27	1-12	E1	NA	2A6	Scenario Tape Input (N.A. or Number)
28	1-12	E1	1963-1970	2A6	Dates for Data Base
29	1-12	E1	PEAK	2A6	Season (Peak or Now Peak)
30	1-5	E1	98400	I5	Number of Cases
31	1-30	E1	FROM 12/21/60 TO 12/06/67	5A6	Number of Days or Inclusive Dates
32	1-3	E2	005	I3	Number of Special Reports
33	1-3	E2	023	I3	Number of Each Special Report

FIGURE IV-5
Samples Output from Subroutine JUMPER

DATE AUG12,1970

SARSIM - DISTRICT 2

NON - PEAK 1969

FORECAST FROM 1968 TO 69

WITH

2.4 PCT CHANGE FOR OPFAC 56

-17.3 PCT CHANGE FOR CLIENTEL 31

6.8 PCT CHANGE FOR TIME PERIOD 6

1. INPUT CONDITIONS

A. STATION CHANGES

1. ADD

OPFAC 122 XS = 631.8YS = 765432.1 ACS = 1. 2. 3. 4 ADJS = 523.524,525,526 CUT = 636.637,638,639,640
OPFAC 123 XS = 531.7YS = 123456.7 ACS = 122,121,124, 25 ADJS = 2, 3, 4, 5 CUT = 909, 98,907,906,905
OPFAC 124 XS = 1000.0YS = 666666.6 ACS = 444,333,222,111 ADJS = 555,666,777,888 CUT = 353,354,355,356,357

2. DELETE

OPFAC 121
OPFAC 133
OPFAC 145

3. ATTRIBUTE CHANGE

OPFAC 67 CHANGE ARC TO XXX, DEP TO YYY,CHI TO ZZZ
OPFAC 21 CHANGE JKL TO PPP, MNO TO SSS, FGR TO HQX

B. RESOURCE TYPE CHANGES

1. NEW (SEE INITIALIZATION DATA FOR CHANGES TO CAPABILITY MATRIX(CPRL))

RST= 5 COSTD= 9999.9 ENO= 6375.2 HR=63.57 SLIM=71.1 SOA1= 22.2 SOA2= 33.3 SOA3= 44.4 TF= 555.5

2. ATTRIBUTE CHANGE

RST 8 CHANGE COSTD TO 357.5, SLIM TO 24.3 AND TF TO 5555.5

3. CAPABILITY CHANGE

NO CAPABILITY CHANGE

C. RESOURCE INVENTORY CHANGES

1. NEW OPFACS

OPFAC 122 RST 1 = 2 RST 9 = 5
OPFAC 123 RST 3 = 4 RST 17 = 2 RST 13 = 6
OPFAC 124 RST 2 = 3

2. EXISTING OPFACS

NO RESOURCE CHANGES TO EXISTING OPFACS

D. CREW MANNING LEVEL CHANGES

1. NEW OPFACS

OPFAC 122 SHFT1= 3 SHFT2= 3 SHFT3= 3 SHFT4= 4 SHFT5= 4 SHFT6= 3 SHFT7= 3 SHFT8= 3
OPFAC 123 SHFT1= 2 SHFT2= 2 SHFT3= 2 SHFT4= 2 SHFT5= 3 SHFT6= 3 SHFT7= 1 SHFT8= 1
OPFAC 124 SHFT1= 5 SHFT2= 5 SHFT3= 5 SHFT4= 5 SHFT5= 5 SHFT6= 5 SHFT7= 2 SHFT8= 2

2. EXISTING OPFACS

OPFAC 79, CHANGE SHFT1 TO 003 SHFT8 TO 5
OPFAC 30, CHANGE SHFT5 TO 2, SHFT9 TO 6

F. USER INPUT OPTIONS

1. PREPROCESSOR

DEMGEN TAPE 22
SCENFRI0 INPUT NA
DATA BASE 1963-1970
SEASON PEAK
NUMBER OF CASES 98400
NUMBER OF DAYS FROM 12/07/66 TO 12/06/67

2. POSTPROCESSOR

SPECIAL OUTPUT VIA QUICK QUERY
REPORT 23
REPORT 31
REPORT 65

V. User's Guide

The computer code consisting of the Definition Deck, Events List, Exogenous Events, Endogenous Events, and subroutines is stored on the FASTRAND drum for the UNIVAC 1108 at NBS under the file name CGSIM. It is assumed that the case input or demand data is stored on magnetic tape. (The large number of cases for most runs makes the use of keypunched cards impractical.) The unit or input device on which the tape is to be mounted is specified by letter on an ASG (assign) control card and by number in column 42 of the first card of the Initialization Deck referred to as the System Specifications Card. The letter and number must be in agreement, with A corresponding to 7, B to 8, etc. If it is desired to output attributes of the individual cases, the system variable STAPE must be set equal to the number of the output device. If this number corresponds to a tape drive, there must be an ASG control card assigning the appropriate tape.

A sample run deck will now be described. The reader is referred to Figure V-1. The following symbols will be used:

@ = keypunch both a seven and an eight in column one

Δ = blank

A complete description of the individual cards follows:

Card 1:

D is the priority of the run. The number of tapes, execution time, and the number of output pages determine the priority of a run.

RUN is simply the indication of a RUN card.

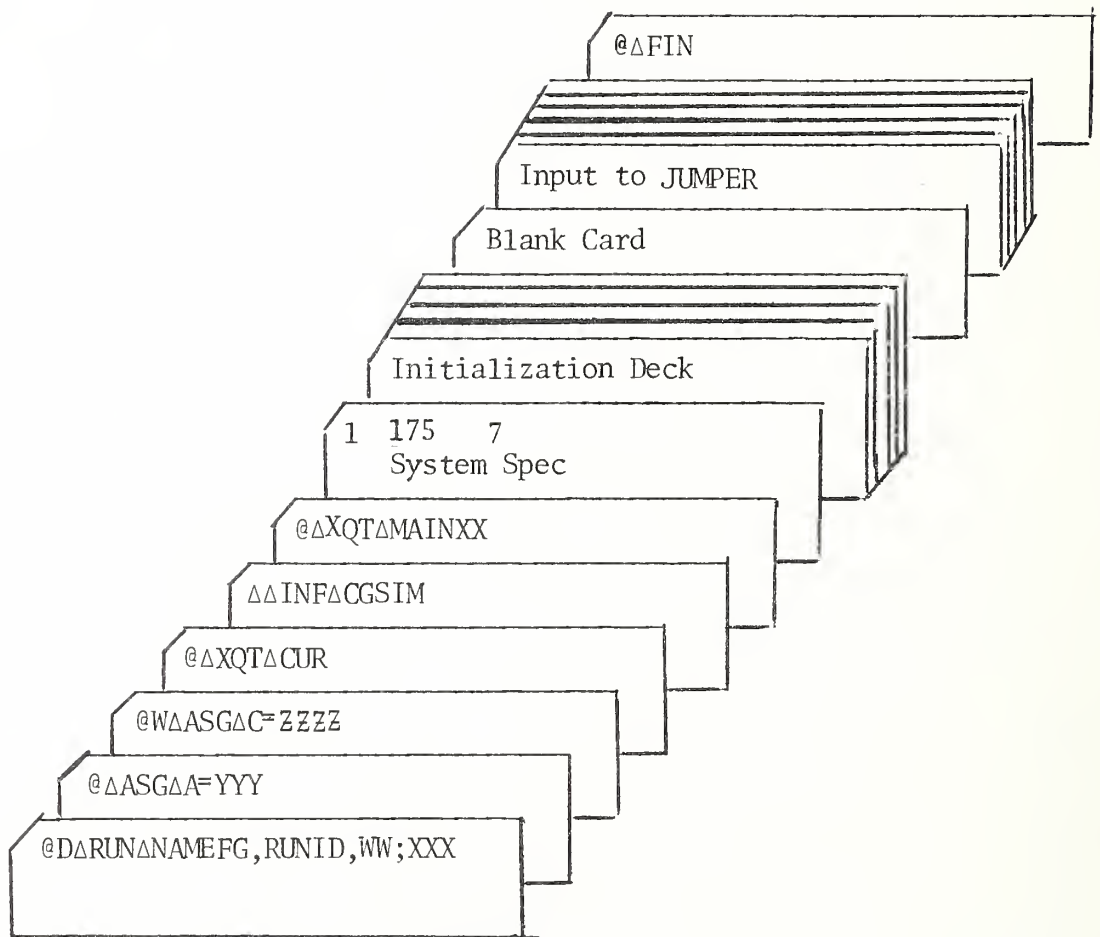


FIGURE V-1
A Sample Run Deck

NAMEFG is the six character user name.

RUNID is a five digit charge number.

WW is the maximum time in minutes. Execution terminates abruptly if WW is exceeded.

XXX is the maximum number of pages to be output. Execution terminates if XXX is exceeded.

Card 2:

ASG designates a tape assignment.

A specifies the letter of the tape drive.

YYYY is the reel number of the tape to be mounted. For Figure V-1 this corresponds to the case input data since the number 7 appears in column 42 of the System Specifications Card.

Card 3:

W indicates the tape will be written on.

C is the letter of the tape drive. The variable STAPE should be set to 9 so that case output will be written on this tape.

ZZZZ is the reel number of the tape to be mounted. If it is desired to obtain a new tape for this purpose, an S is placed next to the W (on either side) and nothing is keypunched on the card after the letter C.

Card 4:

Keypunched exactly as shown. This calls in the Complex Utility Routines.

Card 5:

Keypunched exactly as shown. This brings the program file CGSIM into the user storage.

Card 6:

Keypunch exactly as shown. This begins execution of the program.

Card 7:

This is the System Specifications Card described in part IV of the Operational Simulator documentation. It receives individual attention here only to show the correspondence between the 7 in column 42 and the assignment of tape A on Card 2.

Initialization, Blank Card, and JUMPER Input: These were described in part IV.

Last Card

Keypunch exactly as shown. This indicates that the run is finished.

It may at some time be desirable to change some portion of the computer code. A complete detailed description of all the control cards needed to accomplish such a change is quite lengthy and involves detailed explanation of UNIVAC 1108 control cards and SIMSCRIPT techniques. Instead, Figure V-2 will list the formatted cards required to change both Subroutine SERVE and Endogenous Event ARVSN as an example. The new version of the program will exist in the second file of the tape reel YYYY mounted here on unit B.

Major points to note in Figure V-2 are as follows:

1. There is no choice regarding the tape unit used by SIMSCRIPT to output the compiled version of the program, it must be unit B.
2. The Definition Deck must precede the routines being recompiled.
3. A card with "\$" in column 1 must follow the last routine being recompiled.

Figure V-2

Run Deck to Revise SERVE and ARVSN

Card Column

Number 1

@DΔRUNΔNAMEFG,RUNID,WW,XXX

@WΔASGΔB=YYYY

@ΔXQTΔCUR

ΔΔINFΔSIMSC6

@NΔXQTΔSIM

Place the Definition Deck here.

Place the New Version of Subroutine SERVE here.

Place the New Version of Endogenous Event ARVSN here.

\$

@ΔXQTΔCUR

ΔΔERS

ΔΔINFΔCGSIM

ΔΔDELΔSERVE/CODE

ΔΔDELΔXARVSN/CODE

ΔΔINΔB

@NΔASM,*ΔSERVE,SERVE

@NΔASM,*ΔXARVSN,XARVSN

@ΔXQTΔCUR

ΔΔDELΔSERVE

ΔΔDELΔXARVSN

ΔΔDELΔDEFSXX

ΔΔPAC

ΔΔOUTΔB

ΔΔTEFΔB

ΔΔTRIΔB

@ΔFIN

Figure V-3

Execution of the Revised Program

Card Column

Number 1

@D△RUN△NAMEFG,RUNID,WW,XXX

@△ASG△A=XXXX

@△ASG△B=YYYY

@△XQT△CUR

△△PEF△B

△△IN△B

@△XQT△MAINXX

Initialization Deck

Blank Card

Input to JUMPR

@△FIN

4. Endogenous Events are referred to on DEL (delete) Cards and ASM (assemble) cards with an "X" preceeding the name.

5. There are other ways by which to accomplish the change shown in Figure V-2. This is a reasonable way, however, which should serve the purpose for users who wish to avoid detailed involvement with SIMSCRIPT and/or the UNIVAC 1108.

Having revised the code, it is then desired to execute the new version of the program. Assuming the case input tape to be found on tape reel XXXX and that STAPE = 0 so that no case output is desired, Figure V-3 shows a typical follow-up run to the run shown in Figure V-2.

The process of adding or deleting entries in the Definition Deck is somewhat complicated. SIMSCRIPT compiles a translator provided subroutine package for every definition on every card of the Definition Deck. Because of the large number of definitions required by OPSIM, the standard compilation and assembly procedures set up an overflow condition on the UNIVAC 1108. The suggested "fix" for this overflow breaks the assembled version into two parts which are now arbitrarily named A and B. Thus, one run is required to compile, assemble, the list the assembled code in order to see how to split the code, and a second run actually accomplishes the split via two more assemblies. An example of the first run is shown in Figure V-4.

The user must next examine the output from this first run. A computer reproduction of a sample Definition Deck is shown in Figure V-5. The assembly listing corresponding to this Definition Deck

FIGURE V-4

Run to Compile and List Assembly of Definition Deck

@D△RUN△NAMEFG,RUNID,WW,XXX

@W△ASG△B=YYYY

@△XQT△CUR

△△INF△SIMSC6

@N△XQT△SIM

Place the revised Definition Deck here.

\$

@△XQT△CUR

△△ERS

△△INF△SIMLIB

△△IN△B

@I△ASM,*△DEFSXX,DEFSXX

@△FIN

COMPILED BY UNIVAC 1107/1108 SIMSCRIPT 1.5 DATED - MAR. 6, 1969 VERSION 2.11

2345678901234567890123456789012345678901234567890123456789012
T AIR 011/4 1 IRES E
T CASE 2 T XC 02 *F 2COST 1 2 F

FIGURE V-5

Computer Output Version of Sample Definition Deck

is shown in Figure V-6. The six-digit numbers at the left of the listing are line numbers. The entities and attributes appear in the listing with a single letter prefix. The line on which an entity or attribute name appears and all lines up to the next entity or attribute constitute a package which must not be split. The first four lines and the last line (line 52) must appear in both sections A and B. A "good" place to split this assembly is after line 27. Figure V-7 shows the run which will result in A containing lines 1 - 27 and 52 B containing lines 1 - 4 and 28 - 52. The new version of OPSIM is then output in the second file of reel number YYYY.

Before concluding this part, some mention should be made of computer running time. Generally it takes approximately three to five minutes to compile all of the OPSIM routines. The assembly process requires approximately 10 minutes. To compile and assemble one or two routines in a single computer run can take as long as two to three minutes. As far as execution times are concerned, a set of about 900 real cases occurring during the month of July 1968 in District 1 was simulated in approximately 5 minutes when operating with 109 resources. When the number of resources was reduced to 34, execution time decreased to 2 1/2 minutes. When the number of resources was increased to 218, execution time increased to approximately 7 1/2 minutes.

FIGURE V-6

@! ASM, DEF5XX,DEF5XX

[illegible]

FIGURE V-7

Splitting the Assembly of the Definition Deck

@D△RUN△NAMEFG, RUNID,WW,XXX

@W△ASG△B=YYYY

@△XQT△CUR

△△INF△CGSIM

△△DEL△A/CODE

△△DEL△B/CODE

△△IN△B

@I△ASM,*△DEFSXX,A

-28,51

@I△ASM,*△DEFSXX,B

-5,27

@△XQT△CUR

△△DEL△DEFSXX

△△PAC

△△OUT△B

△△TEF△B

△△TRI△B

@△FIN

VI. Interpretation of Output

In order to interpret properly the output produced by OPSIM, it is necessary to understand the calculations of the various statistics. A complete list of all statistical attributes discussed herein is given in Figure VI-1. The explanation of the collection of these statistics will be presented in like order; however, some preliminary definitions are required first.

- TIME: In the context to follow, this will refer to the total time simulated for a given run.
- NRES: The total number of resources in the district being simulated.
- NSTA: The total number of stations in the district being simulated.
- NWEWDS: The total number of weekend and weekday shifts.
- NRST: The total number of resource types.
- REST(I,J): The total number of resources of type J at station I.
- TOTME(K): The total simulated time occurring during shift K. This attribute of WEWDS is accumulated in Endogenous Event NUCRU and Exogenous Event ENDSIM.
- TUTIL(L): The total time during a particular shift for which $EIAT(L) \neq 0$. This attribute of RES is set to zero at the start of every new shift. At the end of a shift its value is accumulated into UTIL(L) and USHP(I,K) for the appropriate values of I and K.

FIGURE VI-1

COLLECTION OF STATISTICS IN OPSIM

```
*****
* ENTITY * STATISTIC * ROUTINES WHERE STATISTICS ARE COLLECTED *****
*****

CASE:  CNRES      SERVE,SSS,EXQ,STNBY
        COSTC      SERVE,SSS,EXQ,STNBY
        DMERT      STATS
        NDINT      SAQ
        NQUE       SRAS,SRCH,NOTE,SRISE,SAQ,QUEUE
        REA        SRAS,SRCH,NOTE,SRISE,SAQ,QUEUE
        RESA       ARVSN,ARSC
        TINT       NUCRU,XSET,EXQ,STNBY,SVQUE
        TOUE       NUCRU,XSET,EXQ,STNBY,SVQUE
        TQUEI      ARVSN,ARSC
        TSVC       TERM
        TMAIT      ARVSN,ARSC
        RESA       ARVSN
        RESA       ARSC
        NCASE      SERVE,SSS,EXQ,STNBY
        UTIL       NUCRU,ENDSIM
        AUT        ENDSIM
        AVGT*      ARVSN,ARSC,ENDSIM
        CFTT       ENDSIM
        DHRT       STATS,ENDSIM
        FAIL1      SRAS,NOTIF,SRCH
        FAIL2      SRAS,NOTIF,SRCH
        FAIL3      ARVSN,ARSC
        NCAS       ARVSN,ARSC
        NEEDS      SERVE,SSS,EXQ,STNBY
        NINTR      SAQ
        NMBPQ      TERM
        NSTBY      ROCA
        TMTOL      STATS,ENDSIM
        UNPRO      STNBY
        USE        ENDSIM
        USHF       NUCRU,ENDSIM
        VCTR       STATS,ENDSIM
        AVUS       ENDSIM
        USHF       NUCRU,ENDSIM
        AVORT      STATS,ENDSIM
        CS         ENDSIM
        FL1        ENDSIM
        FL2        ENDSIM
        FL3        ENDSIM
        INT*P      ENDSIM
        NDS        ENDSIM
        NOMPR      ENDSIM
        HOSH       ENDSIM
        TMTAY      STATS,ENDSIM
        TVAVG      STATS,ENDSIM
        TAVG       STATS,ENDSIM
        USEAV      ENDSIM
        MEEM       NUCRU,STATS,TERM,ENDSIM
        C*TP      NUCRU,STATS,TERM

WEADS:

SPOLUP:

*****
* ERR: *****
*****
```


Following is an explanation of the statistics collected in OPSIM:

CNRES(CASE): The total number of resources assigned to serve a case.

COSTC(CASE): This is the total cost of the case. It is equal to the sum of COST(IRS) for every resource IRS assigned to serve the case.

DMERT(CASE): This is the case demerit calculated in Subroutine STATS. If $(\text{TWAIT} - \text{TOL}) \leq 0$, then $\text{DMERT} = 0.0$. If $(\text{TWAIT} - \text{TOL}) > 0$, then DMERT is calculated as follows. If $\text{OFSHR} > 20$ and $\text{PRI} \leq 2$ or if $\text{OFSHR} > 20$ and $\text{PRI} > 2$, then $\text{DMERT} = 2.0 * (\text{TWAIT} - \text{TOL})$. If $\text{OFSHR} \leq 20$ and $\text{PRI} > 2$, then $\text{DMERT} = 3.0 * (\text{TWAIT} - \text{TOL})$. If $\text{OFSHR} > 20$ and $\text{PRI} \leq 2$, then $\text{DMERT} = \text{TWAIT} - \text{TOL}$.

NOINT(CASE): The total number of times that the resource(s) serving a case are interrupted.

NQUE(CASE): The total number of times that the case enters a queue. This value is increased by one every time that a need, tow, or search is filed in the queue.

REA(CASE): The reason the case first enters a queue. The meanings of the various values this can assume are given in part II.

RESA(CASE): This is the first resource to arrive on the scene of the case.

TINT(CASE): The total time that some need, tow, or search of the case is in the queue because of an interrupt. Time starts to accumulate in this attribute as soon as the first need, tow, or search of the case is in interrupt status in CQUE. It ceases to accumulate when the last need, tow, or search in the queue because of an interrupt is served.

TQUE(CASE): Total time during which at least one need, tow, or search of the case is in the queue.

TQUE1(CASE): Total time before the first resource arrives on the scene of the case for which at least one need, tow or search of the case is in the queue.

TSVC(CASE): Total time the case is in the system. A case is considered "in the system" from the time it occurs until the time at which the resource serving the last need, tow, or search leaves the scene of the case having completed its duty.

TWAIT(CASE): Total time between the occurrence of the case and the time that the first resource arrives on scene.

RESA(NOTIF): The first resource to arrive on the scene of the case for the purpose of serving a particular need or tow NOTIF.

RESA(NOTE): The first resource to arrive on the scene of the case for the purpose of serving a long search NOTE.

NCASE(RES): The total number of times a resource is assigned to service. It is increased every time a resource is assigned to a need, even if it serves more than one need of the same case.

UTIL(L): This attribute assumes two roles in the simulation. While the simulation is in progress it contains the total time for which EIAT(L) $\neq$ 0. At the end of the simulation in ENDSIM the value UTIL(L) is divided by TIME. It then represents average utilization for resource L. Let UTIL(L)₁ denote the value before the division occurs.

AUT(J): This is the average utilization of resource type J. It is calculated in ENDSIM as follows:

$$AUT(J) = \left[\sum_{L \in J} UTIL(L)^1 \right] / \left[TIME * \sum_{I=1}^{NSTA} REST(I,J) \right].$$

AVGTW(STA): The average time in hours that cases have to wait. The waiting time is attributed to the station of the first resource to arrive on the scene of the case.

CFTT(STA): The average Failure type C(TWAIT-TOL) at a station expressed in decimal hours. This is calculated in Subroutine ENDSIM.

$$CFTT(STA) = TWTOL(STA)_1 * 24.0 / FAIL3(STA).$$

DMRT(STA): During the simulation, DMRT(STA) is an accumulation of the case demerits, DMERT(CASE), and is accounted to the station of the first resource to arrive on the scene of the case. In ENDSIM, to obtain the normalized demerit at the station in decimal hours, DMRT(STA) is replaced by (DMRT(STA) * 24.0 * R) / NCAS(STA) where R

is the sum of all positive (TWAIT-TOL) in the district divided by the sum of all case demerits in the district.

FAIL1(STA),

FAIL2(STA),

FAIL3(STA): The total number of Failure type A, type B, and type C respectively at a given station. FAIL1 and FAIL2 are attributed to the primary station of the case. FAIL3 is accounted to the station of the first resource to arrive on the scene of the case.

NCAS(STA): The number of cases for which a resource from this station was the first resource to arrive on the scene of the case.

NEEDS(STA): The number of times resources from this station were assigned to service.

NINTR(STA): The number of times resources from this station were interrupted while serving one case to serve another case.

NMBRQ(STA): The number of times a case, multi-resource need or long search need was queued at this station. The queue is attributed to the primary station of the case.

NSTBY(STA): The number of times that a standby was called at the station.

TWTOL(STA): During the simulation, TWTOL(STA) is an accumulation of all positive (TWAIT-TOL) and is accounted to

the station of the first resource to arrive on the scene of the case. In ENDSIM, to obtain the average positive (TWAIT-TOL) at the station in decimal hours, TWTOL(STA) is replaced by $TWTOL(STA)^1 * 24.0 / NCAS(STA)$. Let TWTOL(STA)¹ denote the value before the division occurs.

UNPRO(STA): The number of times that a standby was called at the station but not used.

USE(I): This is the average utilization at station I. It is calculated in ENDSIM as follows:

$$USE(I) = \left[\sum_{K=1}^{NWWS} USHF(I,K)^1 \right] / \left[TIME * \sum_{J=1}^{NRST} REST(I,J) \right].$$

USHFI,K): This attribute assumes two roles in the simulation.

During the simulation it is an accumulation of TUTIL(L) for "appropriate" values of L. That is, at the end of every shift K, the value of TUTIL(L) is accumulated into USHF(I,K) if resource L has STN(L) = I. At the end of the simulation in ENDSIM, USHF(I,K) is replaced by the following quotient:

$$USHF(I,K) / \left[TOTIME(K) * \sum_{J=1}^{NRST} REST(I,J) \right].$$

Thus USHF(I,K) becomes average utilization during shift K at station I. Let $USHF(I,K)^1$ refer to the value of USHF(I,K) described above immediately before the division is executed.

VCTR(STA): VCTR(STA) is an accumulation of the time-to-vector (TVEC) of the first resource to arrive on the scene of the case and is accounted to the station of that resource. At the end of the simulation in ENDSIM, VCTR(STA) is replaced by $VCTR(STA) * 24.0 / NCAS(STA)$ for the average TVEC in decimal hours.

AVUS(K): This is the average utilization during shift K. It is calculated in ENDSIM as follows:

$$AVUS(K) := \left[\sum_{I=1}^{NSTA} USHF(I,K) \right] / [TOTME(K) * NRES].$$

AVDRT(GROUP): AVDRT(GROUP) is an accumulation of case demerits, DMERT(CASE), and is accounted to the group of the station of the first resource to arrive on the scene of the case. To obtain the normalized demerit of the group in decimal hours, AVDRT(GROUP) is replaced by $(AVDRT(GROUP) * 24.0 * R) / CS(GROUP)$ in ENDSIM. R is the sum of all positive (TWAIT-TOL) in the district divided by the sum of all case demerits in the district.

CS(GROUP) The number of cases for which a resource from this group was the first resource to arrive on the scene of the case.

FL1(GROUP),
FL2(GROUP),
FL3(GROUP): The total number of failure type A, type B and type C respectively in a given group. FL1 and FL2

are attributed to the group of the primary station of a case. FL3 is attributed to the group of the station of the first resource to arrive on the scene of a case.

INTRP(GROUP): The number of times resources from this group were interrupted.

NDS(GROUP): The number of times resources from this group were assigned to service.

NONPR(GROUP): The number of times that a standby was called at the stations belonging to the group but not used.

NOSB (GROUP): The number of times that a standby was called at the stations belonging to the group.

TMTAV(GROUP): During the simulation, TMTAV(GROUP) is an accumulation of all positive (TWAIT-TOL) and is accounted to the group of the station of the first resource to arrive on the scene of the case. To obtain, the average positive (TWAIT-TOL) of the group in decimal hours, TMTAV(GROUP) is replaced by $TMTAV(GROUP) * 24.0 / CS(GROUP)$ in ENDSIM.

TVAVG (GROUP): During the simulation, TVAVG(GROUP) is an accumulation of TVEC of the first resource to arrive on the scene of a case and is accounted to the group of the station of that resource. In ENDSIM, to obtain the average

TVEC of the group in decimal hours, TVAVG(GROUP) is replaced by TVAVG(GROUP) *24.0/CS(GROUP).

TWAVG(GROUP): TWAVG(GROUP) is an accumulation of TWAIT(CASE) and is attributed to the group of the station of the first resource to arrive on the scene of the case. To obtain the average TWAIT of the group in decimal hours, TWAVG(GROUP) is replaced by TWAVG(GROUP) *24.0/CS(GROUP) in ENDSIM.

USEAV(GROUP): This is the average utilization of the group. It is calculated in ENDSIM as follows:

$$USEAV(GROUP) = \left[\sum_{K=1}^{NWEWDS} \sum_{I \in GROUP} USHF(I,K)^1 \right] / \left[TIME * \sum_{J=1}^{NRST} \sum_{I \in GROUP} REST(I,J) \right]$$

MEEN(I): The arithmetic mean of certain attributes output in REPORT DSTRIB. During the simulation, MEEN(I) contains the sum of the values of the observations. In ENDSIM, this sum is divided by the number of observations to obtain the mean.

CNTR(I): The number of observations made.

STDEV(I): The standard deviation of certain attributes output in REPORT DSTRIB. During the simulation, STDEV(I) contains the sum of the squares of the observation values. In ENDSIM, STDEV(I) is replaced by:

$$[STDEV(I)/CNTR(I)] - [MEEN(I)]^2$$

- ⊃ MEEN(I) is the arithmetic mean as explained
- ⊃ after the division in ENDSIM.

CAT1(I) -

CATG8(I): Eight separate categories in which to store the distribution of observations for output in REPORT DSTRIB.

AIRU: The average utilization of aircraft excluding C-130's.

This is calculated in ENDSIM as follows:

$$AIRU = [\sum_{I \in L} UTIL(I)^1] / [TIME * \sum_{J=1}^{NSTA} \sum_{K \in M} REST(J,K)]$$

where L is the set of resources having SQTAG(TYPE(I)) = 3 and M is the set of resource types having SQTAG(K) = 3.

AVUTØ: This is average overall utilization. It is calculated in ENDSIM as follows:

$$AVUTO = [\sum_{K=1}^{NWWDs} \sum_{I=1}^{NSTA} USHF(I,K)^1] / [TIME * NRES].$$

BUTIL: The average utilization of small vessels. This is calculated in ENDSIM as follows:

$$BUTIL = [\sum_{I \in L} UTIL(I)^1] / [TIME * \sum_{J=1}^{NSTA} \sum_{K \in M} REST(J,K)]$$

where L is the set of resources having SQTAG(TYPE(I)) = 0 and M is the set of resource types having SQTAG(K) = 0.

CUTIL: The average utilization of cutters. In ENDSIM, this is calculated as follows:

$$CUTIL = [\sum_{I \in L} UTIL(I)^1] / [TIME * \sum_{J=1}^{NSTA} \sum_{K \in M} REST(J,K)]$$

where L is the set of resources having $SQTAG(TYPE(I)) = 1$ and M is the set of resource types having $SQTAG(K) = 11$

- C130U: The average utilization of C-130's.
- KOUNT: During the simulation KOUNT is the number of cases currently residing in core storage. At the end of the simulation KOUNT is set equal to the sum of the values NCAS for all stations.
- LIMIT: During the simulation, LIMIT is an estimate of the maximum number of cases which can reside in core storage simultaneously. In ENDSIM, LIMIT is set equal to the sum of the values NMBRQ for all stations.
- MCFTT: The average Failure type C in the district expressed in decimal hours. This is calculated in Subroutine ENDSIM; it is the sum of all the positive values of (TWAIT-TOL) in the district multiplied by 24 and divided by NBRFC.
- MEAND: The normalized demerit in the district. It is an accumulation of all the case demerits during the simulation. In ENDSIM, its is replaced with $(MEAND * 24.0 * R) /$

$$NSTA \sum_{I=1}^{NSTA} NCAS(I)$$
where R is the sum of all positive (TWAIT-TOL) in the district divided by the sum of all case demerits in the district.

MEANV: The average TVEC in the district of the first resource to arrive on the scene of a case. It is an accumulation of these times-to-vector during the simulation. In ENDSIM, it is replaced by $\text{MEANV} * 24.0 / \sum_{I=1}^{\text{NSTA}} \text{NCAS}(I)$.

MEANW: The average time that a case must wait prior to the arrival of the first resource. This is the sum of the values of TWAIT for all cases multiplied by 24 and divided by the sum of the values NCAS for all stations.

MNTMT: The average positive (TWAIT-TOL) in the district. This is the sum of all the positive values of (TWAIT-TOL) multiplied by 24 and divided by the sum of the values NCAS for all stations.

NBRCO: The number of cases that were actually completed.

NBRCS: The total number of cases that occurred.

NBRFA,
NBRFB,
NBRFC: Total number of Failures of type A, B, and C, respectively in the district. These are the sums of FAIL1(STA), FAIL2(STA) and FAIL3(STA) respectively taken over all stations.

SNEED: The total number of needs. This is the sum of NEEDS(STA) over all stations. This may not equal the actual number of needs that occurred since any need served by more than one resource (as would be the case, for example, if an interrupt occurs) is counted more than once.

TOSBY: The total number of times a standby is called. This is the sum of NSTBY(STA) over all stations.

TOTIN: The total number of interrupts. This is the sum of NINTR(STA) over all stations.

TUNPR: The total number of standbys called and not used. This is the sum of UNPRO(STA) over all stations.

The output produced by OPSIM is of two basic types, the "Report Output" and the "Tape Output" containing the attributes of the individual cases. The two types will be discussed separately below.

The Report Output consists of eight different divisions. A sample of the Report Output received when OPSIM is run with PRTOT = 0 is given in Figure VI-2. The first division is labeled "Input Conditions". This is the output produced by the FORTRAN Subroutine JUMPER described in part IV. It indicates cahnges from a base condition in the Initialization Deck which were made for the current run.

The second division is labeled "District Statistics". The following entities and attributes are output in this division: NBRCS, NBRCO, NBRFA, NBRFB, NBRFC, TIME, AVUTO, AVUS for all shifts, AUT for all resource types, BUTIL, CUTIL, C130U, AIRU, TOSBY, and TUNPR. All these statistics are labeled by the output with a brief but reasonable definition.

The third division is labeled "Station Response". There is a row of print for every station in the district being simulated. The following list will indicate the correspondence between column labels and attribute names.

FIGURE VI-2 (Sample Report Output)

DATE MAY 21, 1971

SARSIM - DISTRICT13

PEAK 1968

FORECAST FROM 1968 TO 68

I. INPUT CONDITIONS

```

A. STATION CHANGES
  1. ADD
    NO ADDITIONS
  2. DELETE
    NO DELETIONS
  3. ATTRIBUTE CHANGE
    NO ATTRIBUTE CHANGES
B. RESOURCE TYPE CHANGES
  1. NEW (SEE INITIALIZATION DATA FOR CHANGES TO CAPABILITY MATRIX(CPIL))
    NO NEW ADDITIONS
  2. ATTRIBUTE CHANGE
    NO ATTRIBUTE CHANGES
  3. CAPABILITY CHANGE
    NO CAPABILITY CHANGES
C. RESOURCE INVENTORY CHANGES
  1. NEW OFFACS
    NO NEW OFFACS
  2. EXISTING OFFACS
    NO RESOURCE CHANGES TO EXISTING OFFACS
D. CREW MANNING LEVEL CHANGES
  1. NEW OFFACS
    NO CHANGES
  2. EXISTING OFFACS
    NO CHANGES IN EXISTING MANNING LEVELS
E. USER INPUT OPTIONS
  1. PREPROCESSOR
    DEMGEN TAPE 0
    SCENERIO INPUT NA
    DATA BASE JULY 68 HIST
    SEASON PEAK
    NUMBER OF CASES 865
    NUMBER OF DAYS FROM JULY 1 THROUGH JULY 31
  2. POSTPROCESSOR
    SPECIAL OUTPUT VIA QUICK QUERY
    NO SPECIAL REPORTS
  3. OPSIM
    RAP = 2
    TOL(1) = 0.17 DAYS
    TOL(2) = 0.12 DAYS
    TOL(3) = 0.08 DAYS
    TOL(4) = 0.04 DAYS
    TOL(5) = 0.02 DAYS
    IDELT = 1
    KKK = 2.
    PRON = 0.65
    PRUP = 0.10
    HO = 4. NAUTICAL MILES
    TOLS(1) = 0.58 DAYS
    TOLS(2) = 0.25 DAYS
    TOLS(3) = 0.17 DAYS
    TOLS(4) = 0.08 DAYS
    TOLS(5) = 0.04 DAYS

```

II. DISTRICT STATISTICS

A. CASE SUMMARY

TOTAL NUMBER OF CASES THAT OCCURRED = 865
TOTAL NUMBER OF CASES THAT WERE COMPLETED = 860
TOTAL NUMBER OF CASES WITH FAILURE A = 0
TOTAL NUMBER OF CASES WITH FAILURE B = 0
TOTAL NUMBER OF CASES WITH FAILURE C = 118
TOTAL SIMULATED TIME (DAYS) = 31.

B. RESOURCE SUMMARY

AVERAGE UTILIZATION OVERALL = 4.73%
AVERAGE UTILIZATION BY SHIFTS:
SHIFT 1 - 2.55%
SHIFT 2 - 4.47%
SHIFT 3 - 5.07%
SHIFT 4 - 4.04%
SHIFT 5 - 4.47%
SHIFT 6 - 9.26%
SHIFT 7 - 7.71%
SHIFT 8 - 5.99%
AVERAGE UTILIZATION BY RESOURCE TYPES:
RESOURCE TYPE 1 - 8.91%
RESOURCE TYPE 2 - 1.99%
RESOURCE TYPE 3 - 0.27%
RESOURCE TYPE 4 - 5.13%
RESOURCE TYPE 5 - 9.48%
RESOURCE TYPE 6 - 1.99%
RESOURCE TYPE 7 - 0.37%
RESOURCE TYPE 8 - 6.86%
RESOURCE TYPE 9 - 0. %
RESOURCE TYPE 10 - 0.47%
RESOURCE TYPE 11 - 11.60%
RESOURCE TYPE 12 - 0. %
RESOURCE TYPE 13 - 5.13%
RESOURCE TYPE 14 - 2.74%
RESOURCE TYPE 15 - 2.62%
RESOURCE TYPE 16 - 0. %
COMBINED UTILIZATION OF BOATS - 4.90%
COMBINED UTILIZATION OF CUTTERS - 5.27%
COMBINED UTILIZATION OF C130 - 5.13%
COMBINED UTILIZATION OF OTHER AIRCRAFT - 2.67%

C. STATION SUMMARY

TOTAL NUMBER OF TIMES A STANDBY WAS CALLED (ALL STATIONS) = 95
TOTAL NUMBER OF TIMES A STANDBY WAS CALLED BUT NOT USED (ALL STATIONS) = 93

III. STATION RESPONSE

NUMBER OF CASES	NUMBER OF NEEDS	FAILURE TYPE A	FAILURE TYPE B	FAILURE TYPE C	FAILURE TYPE D	TOTAL INTERRUPTED NEEDS	AVERAGE TREC (HOURS)	AVERAGE TWAIT (HOURS)	AVG. CFAIL TWAIT-TOL (HOURS)	AVG. POS. TWAIT-TOL (HOURS)	NORMALZD DEMERIT CALLS/UNPRO. (HOURS)	STANDRYS	AVERAGE UTILIZATION
STA 1	0	0	0	0	0	0	0.	0.	0.	0.	0.	0/ 0	0. %
STA 2	0	0	0	0	0	0	0.	0.	0.	0.	0.	0/ 0	0. %
STA 3	1	2	0	0	0	0	0.67	2.17	0.	0.	0.	0/ 0	0.47%
STA 4	14	20	0	13	0	0	3.27	6.11	4.02	3.73	2.77	0/ 0	22.79%
STA 5	0	0	0	0	0	0	0.	0.	0.	0.	0.	0/ 0	0. %
STA 6	0	0	0	0	0	0	0.	0.	0.	0.	0.	0/ 0	0. %
STA 7	18	26	0	0	0	3	1.03	1.24	0.	0.	0.	0/ 0	9.57%
STA 8	3	3	0	1	2	0	2.86	3.11	4.38	1.46	1.27	0/ 0	3.23%
STA 9	22	25	0	3	1	2	1.03	1.24	0.46	0.06	0.08	0/ 0	9.73%
STA 10	11	28	0	3	5	2	0.96	1.16	0.51	0.14	0.18	0/ 0	11.86%
STA 11	30	41	0	5	0	1	0.26	0.52	0.23	0.04	0.05	13/12	2.74%
STA 12	18	25	0	8	0	0	0.65	0.77	0.48	0.21	0.28	2/ 2	4.67%
STA 13	4	9	0	0	0	0	0.53	0.69	0.	0.	0.	0/ 0	1.14%
STA 14	121	171	0	11	0	0	0.90	1.06	1.97	0.13	0.19	0/ 0	10.68%
STA 15	34	48	0	6	1	0	0.63	0.79	0.29	0.05	0.07	0/ 0	3.79%
STA 16	123	146	0	3	0	0	0.44	0.60	0.70	0.02	0.02	0/ 0	5.91%
STA 17	27	47	0	0	0	0	0.42	0.59	0.	0.	0.	0/ 0	2.84%
STA 18	25	42	0	4	0	0	0.95	1.11	1.06	0.17	0.22	0/ 0	7.07%
STA 19	15	30	0	1	0	1	0.28	0.45	0.08	0.01	0.01	0/ 0	2.02%
STA 20	67	77	0	15	1	0	0.47	0.64	0.18	0.04	0.04	0/ 0	4.57%
STA 21	26	32	0	1	0	0	0.43	0.60	0.17	0.01	0.01	0/ 0	1.79%
STA 22	55	74	0	12	0	0	0.50	0.68	0.28	0.06	0.08	0/ 0	6.01%
STA 23	56	73	0	6	0	2	0.96	1.18	2.72	0.29	0.27	5/ 4	5.40%
STA 24	10	16	0	5	1	0	3.47	3.59	4.98	2.44	2.89	0/ 0	5.41%

STA	NUMBER OF CASES	NUMBER OF NEEDS	FAILURE TYPE A	FAILURE TYPE B	FAILURE TYPE C	NO. OF Q	TOTAL INTERRUPTED NEEDS	AVERAGE TVEC (HOURS)	AVERAGE TWAIT (HOURS)	AVG. CFAIL TWAIT-TOL (HOURS)	POS. TWAIT-TOL (HOURS)	NORMLZD DEMERIT (HOURS)	STANDARDS CALLS/UNPRO.	AVERAGE UTILIZATION
STA 25	20	27	0	0	1	0	0	0.52	0.68	0.47	0.02	0.03	0/0	3.11%
STA 26	11	15	0	0	1	0	0	0.61	0.78	0.36	0.03	0.04	0/0	1.48%
STA 27	0	0	0	0	0	0	0	0.	0.	0.	0.	0.	0/0	0. %
STA 28	4	5	0	0	1	0	0	1.02	3.07	4.33	1.08	0.04	0/0	2.48%
STA 29	11	15	0	0	1	0	1	0.54	0.60	0.02	0.00	0.00	0/0	1.26%
STA 30	0	2	0	0	0	0	0	0.	0.	0.	0.	0.	0/0	0.22%
STA 31	7	8	0	0	2	0	0	2.42	2.58	4.46	1.27	1.42	0/0	2.32%
STA 32	21	23	0	0	1	0	0	0.70	0.92	2.02	0.10	0.12	0/0	2.82%
STA 33	11	22	0	0	8	2	1	0.84	1.69	1.31	0.95	1.16	2/2	5.13%
STA 34	2	2	0	0	1	5	0	0.53	0.86	0.44	0.22	0.29	2/2	0.47%
STA 35	45	63	0	0	4	1	8	0.87	1.00	1.80	0.16	0.14	42/42	25.63%
STA 36	6	8	0	0	0	3	0	0.09	0.26	0.	0.	0.	4/4	1.92%
STA 37	39	42	0	0	1	1	3	0.33	0.47	0.60	0.02	0.01	21/21	8.85%
STA 38	7	7	0	0	0	1	0	0.08	0.25	0.	0.	0.	4/4	1.02%
TOTAL/AVG	864	1174	0	0	118	24	24	0.74	0.97	1.49	0.20	0.20	95/93	4.73%

NOTE: 1. SCALING FACTOR FOR NORMLZD DEMERIT (12TH COLUMN ABOVE) = 0.433
2. COEFFICIENTS USED IN THE CALCULATION OF CASE DEMERIT: 1,2,3

IV. RESOURCE UTILIZATION (PERCENT)

STATION 1 RST 12	SHIFT1 0. %	SHIFT2 0. %	SHIFT3 0. %	SHIFT4 0. %	SHIFT5 0. %	SHIFT6 0. %	SHIFT7 0. %	SHIFT8 0. %
RES 1 RES 2	1 (ASSIGNED TO 0 NEEDS) = 0. %	0. %						
STATION 2 RST 12	SHIFT1 0. %	SHIFT2 0. %	SHIFT3 0. %	SHIFT4 0. %	SHIFT5 0. %	SHIFT6 0. %	SHIFT7 0. %	SHIFT8 0. %
RES 3 RES 4	3 (ASSIGNED TO 0 NEEDS) = 0. %	0. %						
STATION 3 RST 11	SHIFT1 0. %	SHIFT2 2.00%	SHIFT3 0. %	SHIFT4 0. %	SHIFT5 0. %	SHIFT6 0. %	SHIFT7 0. %	SHIFT8 0. %
RES 4 RES 5	4 (ASSIGNED TO 2 NEEDS) = 0.47%	0.47%						
STATION 4 RST 11	SHIFT1 8.97%	SHIFT2 20.62%	SHIFT3 25. %	SHIFT4 16.70%	SHIFT5 31.16%	SHIFT6 36.58%	SHIFT7 50.12%	SHIFT8 39.59%
RES 5 RES 6	5 (ASSIGNED TO 20 NEEDS) = 22.73%	22.73%						
STATION 6 RST 8	SHIFT1 0. %	SHIFT2 0. %	SHIFT3 0. %	SHIFT4 0. %	SHIFT5 0. %	SHIFT6 0. %	SHIFT7 0. %	SHIFT8 0. %
RES 6 RES 7	6 (ASSIGNED TO 0 NEEDS) = 0. %	0. %						
STATION 7 RST 8	SHIFT1 2.91%	SHIFT2 9.86%	SHIFT3 13.13%	SHIFT4 12.20%	SHIFT5 1.83%	SHIFT6 17.99%	SHIFT7 18.28%	SHIFT8 15.95%
RES 7 RES 8	7 (ASSIGNED TO 26 NEEDS) = 9.56%	9.56%						
STATION 8 RST 8	SHIFT1 2.13%	SHIFT2 4.55%	SHIFT3 5.97%	SHIFT4 6.19%	SHIFT5 2.89%	SHIFT6 0. %	SHIFT7 0. %	SHIFT8 0. %
RES 8 RES 9	8 (ASSIGNED TO 3 NEEDS) = 3.23%	3.23%						
STATION 9 RST 8	SHIFT1 7.10%	SHIFT2 7.99%	SHIFT3 9.28%	SHIFT4 10.80%	SHIFT5 2.59%	SHIFT6 20.52%	SHIFT7 20.86%	SHIFT8 11.87%
RES 9 RES 10	9 (ASSIGNED TO 25 NEEDS) = 9.71%	9.71%						
STATION 10 RST 8	SHIFT1 1.76%	SHIFT2 10.35%	SHIFT3 20.73%	SHIFT4 10.11%	SHIFT5 19.49%	SHIFT6 16.46%	SHIFT7 30.09%	SHIFT8 19.01%
RES 10 RES 11	10 (ASSIGNED TO 28 NEEDS) = 11.83%	11.83%						
STATION 11 RST 14	SHIFT1 1.39%	SHIFT2 3.06%	SHIFT3 1.56%	SHIFT4 1.15%	SHIFT5 3.50%	SHIFT6 5.11%	SHIFT7 6.29%	SHIFT8 9.89%
RES 11 RES 12	11 (ASSIGNED TO 1 NEEDS) = 0.08%	0.08%						
STATION 12 RST 15	SHIFT1 0.29%	SHIFT2 3.58%	SHIFT3 3.57%	SHIFT4 4.00%	SHIFT5 9.28%	SHIFT6 14.16%	SHIFT7 8.13%	SHIFT8 7.23%
RES 12 RES 13	12 (ASSIGNED TO 3 NEEDS) = 0.23%	0.23%						
STATION 13 RST 4	SHIFT1 2.76%	SHIFT2 0. %	SHIFT3 0.57%	SHIFT4 0.79%	SHIFT5 3.23%	SHIFT6 1.22%	SHIFT7 0. %	SHIFT8 0. %
RES 13 RES 14	13 (ASSIGNED TO 8 NEEDS) = 1.08%	1.08%						

RST 0	RES 17 (ASSIGNED TO 1 NEEDS) = 0.31%	SHIFT1	SHIFT2	SHIFT3	SHIFT4	SHIFT5	SHIFT6	SHIFT7	SHIFT8
STATN 14	8.05%		7.89%	12.36%	10.74%	9.69%	18.06%	16.90%	14.37%
RST 1									
RES 18 (ASSIGNED TO 50 NEEDS) = 14.29%									
RES 19 (ASSIGNED TO 75 NEEDS) = 29.27%									
RST 4									
RES 20 (ASSIGNED TO 6 NEEDS) = 2.14%									
RES 21 (ASSIGNED TO 15 NEEDS) = 5.01%									
RES 22 (ASSIGNED TO 23 NEEDS) = 12.91%									
RST 7									
RES 23 (ASSIGNED TO 2 NEEDS) = 0.36%									
STATN 15	1.58%	SHIFT1	SHIFT2	SHIFT3	SHIFT4	SHIFT5	SHIFT6	SHIFT7	SHIFT8
RST 1			4.56%	0.98%	3.39%	2.41%	8.13%	8.04%	8.75%
RES 24 (ASSIGNED TO 39 NEEDS) = 9.06%									
RST 5									
RES 25 (ASSIGNED TO 8 NEEDS) = 2.05%									
RST 7									
RES 26 (ASSIGNED TO 1 NEEDS) = 0.26%									
STATN 16	1.01%	SHIFT1	SHIFT2	SHIFT3	SHIFT4	SHIFT5	SHIFT6	SHIFT7	SHIFT8
RST 1			6.08%	8.92%	3.78%	6.47%	14.66%	12.25%	2.22%
RES 27 (ASSIGNED TO 31 NEEDS) = 5.49%									
RES 28 (ASSIGNED TO 90 NEEDS) = 17.45%									
RST 4									
RES 29 (ASSIGNED TO 19 NEEDS) = 5.07%									
RST 5									
RES 30 (ASSIGNED TO 6 NEEDS) = 1.47%									
RST 7									
RES 31 (ASSIGNED TO 0 NEEDS) = 0. %									
STATN 17	1.92%	SHIFT1	SHIFT2	SHIFT3	SHIFT4	SHIFT5	SHIFT6	SHIFT7	SHIFT8
RST 1			3.64%	5.62%	4.07%	1.37%	0.80%	2.99%	0.61%
RES 32 (ASSIGNED TO 34 NEEDS) = 6.23%									
RST 4									
RES 33 (ASSIGNED TO 12 NEEDS) = 2.14%									
RST 6									
RES 34 (ASSIGNED TO 1 NEEDS) = 0.13%									
STATN 18	5.09%	SHIFT1	SHIFT2	SHIFT3	SHIFT4	SHIFT5	SHIFT6	SHIFT7	SHIFT8
RST 4			7.64%	6.87%	9.22%	9.28%	9.53%	4.00%	3.25%
RES 35 (ASSIGNED TO 34 NEEDS) = 11.32%									
RST 6									
RES 36 (ASSIGNED TO 8 NEEDS) = 2.81%									
STATN 19	0.09%	SHIFT1	SHIFT2	SHIFT3	SHIFT4	SHIFT5	SHIFT6	SHIFT7	SHIFT8
RST 4			3.51%	3.60%	2.45%	0.21%	3.58%	1.78%	0. %
RES 37 (ASSIGNED TO 27 NEEDS) = 3.62%									
RST 6									
RES 38 (ASSIGNED TO 3 NEEDS) = 0.41%									
STATN 20	2.23%	SHIFT1	SHIFT2	SHIFT3	SHIFT4	SHIFT5	SHIFT6	SHIFT7	SHIFT8
RST 4			3.46%	1.05%	4.05%	5.32%	14.91%	8.67%	5.30%

RES 39	(ASSIGNED TO 57 NEEDS) = 10.58%								
RST 6									
RES 40	(ASSIGNED TO 17 NEEDS) = 2.62%								
RST 7									
RES 41	(ASSIGNED TO 3 NEEDS) = 0.49%								
STATN 21	SHIFT1 0. %	SHIFT2 1.17%	SHIFT3 3.55%	SHIFT4 0.30%	SHIFT5 2.07%	SHIFT6 5.43%	SHIFT7 5.14%	SHIFT8 1.86%	
RST 2									
RES 42	(ASSIGNED TO 16 NEEDS) = 1.99%								
RST 4									
RES 43	(ASSIGNED TO 15 NEEDS) = 3.25%								
RST 6									
RES 44	(ASSIGNED TO 1 NEEDS) = 0.14%								
STATN 22	SHIFT1 4.46%	SHIFT2 7.67%	SHIFT3 7.31%	SHIFT4 4.08%	SHIFT5 1.84%	SHIFT6 10.33%	SHIFT7 6.90%	SHIFT8 6.20%	
RST 1									
RES 45	(ASSIGNED TO 51 NEEDS) = 19. %								
RST 4									
RES 46	(ASSIGNED TO 21 NEEDS) = 4.66%								
RST 6									
RES 47	(ASSIGNED TO 2 NEEDS) = 0.34%								
RST 7									
RES 48	(ASSIGNED TO 0 NEEDS) = 0. %								
STATN 23	SHIFT1 3.42%	SHIFT2 4.68%	SHIFT3 7.15%	SHIFT4 5.81%	SHIFT5 6.14%	SHIFT6 5.22%	SHIFT7 5.20%	SHIFT8 12.71%	
RST 1									
RES 49	(ASSIGNED TO 1 NEEDS) = 1.15%								
RES 50	(ASSIGNED TO 4 NEEDS) = 0.46%								
RES 51	(ASSIGNED TO 13 NEEDS) = 2.37%								
RES 52	(ASSIGNED TO 55 NEEDS) = 17.56%								
STATN 24	SHIFT1 2.12%	SHIFT2 0.83%	SHIFT3 1.39%	SHIFT4 0.76%	SHIFT5 15.42%	SHIFT6 15.63%	SHIFT7 16.66%	SHIFT8 13.51%	
RST 4									
RES 53	(ASSIGNED TO 12 NEEDS) = 8.78%								
RST 6									
RES 54	(ASSIGNED TO 3 NEEDS) = 7.24%								
RST 7									
RES 55	(ASSIGNED TO 1 NEEDS) = 0.19%								
STATN 25	SHIFT1 2.39%	SHIFT2 6.99%	SHIFT3 0. %	SHIFT4 0. %	SHIFT5 1.04%	SHIFT6 6.40%	SHIFT7 3.64%	SHIFT8 0. %	
RST 4									
RES 56	(ASSIGNED TO 23 NEEDS) = 5.27%								
RST 6									
RES 57	(ASSIGNED TO 4 NEEDS) = 0.94%								
STATN 26	SHIFT1 0.69%	SHIFT2 2.22%	SHIFT3 1.98%	SHIFT4 1.87%	SHIFT5 0.11%	SHIFT6 2.51%	SHIFT7 1.15%	SHIFT8 0.53%	
RST 4									
RES 58	(ASSIGNED TO 12 NEEDS) = 2.58%								
RST 6									
RES 59	(ASSIGNED TO 3 NEEDS) = 0.37%								
STATN 27	SHIFT1 0. %	SHIFT2 0. %	SHIFT3 0. %	SHIFT4 0. %	SHIFT5 0. %	SHIFT6 0. %	SHIFT7 0. %	SHIFT8 0. %	
RST 1									
RES 60	(ASSIGNED TO 0 NEEDS) = 0. %								
STATN 28	SHIFT1 0. %	SHIFT2 0. %	SHIFT3 0. %	SHIFT4 0. %	SHIFT5 0. %	SHIFT6 0. %	SHIFT7 0. %	SHIFT8 0. %	

STATN 28	1.25%	0.03%	0.39%	0.0%	1.68%	14.54%	0.0%	11.57%
RST 1								
RES 01 (ASSIGNED TO 5 NEEDS) = 2.47%								
STATN 29	SHIFT1 0.15%	SHIFT2 0.38%	SHIFT3 0.0%	SHIFT4 0.66%	SHIFT5 2.31%	SHIFT6 3.95%	SHIFT7 4.81%	SHIFT8 4.50%
RST 15								
RES 62 (ASSIGNED TO 3 NEEDS) = 0.15%								
RES 63 (ASSIGNED TO 2 NEEDS) = 0.68%								
RES 64 (ASSIGNED TO 10 NEEDS) = 2.94%								
STATN 30	SHIFT1 0.0%	SHIFT2 0.92%	SHIFT3 0.0%	SHIFT4 0.0%	SHIFT5 0.0%	SHIFT6 0.0%	SHIFT7 0.0%	SHIFT8 0.0%
RST 1								
RES 65 (ASSIGNED TO 1 NEEDS) = 0.16%								
RST 3								
RES 66 (ASSIGNED TO 1 NEEDS) = 0.27%								
STATN 31	SHIFT1 4.33%	SHIFT2 0.44%	SHIFT3 3.40%	SHIFT4 6.24%	SHIFT5 0.0%	SHIFT6 0.0%	SHIFT7 0.0%	SHIFT8 1.19%
RST 6								
RES 67 (ASSIGNED TO 7 NEEDS) = 3.16%								
RST 7								
RES 68 (ASSIGNED TO 1 NEEDS) = 1.49%								
STATN 32	SHIFT1 3.15%	SHIFT2 3.47%	SHIFT3 1.07%	SHIFT4 2.76%	SHIFT5 0.0%	SHIFT6 3.18%	SHIFT7 6.29%	SHIFT8 4.05%
RST 6								
RES 69 (ASSIGNED TO 21 NEEDS) = 5.45%								
RST 7								
RES 70 (ASSIGNED TO 2 NEEDS) = 0.19%								
STATN 33	SHIFT1 4.82%	SHIFT2 2.97%	SHIFT3 3.83%	SHIFT4 4.16%	SHIFT5 6.08%	SHIFT6 4.23%	SHIFT7 13.10%	SHIFT8 14.87%
RST 13								
RES 71 (ASSIGNED TO 7 NEEDS) = 2.43%								
RES 72 (ASSIGNED TO 15 NEEDS) = 7.83%								
STATN 34	SHIFT1 0.0%	SHIFT2 0.0%	SHIFT3 0.0%	SHIFT4 0.0%	SHIFT5 0.0%	SHIFT6 4.23%	SHIFT7 1.27%	SHIFT8 0.0%
RST 10								
RES 73 (ASSIGNED TO 2 NEEDS) = 0.47%								
STATN 35	SHIFT1 12.29%	SHIFT2 30.35%	SHIFT3 32.86%	SHIFT4 22.45%	SHIFT5 14.46%	SHIFT6 62.02%	SHIFT7 23.02%	SHIFT8 11.11%
RST 5								
RES 74 (ASSIGNED TO 63 NEEDS) = 25.56%								
STATN 36	SHIFT1 0.0%	SHIFT2 3.77%	SHIFT3 3.24%	SHIFT4 0.0%	SHIFT5 0.0%	SHIFT6 6.69%	SHIFT7 0.0%	SHIFT8 0.0%
RST 4								
RES 75 (ASSIGNED TO 8 NEEDS) = 1.92%								
STATN 37	SHIFT1 0.07%	SHIFT2 12.11%	SHIFT3 12.57%	SHIFT4 4.55%	SHIFT5 0.0%	SHIFT6 37.44%	SHIFT7 6.97%	SHIFT8 0.0%
RST 5								
RES 76 (ASSIGNED TO 42 NEEDS) = 8.83%								
STATN 38	SHIFT1 0.0%	SHIFT2 2.08%	SHIFT3 0.0%	SHIFT4 0.0%	SHIFT5 0.0%	SHIFT6 5.46%	SHIFT7 0.0%	SHIFT8 0.0%
RST 4								
RES 77 (ASSIGNED TO 7 NEEDS) = 1.02%								

V. EXCEPTIONAL CASES

VI. DISTRIBUTIONS

A. SYSTEM

	MEAN	STD. DEV.	0-0.5	0.5-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-10.0	>10
DAILY UTILIZATION OVERALL (WEEKDAYS)	3.86	1.25	0	0	1	5	7	5	4	0
DAILY UTILIZATION OVERALL (WEEKENDS)	6.88	1.30	0	0	0	0	0	0	9	0

B. CASES

	MEAN	STD. DEV.	0-0.5	0.5-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0-5.0	5.0-10.0	>10
TWAIT (ALL CASES)	1.00	1.42	161	183	73	16	4	5	14	2
TWAIT (ALL CASES)	0.86	1.32	165	173	45	6	3	5	7	2
TVEC (ALL CASES)	0.77	1.26	268	106	54	8	5	6	10	1
TVEC (ALL CASES)	0.63	0.89	243	107	35	8	2	7	4	0
TWAIT-TOL (ALL CASES)	-1.81	2.07	30	10	8	3	5	3	7	0
TWAIT-TOL (ALL CASES)	-2.03	1.98	30	10	3	1	2	2	3	1
DEMERIT (ALL CASES)	0.24	1.04	30	10	8	3	5	3	7	0
DEMERIT (ALL CASES)	0.16	0.93	30	10	3	1	2	2	3	1
TSVC (ALL CASES)	2.66	3.65	7	69	204	78	31	15	31	19
TSVC (ALL CASES)	2.32	3.30	3	84	192	59	22	11	21	14

THERE WERE NO CASES IN THE QUEUE WHEN THE SIMULATION ENDED AT 31.00.04

THE FOLLOWING RESOURCES WERE BUSY WHEN THE SIMULATION ENDED AT 31.00.04

RESOURCE	RESOURCE STATION	XR	YR	IB	CASE	OCCUR	CASE STATION	NN	MM	S1S	S2S	XC	YC	TWAIT
9	9	111.	129.	2	2220039	30.21.34	9	0	1	0	0	111.	129.	0.01.24
10	10	-11.	96.	2	2110037	30.04.57	34	1	2	0	0	-11.	96.	0.00.57
45	22	72.	-99.	1	3610036	27.14.34	22	9	0	1	0	72.	-99.	0.01.13
53	24	84.	-59.	1	3120031	30.21.49	19	1	0	0	0	86.	-26.	0.00.00

<u>LABEL</u>	<u>ATTRIBUTE</u>
Number of Cases	NCAS (STA)
Number of Needs	NEEDS (STA)
Failure Type A	FAIL1 (STA)
Failure Type B	FAIL2 (STA)
Failure Type C	FAIL3 (STA)
Number of Q's	NMBRQ (STA)
Total Interrupted Needs	NINTR (STA)
Average TVEC (Hours)	VCTR (STA)
Average TWAIT (Hours)	AVGTW (STA)
Average CFAIL (TWAIT-TOL) (Hours)	CFIT (STA)
Average Pos. TWAIT-TOL (Hours)	TWTOL (STA)
Normalized Demerit (Hours)	DMRT (STA)
Standbys Calls/Unpro.	NSTBY (STA), UNPRO (STA)
Average Utilization	USE (STA)

The last row printed in this division is labeled "TOTAL/AVG". Reading from left to right the entries in this row are KOUNT, SNEED, NBRFA, NBRFB, NBRFC, LIMIT, TOTIN, MEANV, MEANW, MCFTT, MNTMT, MEAND, TOSBY, TUNPR, and AVUTO.

"Group Response" labels the fourth division. The correspondence between column labels and attribute names follows.

<u>LABEL</u>	<u>ATTRIBUTE</u>
Number of cases	CS (GROUP)
Number of needs	NDS (GROUP)

Failure Type A	FL1(GROUP)
Failure Type B	FL2(GROUP)
Failure Type C	FL3(GROUP)
Total Interrupted Needs	INTRP(GROUP)
Average TVEC (Hours)	TVAVG(GROUP)
Average TWAIT (Hours)	TWAVG(GROUP)
Average Pos. TWAIT-TOL (Hours)	TMTAV(GROUP)
Normalized Demerit	AVDRT(GROUP)
Times Standby Called	NOSB(GROUP)
Unproductive Standby Calls	NONPR(GROUP)
Average Utilization	USEAV(GROUP)

The fifth division is labeled "Resource Utilization (Percent)". Here again the output is grouped by station. The columns labeled "SHIFT1", "SHIFT2", etc. contain the attribute USHF(I,J) for the station I and shift J. Every resource assigned to the station is listed in a group according to resource type; the average utilization UTIL and the number of needs served by the resource NCASE are printed.

The sixth division is labeled "Exceptional Cases". It prints the major attributes of all cases which were not completely processed because of some unusual circumstances. The value of ITOL(CASE) which is among the attributes printed gives some indication of the reason that the case was termed "exceptional" and was filed in the set EXCS.

The seventh division is broken into two sections. The mean, standard deviation and distribution of both weekday and weekend utilization are

output in the first section. In the second section, the mean, standard deviation and distribution of ~~certain critical~~ attributes are printed.

The eighth and final division prints the status of cases which are in the queue and are not completed and resources which are still busy when the simulation ends. The following attributes are labeled and printed for cases remaining in the queue: NOCAS, OCCUR, STATN, NNN, MMM, S1S, S2S, XC, YC, TINC, SIGNL and FLG. If there are no remaining cases in the queue, a message only is printed. For the cases being served when the simulation ends the following attributes are labeled and printed: NOCAS, OCCUR, STATN, NNN, MMM, S1S, S2S, XC, YC, and TWAIT. The case attributes here refer to the case stored in ACASE (IFLT(IRS)), that is the case to which the resource is assigned. It should be noted here that TWAIT is zero until the first resource arrives on the scene of the case. If no resources are busy at the end of the simulation a message to this effect is printed.

The second basic type of output has been referred to as the "Tape Output". This output is produced only if the value of STAPE is non-zero. If the value of STAPE corresponds to a tape unit, a tape must be requested by the appropriate letter on an ASG control card as described in part V, User's Guide. Every time that a case terminates via completion and STAPE $\neq 0$, Subroutine TERM outputs the major attributes of the case. Four records are written for each case. The contents of each record will be given, followed by the SIMSCRIPT format as well as a FORTRAN format for reading the records.

Record 1: NBRCO, OPFAC, NOCAS, IDLOC, OCCUR, BOX, FPRI, MMM, NNN, GAMMA, NEED, AIR, OFSHR, VIS, WIND, SWELL, L, POB, S1S, S2S, TSM, OST, DMERT.

SIMSCRIPT Format: (3I5, I3, D3.4, I5, I1, 2I2, D3.2, I2, I5, D4.2, 6I5, I2, D5.0, 2D1.4).

FORTRAN Format: (3I5, I3, F8.4, I5, I1, 2I2, F6.2, I2, I5, F7.2, 6I5, I2, F6.0, 2F6.4).

Record 2: UTYPE, VALJE, XCX, YCY, XC, YC, STATN, CNRES, RESA, PRI, REA, COSTC, ITOL, NOINT, NQUE, TINT, TQUE, TQUE1, TSVC, TWAIT.

SIMSCRIPT Format: (I5, I10, 4D5.2, I5, I2, I3, 2I1, D7.2, I1, 2I2, 5D3.4).

FORTRAN Format: (I5, I10, 4F8.2, I5, I2, I3, 2I1, F10.2, I1, 2I2, 5F8.4).

Records 3 and 4 apply to NOTIF's and NOTE's respectively. Four attributes of NOTIF and one attribute of NOTE are always output for five NOTIF's and five NOTE's, regardless of the actual number of NOTIF's and NOTE's associated with the case. If there are less than five of either, the meaningless portion of the record will contain zero's. If there are more than five of either, only the "first" five will be output. "First" refers to the order in which they were filed in their respective sets NSET and SRHS. The actual variables are first stored in a buffer and then output.

Record 3: NEED, OST, DELTA, RESA, NEED, OST, DELTA, RESA, etc.

SIMSCRIPT Format: (5(I2, D1.4, D1.2, I3)).

FORTRAN Format: (5(I2, F6.4, F4.2 I3)).

Record 4: RESA, RESA, RESA, RESA, RESA.

SIMSCRIPT Format: (5I3).

FORTTRAN Format: (5I3).

It should be noted that the variable NBRCO output in record 1 simply provides a sequence number for the cases being printed.

At the end of the simulation, if STAPE $\neq$ 0, the four records described above are output for all cases filed in EXCS. They are printed in the order in which they were filed in EXCS. It should be noted that all information for NOTE or NOTIF was destroyed when the case was filed in EXCS. Thus the third and fourth records for these cases will always be zero filled. The sequence numbers for these cases begins with the value NBRCO + 1, where NBRCO is the number of cases completed at the end of the simulation.

There is one significant warning message which could occur during the execution of a simulation. It is printed in Exogenous Event OPSIM, as an attempted "Failsafe" device to prevent too many cases from entering the simulation system at one time, thereby exceeding core storage and destroying all data of the run because of an abnormal abort. The variable KOUNT is increased by one every time a case is created and decreased by one when a case is destroyed. Thus KOUNT is (during the simulation) the number of cases currently being processed in the system. A variable LIMIT is calculated in Exogenous Event START. It is an estimate of the maximum number of Cases which can reside in core storage at one time. It is an empirical

relation based on the number of resources NRES, the number of stations NSTA, the number of resource types NRST, the number of groups NGROUP and the number of distributions, NDSTRB; it is given by:

$$(10500. - 10. * NRES - 19. * NSTA - 6. * NRST - 6. * NGROUP - 5. * NDSTRB) / 50.$$

For example, with 109 resources, 47 stations, 16 resource types, 8 groups and 12 distributions, there can be approximately 165 cases in the system at one time. It should be emphasized that this is only an estimate which could be revised at any time.

If at any time the value of KOUNT exceeds the value of LIMIT, the warning is printed. From then on, cases will be destroyed as soon as they occur. Those cases already in the system at the time the message is written will be processed until completion.

