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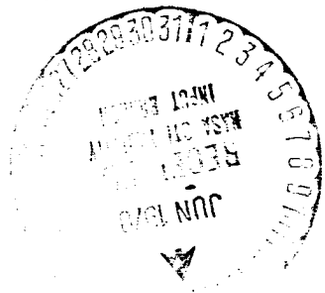
JPL Contract 952532

MCR-68-97 (Vol VIII) Copy No. 17

A Study Program on the Development of a Mathematical Model(s) for Microbial Burden Prediction

Final Report
Addendum

Volume VIII
Revisions to Volume VI
User's Manual



APRIL 1970

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MARTIN MARIETTA CORPORATION

A STUDY PROGRAM ON THE DEVELOPMENT OF MATHEMATICAL MODEL(S) FOR MICROBIAL BURDEN PREDICTION

JPL Contract 952532

Volume VIII

Revisions to Volume VI

User's Manual

(Task 3 of Phase VIII)

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FOREWORD

This document describes the work performed as Task 3 of Phase VIII of JPL Contract 952532. (This is a follow-on the JPL Contract 952028.) Phase VIII accomplished improvements in the preparation of input data for the computer programs generated in Phase III.

This document contains all the corrections to the Revised User's Manual for the Microbial Burden Prediction Model (Volume VI) and is to be considered an addendum to that Manual, and, by extension, to the original User's Manual for the Microbial Burden Prediction Model (Volume II).

CONTENTS

I. INTRODUCTION

During Phases I, II, and III of JPL Contract 952028 the requirements for the Microbial Burden Prediction Model (MBPM) were established, and the model was developed and programmed for computer utilization. During Phases IV, V, and VI, the model was used to estimate the burden on the Mariner V Spacecraft.

As a result of the above work, a number of changes were identified that would improve the effectiveness of the existing computer programs. These changes were effected during Phase VII of the carry-on contract (JPL Contract 952532). As a result of the experience gained during the preparation of the input data, the desirability of a more manageable method of preparing this data for input to the program was recognized.

The Input Translator Program (ITP) has been developed during Phase VIII of JPL Contract 952532 to meet this latter need. The ITP performs much of the repetitious and time-consuming work involved in preparing input data. In addition, it also performs bookkeeping chores such as maintaining the current status of all parts. The ITP has been programmed so that only minor revisions have been made to the previously developed portions of the program. In most cases, an error of input data to the ITP is printed as an error, but does not stop the production of an input tape for the Tape Alteration Subroutine (TAS). The manual preparation of input data is therefore reduced to coding the JPL Quality Assurance Daily Activity Report information for key punching, key punching this information, and making corrections to the errors which are flagged by the ITP. (Ref. 8)

Volume VII of this series of reports is a User's Manual whi h describes the various subroutines comprising the Input Translator Program, the method of data input, and the process of transferring the output data to the MBPM.

The principal factor in the development of the ITP that contributed to changes in existing programs was the change from making parts inputs at the Task level to making these inputs at the Subtask level.

Although the changes are minor in nature and small in number, the effect is felt on a number of pages of the User's Manual. All references to page number in this document are to Volume VI, the Revised User's Manual for the Microbial Burden Prediction Model. Revisions are listed sequentially, whether by reference to a revised item or by the issue of a revised page.

The ITP has been used to prepare input data based on the Mariner Mars 69-3 spacecraft for use of the MBPM. Using this input data, the MBPM has been run on the CDC 6400 at Martin Marietta's Denver facility and on the Univac 1108 at JPL in Pasadena.

Volume IX of this series of reports describes the preparation of the input data, the results of the burden prediction of the MM 69-3, and a comparison with swab sample data taken during the spacecraft preparation.

II. REVISIONS TO VOLUME VI

Page

4 Option #2 can no longer be used as before. If this option is used, the dumps will all be on Tape 3 in succession. Restart capabilities are built into the ITP.

6 Under item "---- START OF NEW SUBTASK ----", change "PREREQUISITE SUBTASKS - -0, -0" to read "PREREQUISITE TIME DISTRIBUTIONS- -0, -0".

9 Replace with new page 9, dated April 1970.

12 Change line starting "K = 2" from "Add M cards ...." to read "Add M records ...."

18 To the list of tapes add "Tape 3: Binary restart dumps (write)"; to the description of Tape 12 add "Tape 12 is written by the ITP for input to TAS".

22 Delete block labelled "Determine Task Start Time". This function has been transferred to the MBS.

23 Replace with new page 23, dated April 1970.

27 Replace with new page 27, dated April 1970.

28 Delete lines starting "IK = 3" and "IL = 4"; change "IK = 5" to read "IK = 3"; with reference to I2 = 2 it should be noted that the restart tape is no longer rewound at each task because of the new ITP, TAS, and BPS restart capability; therefore, restart dumps at the end of each task are now of no value.

29 Under discussion of KK = 6, change "Tape 2" to read "Tape 3".

30 Replace with new page 30, dated April 1970.

31 Replace with new page 31, dated April 1970.

32 Replace with new page 32, dated April 1970.

35 Delete description of SUBTASK DESCRIPTION CARD.

Appendix - Replace entirely with new program source deck listing.

Table 3 Tape 9 Record Formats

Card Type	PARAMETERS												
	INTEGER						FLOATING OR ALPHAMERIC						
	1	2	2	4	5	6	7	8	9	10	11	12	13
CC	KK	IK	I1	I2	I5	I6	I3	I4					
RD	KR						← RUN (7) →						
SD	KS						← STG (7) →						
TD	KT	L4	K3				← TSK (7) →						
EM							AES(1)	AES(2)	AES(3)	AES(4)			
ED	N						← DSC(4) →						
EQ	IEC	IET					AEC	AET	AED	AEF(1)	AEF(2)	AEF(3)	AEF(4)
OD	N						← DSC(4) →						
OQ	IOT	IOQ	IOC										
KD	N	L1	L2	L3			← DSC(4) →						
PD	N						← DSC(6) →						
PQ	IAB(1)	IAB(2)	IAB(3)	IAB(4)	IAB(5)	IAB(6)	AAG	AAS					
DD	N	M	L				← DSC(4) →						
KC	K	IR(1)	IR(2)	IR(3)	IR(4)		AR(1)	AR(2)	AR(3)				
KO	IO	IKE					AKT	AKQ					
PE	IP	LS					APD	APC	APS	APA(1)	APA(2)		
PE	IP	LK					AR(1)	AR(2)	AR(3)	AR(4)			
ZD	IZ						← DSC(4) →						
ZC	IP						FP(1)	FP(2)	FP(3)	FP(4)			
DQ	Different Format			22 Parameters: DR(N,1), DR(N,2),...,DR(N,11), XR(N,11) Numbered 1 thru 22.									

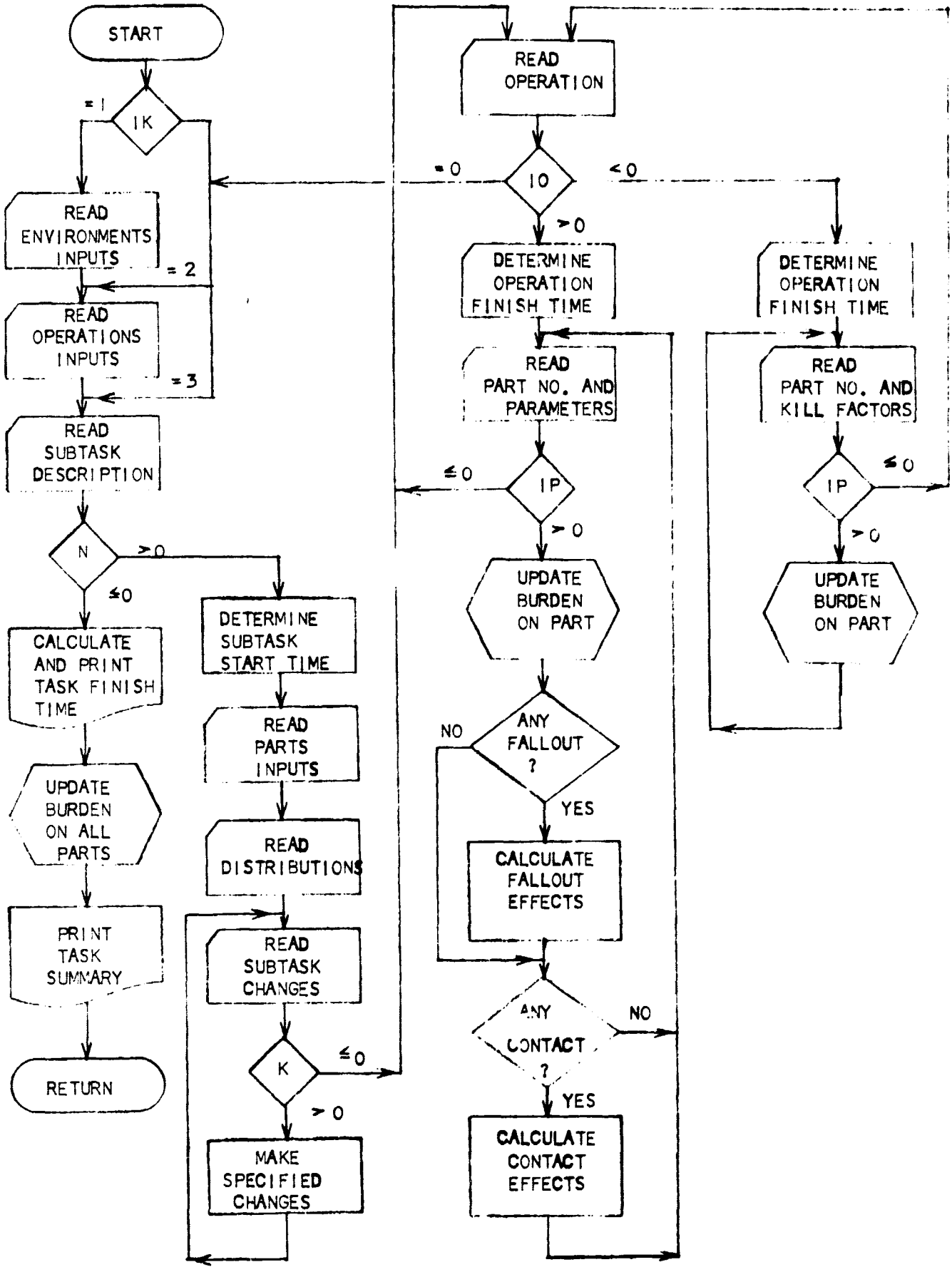
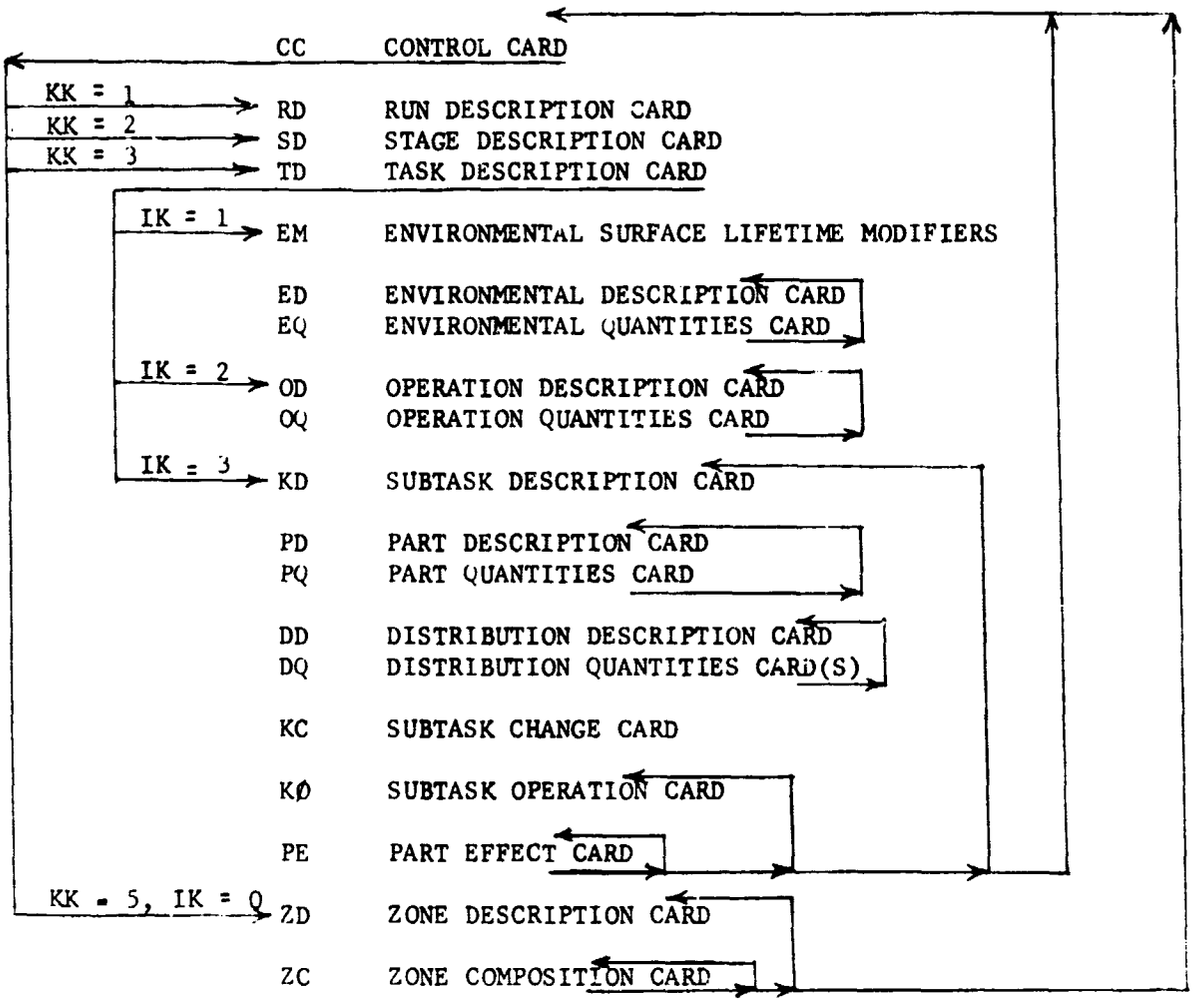


Figure 3. Subroutine MBS Macrologic

Vol. VI, p. 27
(dated April 1970)

TABLE 8

Input Data Deck



RD RUN DESCRIPTION CARD

KR, RUN

FORMAT (I5, 1X, 7A6)

A RUN DESCRIPTION CARD is the first card to follow the CONTROL CARD initiating a run. KR is the run number and RUN is a 42 alphameric character description of the run.

SD STAGE DESCRIPTION CARD

KS, STG

FORMAT (I5, 1X, 7A6)

A STAGE DESCRIPTION CARD follows a RUN DESCRIPTION CARD or a CONTROL CARD initiating a stage. KS, which must be in the range 1 to 20, is the stage number and STG is a 42 alphameric character description of the stage.

TD TASK DESCRIPTION CARD

KT, TSK, L4, K3

FORMAT (I5, 1X, 7A6, 2X, 2I5)

A TASK DESCRIPTION CARD follows a STAGE DESCRIPTION CARD or a CONTROL CARD initiating a task. KT, which must be in the range 1 to 100, is the task number and TSK a 42 alphameric character description of the task. L4, if specified, causes the total microbial burden at the end of the task to be stored in special storage distribution L4 and to be available for later computation of a burden difference. 1K on the preceding CONTROL CARD indicates the card type to follow. L4 is in the range 1 to 20. K3 is a print flag which when non-zero causes burden distributions by zone and surface to be printed at the end of the task. This flag does not operate like I1 or I2 on CC. K3 must be non-zero for each print desired.

EM ENVIRONMENTAL AVERAGE LIFETIME MODIFIERS CARD

AES(1), AES(2), AES(3), AES(4)

FORMAT (4E10.3)

The ENVIRONMENTAL AVERAGE LIFETIME MODIFIERS appear on the first card of the environments inputs. AES(J) is the factor which modifies the quantity AET(N) on card EQ.

ED ENVIRONMENTAL DESCRIPTION CARD

N, DSC

FORMAT (I5, 1X, 4A6)

Each of the (up to 10) environments requires two input cards. The first of these is the ENVIRONMENT DESCRIPTION CARD which gives the index N and the 24 alphameric character description DSC. The last such description card is to be blank to indicate that all environment inputs have been read. All but the last (blank) ENVIRONMENT DESCRIPTION CARD are to be followed by an ENVIRONMENT QUANTITIES CARD.

EQ ENVIRONMENT QUANTITIES CARD

IEC(N), IET(N), AEC(N), AET(N), AED(N), AEF(N,1), AEF(N,2), AEF(N,3), AEF(N,4)

FORMAT (2I5, 7E10.3)

IEC(N), AEC(N) describe the background number of organisms/cu ft (C) in environment N. IEC is a "shape" distribution index and AEC is the mean of the distribution for this application.

IET(N), AET(N) are the average lifetime distribution shape and mean (V).

AED(N) is the mean number of organisms per cubic foot of air per man in this environment (d).

AEF(N) is the fallout velocity mean value (f).

OD OPERATION DESCRIPTION CARD

N, DSC

FORMAT (I5, 1X, 4A6)

Each of the (up to 35) cataloged operations requires two input cards. The first of these is the OPERATION DESCRIPTION CARD which gives the index N and the 24 alphameric character description DSC. The last of these cards is to be blank to indicate that all operations input have been read. All but the last (blank) card are to be followed by an OPERATION QUANTITIES CARD.

OQ OPERATION QUANTITIES CARD

IOT(N), IOQ(N), IOC(N)

FORMAT (3I5)

IOT(N) is the distribution shape for the time required to perform operation N.

IOQ(N) is the distribution shape for the number of organisms per cubic foot per man.

IOC(N) is the distribution shape for the number of organisms on hand or tool (contact contamination).

KD SUBTASK DESCRIPTION CARD

N, DSC, L1, L2, L3

FORMAT (I5, 1X, 4A6, 3I5)

The input data for each of the subtasks per task is headed with a SUBTASK DESCRIPTION CARD that gives the subtask number N and the 24 alphameric character description DSC. L1 and L2 indicate the finish time special storage distributions of prerequisite tasks which are to determine the start time of this task. If only one prerequisite (L1) is specified, the new start time is set equal to the time stored in L1. If no prerequisite is specified, the start time is set equal to zero. L3 is the index of the finish time special storage distribution if this subtask is to be prerequisite for any later subtask. L1, L2, and L3 are in the range 1 to 20.

APPENDIX

PROGRAM SOURCE DECK

LISTINGS

```
                                                                      A1
      SUBROUTINE TAS
C     TAPE ALTERATION SUBROUTINE
C     THIS SUBROUTINE READS FROM TAPE12 AND WRITES ON TAPE9
      COMMON   LN, LR, IX(6), XX(22), M, N1, N2, I(6,120), X(22,20),
     .         K(22,20), KIL, NE, KE(11), IAB(120,6), DR(500), XR(500),
     .         IO, AR(4), NP, LH(20), KXT, DUM(14423)
  600 FORMAT(/13H ----- CHANGE,I10,2I5,F15.6/)
      REWIND 9
      REWIND 12
      KXT=0                                                           A
      DO 1000 L=1,11
 1000 KE(L)=0
      N1=0
      N2=0
      KIL=1
      ND=0
      NE=0
      LN=1
      CALL PTS
      DO 1 J=1,22
      DO 1 L=1,20
    1 K(J,L)=0
      READ(5,500) NN,KK,MM,F,KLL
      IF((NN.NE.0).OR.(KK.NE.2)) GO TO 9
      NP=NP+3
      IF(NP.GE.55) CALL PTS
      WRITE(6,600) NN,KK,MM,F
      GO TO 21
    2 READ(5,500) NN,KK,MM,F,KLL
  500 FORMAT(I10,2I5,F10.0,I5)
    9 IF(KLL.GT.0) KIL=KLL
    3 CALL TRS
    4 IF(NN-N1) 6666,7,5
    5 CALL RAS
      CALL RCWS
      IF(LN.EQ.0) RETURN
      GO TO 3
 6666 NP=NP+5
      IF(NP.GE.55) CALL PTS
      WRITE(6,601)
  601 FORMAT(/34H ***** INSTRUCTION OUT OF SEQUENCE)
      WRITE(6,600) NN,KK,MM,F
    6 READ(5,500) NN,KK,MM,F,KLL
      IF(KLL.GT.0) KIL=KLL
      GO TO 4
    7 NP=NP+3
      IF(NP.GE.55) CALL PTS
      WRITE(6,600) NN,KK,MM,F
      IF(KK.GT.0) GO TO 8
      CALL RAS
      CALL RCWS
      CALL EPS(0)
      RETURN
    8 GO TO(101,102,103,104,105,106,107,108),KK
C     REPLACE RECORD NN WITH A NEW CARD
  101 CALL CRS
      CALL RCWS
      IF(LN.EQ.0) RETURN
      GO TO 2
C     ADD MM CARDS AFTER RECORD NN
  102 CALL RAS
      CALL RCWS
```

```
      IF(LN.EQ.0) RETURN                                              A2
   21 IF(KLL.GT.0) KIL=KLL                                             G
      DO 20 L=1,MM                                                     G
      CALL CRS
      CALL RCWS
      IF(LN.EQ.0) RETURN
   20 CONTINUE
      GO TO 2
C     DELETE MM RECORDS STARTING WITH RECORD NN
  103 DO 30 L=1,MM
      CALL TRS
   30 CONTINUE
      GO TO 6
C     REPLACE PARAMETER MM ON RECORD NN BY F
  104 IF(LR.EQ.17) GO TO 40
      IF(MM.LE.6) GO TO 41
      XX(MM-6)=F
      GO TO 6
   41 IX(MM)=F
      GO TO 6
   40 XX(MM)=F
      GO TO 6
C     MULTIPLY PARAMETER MM ON RECORD NN BY F
  105 IF(LR.EQ.17) GO TO 50
      IF(MM.LE.6) GO TO 6
      XX(MM-6)=XX(MM-6)*F
      GO TO 6
   50 XX(MM)=XX(MM)*F
      GO TO 6
C     REPLACE PARAMETER MM BY F ON NN AND SUBSEQUENT RECORDS
  106 K(MM,LR)=1
   60 IF(LR.EQ.17) GO TO 66
      IF(MM.LE.6) GO TO 64
      X(MM-5,LR)=F
      GO TO 6
   64 I(MM,LR)=F
      GO TO 6
   66 X(MM,LR)=F
      GO TO 6
C     MULTIPLY PARAMETER MM BY F ON NN AND SUBSEQUENT RECORDS
  107 K(MM,LR)=2
      GO TO 60
C     STOP ALTERING PARAMETER MM.  (RECORD NN IS NOT ALTERED.)
  108 K(MM,LR)=0
      GO TO 6
      END
```

```
      SUBROUTINE TRS
C     TAPE READING SUBROUTINE  (READS BINARY RECORDS FROM TAPE12)
      COMMON    LN, LR, IX(6), XX(22), M, N1, N2, I(6,120), X(22,20),
     .          K(22,20), KIL, NC, KE(11), IAB(120,6), DR(500), XR(500),
     .          IO, AR(4), NP, LH(20), KYT, DUM(14423)
      N1=N1+1
      IF(LN.EQ.17) GO TO 5
      READ(12)LR,IY,(XX(J),J=1,7)
      RETURN
    5 READ(12)LR,XX
      RETURN
      END
```

```
      SUBROUTINE CRS
C     CARD-READING SUBROUTINE
      COMMON   LN, LR, IX(6), XX(22), M, N1, N2, I(6,120), X(22,20),
     .         K(22,20), KIL, NE, KE(11), IAB(120,6), DR(500), XR(500),
     .         IO, AR(4), NP, LH(20), KXT, DUM(14423)
      LR=LN
      GO TO(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,5),LN
    1 READ(5,501) IX
  501 FORMAT(4I5,10X,2I5)
      RETURN
    2 READ(5,502) IX(1),(XX(J),J=1,4),(IX(J),J=2,4)                    G
  502 FORMAT(I5,1X,4A6,4I5)                                            G
      RETURN
    3 READ(5,503) IX,(XX(J),J=1,3)
  503 FORMAT(6I5,3E10.3)
      RETURN
    4 READ(5,505) IX(1),IX(2),XX(1),XX(2)
      RETURN
    5 READ(5,505) IX(1),IX(2),(XX(J),J=1,5)
  505 FORMAT(2I5,7E10.3)
      RETURN
    6 READ(5,508) IX(1),(XX(J),J=1,7)
      RETURN
    7 READ(5,508) IX(1),(XX(J),J=1,7)
      RETURN
    8 READ(5,508) IX(1),(XX(J),J=1,7),(IX(J),J=2,3)                    G
  508 FORMAT(I5,1X,7A6,2X,4I5)
      RETURN
    9 READ(5,509) (XX(J),J=1,4)
  509 FORMAT(8E10.3)
      RETURN
   10 READ(5,502) IX(1),(XX(J),J=1,4)
      RETURN
   11 READ(5,505) IX(1),IX(2),(XX(J),J=1,7)
      RETURN
   12 READ(5,502) IX(1),(XX(J),J=1,4)
      RETURN
   13 READ(5,501) (IX(J),J=1,3)
      RETURN
   14 READ(5,508) IX(1),(XX(J),J=1,6)
      RETURN
   15 READ(5,503) IX,XX(1),XX(2)
      RETURN
   16 READ(5,502) IX(1),(XX(J),J=1,4),IX(3),IX(2)
      RETURN
   17 READ(5,509) (XX(J),J=1,M)
      MP=M+11
      READ(5,509) (XX(J),J=12,MP)
      RETURN
   18 READ(5,502) IX(1),(XX(J),J=1,4)
      RETURN
   19 READ(5,519) IX(1),(XX(J),J=1,4)
  519 FORMAT(I5,5X,4E10.7)
      RETURN
      END
```

```
      SUBROUTINE RAS                                                    AS
C     RECORD ALTERATION SUBROUTINE
      COMMON   LN, LR, IX(6), XX(22), M, N1, N2, I(6,120), X(22,20),
     .         K(22,20), KIL, KE, KE(11), IAB(120,6), DR(500), XR(500),
     .         IO, AR(4), NP, LH(20), KXT, DUM(14423)
      IF(LR.EQ.17) GO TO 29
      DO 10 L=1,6
      IF(K(L,LR).EQ.1) IX(L)=I(L,LR)
   10 CONTINUE
      DO 20 L=7,13
      IF(K(L,LR)-1) 20,21,22
   21 XX(L-6)=X(L-6,LR)
      GO TO 20
   22 XX(L-6)=XX(L-6)*X(L-6,LR)
   20 CONTINUE
      RETURN
   29 DO 30 L=1,22
      IF(K(L,LR)-1) 30,31,32
   31 XX(L)=X(L,LR)
      GO TO 30
   32 XX(L)=XX(L)*X(L,LR)
   30 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE RCWS
C     RECORD CHECKING AND WRITING SUBROUTINE  (WRITES BINARY ON TAPE9)
C     LR IS CURRENT RECORD TYPE, LN IS NEXT RECORD TYPE.
      COMMON   LN, LR, IX(6), XX(22), M, N1, N2, I(6,120), X(22,20),
     .         K(22,20), KIL, NE, KE(11), IAB(120,6), DR(500), XR(500),
     .         IO, AR(4), NP, LH(20), KXT, DUM(14423)
      DIMENSION CT(20)
      DATA(CT(I),I=1,20)/2HCC,2HKD,2HKC,2HKO,2HPE,2HRD,2HSD,2HTD,2HEM,
     .2HED,2HEO,2HDD,2HCO,2HPD,2HPO,2HDD,2HDO,2HZD,2HZC,2HPE/
      DATA     NAME      / 6HTAS     /
  600 FORMAT(I7,3X,A2,I4,1H/,I3,1H/,I2)
      N2=N2+1
      LX=LN
      NP=NP+1
      IF(LR.EQ.17) NP=NP+2
      IF(NP.GE.55) CALL PTS
      GO TO(10,20,30,40,50,60,70,80,90,100,110,120,130,140,150,160,170,
     .180,190,200),LR
C                                CC CARD
   10 WRITE(6,600) N2,CT(LR)
      WRITE(6,601) IX
  501 FORMAT(1H ,23X,6I4)
      KK=IX(1)
      IF(KK.GT.0) GO TO 11
      WRITE( 9) LR,IX,(XX(J),J=1,7)
      WRITE (3)  NAME, (( IAB(J,L), J=1,120 ), L=1,6 ), ( DR(J), J=1,    G
     .       500 ), ( XR(J), J = 1, 500 ), ( LH(J), J = 1, 20 ), KS      6
      CALL EPS(0)
      LN=0
      RETURN
   11 IF(KK.LE.5) GO TO 12
      KJI = 0
  111 KJI = KJI + 1
      READ (2)  INAME, (( IAB(J,L), J=1,120 ), L=1,6 ), ( DR(J), J=1,    G
     .       500 ), ( XR(J), J = 1, 500 ), ( LH(J), J = 1, 20 ), KS      6
      IF ( INAME .EQ. NAME )              GO TO 113
      IF ( KJI .LT. 2 )                   GO TO 111
      WRITE (6,112)
  112 FORMAT ( 42H1*****ERROR***** NO TAS RESTART DUMP FOUND )
      STOP
  113 LN=1
      IF(KK.EQ.6) GO TO 1000                                              A
      KXT=0                                                               A
      CALL EPS(1)
      LN=8
      GO TO 1000
   12 IF(KK-4) 13,14,15
   13 IK=IX(2)
      LN=KK+5
      IF((IK.GT.0).AND.(IK.LE.3)) GO TO 1000                              G
      CALL EPS(1)
      IK=3                                                                G
      GO TO 1000
   14 IF((IX(3).LE.0).OR.(IX(3).GT.20)) CALL EPS(1)
      IF((IX(4).LE.0).OR.(IX(4).GT.20)) CALL EPS(1)
      LN=1
      GO TO 1000
   15 LN=18
      IF(IX(2).EQ.1) LN=1
      GO TO 1000
C                                KD CARD
   20 IF ( IX(1) .NE. 0 )                 N = IX(1)                     G
```

```
      WRITE(6,600) N2,CT(LR),KS,KT,N                                    A7
      WRITE(6,602) (IX(J),J=1,4),(XX(J),J=1,4)                           G
  602 FORMAT (1H+,23X,4I4,13X,4A6)                                       G
      IF ( IX(1) .GT. 0 )                GO TO 21
      LN=1
      GO TO 1000
   21 LN=14                                                              G
   22 L1=IX(2)                                                           G
      IF(L1.LE.0) GO TO 24                                               G
      IF(L1.GT.20) GO TO 23                                              G
      IF(LH(L1).LE.0) CALL EPS(2)                                        G
      L2=IX(3)                                                           G
      IF(L2.LE.0) GO TO 24                                               G
      IF(L2.GT.20) GO TO 23                                              G
      IF(LH(L2).LE.0) CALL EPS(2)                                        G
      GO TO 24                                                           G
   23 CALL EPS(1)                                                        G
   24 L3=IX(4)                                                           G
      IF(L3.LE.0) GO TO 26                                               G
      IF(L3.GT.20) GO TO 25                                              G
      LH(L3)=1                                                           G
      GO TO 26                                                           G
   25 CALL EPS(1)                                                        G
   26 IF(IX(5).GT.20) CALL EPS(1)                                        G
      DO 27 J = 101, 120                                                 G
      DO 27 L = 1, 6                                                     G
   27 IAB(J,L) = 0                                                       G
      GO TO 1000
C                                KC CARD
   30 WRITE(6,600) N2,CT(LR),KS,KT,N
      WRITE(6,603) IX,(XX(J),J=1,3)
  603 FORMAT(1H+,23X,6I4,3F10.3)
      IF(IX(1).GT.0) GO TO 32
      LN=4
      GO TO 1000
   32 IF(XX(1).GT.0.) GO TO 33
      IF(IX(2)) 38,38,39
   33 I1=IX(2)
      I2=IX(3)
      IF((I1.LE.0).OR.(I1.GT.120)) GO TO 38
      IF((I2.LE.0).OR.(I2.GT.4)) GO TO 38
      IB=IAB(I1,I2)
      I3=IX(4)
      I4=IX(5)
      IF((I3.LE.0).OR.(I3.GT.120)) GO TO 38
      IF((I4.LE.0).OR.(I4.GT.4)) GO TO 38
      IA=IAB(I3,I4)
      IF(IA.GT.0) GO TO 34
      CALL EPS(3)
      GO TO 39
   34 IF(IB.GT.0) GO TO 35
      CALL EPS(3)                                                        G
      GO TO 39                                                           G
   35 DR(IA)=DR(IA)-XX(1)
      DR(IB)=DR(IB)+XX(1)
      WRITE(6,633) DR(IB),DR(IA)                                         A
  633 FORMAT(1H+,83X,9HNEW AREA=,F8.3,5X,10HAREA LEFT=,F8.3)
      IF(DR(IA)) 36,37,39
   36 IF ( ( DR(IA) + 1.E-6 ) .GT. 0 )  GO TO 37                         G
      CALL EPS(10)
   37 DR(IA) = 0.                                                        G
      GO TO 39
```

```
   38 CALL EPS(1)                                                    A8
   39 LN=3
      GO TO 1000
C                                KO CARD
   40 WRITE(6,600) N2,CT(LR),KS,KT,N
      WRITE(6,604) (IX(J),J=1,2),(XX(J),J=1,2)
  604 FORMAT(1H+,23X,2I4,16X,2F10.3)
      IO=IX(1)
      IF(IO) 49,41,42
   49 LN=20
      GO TO 1000
   41 LN=2
      GO TO 1000
   42 IF(IO.GT.35) CALL EPS(1)                                       G
      IF((IX(2).LE.-1).OR.(IX(2).GT.10)) CALL EPS(1)
      LN=5
      GO TO 1000
C                                PE CARD ( CONTAMINATION )
   50 WRITE(6,600) N2,CT(LR),KS,KT,N
      WRITE(6,605) (IX(J),J=1,2),(XX(J),J=1,5)
  605 FORMAT(1H+,23X,2I4,16X,5F10.3)
      IP=IX(1)
      IF(IP.GT.0) GO TO 51
      LN=4
      GO TO 1000
   51 IF(IP.GT.120) GO TO 58
      IF(IX(2).GT.500) CALL EPS(1)
      AA=0.
      DO 54 J=1,4
      AR(J)=0.
      IB=IAB(IP,J)
      IF(IB.LE.0) GO TO 54
      AR(J)=DR(IB)
      AA=AA+AR(J)
   54 CONTINUE
      NP=NP+1
      WRITE(6,635) IP,AR
  635 FORMAT(55X,4HPART,I4,15H SURFACE AREAS=,4F10.3)
      IF(AA.LE.0.) CALL EPS(8)
      DO 55 J=1,2
      IF(XX(J+3).GT.AR(J)) CALL EPS(9)
   55 CONTINUE
      GO TO 59
   58 CALL EPS(1)
   59 LN=5
      GO TO 1000
C                                RD CARD
   60 WRITE(6,600) N2,CT(LR)
      WRITE(6,606) IX(1),(XX(J),J=1,7)
  606 FORMAT(1H+,23X,I4,25X,7A6)
      DO 61 J=1,100                                                  G
      DO 61 L=1,6
   61 IAB(J,L)=0                                                     G
      DO 62 J=1,500
   62 DR(J)=0.
      DO 63 J=1,20
   63 LR(J)=0
      LN=7
      GO TO 1000
C                                SD CARD
   70 KS=IX(1)
      WRITE(6,600) N2,CT(LR),KS
```

```
      WRITE(6,607) KS,(XX(J),J=1,7)                                    A9
  607 FORMAT(1H+,23X,I4,25X,7A6)
      LN=8
      IF((KS.GT.0).AND.(KS.LE.20)) GO TO 1000
      CALL EPS(1)
      KS=-1
      GO TO 1000
C                                 TD CARD
   80 KT=IX(1)
      WRITE(6,600) N2,CT(LR),KS,KT
      WRITE(6,608) (IX(J),J=1,3),(XX(J),J=1,7)                          G
  608 FORMAT(1H+,23X,3I4,17X,7A6)                                       G
      IF((KT.GT.0).AND.(KT.LE.100)) GO TO 82
      CALL EPS(1)
      KT=-1
   82 GO TO(801,802,803),IK                                             G
  801 LN=9
      GO TO 1000
  802 LN=12
      GO TO 1000
  803 LN=2                                                              G
      GO TO 1000
C                                 EM CARD
   90 WRITE(6,600) N2,CT(LR),KS,KT
      WRITE(6,609) (XX(J),J=1,4)
  609 FORMAT(1H+,47X,4F10.3)
      LN=10
      GO TO 1000
C                                 ED CARD
  100 WRITE(6,600) N2,CT(LR),KS,KT
      WRITE(6,610) IX(1),(XX(J),J=1,4)
  610 FORMAT(1H+,23X,I4,25X,4A6)
      IF(IX(1).GT.0) GO TO 101
      LN=12
      GO TO 1000
  101 IF(IX(1).GT.10) CALL EPS(1)
      LN=11
      GO TO 1000
C                                 EQ CARD
  110 WRITE(6,600) N2,CT(LR),KS,KT
      WRITE(6,611) (IX(J),J=1,2),(XX(J),J=1,7)
  611 FORMAT(1H+,23X,2I4,16X,7F10.3)
      LN=10
      GO TO 1000
C                                 OD CARD
  120 WRITE(6,600) N2,CT(LR),KS,KT
      WRITE(6,612) IX(1),(XX(J),J=1,4)
  612 FORMAT(1H+,23X,I4,25X,4A6)
      IF(IX(1).GT.0) GO TO 121
      LN=2                                                              G
      GO TO 1000
  121 IF(IX(1).GT.35) CALL EPS(1)                                       G
      LN=13
      GO TO 1000
C                                 OQ CARD
  130 WRITE(6,600) N2,CT(LR),KS,KT
      WRITE(6,613) (IX(J),J=1,3)
  613 FORMAT(1H+,23X,3I4)
      LN=12
      GO TO 1000
C                                 PD CARD
  140 WRITE(6,600) N2,CT(LR),KS,KT,N                                    G
```

```
      WRITE(6,614) IX(1),(XX(J),J=1,6)                                  A10
  614 FORMAT(1H+,23X,I4,25X,6A6)
      IF(IX(1).GT.0) GO TO 141
      LN=15
      GO TO 1000
  141 IF(IX(1).GT.120) CALL EPS(1)
      IP=IX(1)
      LN=15
      GO TO 1000
C                                 PQ CARD
  150 WRITE(6,600) N2,CT(LR),KS,KT,N                                    6
      WRITE(6,615) IX,(XX(J),J=1,2)
  615 FORMAT(1H+,23X,6I4,2F10.3)
      DO 152 J=1,4
      IF(IX(J).GT.500) GO TO 151
      IF((IX(J).GT.0).AND.(IX(J).LE.20)) GO TO 151
      IAB(IP,J)=IX(J)
      GO TO 152
  151 CALL EPS(1)
  152 CONTINUE
      IF(IX(5).GT.10) CALL EPS(1)
      IF(IX(6).GT.500) CALL EPS(1)
      IF(IX(6).LE.0) CALL EPS(3)
      LN=14
      GO TO 1000
C                                 DD CARD
  160 WRITE(6,500) N2,CT(LR),KS,KT,N                                    6
      WRITE(6,616) (IX(J),J=1,2),(XX(J),J=1,4)
  616 FORMAT(1H+,23X,2I4,21X,4A6)
      JD=IX(1)
      M=IX(2)
      IF(IX(1).GT.0) GO TO 161
      LN=3                                                              6
      GO TO 1000
  161 IF(IX(1).GT.500) CALL EPS(1)
      IF((M.GT.0).AND.(M.LE.11)) GO TO 162
      CALL EPS(1)
      M=11
  162 LN=17                                                             6
      GO TO 1000
C                                 DQ CARD
  170 WRITE(6,600) N2,CT(LR),KS,KT,N                                    6
      WRITE(6,617) (XX(J),J=1,M)
  617 FORMAT(8X,F10.2,10F10.6)
      DR(JD)=XX(1)
      XR(JD)=XX(M+11)
      IF(M.EQ.1) GO TO 172
      SUM=0.
      DO 171 J=2,M
  171 SUM=SUM+XX(J)
      IF(ABS(SUM-1.).GT..0000001) CALL EPS(11)
  172 MP=M+11
      WRITE(6,637) (XX(J),J=12,MP)
  637 FORMAT(8X,11E10.2)
      LN=16
      IF(M.EQ.1) GO TO 1001
      DO 173 J=2,M
      IF(XX(J+10).LE.XX(J+11)) GO TO 173
      CALL EPS(6)
      GO TO 1001
  173 CONTINUE
      GO TO 1001
```

```
C                                   ZD CARD
  180 WRITE(6,600) N2,CT(LR),KS,KT
      WRITE(6,618) IX(1),(XX(J),J=1,4)
  618 FORMAT(1H+,23X,I4,25X,4A6)
      IF(IX(1).GT.0) GO TO 181
      LN=1
      GO TO 1000
  181 IF(IX(1).GT.120) CALL EPS(1)
      LN=19
      GO TO 1000
C                                   ZC CARD
  190 WRITE(6,600) N2,CT(LR),KS,KT
      WRITE(6,619) IX(1),(XX(J),J=1,4)
  619 FORMAT(1H+,23X,I4,20X,4F10.3)
      IF(IX(1).GT.0) GO TO 191
      LN=18
      GO TO 1000
  191 IF(IX(1).GT.120) CALL EPS(1)
      LN=19
      GO TO 1000
C                                   PE CARD ( DECONTAMINATION )
  200 WRITE(6,600) N2,CT(LR),KS,KT,N
      WRITE(6,605) (IX(J),J=1,2),(XX(J),J=1,4)
      IP=IX(1)
      IF(IP.GT.0) GO TO 201
      LN=4
      GO TO 1000
  201 IF(IP.GT.120) GO TO 208
      LK=IX(2)
      IF((LK.LE.0).OR.(LK.GT.500)) GO TO 58
      DO 202 J=1,4
      IF(XX(J)*XR(LK).GT.1.) CALL EPS(6)
  202 CONTINUE
      GO TO 209
  208 CALL EPS(1)
  209 LN=20
 1000 WRITE(9)  LR,IX,(XX(J),J=1,7)
      IF(LR.NE.LX) CALL EPS(7)
      RETURN
 1001 WRITE(9)  LR,XX
      IF(LR.NE.LX) CALL EPS(7)
      RETURN
      END
```

```
      SUBROUTINE EPS(LE)
C     ERROR PRINTING SUBROUTINE
      COMMON   LN, LR, IX(6), XX(22), M, N1, N2, I(6,120), X(22,20),
     .         K(22,20), KIL, NE, KE(11), IA8(120,6), DR(500), XR(500),
     .         IO, AR(4), NP, LH(20), KXT, DUM(14423)
      IF(LE.EQ.0) GO TO 100
      NE=NE+1
      KE(LE)=KE(LE)+1
      IF((KIL.EQ.1).AND.(LE.GT.7)) RETURN
      NP=NP+3
      IF(NP.GE.55) CALL PTS
      WRITE(6,600) NE
  600 FORMAT(/12H ******ERROR,I4)
      GO TO(1,2,3,4,5,6,7,8,9,10,11),LE
    1 WRITE(6,601)
  601 FORMAT(1H+,17X,30HINDEX OUT OF RANGE              /)
      RETURN
    2 WRITE(6,602)
  602 FORMAT(1H+,17X,30HPREREQUISITE MISSING            /)
      RETURN
    3 WRITE(6,603)
  603 FORMAT(1H+,17X,30HNECESSARY DATA MISSING          /)
      RETURN
    4 WRITE(6,604)
  604 FORMAT(1H+,17X,30HTOO MANY CARDS IN SET           /)
      RETURN
    5 WRITE(6,605)
  605 FORMAT(1H+,17X,30HINDEX USED PREVIOUSLY           /)
      RETURN
    6 WRITE(6,606)
  606 FORMAT(1H+,17X,30HDATA OUT OF RANGE               /)
      RETURN
    7 WRITE(6,607)
  607 FORMAT(1H+,17X,30HCARD OUT OF SEQUENCE            /)
      RETURN
    8 WRITE(6,608)
  608 FORMAT(1H+,17X,30HAFFECTED PART AREA ZERO         /)
      RETURN
    9 WRITE(6,609)
  609 FORMAT(1H+,17X,30HCONTACT AREA GT SURFACE AREA    /)
      RETURN
   10 WRITE(6,610)
  610 FORMAT(1H+,17X,30HREMAINING AREA NEGATIVE         /)
      RETURN
   11 WRITE(6,611)
  611 FORMAT(1H+,17X,30HTOTAL PROB. NOT EQUAL TO 1      /)
      RETURN
  100 WRITE(6,620)
  620 FORMAT(1H1//////20X,27HMICROBIAL BURDEN DATA CHECK/)
      IF(NE.GT.0) GO TO 150
      WRITE(6,621)
  621 FORMAT(24X,18HNO ERRORS THIS RUN)
      RETURN
  150 WRITE(6,622)
  622 FORMAT(20X,27H*****  ERROR SUMMARY  *****/)
      IOUT=0
      DO 152 J=1,7
      IF(KE(J)-1) 152,156,155
  155 WRITE(6,623) KE(J)
  623 FORMAT(I5,9H ERRORS -)
      GO TO 159
  156 WRITE(6,624) KE(J)
```

```
624 FORMAT(I6,9H ERROR  -)                                          A13
159 IOUT=1
    GO TO(101,102,103,104,105,106,107),J
101 WRITE(6,601)
    GO TO 152
102 WRITE(6,602)
    GO TO 152
103 WRITE(6,603)
    GO TO 152
104 WRITE(6,604)
    GO TO 152
105 WRITE(6,605)
    GO TO 152
106 WRITE(6,606)
    GO TO 152
107 WRITE(6,607)
152 CONTINUE
    IF(KIL.NE.1) GO TO 154                                           A
    IF(KXT.EQ.1) RETURN                                              A
    IF(IOUT.EQ.1) CALL EXIT                                          A
    RETURN                                                           A
154 DO 153 J=8,11                                                    A
    IF(KE(J)-1) 153,158,157
157 WRITE(6,623) KE(J)
    GO TO 160
158 WRITE(6,624) KE(J)
160 JM=J-7
    GO TO(108,109,110,111),JM
108 WRITE(6,608)
    GO TO 153
109 WRITE(6,609)
    GO TO 153
110 WRITE(6,610)
    GO TO 153
111 WRITE(6,611)
153 CONTINUE
    IF(KXT.EQ.1) RETURN                                              A
    IF(IOUT.EQ.1) CALL EXIT
    RETURN
    END
```

```
      SUBROUTINE PTS
C     PAGE TITLING SUBROUTINE
      COMMON   LN, LR, IX(6), XX(22), M, N1, N2, I(5,120), X(22,20),
     .         K(22,20), KIL, NE, KE(11), IAB(120,6), DR(500), XR(500),
     .         IO, AR(4), NP, LH(20), KXT, DUM(14423)
      WRITE(6,600)
  600 FORMAT( 115H1RECORD, TYPE, S/TSK/ST    1   2   3   4   5   6
     .7         8          9         10        11        12        13/)
      NP=0
      RETURN
      END
```

```
      SUBROUTINE BPS                                                    A15
C     BURDEN PREDICTION SUBROUTINE
C     THIS PROGRAM READS FROM TAPE 9
      COMMON   KK, IK, KR, RUN(7), KS, STG(7), KT, TSK(7), DSC(6), ID,
     .         NE, AES(4), IEC(10), IET(10), AEC(10), AET(10), AED(10),
     .         AEF(10,4), NO, IOT(35), IOQ(35), IOC(35), NP, DAC(120,2),
     .         IU(120), IAB(120,6), AAG(120), AAS(120), AAT(120),
     .         NX(572), DR(572,11), XR(572,11), KO, NS, IR(5), AR(4),
     .         APA(2), NT, JT(100), XMT(100), XVT(100), L1, L2, L3, L4,
     .         KTS, ITE, K3, DUM(2664)
      DIMENSION XX(7),IX(6)
    3 FORMAT(34H1MICROBIAL BURDEN PREDICTION MODEL/4H RUN,I5,2H, ,7A6)
      REWIND 9
      REWIND 11
      NT=0
  100 READ (9) L,KK,IK,I1,I2,I5,I6,XX
C     KK=1 INDICATES A NEW RUN, STAGE, AND TASK
C     KK=2 INDICATES A NEW STAGE AND TASK
C     KK=3 INDICATES A NEW TASK
C     KK=4 CALLS FOR A BURDEN DIFFERENCE DETERMINATION
C     KK=5 CALLS FOR ZONE BURDEN WRITEOUT
C        IK=0 CALLS FOR ZONE DEFINITION DATA INPUTS
C        IK=1 INDICATES ZONES CORRESPOND TO PARTS
C     KK=6 CALLS FOR A RESTART AND REQUIRES A BINARY DECK INPUT
      IF(KK.NE.6)GO TO 102
      READ(2) KR,(RUN(J),J=1,7),KS,(STG(J),J=1,7),NE,(AES(J),J=1,4),     A
     . (IEC(J),IET(J),AEC(J),AET(J),AED(J),(AEF(J,K),K=1,4),J=1,10),     G
     . NO,(IOT(J),IOQ(J),IOC(J),J=1,35),NP,((DAC(J,K),K=1,2),IU(J),      G
     . (IAB(J,K),K=1,6),AAG(J),AAS(J),AAT(J),J=1,100),KO,NT,             G
     . (JT(J),XMT(J),XVT(J),J=1,100),KTS,ID,ITE,K1,K2,                   G
     . (NX(I),(DR(I,J),XR(I,J),J=1,11),I=1,572)                          G
      GO TO 100
  102 IF(KK-3) 103,130,109
  103 IF(NT.EQ.0)GO TO 106
C
C     WRITE STAGE SUMMARY FOR PRECEEDING STAGE
      WRITE(6,3)KR,(RUN(J),J=1,7)
      WRITE(6,4)KS,(STG(J),J=1,7)
    4 FORMAT(6H STAGE,I3,2H, ,7A6/15H STAGE SUMMARY-//
     .3X,4HTASK,7X,4HMEAN,6X,6HFINISH/13X,6HBURDEN,5X,4HTIME/)
      DO 104 I=1,NT
  104 WRITE(6,5)JT(I),XMT(I),XVT(I)
    5 FORMAT(I7,E13.3,F10.3)
  106 IF(KK.GT.0) GO TO 109
      IF(K2.EQ.3) GO TO 108
C
      WRITE(3) KR,(RUN(J),J=1,7),KS,(STG(J),J=1,7),NE,(AES(J),J=1,4),     G
     . (IEC(J),IET(J),AEC(J),AET(J),AED(J),(AEF(J,K),K=1,4),J=1,10),     G
     . NO,(IOT(J),IOQ(J),IOC(J),J=1,35),NP,((DAC(J,K),K=1,2),IU(J),      G
     . (IAB(J,K),K=1,6),AAG(J),AAS(J),AAT(J),J=1,100),KO,NT,             G
     . (JT(J),XMT(J),XVT(J),J=1,100),KTS,ID,ITE,K1,K2,                   G
     . (NX(I),(DR(I,J),XR(I,J),J=1,11),I=1,572)                          G
  108 M=0
C
      WRITE(11) M,KR,KS,M,M,(DSC(J),J=1,4),M,M,(RUN(J),J=1,7),(STG(J),
     .J=1,7),(JT(J),J=1,18)
      RETURN
  109 GO TO (110,120,130,140,150),KK
C
C     READ RUN NUMBER AND DESCRIPTION
  110 READ (9) L,KR,(IX(J),J=1,5),RUN
      WRITE(6,600) KR,(RUN(J),J=1,7)
```

```
  600 FORMAT(34H1MICROBIAL BURDEN PREDICTION MODEL//4H RUN,I2,2X,7A6//)
      ID=0
      MD=0
      K1=0                                                              G
      K2=1
      NE=0
      NO=0
      NP=0
      NT=0
      DO 111 I=1,120
      IU(I)=0
      AAG(I)=0.
      AAS(I)=0.
      AAT(I)=0.
      DO 111 J=1,6                                                      G
  111 IAB(I,J)=0
      DO 112 N=1,572
  112 NX(N)=-1
      KO=508                                                            G
      NX(KO)=1                                                          G
      DR(KO,1)=0.                                                       G
      XR(KO,1)=0.                                                       G
C
C     READ STAGE NUMBER AND DESCRIPTION
  120 READ (9) L,KS,(IX(J),J=1,5),STG
      NT=0
      M=1
C
      WRITE(11) M,KR,KS,M,M,(DSC(J),J=1,4),M,M,(RUN(J),J=1,7),(STG(J),
     .J=1,7),(JT(J),J=1,18)
C
C     READ TASK NUMBER AND DESCRIPTION
C     L4 IS THE INDEX FOR SAVING THE TOTAL MICROBIAL BURDEN
C        IF NEEDED FOR USE IN DETERMINING A BURDEN DIFFERENCE
C        K3 IS BURDEN PRINT FLAG                                        G
  130 READ(9) L,KT,L4,K3,(IX(J),J=1,3),TSK                              G
      WRITE(6,612) KS,STG,KT,TSK
  612 FORMAT(6H1STAGE,I3,2X,7A6/5H TASK,I4,2X,7A6//)
      IF(I1.GT.0)K1=I1
      IF(I2.GT.0)K2=I2
      IF(I5.LE.0) GO TO 138
      IF(ID.GT.0) MD=NX(ID)
      ID=I5
C  RESTORE THE FIRST 20 DISTRIBUTIONS
      DO 137 K=1,20
      J=K+552
      CALL MES(K,J)
  137 CONTINUE
  138 IF(I6.GT.0)ITE=I6
      NT=NT+1
      CALL MBS(MD,K1,K2)
      IF(K2.NE.2) GO TO 100
C
      WRITE(3) KR,(RUN(J),J=1,7),KS,(STG(J),J=1,7),NE,(AES(J),J=1,4),   G
     . (IEC(J),IET(J),AEC(J),AET(J),AED(J),(AEF(J,K),K=1,4),J=1,10),    G
     . NO,(ICT(J),ICG(J),ICC(J),J=1,35),NP,((DAC(J,K),K=1,2),IU(J),     G
     . (IAB(J,K),K=1,6),AAG(J),AAS(J),AAT(J),J=1,100),KO,NT,            G
     . (JT(J),XMT(J),XVT(J),J=1,100),KTS,ID,ITE,K1,K2,                  G
     . (NX(I),(DR(I,J),XR(I,J),J=1,11),I=1,572)                         G
C
C     DETERMINE AND WRITE BURDEN DIFFERENCE
  140 WRITE(6,3)KR,(RUN(J),J=1,7)
```

```
      WRITE(6,601)                                                    A17
  601 FORMAT(//13H BURDEN DIFFERENCE/)
      L1=I1+530
      L2=I2+530
      WRITE(6,602) I1,DR(L1,1)
  602 FORMAT(/17H BURDEN STORED IN,I3,7H, AREA=,F9.2,4X,6HBURDEN)
      CALL HWS(L1)
      WRITE(6,602) I2,DR(L2,1)
      CALL HWS(L2)
      A1=DR(L1,1)
      A2=DR(L2,1)
      DR(L1,1)=AVF(L1)
      DR(L2,1)=AVF(L2)
      CALL HCS(L2,L1,551,2)
      CALL HAS(551)
      WRITE(6,601)
      CALL HWS(551)
      DR(L1,1)=A1
      DR(L2,1)=A2
      GO TO 100
C
C     DETERMINE AND WRITE ZONE BURDEN DISTRIBUTIONS
  150 WRITE(6,3)KR,(RUN(J),J=1,7)
      WRITE(6,7)KS,KT
    7 FORMAT(43H MICROBIAL BURDEN BY ZONES (FOLLOWING STAGE,I3,6H, TASK,
     .I3,2H)-/)
      IF(IK.EQ.1)GO TO 180
C
C     USE ZONE DEFINITION INPUTS
  155 READ (9) L,IZ,(IX(J),J=1,5),DSC,XX(1)
      IF(IZ.LE.0)GO TO 100
      A=0.
      CALL HES(510,K0)
  160 READ (9) L,IP,(IX(J),J=1,5),AR,(XX(J),J=1,3)
C     IP IS THE PART
C     AR(J) THE FRACTION OF SURFACE J OF PART IP BELONGING TO ZONE IZ
      IF(IP.LE.0)GO TO 170
      DO 165 J=1,4
      IF(AR(J).EQ.0.)GO TO 165
      IF(IAB(IP,J).EQ.0)GO TO 165
      F=AR(J)
      IB=IAB(IP,J)
      CALL HMS(IB,F,509)
      A=A+DR(509,1)
      DR(509,1)=AVF(509)
      CALL HCS(510,509,510,1)
  165 CONTINUE
      GO TO 160
  170 WRITE(6,9)IZ,(DSC(J),J=1,4),A
    9 FORMAT(5H ZONE,I4,2X,4A6,7H, AREA=,F8.3/33X,11HZONE BURDEN)
      CALL HWS(510)
      GO TO 155
C
C     USE PARTS AS ZONES
  180 DO 190 I=1,100                                                  G
      IF(IU(I).EQ.0)GO TO 190
      A=0.
      CALL HES(510,K0)
      DO 185 J=1,4
      IB=IAB(I,J)
      IF(IB.LE.0) GO TO 185
      A=A+DR(IB,1)
```

```
      CALL HES(509,IB)                                                    A18
      DR(509,1)=AVF(IB)
      CALL HCS(510,509,510,1)
  185 CONTINUE
      WRITE(6,10)I,DAC(I,1),DAC(I,2),DR(510,1)
   10 FORMAT(5H ZONE,I4,2X,2A6,7H, AREA=,F7.2,8H, BURDEN)                    A
      CALL HWS(510)
  190 CONTINUE
      GO TO 100
      END
```

```
      SUBROUTINE MBS(MD,K1,K2)
C     MICROBIAL BUILDUP SUBROUTINE
      COMMON   KK, IK, KR, RUN(7), KS, STG(7), KT, TSK(7), DSC(6), ID,
     .         NE, AES(4), IEC(10), IET(10), AEC(10), AET(10), AED(10),
     .         AEF(10,4), NO, IOT(35), IOQ(35), IOC(35), NP, DAC(120,2),
     .         IU(120), IAB(120,6), AAG(120), AAS(120), AAT(120),
     .         NX(572), DR(572,11), XP(572,11), KO, NS, IR(5), AR(4),
     .         APA(2), NT, JT(100), XMT(100), XVT(100), L1, L2, L3, L4,
     .         KTS, ITE, K3, DUM(2664)
      DIMENSION IX(6),XX(7),DES(6)                                      G
      GO TO (100,120,200), IK                                           G
C
C     ENVIRONMENTS INPUTS-
  100 READ (9) L,IX,AES,(XX(J),J=1,3)
      WRITE(6,8)(AES(J),J=1,4)
    8 FORMAT(//30H ENVIRONMENTS INPUTS - - - - -/5H AES=,4E12.4)
C     AES(J) IS THE SURFACE LIFETIME MODIFIER FOR SURFACE J
      DO 110 I=1,11                                                     G
      READ (9) L,N,(IX(J),J=1,5),DSC,XX(1)
      IF(N.LE.0)GO TO 120
      READ (9) L,IEC(N),IET(N),(IX(J),J=1,4),AEC(N),AET(N),AED(N),
     .(AEF(N,J),J=1,4)
C     IEC,AEC DESCRIBE THE ENVIRONMENTS BIOTA CONCENTRATION
C     IET,AET DESCRIBE THE REFERENCE ACCPETION TIME
C     AED IS THE AIRBOURNE CONCENTRATION PER MAN
C     AEF IS THE RATE AT WHICH, FOR ALL OTHER FACTORS STANDARD,
C        BIOTA REACH EACH SURFACE
      WRITE(6,20)N,(DSC(J),J=1,4),IEC(N),AEC(N),IET(N),AET(N),AED(N),
     .(AEF(N,J),J=1,4)
   20 FORMAT(/I4,1X,4A6,4X,4HIEC=,I3,6H, AEC=,F7.4,6H, IET=,I3,6H, AET=,
     .F7.2,5H, AED=,F7.4,6H, AEF=,4F6.2)
  110 IF(NE.LT.N)NE=N
C
C     OPERATIONS INPUTS-
  120 DO 130 I=1,36                                                     G
      READ (9) L,N,(IX(J),J=1,5),DSC,XX(1)
      IF(N.LE.0)GO TO 200                                               G
      IF ( I .EQ. 1 )          WRITE (6,9)                              G
    9 FORMAT(//30H OPERATIONS INPUTS - - - - - -/)
      READ (9) L,IOT(N),IOQ(N),IOC(N),(TX(J),J=1,3),XX
      WRITE(6,21)N,(DSC(J),J=1,4),IOT(N),IOQ(N),IOC(N)
   21 FORMAT(/I4,1X,4A6,4X,4HIOT=,I3,6H, IOQ=,I3,6H, IOC=,I3)
C     IOT IS THE OPERATION TIME INTERVAL
C     IOQ IS THE DIRTINESS FACTOR
C     IOC IS THE BIOTA CONCENTRATION FOR CONTACT CONTAMINATION
  130 IF(NO.LT.N)NO=N
C
C     SUBTASK LEVEL MICROBIAL BUILDUP DETERMINATION
  200 DO 295 I=1,1001                                                   G
      READ(9) L,NS,L1,L2,L3,IX(1),IX(2),DSC,XX(1)                       G
      IF(NS.LE.0)GO TO 300                                              G
      N1=L1                                                             G
      N2=L2                                                             G
      WRITE(6,12)NS,(DSC(J),J=1,4)                                      G
   12 FORMAT(/13H **** SUBTASK,I3,2H, ,4A6)                             G
C     L1 AND L2 ARE PREREQUISITE TIME DISTRIBUTIONS                     G
C     L3 IS THE FINISH TIME DISTRIBUTION IF NEEDED                      G
C        AS PREREQUISITE FOR ANOTHER SUBTASK                            G
C                                                                       G
C     DETERMINE SUBTASK START TIME                                      G
C     IT IS THE SUBTASK START TIME INDEX                                G
      IT=0                                                              G
```

```
      IF(L1.LE.0)GO TO 210                                                  G
      L1=L1+530                                                             G
      IF(L2.GT.0)GO TO 205                                                  G
      IT=L1                                                                 G
      GO TO 210                                                             G
  205 L2=L2+530                                                             G
      IT=551                                                                G
      CALL HOS(L1,L2,IT,5)                                                  G
      IF(ID.LE.0) GO TO 210                                                 G
      IF(NX(IT).GT.NX(ID))CALL HAS(IT)                                      G
  210 IF ( I .NE. 1 )          GO TO 215                                    G
C     KTS IS THE TASK START TIME                                            G
      KTS = 552                                                             G
      IF ( IT .EQ. 0 )                    CALL HES(KTS,KO)                  G
      IF ( IT .NE. 0 )                    CALL HES(KTS,IT)                  G
  215 IF ( IT .NE. 0 )                    GO TO 218                         G
      IT = 551                                                              G
      CALL HES(IT,KTS)                                                      G
  218 LL = IT                                                               G
      T1=DR(IT,1)                                                           G
C
C     PARTS INPUTS-
  140 DO 150 K=1,121                                                        G
      READ (9) L,N,(IX(J),J=1,5),DES,XX(1)                                  G
      IF(N.LE.0)GO TO 160
      IF ( K .EQ. 1 .AND. K1 .GE. 1 )   WRITE(6,10)                         G
   10 FORMAT(//30H PARTS INPUTS  - - - - - - - -/)
      DAC(N,1)=DES(5)                                                       G
      DAC(N,2)=DES(6)                                                       G
      IU(N)=0
      AAT(N)=0.
      IF(IT.GT.0) AAT(N)=DR(IT,1)                                           G
      READ (9) L,(IAB(N,J),J=1,6),AAG(N),AAS(N),(XX(J),J=1,5)
      IF(IAB(N,6).GT.0)GO TO 142
      AAG(N)=0.
      AAS(N)=0.
  142 CONTINUE
C     DAC IS THE PERMANENT ALPHAMERIC DESCRIPTION OF PART N
C     IAB(J) INDICATES THE DISTRIBUTION FOR AREA/BURDEN FOR
C        J=1, TOP SURFACE
C        J=2, OTHER EXTERIOR SURFACE
C        J=3, MATED SURFACE
C        J=4, OCCLUDED SURFACE
C     IAB(5) IS THE ENVIRONMENT INDEX (MAY BE LEFT BLANK)
C     IAB(6) IS THE RETENTION DISTRIBUTION FOR CONTACT
C     AAG IS THE RETENTION DISTRIBUTION MEAN FOR FALLOUT
C     AAS IS THE RETENTION DISTRIBUTION MEAN FOR CONTACT
C     AAT IS THE LAST TIME OF ACCRETION UPDATE
      IF ( K1 .GE. 1 )        WRITE(6,22)  N,(DES(J),J=1,6),(IAB(N,J),    G
                              J=1,6),AAG(N),AAS(N)                          G
   22 FORMAT(/I4,1X,6A6,4X,4HIAB=,6I4,6H, AAG=,F7.3,6H, AAS=,F7.3)
      DO 145 J = 1, 4                                                       G
      IF ( IAB(N,J) .GT. 0 )              CALL HES(IAB(N,J),KO)             G
  145 CONTINUE                                                              G
  150 IF(NP.LT.N)NP=N
C
C     DISTRIBUTIONS INPUTS -
  160 DO 175 K=1,501                                                        G
      READ (9) L,N,M,(IX(J),J=1,4),DES,XX(1)                                G
C     M=1 INDICATES THE DISTRIBUTION IS A CONSTANT
      IF(N.LE.0)GO TO 179
      IF ( K .EQ. 1 .AND. K1 .GE. 1 )   WRITE(6,11)                         G
```

```
   11 FORMAT(//30H DISTRIBUTIONS INPUTS  - - - -//)                    A21
      READ (9) L,(DR(N,J),J=1,11),(XR(N,J),J=1,11)
      NX(N)=M
      IF(DR(N,1).LE.0.) DR(N,1)=AYF(N)
      IF(N.GT.20) GO TO 171
      J=N+552
      CALL HES(J,N)
  171 IF(ID.LE.0) GO TO 172
      IF(M.GT.NX(ID)) CALL HAS(N)
  172 IF ( K1 .GE. 1 )  WRITE(6,23)  N,(DES(J),J=1,4),DR(N,1)          G
   23 FORMAT(I4,1X,4A6/5X,12HCOEFFICIENT=,E11.4,6X,12HDISTRIBUTION)
      IF ( K1 .GE. 1 )         CALL HWS(N)                            G
  175 CONTINUE
  179 IF(ID.LE.0) GO TO 190
      IF(MD.EQ.NX(ID)) GO TO 190
      DO 180 K=1,20
      IF(NX(K).GT.NX(ID)) CALL HAS(K)
  180 CONTINUE
      IF(MD.LE.NX(ID)) GO TO 189
      DO 185 K=21,552
      IF(NX(K).GT.NX(ID)) CALL HAS(K)
  185 CONTINUE
  189 MD=NX(ID)
C
  190 M=2                                                             G
C
      WRITE(11) M,KR,KS,KT,NS,(DSC(J),J=1,4),IT,NX(IT),(DR(IT,J),J=1,   G
     .11),(XR(IT,J),J=1,11),(AEC(J),J=1,5),N1,N2,(JT(J),J=1,3)        G
      NC=0
C     ENVIRONMENT,AREA/BIOTA BURDEN CHANGES-
  220 READ (9) L,K,IR,AR,(XX(J),J=1,3)
C     K IS THE CHANGE IDENTIFIER
C     IR(1),IR(2) ARE THE NEW PART AND SURFACE INDICES
C     IR(3),IR(4) ARE THE CONTRIBUTING PART AND SURFACE
C     IR(5) IS THE NEW ENVIRONMENT (IF ANY) FOR PART IR(1)
C     AR(1) IS THE AREA CHANGED TO IR(1),IR(2) FROM IR(3),IR(4)
C     AR(2) IS THE NEW AAG FACTOR
C     AR(3) IS THE NEW AAS FACTOR
C     IF IR(5), AR(1), AR(2), AR(3) ZERO, NO CHANGE IS MADE
      IF(K.LE.0)GO TO 240
      NC=NC+1
      IF ( NC .EQ. 1 .AND. K1 .GE. 2 )  WRITE(6,16)                    G
   16 FORMAT(//6X,42HENVIRONMENT/AREA/RETENTION FACTOR CHANGES-/)
      I1=IR(1)
      IF(NP.LT.I1)NP=I1
      IF(AR(1).LE.0.)GO TO 232
      CALL MAS(I1,T1)
      IU(I1)=IU(I1)+1
      I2=IR(2)
      I3=IR(3)
      CALL MAS(I3,T1)
      IU(I3)=IU(I3)+1
      I4=IR(4)
      IB=IAB(I1,I2)
      IA=IAB(I3,I4)
      IF(IR(5).GT.0) IAB(I1,5)=IR(5)
      IF(AR(2).GT.0.) AAG(I1)=AR(2)
      IF(AR(3).GT.0.) AAS(I1)=AR(3)
      IF(DR(IA,1).LE.0.)GO TO 220
      F=AR(1)/DR(IA,1)
      IF(F.LT..995)GO TO 230
      F=1.
```

```
                                                                      A22
  230  CALL HMS(IA,F,501)                                              G
       A=DR(IB,1)+DR(501,1)                                            G
       DR(IB,1)=AVF(IB)
       DR(501,1)=AVF(501)                                              G
       CALL HCS(IB,501,IB,1)                                           G
       DR(IB,1)=A
       F=1.-F
       CALL HMS(IA,F,IA)
       GO TO 220
  232  IF(IR(5).GT.0) IAB(I1,5)=IR(5)
       IF(AR(2).GT.0.) AAG(I1)=AR(2)
       IF(AR(3).GT.0.) AAS(I1)=AR(3)
       GO TO 220
C
C      OPERATIONAL LEVEL BUILDUP-
  240  IE=ITE                                                          G
C      IT IS THE CURRENT TIME DISTRIBUTION INDEX                       G
  250  READ (9) L,IO,IKE,(IX(J),J=1,4),AKT,AKG,(XX(J),J=1,5)
C      IO IS THE OPERATION
C      IKE IS THE OPERATION ENVIRONMENT WHEN DIFFERENT FROM
C         THE TASK ENVIRONMENT OR THE PREVIOUS OPERATION ENVIRONMENT
C      AKT IS THE OPERATION TIME MODIFIER
C      AKG IS THE NUMBER OF MEN
C         IO LT 0 INDICATES A DECONTAMINATION OPERATION FOR WHICH
C         AKT IS THE FIXED OPERATION INTERVAL
       IF(IO)252,290,258
C
C      DECONTAMINATION
  252  IO=-IO
       T1=DR(IT,1)
       IF(AKT.LE.0.)GO TO 253
       NX(507)=1                                                       G
       DP(507,1)=AKT                                                   G
       XR(507,1)=AKT                                                   G
       CALL HCS(IT,507,IT,1)                                           G
  253  IF(K1.GE.2) WRITE(6,37)IO,T1,DR(IT,1)
   37  FORMAT(5X,9HOPERATION,I3,25H, (DECONTAMINATION), FROM,F8.2,3H TO, G
      .F8.2,6H HOURS)                                                  G
       T1=DR(IT,1)                                                     A
  254  READ (9) L,IP,LK,(IX(J),J=1,4),AR,(XX(J),J=1,3)
C      IP IS THE PART AFFECTED
C      LK IS THE CURVE DESCRIBING FRACTION OF BIOTA REMOVED
C      AR(J) IS THE MEAN FRACTION OF BIOTA REMOVED FROM SURFACE J
       IF(IP.LE.0)GO TO 250
       IU(IP)=IU(IP)+1
       DT=T1-AAT(IP)
       CALL MAS(IP,T1)
       DO 255 J=1,4
       IF(AR(J).LE.0.)GO TO 256
       IB=IAB(IP,J)
       IF(IB.LE.0)GO TO 256
       A=DR(IB,1)
       IF(A.LE.0.) GO TO 256
       IF(DT.LE.0.) GO TO 255
       M=8
C
       WRITE(11)M,KE,KS,KT,NS,(DSC(L),L=1,4),IB,NX(IB),(DR(IB,L),L=1,11),G
      .(XR(IB,L),L=1,11),A,T1,(DAC(IP,L),L=1,2),A,IP,J,IO,IAB(IP,5),IT
  255  F=(1.-AR(J))/DP(LK,1)                                           A
       CALL HMS(LK,F,501)                                              G
       DR(IB,1)=AVF(IB)
       DR(501,1)=AVF(501)                                              G
```

```
      CALL HCS(IB,501,IB,3)                                              G
      BD=DR(IB,1)
      DR(IB,1)=A
      M=9
C
      WRITE(11)M,KR,KS,KT,NS,(DSC(L),L=1,4),IB,NX(IB),(DR(IB,L),L=1,11),G
     .(XR(IB,L),L=1,11),A,T1,AKT,AR(J),A,IP,J,IO,LK,IP
      IF(K1.EQ.3) WRITE(6,39)IP,DAC(IP,1),DAC(IP,2),J,A,AR(J),BD
   39 FORMAT(10X,4HPART,I4,2X,2A6,9H, SURFACE,I2,7H, AREA=,F8.3,
     .1H, FRACTION REMOVED=,F5.3,17X,9H, BURDEN=,E10.3)                  A
  256 CONTINUE
      GO TO 254
C
C     FALLOUT CONTAMINATION-
  258 IF(IKE.GT.0)IE=IKE
      IC=IOC(IO)
      IQ=IOQ(IO)
      II=IET(IE)
      JC=IEC(IE)
      ITK=IOT(IO)
      T1=DR(IT,1)
      IF(ITK.EQ.0)GO TO 259
      F=AKT/DR(ITK,1)
      CALL HMS(ITK,F,507)                                                G
      DR(507,1)=AVF(507)                                                 G
      CALL HCS(IT,507,IT,1)                                              G
C     507 INDICATES THE OPERATION TIME DISTRIBUTION                      G
  259 IF(K1.GE.2) WRITE(6,29) IO,IE,T1,DR(IT,1),AKQ
   29 FORMAT(5X,9HOPERATION,I3,13H, ENVIRONMENT,I3,6H, FROM,F8.2,3H TO, G
     .F8.2,7H HOURS,,F3.0,4H MEN)                                        G
      AQ=AKQ/DR(IQ,1)
      Q = AQ*AED(IE)
      CALL HMS(IQ,Q,505)                                                 G
      DR(505,1)=AVF(505)                                                 G
C     505 IS THE CURVE Q*D                                               G
      AC=AEC(IE)/DR(JC,1)
      CALL HMS(JC,AC,506)                                                G
      DR(506,1)=AVF(506)                                                 G
C     506 IS THE CURVE C                                                 G
      CALL HCS(505,506,506,1)                                            G
C     506 INDICATES THE TOTAL FALLOUT SOURCE CONCENTRATION (C*Q*D)       G
  260 READ (9) L,IP,LS,(IX(J),J=1,4),APD,APC,APS,APA,(XX(J),J=1,2)
C     IP IS THE PART AFFECTED
C     LS IS THE TOOL STICKINESS DISTRIBUTION
C     APD IS NOT USED IN THIS VERSION
C     APC IS THE TOOL BIOTA CONCENTRATION MODIFIER
C     APS IS THE MEAN TOOL STICKINESS
C     APA IS THE CONTACT AREA FOR EACH TOUCHED SURFACE
      IF(IP.LE.0)GO TO 250
      IU(IP)=IU(IP)+1
      DT=T1-AAT(IP)
      CALL MAS(IP,T1)
      IF(A9.LE.0.)GO TO 275
      IF(IE.LE.0)GO TO 275
      IF(ITK.LE.0)GO TO 275
      AAT(IP)=DR(IT,1)
      DO 270 J=1,4
      IB=IAB(IP,J)
      F=AEF(IE,J)*AAG(IP)
      IF(IB.LE.0)GO TO 270
      IF(F.LE.0.)GO TO 270
      A=DR(IB,1)
```

```
      IF(A.LE.0.)GO TO 270                                              A24
      IF(DT.LE.0.) GO TO 263
      M=8
C
      WRITE(11)M,KR,KS,KT,NS,(DSC(L),L=1,4),IB,NX(IB),(DR(IB,L),L=1,11),G
     .(XR(IB,L),L=1,11),A,T1,(DAC(IP,L),L=1,2),A,IP,J,IO,IAB(IP,5),IT
  263 F=F*A
      CALL HMS(506,F,505)                                               G
C     505 IS THE CURVE A*R = A*F*G*(C+0*D)                              G
      EE=AET(IE)*AES(J)/DR(II,1)
      CALL HMS(II,EE,502)                                               G
      DR(502,1)=AVF(502)                                                G
C     502 IS THE CURVE V                                                G
      CALL HCS(505,502,504,3)                                           G
C     504 IS THE CURVE A*V*R                                            G
      CALL HCS(507,502,502,4)                                           G
C     502 IS THE CURVE T/V                                              G
      M=NX(502)                                                         G
      NX(503)=M                                                         G
      DO 265 JJ=1,M
      DR(503,JJ)=DR(502,JJ)                                             G
      XR(502,JJ)=EXP(-XR(502,JJ))                                       G
  265 XR(503,JJ)=1.-XR(502,JJ)                                          G
      DR(502,1)=AVF(502)                                                G
      DR(503,1)=AVF(503)                                                G
C     502 IS THE CURVE EXP(-T/V)                                        G
C     503 IS THE CURVE 1-EXP(-T/V)                                      G
      CALL HCS(504,503,504,3)                                           G
      DR(IB,1)=AVF(IB)
      CALL HCS(IB,502,502,3)                                            G
      CALL HCS(502,504,IB,1)                                            G
      CALL HAS(IB)
      BD=DR(IB,1)
      DR(IB,1)=A
      M=3
C
      WRITE(11)M,KR,KS,KT,NS,(DSC(L),L=1,4),IB,NX(IB),(DR(IB,L),L=1,11),G
     .(XR(IB,L),L=1,11),A,T1,AKT,AKQ,A,IP,J,IO,IE,IP
      IF(K1.EQ.3) WRITE(6,30) IP,DAC(IP,1),DAC(IP,2),J,A,APC,APA(J),BD
   30 FORMAT(10X,4HPART,I4,2X,2A6,9H, SURFACE,I2,7H, AREA=,F8.3,
     .14H, TOOL BURDEN=,F6.0,15H, AREA TOUCHED=,F6.3,9H, BURDEN=,E10.3)
  270 CONTINUE
C
C     CONTACT CONTAMINATION-
  275 IF(IC.LE.0)GO TO 260
      DR(IC,1)=AVF(IC)
      IG=IAB(IP,6)
      IF(IG.LE.0) GO TO 260                                             A
      DR(IG,1)=AVF(IG)
      S1=.5*AAS(IP)*APC
      IF(LS.LE.0)GO TO 260
      DR(LS,1)=AVF(LS)
      IF(DR(LS,1).LE.0.)GO TO 260
      S2=.5*APS/DR(LS,1)
      B=S1*S2
      IF(B.EQ.0.)GO TO 260
      S1=S1/(DR(IC,1)*DR(IG,1))
      DO 280 J=1,2
      IB=IAB(IP,J)
      IF(IB.LE.0)GO TO 280
      A=DR(IB,1)
      IF(A.LE.0.)GO TO 280
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      IF(APA(J).LE.0.)GO TO 280                                          A25
      DR(IB,1)=AVF(IB)
      F=S1*APA(J)
      CALL HMS(IC,F,504)                                                  G
      CALL HCS(504,IG,504,3)                                              G
      F=S2*APA(J)/A
      CALL HMS(LS,F,505)                                                  G
      CALL HCS(IB,505,505,3)                                              G
      CALL HCS(IB,505,IB,2)                                               G
      CALL HCS(IB,504,IB,1)                                               G
      CALL HAS(IB)
      DR(IB,1)=A
      M=4
C
      WRITE(11)M,KR,KS,KT,NS,(DSC(L),L=1,4),IB,NX(IB),(DR(IB,L),L=1,11),G
     .(XR(IB,L),L=1,11),A,APA(J),AAS(IP),APS,APC,IP,J,IAB(IP,6),IC,IP
  280 CONTINUE
      GO TO 260
  290 IF(DR(LL,1).LT.DR(IT,1))LL=IT
      IF(L3.LE.0)GO TO 295                                                G
      L3=L3+530                                                           G
      CALL HES(L3,LL)                                                     G
  295 CONTINUE
  300 T=DR(LL,1)                                                          G
      WRITE(6,601) KR,KS,KT,(TSK(J),J=1,7)
  601 FORMAT(13H1TASK SUMMARY/4H RUN,I2,7H, STAGE,I3,6H, TASK,I4,2X,7A6,
     .//29X,15HTASK START TIME)
      CALL HWS(KTS)
      WRITE(6,604)
  604 FORMAT(29X,16HTASK FINISH TIME)
      CALL HWS(LL)
      IF(K3.NE.0) WRITE(6,605)                                            G
  605 FORMAT(/35H BURDEN DISTRIBUTIONS AT END OF TASK//50H BURDENS BY ZO
     .NE AND SURFACE   - - - - - - - - - - -/)
      DO 303 J=1,4
      JJ=503+J                                                            G
      CALL HES(JJ,K0)
  303 AR(J)=0.
      DO 310 I=1,100                                                      G
      IF(IU(I).EQ.0)GO TO 310
      CALL HAS(I,T)
      IF(K3.NE.0) WRITE(6,602) I,(DAC(I,J),J=1,2)                         G
  602 FORMAT(/5H ZONE,I4,2X,2A6)
      DO 305 J=1,4
      JJ=503+J                                                            G
      IB=IAB(I,J)
      IF(IB.LE.0)GO TO 305
      IF(DR(IB,1).LE.0.)GO TO 305
      A=DR(IB,1)
      AR(J)=AR(J)+A
      DR(IB,1)=AVF(IB)
      CALL HCS(JJ,IB,JJ,1)
      DR(IB,1)=A
      IF(K3.NE.0) WRITE(6,603) J,DR(IB,1)                                 G
  603 FORMAT(5X,14HSURFACE NUMBER,I2,7H, AREA=,F9.3,8H, BURDEN)
      IF ( K3 .NE. 0 )          CALL HWS(IB)                              G
  305 CONTINUE
  310 CONTINUE
      WRITE(6,608)
  608 FORMAT(//50H BURDEN TOTALS BY SURFACE  - - - - - - - - - - - -//)
      A=0.
      CALL HES(501,K0)                                                    G
```

```
                                                                      A26
      DO 320 J=1,4
      JJ=503+J                                                          G
      CALL HAS(JJ)
      WRITE(6,606) J,AR(J)
  606 FORMAT(//8H SURFACE,I2,13H, TOTAL AREA=,F9.3,14H, TOTAL BURDEN)
      CALL HWS(JJ)
      A=A+AR(J)
  320 CALL HCS(501,JJ,501,1)                                            G
      CALL HAS(501)                                                     G
      WRITE(6,609)
  609 FORMAT(//50H - - - - - - - - - - - - - - - - - - - - - - - - -//)
      WRITE(6,607) A
  607 FORMAT(//28H TOTAL, ALL SURFACES.  AREA=,F9.3,9H,  BURDEN)
      CALL HWS(501)                                                     G
      JT(NT)=KT
      XMT(NT)=AVF(501)                                                  G
      XVT(NT)=AVF(LL)
      IF(L4.LE.0)RETURN
      L4=L4+530
      CALL HES(L4,501)                                                  G
      DR(L4,1)=A
      RETURN
      END
```

```
      SUBROUTINE HCS(IA,IB,IC,K)
C
C     HISTOGRAM COMBINING SUBROUTINE
      DIMENSION CA(11),CB(11),CR(21),ZR(21),QR(11,11),NQ(11)
      COMMON    KK, IK, KR, RUN(7), KS, STG(7), KT, TSK(7), DSC(6), ID,
     .          NE, AES(4), IEC(10), IET(10), AEC(10), AET(10), AED(10),
     .          AEF(10,4), NC, IOT(35), IOQ(35), IOC(35), NP, DAC(120,2),
     .          IU(120), IAB(120,6), AAG(120), AAS(120), AAT(120),
     .          NX(572), DR(572,11), XR(572,11), KO, NS, IR(5), AR(9),
     .          APA(2), NT, JT(100), XMT(100), XVT(100), L1, L2, L3, L4,
     .          KTS, ITE, K3, DUM(2664)
      NA=NX(IA)
      NB=NX(IB)
      A=DR(IA,1)
      B=DR(IB,1)
      X=XR(IA,1)
      Y=XR(IB,1)
      CR(1)=ZF(A,B,K)
      CM=CR(1)
      DR(IC,1)=CR(1)
      ZR(1)=ZF(X,Y,K)
      IF(NA.GT.1)GO TO 50
      IF(X.NE.0.)GO TO 30
      IF((K-3)*(K-4).EQ.0)GO TO 35
   30 IF(NB.GT.1)GO TO 40
   35 XR(IC,1)=ZR(1)
      NX(IC)=1
      GO TO 1000
   40 NC=NB
      DO 45 J=2,NC
      Y=XR(IB,J)
      CR(J)=DR(IB,J)
   45 ZR(J)=ZF(X,Y,K)
      GO TO 60
   50 IF(NB.GT.1)GO TO 90
      NC=NA
      DO 55 J=2,NC
      X=XR(IA,J)
      CR(J)=DR(IA,J)
   55 ZR(J)=ZF(X,Y,K)
   60 NX(IC)=NC
      IF(ZR(NC).GT.ZR(1))GO TO 70
      XR(IC,1)=ZR(NC)
      JC=NC
      DO 65 J=2,NC
      DR(IC,J)=CR(JC)
      JC=JC-1
   65 XR(IC,J)=ZR(JC)
      GO TO 80
   70 XR(IC,1)=ZR(1)
      DO 75 J=2,NC
      DR(IC,J)=CR(J)
   75 XR(IC,J)=ZR(J)
   80 IF(K.LE.4)GO TO 1000
C     ELIMINATION OF DUPLICATE X VALUES FOR K=5
      CR(1)=0.
      CR(2)=0.
      JC=1
      ZR(1)=XR(IC,1)
      DO 85 J=2,NC
      CR(J)=CR(J)+DR(IC,J)
      IF(XR(IC,J).LE.XR(IC,J-1))GO TO 85
```

```
      JC=JC+1
      CR(JC)=CR(J)
      ZR(JC)=XR(IC,J)
   85 CR(J+1)=CR(J)
      NC=JC
      GO TO 300
   90 IF(K.EQ.5)GO TO 200
      JA=0
      JB=0
      JC=0
      KA=NA+1
      KB=NB+1
      IF(NA.GE.NB)GO TO 94
      NC=NB
      KC=KB
      GO TO 100
   94 NC=NA
      KC=KA
  100 JC=JC+1
      KC=KC-1
      IF(JC.GT.KC)GO TO 140
      IF(JA+1.GE.KA)GO TO 124
      JA=JA+1
      KA=KA-1
      X1=XR(IA,JA)
      X2=XR(IA,KA)
      IF(JB+1.GE.KB)GO TO 120
      JB=JB+1
      KB=KB-1
      Y1=XR(IB,JB)
      Y2=XR(IB,KB)
      IF(K.EQ.2)GO TO 110
      Z1=ZF(X1,Y1,K)
      Z2=ZF(X1,Y2,K)
      IF(Z2.GT.Z1)GO TO 102
      ZR(JC)=Z2
      GO TO 104
  102 ZR(JC)=Z1
  104 Z1=ZF(X2,Y1,K)
      Z2=ZF(X2,Y2,K)
      IF(Z2.GT.Z1)GO TO 106
      ZR(KC)=Z1
      GO TO 100
  106 ZR(KC)=Z2
      GO TO 100
  110 ZR(JC)=ZF(X1,Y1,K)
      ZR(KC)=ZF(X2,Y2,K)
      IF(ZR(JC)-ZR(KC))100,112,112
  112 ZR(JC)=.5*(ZR(JC)+ZR(KC))
  114 KC=KC+1
      IF(KC.GT.NC)GO TO 116
      JC=JC+1
      ZR(JC)=ZR(KC)
      GO TO 114
  116 NC=JC
      GO TO 140
  120 Y1=.5*(XR(IB,JB)+XR(IB,KB))
      ZR(JC)=ZF(X1,Y1,K)
      ZR(KC)=ZF(X2,Y1,K)
      GO TO 100
  124 X1=.5*(XR(IA,JA)+XR(IA,KA))
      IF(JB+1.GE.KB)GO TO 128
```

```
      JR=JB+1
      KB=KB-1
      Y1=XR(IB,JB)
      Y2=XR(IB,KB)
      IF(K.EQ.2)GO TO 130
      Z1=ZF(X1,Y1,K)
      Z2=ZF(X1,Y2,K)
      IF(Z2.GT.Z1)GO TO 126
      ZR(JC)=Z2
      ZR(KC)=Z1
      GO TO 100
  126 ZR(JC)=Z1
      ZR(KC)=Z2
      GO TO 100
  128 Y1=.5*(XR(IB,JB)+XR(IB,KB))
      ZR(JC)=ZF(X1,Y1,K)
      ZR(KC)=ZR(JC)
      GO TO 100
  130 ZR(JC)=ZF(X1,Y2,K)
      ZR(KC)=ZF(X1,Y1,K)
      GO TO 100
  140 NX(IC)=NC
      IF(NC.EQ.1)GO TO 35
      IF(K.EQ.2)GO TO 171
      DO 150 J=1,NC
  150 CR(J)=0.
      DO 170 JA=2,NA
      DO 170 JB=2,NB
      P=DR(IA,JA)*DR(IB,JB)
      X1=XR(IA,JA-1)
      X2=XR(IA,JA)
      Y1=XR(IB,JB-1)
      Y2=XR(IB,JB)
      Z1=ZF(X1,Y1,K)
      Z2=ZF(X1,Y2,K)
      IF(Z2.GT.Z1)GO TO 154
      ZA=Z2
      GO TO 155
  154 ZA=Z1
  155 Z1=ZF(X2,Y1,K)
      Z2=ZF(X2,Y2,K)
      IF(Z2.GT.Z1)GO TO 158
      ZB=Z1
      GO TO 160
  158 ZB=Z2
  160 DO 170 JC=2,NC
      IF(ZR(JC).LE.ZA)GO TO 170
      IF(ZR(JC).GE.ZB)GO TO 166
      CR(JC)=CR(JC)+P*(ZR(JC)-ZA)/(ZB-ZA)
      GO TO 170
  166 CR(JC)=CR(JC)+P
  170 CONTINUE
      GO TO 300
  171 KC=1
      DO 172 JC=2,NC
      IF(ZR(JC).GT.ZR(NC))ZR(JC)=ZR(NC)
      IF(ZR(KC).GE.ZR(JC))GO TO 172
      KC=KC+1
      ZR(KC)=ZR(JC)
  172 CONTINUE
      NC=KC
      IF(NC.GT.1)GO TO 173
```

```
      NX(IC)=1
      XR(IC,1)=ZR(1)
      GO TO 1000
  173 DO 174 JA=2,NA
  174 CA(JA)=DR(IA,JA)
      DO 180 JC=2,NC
      Z1=ZR(JC-1)
      Z2=ZR(JC)
      DO 175 JA=1,NA
  175 QR(JA,JC)=0.
      DO 178 JB=2,NB
      Y1=XR(IB,JB-1)
      Y2=XR(IB,JB)
      XA=ZF(Z1,Y1,1)+.0001
      XA=ZF(Z1,Y1,1)
      XB=ZF(Z2,Y2,1)
      DO 178 JA=2,NA
      IF(XR(IA,JA).LE.XA)GO TO 178
      IF(XR(IA,JA).GE.XB)GO TO 176
      QR(JA,JC)=QR(JA,JC)+DR(IB,JB)*(XR(IA,JA)-XA)/(XB-XA)
      GO TO 178
  176 QR(JA,JC)=QR(JA,JC)+DR(IB,JB)
  178 CONTINUE
      KA=NA
      DO 180 JA=2,NA
      QR(KA,JC)=QR(KA,JC)-QR(KA-1,JC)
      KA=KA-1
  180 CONTINUE
      DO 190 JA=2,NC
      KC=0
      QRX=.0001
      DO 182 JC=2,NC
      IF(QR(JA,JC).LE.QRX)GO TO 182
      KC=JC
      NQ(JA)=KC
      QRX=QR(JA,JC)
  182 CONTINUE
      DO 184 JC=2,NC
  184 QR(JA,JC)=QR(JA,JC)/QRX
      CA(JA)=CA(JA)/QRX
      DO 188 J=2,NA
      IF(J.EQ.JA)GO TO 188
      QX=QR(J,KC)
      DO 186 JC=2,NC
      QR(J,JC)=QR(J,JC)-QX*QR(JA,JC)
  186 CONTINUE
      CA(J)=CA(J)-QX*CA(JA)
  188 CONTINUE
  190 CONTINUE
      DO 192 JA=2,NC
      KC=NQ(JA)
  192 CR(KC)=CA(JA)
      CR(1)=0.
      DO 194 JA=2,NC
      IF(CR(JA).LT.0.)CR(JA)=0.
  194 CR(JA)=CR(JA)+CR(JA-1)
      GO TO 300
  200 JA=1
      JB=1
      JC=0
      KA=0
      KB=0
```

```
      CA(1)=0.
      CB(1)=0.
      NM=NA
      IF(NM.LT.NB)NM=NB
205   IF(XR(IA,JA)-XR(IB,JB))210,235,255
210   IF(KA.GT.0)GO TO 260
      IF(XR(IA,JA).LT.XR(IB,1))GO TO 225
      DB=CB(JB-1)+(CB(JB)-CB(JB-1))*(XR(IA,JA)-XR(IB,JB-1))/
     .(XR(IB,JB)-XR(IB,JB-1))
      GO TO 220
215   DB=CB(NB)
220   JC=JC+1
      CR(JC)=CA(JA)+DB
      ZR(JC)=XR(IA,JA)
225   IF(JA.GE.NA)GO TO 230
      JA=JA+1
      CA(JA)=CA(JA-1)+DR(IA,JA)
      GO TO 205
230   IF(KB.GT.0)GO TO 280
      KA=1
      GO TO 205
235   JC=JC+1
      CR(JC)=CA(JA)+CB(JB)
      ZR(JC)=XR(IA,JA)
      IF(JA.GE.NA)GO TO 245
      JA=JA+1
      CA(JA)=CA(JA-1)+DR(IA,JA)
240   IF(JB.GE.NB)GO TO 250
      JB=JB+1
      CB(JB)=CB(JB-1)+DR(IB,JB)
      GO TO 205
245   IF(KB.GT.0)GO TO 280
      KA=1
      GO TO 240
250   IF(KA.GT.0)GO TO 280
      KB=1
      GO TO 205
255   IF(KB.GT.0)GO TO 215
      IF(XR(IB,JB).LT.XR(IA,1))GO TO 270
      DA=CA(JA-1)+(CA(JA)-CA(JA-1))*(XR(IB,JB)-XR(IA,JA-1))/
     .(XR(IA,JA)-XR(IA,JA-1))
      GO TO 265
260   DA=CA(NA)
265   JC=JC+1
      CR(JC)=CB(JB)+DA
      ZR(JC)=XR(IB,JB)
270   IF(JB.GE.NB)GO TO 275
      JB=JB+1
      CB(JB)=CR(JB-1)+DR(IB,JB)
      GO TO 205
275   IF(KA.GT.0)GO TO 280
      KB=1
      GO TO 205
280   NC=JC
290   IF(NC.LE.NM)GO TO 300
      DJ=1.
      JJ=2
      NC=NC-1
      DO 294 J=2,NC
      DS=(CR(J-1)+(CR(J+1)-CR(J-1))*(ZR(J)-ZR(J-1))/(ZR(J+1)-ZR(J-1))
     .-CR(J))**2
      IF(DS.GE.DJ)GO TO 294
```

```
      DJ=DS
      JJ=J
      IF(DJ.LT..0001)GO TO 296
  294 CONTINUE
  296 DO 298 J=JJ,NC
      CR(J)=CR(J+1)
  298 ZR(J)=ZR(J+1)
      GO TO 290
  300 F=1./CR(NC)
      DO 302 J=2,NC
  302 CR(J)=F*CR(J)
      XR(IC,1)=ZR(1)
  308 DO 310 J=2,NC
      DR(IC,J)=CR(J)-CR(J-1)
  310 XR(IC,J)=ZR(J)
      NX(IC)=NC
 1000 DR(IC,1)=AVF(IC)
      IF(K.EQ.5) RETURN
      IF(DR(IC,1).EQ.0.) RETURN
      F=CM/DR(IC,1)
      CALL HMS(IC,F,IC)
      RETURN
      END
```

```
      SUBROUTINE HAS(N)
C     HISTOGRAM ADJUSTING SUBROUTINE
      COMMON   KK, IK, KR, RUN(7), KS, STG(7), KT, TSK(7), DSC(6), ID,
     .         NE, AES(4), IEC(10), IET(10), AEC(10), AET(10), AED(10),
     .         AEF(10,4), NO, IOT(35), IOO(35), IOC(35), NP, DAC(120,2),
     .         IU(120), IAB(120,6), AAG(120), AAS(120), AAT(120),
     .         NX(572), DR(572,11), XR(572,11), KO, NS, IR(5), AR(4),
     .         APA(2), NT, JT(100), XMT(100), XVT(100), L1, L2, L3, L4,
     .         KTS, ITE, K3, DUM(2664)
      DIMENSION C(11),D(11),Z(11)
      M=NX(N)
      IF(M.EQ.1) RETURN
      IF(ID.LE.0) RETURN
      IF(NX(ID).LE.0) RETURN
      AVER=AVF(N)
      MD=NX(ID)
      IF(MD.GT.1) GO TO 5
      XR(N,1)=AVER
      NX(N)=1
      RETURN
    5 C(1)=0.
      D(1)=0.
      Z(MD)=XR(N,M)
      DO 10 I=2,M
   10 C(I)=C(I-1)+DR(N,I)
      IF(C(M).EQ.1.) GO TO 19
      IF(C(M).EQ.0.) RETURN
      DO 15 I=2,M
   15 C(I)=C(I)/C(M)
   19 DO 20 I=2,MD
   20 D(I)=D(I-1)+DR(ID,I)
      IF(D(MD).EQ.1.) GO TO 27
      IF(D(MD).EQ.0.) RETURN
      DO 25 I=2,MD
      DR(ID,I)=DR(ID,I)/D(MD)
   25 D(I)=D(I)/D(MD)
   27 IF(D(MD-1).NE.1.) GO TO 30
      MD=MD-1
      NX(ID)=MD
      GO TO 27
   30 I=2
      J=2
   31 DR(N,I)=DR(ID,I)
   32 IF(C(J).LE.D(I)) GO TO 33
      Z(I)=XR(N,J-1)+(D(I)-C(J-1))*(XR(N,J)-XR(N,J-1))/(C(J)-C(J-1))
      I=I+1
      GO TO 31
   33 J=J+1
      IF(J.LE.M) GO TO 32
      DO 35 I=2,MD
   35 XR(N,I)=Z(I)
      NX(N)=MD
      AVR=AVF(N)
      IF(AVR.EQ.0.) RETURN
      F=AVER/AVR
      DO 40 I=1,M
   40 XR(N,I)=XR(N,I)*F
      RETURN
      END
```

```
      SUBROUTINE HES(J,K)                                              A34
C
C     HISTOGRAM EQUATING SUBROUTINE
C     SET J=K.
      COMMON    KK, IK, KR, RUN(7), KS, STG(7), KT, TSK(7), DSC(6), ID,
     .          NE, AES(4), IEC(10), IET(10), AEC(10), AET(10), AED(10),
     .          AEF(10,4), NO, IOT(35), IOQ(35), IOC(35), NP, DAC(120,2),
     .          IU(120), IAB(120,6), AAG(120), AAS(120), AAT(120),
     .          NX(572), DR(572,11), XR(572,11), KO, NS, IR(5), AR(4),
     .          APA(2), NT, JT(100), XMT(100), XVT(100), L1, L2, L3, L4,
     .          KTS, ITE, K3, DUM(2664)
      M=NX(K)
      NX(J)=M
      DO 10 I=1,M
      DR(J,I)=DR(K,I)
   10 XR(J,I)=XR(K,I)
      RETURN
      END
```

```
      SUBROUTINE HMS(IA,C,IC)
C
C     HISTOGRAM MULTIPLYING SUBROUTINE
C     HISTOGRAM IC EQUALS IA MULTIPLIED BY CONSTANT C
      COMMON   KK, IK, KR, RUN(7), KS, STG(7), KT, TSK(7), DSC(6), ID,
     .         NE, AES(4), IEC(10), IET(10), AEC(10), AET(10), AED(10),
     .         AEF(10,4), NO, IOT(35), IOQ(35), IOC(35), NP, DAC(120,2),
     .         IU(120), IAB(120,6), AAG(120), AAS(120), AAT(120),
     .         NX(572), DR(572,11), XR(572,11), KO, NS, IR(5), AR(4),
     .         APA(2), NT, JT(100), XMT(100), XVT(100), L1, L2, L3, L4,
     .         KTS, ITE, K3, DUM(2664)
      IF(C.EQ.0.)GO TO 20
      M=NX(IA)
      NX(IC)=M
      DO 10 J=1,M
      DR(IC,J)=DR(IA,J)
   10 XR(IC,J)=XR(IA,J)*C
      DR(IC,1)=DR(IA,1)*C
      RETURN
   20 NX(IC)=1
      DR(IC,1)=0.
      XR(IC,1)=0.
      RETURN
      END
```

```
      SUBROUTINE HWS(I)
C  HISTOGRAM WRITING ROUTINE
C  VERSION 16 JULY,1969
      COMMON   KK, IK, KR, RUN(7), KS, STG(7), KT, TSK(7), DSC(6), ID,
     .         NE, AES(4), IEC(10), IET(10), AEC(10), AET(10), AED(10),
     .         AEF(10,4), NO, IOT(35), IOQ(35), IOC(35), NP, DAC(120,2),
     .         IU(120), IAB(120,6), AAS(120), AAS(120), AAT(120),
     .         NX(572), DR(572,11), XR(572,11), KO, NS, IR(5), AR(4),
     .         APA(2), NT, JT(100), XMT(100), XVT(100), L1, L2, L3, L4,
     .         KTS, ITE, K3, DUM(2664)
      M=NX(I)
      IF(M.LE.1) GO TO 100
      D=AVF(I)
      WRITE(6,600) D
  600 FORMAT(1H+,46X,13HMEAN VALUE = ,E12.5)
      WRITE(6,601) (DR(I,J),J=2,M)
  601 FORMAT(15H  PROBABILITY =,5X,10F10.5)
      WRITE(6,602) (XR(I,J),J=1,M)
  602 FORMAT(10H  RANGE = ,11E10.2)
      WRITE(6,609)
  609 FORMAT(/)
      RETURN
  100 WRITE(6,603) XR(I,1)
  603 FORMAT(1H+,46X,2H= ,E12.5/)
      RETURN
      END
```

```
      SUBROUTINE MAS(I,T)
C
C     MICROBIAL ACCRETION SUBROUTINE
C     I IS THE PART AFFECTED, T THE TIME OF UPDATE
      COMMON   KK, IK, KR, RUN(7), KS, STG(7), KT, TSK(7), DSC(6), ID,
     .         NE, AES(4), IEC(10), IET(10), AEC(10), AET(10), AED(10),
     .         AEF(10,4), NO, IOT(35), IOO(35), IOC(35), NP, DAC(120,2),
     .         IU(120), IAB(120,6), AAG(120), AAS(120), AAT(120),
     .         NX(572), DR(572,11), XR(572,11), KO, NS, IR(5), AR(4),
     .         APA(2), NT, JT(100), XMT(100), XVT(100), L1, L2, L3, L4,
     .         KTS, ITE, K3, DUM(2664)
      DT=T-AAT(I)
      IF(DT.LE.0.)RETURN
      AAT(I)=T
      IE=IAB(I,5)
      IF(IE.LE.0)RETURN
      IC=IEC(IE)
      C=AAG(I)*AEC(IE)/DR(IC,1)
      DO 40 J=1,4
      IF(IAB(I,J).EQ.0)GO TO 40
      IF(AEF(IE,J).EQ.0.)GO TO 40
      IB=IAB(I,J)
      A=DR(IB,1)
      F=C*AEF(IE,J)*A
      CALL HMS(IC,F,501)                                              G
      DR(501,1)=AVF(501)                                              G
      V=AET(IE)*AES(J)
      F=EXP(-DT/V)
      CALL HMS(IB,F,502)                                              G
      DR(502,1)=AVF(502)                                              G
      F=V*(1.-F)
      CALL HMS(501,F,503)                                             G
      CALL HCS(502,503,IB,1)                                          G
      DR(IB,1)=A
   40 CONTINUE
      RETURN
      END
```

```
      FUNCTION AVF(I)
C     AVERAGE VALUE FUNCTION
      COMMON   KK, IK, KR, RUN(7), KS, STG(7), KT, TSK(7), DSC(6), ID,
     .         NE, AES(4), IEC(10), IET(10), AEC(10), AET(10), AED(10),
     .         AEF(10,4), NO, IOT(35), IOQ(35), IOC(35), NP, DAC(120,2),
     .         IU(120), IAB(120,6), AAG(120), AAS(120), AAT(120),
     .         NX(572), DR(572,11), XR(572,11), KO, NS, IR(5), AR(4),
     .         APA(2), NT, JT(100), XMT(100), XVT(100), L1, L2, L3, L4,
     .         KTS, ITE, K3, DUM(2664)
      M=NX(I)
      IF(M.GT.1) GO TO 10
      AVF=XR(I,1)
      RETURN
   10 AVF=0.
      DO 20 J=2,M
   20 AVF=AVF+DR(I,J)*(XR(I,J-1)+XR(I,J))
      AVF=.5*AVF
      RETURN
      END
```

```
      FUNCTION ZF(X,Y,K)
C
C     Z FUNCTION OF X AND Y
C     K DETERMINES THE OPERATION + - * /.
      GO TO (10,20,30,40,50),K
   10 ZF=X+Y
      RETURN
   20 ZF=X-Y
      RETURN
   30 ZF=X*Y
      RETURN
   40 ZF=X/Y
      RETURN
   50 ZF=X
      IF(Y.GT.X)ZF=Y
      RETURN
      END
```

```
      SUBROUTINE DPS                                                    A40
C     DETAILED PRINTOUT SUBROUTINE  (READS FROM TAPE11)
      COMMON/X/M,MR,MG,MT,MS,DSC(4),N,NX,DR(11),XR(11),P(5),NP(5)
      REWIND 11
      READ(11) M,MR,MG,MT,MS,(DSC(J),J=1,4),N,NX,(DR(J),J=1,11),
     .(XR(J),J=1,11),(P(J),J=1,5),(NP(J),J=1,5)
      WRITE(6,601) MP,(DR(J),J=1,7)
  601 FORMAT(35H1MICROBIAL BURDEN DETAILED PRINTOUT/4H RUN,I2,2X,7A6//)
      READ(5,500) K,NS,NT,NST,NS2,NT2,NST2
  500 FORMAT(7I5)
C     K=0 CALLS EXIT
C     K=1 PRINTS STAGE NS,TASK NT (SUBTASK NST)
C     K=2 PRINTS FROM NS,NT,(NST) TO NS2,NT2,(NST2)
   10 READ(11) M,MR,MG,MT,MS,(DSC(J),J=1,4),N,NX,(DR(J),J=1,11),
     .(XR(J),J=1,11),(P(J),J=1,5),(NP(J),J=1,5)
      IF(M.LE.0) CALL EXIT
   11 IF(MG.NE.NS) GO TO 10
      IF(MT.NE.NT) GO TO 10
      IF((NST.GT.0).AND.(NST.NE.MS)) GO TO 10
      IF(K.EQ. 2) GO TO 20
   15 CALL PLS
      READ(11) M,MR,MG,MT,MS,(DSC(J),J=1,4),N,NX,(DR(J),J=1,11),
     .(XR(J),J=1,11),(P(J),J=1,5),(NP(J),J=1,5)
      IF(M.LE.0) CALL EXIT
      IF(MG.NE.NS) GO TO 100
      IF(MT.NE.NT) GO TO 100
      IF((NST.GT.0).AND.(NST.NE.MS)) GO TO 100
      GO TO 15
   20 NS=NS2
      NT=NT2
      NST=NST2
   25 CALL PLS
      READ(11) M,MR,MG,MT,MS,(DSC(J),J=1,4),N,NX,(DR(J),J=1,11),
     .(XR(J),J=1,11),(P(J),J=1,5),(NP(J),J=1,5)
      IF(M.LE.0) CALL EXIT
      IF(MG.NE.NS) GO TO 25
      IF(MT.NE.NT) GO TO 25
      IF((NST.GT.0).AND.(NST.NE.MS)) GO TO 25
  100 READ(5,500) K,NS,NT,NST,NS2,NT2,NST2
      IF(K.LE.0) CALL EXIT
      GO TO 11
      END
```

```
      SUBROUTINE PLS                                                    A41
C     PARAMETER LABELING SUBROUTINE
      COMMON/X/M,MR,MG,MT,MS,DSC(4),N,NX,DR(11),XR(11),P(5),NP(5)
  600 FORMAT(//40X,3HRUN,I2,7H, STAGE,I3,6H, TASK,I4,9H, SUBTASK,I3,2X,
     .4A6)
      GO TO(1,2,3,4,5,6,7,8,9),M
    1 WRITE(6,601) MR,(DR(J),J=1,7),MG,(DR(J),J=8,11),(XR(J),J=1,3)
  601 FORMAT(35H1MICROBIAL BURDEN DETAILED PRINTOUT/4H RUN,I2,2X,7A6/
     .6H STAGE,I3,2X,7A6//)
      RETURN
    2 WRITE(6,600) MR,MG,MT,MS,(DSC(J),J=1,4)
      WRITE(6,602) NP(1),NP(2)
  602 FORMAT(31H+----- START OF NEW SUBTASK ----/33H PREREQUISITE TIME DIG
     .STRIBUTIONS-,I4,1H,I4,42X,10HSTART TIME)                          6
      CALL HPS
      RETURN
    3 WRITE(6,600) MR,MG,MT,MS,(DSC(J),J=1,4)
      WRITE(6,603) NP(1),NP(2),P(1),NP(3),P(3),NP(4),P(4)
  603 FORMAT(26H+PART BURDEN AFTER FALLOUT/5H PART,I4,7H, SURF.,I2,
     .7H, AREA=,F7.2,7H, OPER.,I3,1H,,F6.2,6H HOURS,
     .10H, ENVIRON.,I3,1H,,F4.0,5H MEN.,10X,6HBURDEN)
      CALL HPS
      RETURN
    4 WRITE(6,600) MR,MG,MT,MS,(DSC(J),J=1,4)
      WRITE(6,604) NP(1),NP(2),(P(J),J=1,5)
  604 FORMAT(26H+PART BURDEN AFTER CONTACT/5H PART,I4,7H, SURF.,I2,
     .7H, AREA=,F7.2,10H, CONTACT=,F5.3,5H, S1=,F5.3,5H, S2=,F5.3,
     .7H, TOOL=,F7.1,7X,6HBURDEN)
      CALL HPS
      RETURN
    5 WRITE(6,600) MR,MG,MT,MS,(DSC(J),J=1,4)
      CALL HPS
      RETURN
    6 WRITE(6,600) MR,MG,MT,MS,(DSC(J),J=1,4)
      RETURN
    7 WRITE(6,600) MR,MG,MT,MS,(DSC(J),J=1,4)
      RETURN
    8 WRITE(6,600) MR,MG,MT,MS,(DSC(J),J=1,4)
      WRITE(6,608) NP(1),(P(J),J=3,4),NP(2),P(1),P(2),NP(4)
  608 FORMAT(25H+PART BURDEN AFTER UPDATE/5H PART,I4,2X,2A6,7H, SURF.,
     .I2,7H, AREA=,F7.2,7H, TIME=,F9.3,10H, ENVIRON.,I3,14X,6HBURDEN)
      CALL HPS
      RETURN
    9 WRITE(6,600) MR,MG,MT,MS,(DSC(J),J=1,4)
      WRITE(6,609) NP(1),NP(2),P(1),NP(3),P(4),P(5)
  609 FORMAT(34H+PART BURDEN AFTER DECONTAMINATION/5H PART,I4,7H, SURF.,
     .I2,7H, AREA=,F7.2,7H, OPER.,I3,1H,,F6.2,25H HOURS, FRACTION REMOVE
     .D=,F6.3,8X,6HBURDEN)                                              A
      CALL HPS
      RETURN
      END
```

```
      SUBROUTINE HPS
C  HISTOGRAM WRITING ROUTINE
      COMMON/X/M,MP,MG,MT,MS,DSC(4),N,NX,DR(11),XR(11),P(5),NP(5)
      IF(NX.LE.1) GO TO 100
      D=0.
      DO 20 J=2,NX
   20 D=D+.5*DP(J)*(XR(J-1)+XR(J))
      WRITE(6,600) D
  600 FORMAT(1H+,94X,13HMEAN VALUE = ,E12.5)
      WRITE(6,601) (DR(J),J=2,NX)
  601 FORMAT(15H  PROBABILITY =,5X,10F10.5)
      WRITE(6,602) (XR(J),J=1,NX)
  602 FORMAT(10H  RANGE = ,11E10.2)
      RETURN
  100 WRITE(6,603) XR(1)
  603 FORMAT(1H+,94X,2H= ,E12.5)
      RETURN
      END
```