A-101 077

HDL-TR-1918

May 1981

C³ Modified TACWAR Model

by John C. Ingram

THE ARMY'S THEATER NUCLEAR FORCE SURVIVABILITY PROGRAM

TN F/S

U.S. Army Electronics Research
and Development Command
Harry Diamond Laboratories
Adelphi, MD   20783

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER HDL-TR-1918	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* C³ Modified TACWAR Model		5. TYPE OF REPORT & PERIOD COVERED Technical Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR*(s)* John C. Ingram		8. CONTRACT OR GRANT NUMBER*(s)*
9. PERFORMING ORGANIZATION NAME AND ADDRESS Harry Diamond Laboratories 2800 Powder Mill Road Adelphi, MD 20783		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Program Ele: 6.51.08.A
11. CONTROLLING OFFICE NAME AND ADDRESS Commander U.S. Army Training and Doctrine Command Fort Monroe, VA 23651		12. REPORT DATE May 1981
		13. NUMBER OF PAGES 76
14. MONITORING AGENCY NAME & ADDRESS*(If different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*
C³ degradation
Theater-level combat
Computer simulation
Command, control, and communications

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The TACWAR theater-level combat simulation model has been modified to include command, control, and communications degradation (C³/D). Specific areas where C³/D has been incorporated include combat division assets, corps-sector assets, and theater (COMMZ) assets. The results of C³/D impact division combat effectiveness, nuclear and chemical authorization and release processing delays, target acquisition delays, and

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20. Abstract (Cont'd)

nuclear and chemical delivery system and warhead inventory effectiveness. The C^3/D modified TACWAR model has been run using an unclassified "benchmark" data base. Communications degradation and message processing delay data are provided by the TACNET theater-level C^3 model. Parametric studies reveal the effect of C^3/D on the results of theater-level engagements.

CONTENTS

3

FIGURES

4

1. INTRODUCTION

The TACWAR theater-level combat simulation model was developed by the Institute for Defense Analysis (IDA) for the Department of Defense Studies Analysis and Gaming Agency (DoD-SAGA). Presently, TACWAR is being maintained for SAGA by the Defense Communications Agency Command and Control Technical Center (DCA-CCTC).

Since TACWAR does allow theater-level combat assessments, it is being considered as a prime candidate to provide results to the "net assessment" task of the Army-sponsored Theater Nuclear Forces Survivability (TNF/S) program. A broad-scoped program, TNF/S encompasses a number of major task (and subtask) areas including target acquisition; nuclear-chemical-conventional kill; logistics; combat degradation; unconventional warfare; electronic warfare; and command, control, and communications degradation (C^3/D).

Each of these major areas of analysis is controlled by a designated "lead element" who is responsible for coordinating and assessing that portion of the overall program. The author is a member of a team of the Electronics Research and Development Command Harry Diamond Laboratories (ERADCOM-HDL) that is assisting the Combined Arms Combat Development Activity (CACDA), the designated lead element for C^3/D.

A thorough analysis of TACWAR revealed that very little C^3 is modeled explicitly. Consequently, it was decided that those areas within TACWAR that are of major interest and importance to TNF/S-C^3/D will be modified to include C^3/D effects. This report describes those modification efforts, including the rationale for the modifications, the methodology employed, and the explicit FORTRAN code changes that have been implemented. Initial data values and the results of some sample runs also are provided.

2. SUMMARY OF TACWAR

In its broadest categories of simulation, TACWAR can be divided into five major areas of combat or control:[1]

> Air combat
> Nuclear combat
> Chemical combat
> Ground (with air-ground interaction) combat
> Theater control

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[1]*Institute for Defense Analysis Tactical Warfare (TACWAR) Model, Defense Communications Agency CCTC Computer System Manual CSM MM 237-77, Parts I, II, III (6 September 1977).*

Each of these areas was analyzed to determine if C^3/D effects could be readily incorporated into the simulation. The analysis is summarized in the following paragraphs.

2.1 Air Combat Simulation

In TACWAR, aircraft, aircraft shelters, and personnel are stationed at specific airbases. These airbase assets are consolidated within specified geographical "regions" of the theater to establish a "notional" or average airbase. For each of these notional airbases, aircraft are allocated to specific missions, including close air support (CAS), interdiction, and airbase attack. The number of aircraft available for these missions is a function of the operating capability of the actual airbases and will depend on C^3/D.

As a first order effect, the dependence of airbase operating capability on C^3/D can be accounted for by the degradation function currently available in TACWAR. Other C^3/D effects in the air model such as air-to-air coordination and CAS communications are secondary TNF/S considerations. Consequently, no changes in the air combat model are made to include C^3/D explicitly.

2.2 Nuclear Combat Model

The nuclear model in TACWAR includes an escalation process, a prioritized weapons assignment list, target acquisition, a prioritized target assignment list, a weapon-to-target selection process, and a target damage evaluation process. Important C^3/D effects in this model include (1) delays in nuclear escalation and in target acquisition processing due to degraded C^3 and (2) lower effectiveness of nuclear delivery means. Delays in nuclear escalation and in target acquisition can be incorporated into TACWAR by providing an explicit functional dependence of the delay time with degradation of C^3 assets within the several areas (echelons) of control such as division, corps-sector, and theater delivery systems. Similarly, nuclear delivery system effectiveness (availability) can be described as a function of C^3/D.

2.3 Chemical Combat Model

The chemical model in TACWAR has essentially a one-to-one correspondence with the nuclear model. Consequently, those C^3/D aspects described above for the nuclear model have a parallel aspect for the chemical model.

2.4 Ground Combat Model

Ground combat in TACWAR is simulated on a division-level resolution. Personnel and weapon system attrition and subsequent

movement of the forward edge of the battle area (FEBA) are determined as functions of the effectiveness of the divisions of the two combatant sides. Any C^3/D within the divisions will affect this combat effectiveness, which will then affect the attrition and FEBA movement. The amount by which C^3/D influences overall combat effectiveness of a division can be provided by an explicit functional relationship.

2.5 Theater Control Model

In TACWAR, theater control includes division and airbase resupply, reinforcement, replacement, and reallocation. As in the ground combat model above, reinforcement and replacement for divisions are functions of division combat effectiveness, which is itself influenced by C^3/D. Division resupply and reallocation (movement), although strongly dependent on C^3/D, have not been modified. Specifically, the gross nature in which TACWAR simulates the movement of entire divisions (and has no capability of modeling movement of division subunits) is not amendable to a C^3/D augmentation. As with the air combat model, no C^3/D augmentation of airbase resupply and reallocation was attempted within theater control.

3. DETAILS OF C^3/D MODIFICATIONS TO TACWAR

The following four major areas of TACWAR have been augmented to include C^3/D effects:

> Division combat effectiveness
> Nuclear delivery system availability
> Nuclear escalation state authorization delay
> Nuclear and chemical target acquisition processing delay

In each candidate area for C^3/D augmentation to TACWAR, it is necessary to specify C^3 equipment or processes that are attrited or degraded. If these C^3 assets were to be modeled explicitly in TACWAR, it would be necessary also to specify and to explictly model the combat by and against these assets. In particular, the augmentation would have to include target acquisition, weapon resource allocation, damage analysis, repair, and reconstitution of the C^3 assets.

The modeling effort necessary to include the above effects is beyond the scope of the present work. Consequently, C^3 assets are not explicitly included in the C^3/D augmentation. Instead, other combat assets that are already incorporated in TACWAR are employed as surrogates for C^3 assets. For example, the surrogates for C^3 assets within a division will be the different weapons systems of that division. For a corps-sector echelon and theater echelon, the surrogates will be a mix of airbase assets, surface-to-surface missile

7

(SSM) sites, and surface-to-air missile (SAM) sites. These surrogates will be modified by appropriate weighting factors in the augmentations to realistically reflect the actual mix of C^3 assets at the several echelons.

Each of the areas of C^3/D augmentation is described in the following sections. The actual FORTRAN code changes and augmentations are in appendix A and are discussed as part of the details below. With this description and appendix A, the interested reader with a minimum of effort may include C^3/D effects into a local version of TACWAR.

3.1 Division Combat Effectiveness Augmentation

In TACWAR, each combat division is currently described by effectiveness parameters such as EFFDD(ID) and EFFDA(ID), where ID is the division identifier index. These parameters depend on degradation of weapons systems and personnel in the division (compared with levels given by tables of organization and equipment--TOE), the current supplies available to the division, and the current chemical posture of the division.

For C^3/D augmentation, the division combat effectiveness parameters are modified by a C^3/D multiplying factor. This multiplying factor is itself determined by a functional relationship between decreased combat effectiveness due to C^3/D and decreased division communications (message throughput) capability. Similarly, this decreased division communications capability is determined by a functional relationship between itself and a decrease of C^3 assets within the division. Lastly, the decrease in C^3 assets is to be determined by using the degradation of surrogate division assets already modeled, these assets being the several weapons systems belonging to the division.

The general flow of logic beginning with degradation of division weapons systems and resulting in a division combat effectiveness C^3/D reduction factor is shown in figure 1. The actual changes to the TACWAR code are shown in appendix A and are discussed below.

```
|  DIV           |        ┌─────────────┐       |  DIV           |
|  WEAPON SYSTEM |───────▶│  C³ SYSTEM  │──────▶ |  C³ SYSTEM     |
|  DEGRADATION   |        │ DEGRADATION │        |  DEGRADATION   |
                          └─────────────┘

|  DIV           |        ┌─────────────┐       |  DIV           |
|  C³ SYSTEM     |───────▶│  MESSAGE    │──────▶ |  MESSAGE/INFO  |
|  DEGRADATION   |        │  REDUCTION  │        |  REDUCTION     |
                          │ CORRELATION │
                          └─────────────┘

|  DIV           |        ┌─────────────┐       |  DIV           |
|  MESSAGE/INFO  |───────▶│EFFECTIVENESS│──────▶ |  C³/D EFFECTIVENESS |
|  REDUCTION     |        │  REDUCTION  │        |  FACTOR        |
                          │ CORRELATION │
                          └─────────────┘
```

C³ SYSTEM CORRELATION

$$C^3/D = \sum_{TYPE} F_{TYPE} \times \frac{W_{TYPE}}{TO\&E}$$

MESSAGE REDUCTION CORRELATION   TACNET   RESULTS

EFFECTIVENESS REDUCTION CORRELATION   TRASANA   (UNOFFICIAL)

Figure 1. Logic flow algorithm for C^3
degradation of division
effectiveness.

Seven new array variables are needed to hold the user input
functional relationships and surrogate asset weighting factors. These
array variables are consolidated into a common block labeled TNFSC3.

NC3DD(L)   contains the number of function pairs XC3DD and
L = 1 to 2   YC3DD that describe the functional relationship
                   between the division combat effectiveness
                   C^3/D reduction factor and the decreased division
                   communications capability for each combatant
                   side indexed L.

XC3DD(I,L)   contains the Ith abscissa point for the function
I = 1 to 8   associated with NC3DD(L). The abscissae are
L = 1 to 2   fractions of the division communications
                   capability remaining (0.0 corresponding to zero
                   capability and 1.0 corresponding to full
                   capability).

9

YC3DD(I,L)   contains the Ith ordinate point for the
  I = 1 to 8   function associated with NC3DD(L). The
  L = 1 to 2   ordinates are fractional reductions of division
               combat effectiveness due to C^3/D.

NCOMD(L)   contains the number of function pairs XCOMD and
  L = 1 to 2   YCOMD that describe the functional relationship
               between decreased division communications
               capability and the degradation of division C^3
               assets for each combatant side indexed L.

XCOMD(I,L)   contains the Ith abscissa point for the function
  I = 1 to 8   associated with NCOMD(L). The abscissae are
  L = 1 to 2   fractions of division C^3 assets remaining (0.0
               corresponding to zero assets and 1.0 corre-
               sponding to full assets).

YCOMD(I,L)   contains the Ith ordinate point for the function
  I = 1 to 8   associated with NCOMD(L). The ordinates are
  L = 1 to 2   fractions of division communications capability
               remaining (identical to XC3DD).

FCLWL(IW,L)   contains the weighting factors to correlate the
  IW = 1 to 10   division surrogate weapon system indexed IW to
  L = 1 to 2   an equivalent division C^3 asset. Note: Within
               the C^3/D modifications to TACWAR, the variables
               FCLWL are normalized so that the full TOE level
               of weapons systems in the division corresponds
               to full C^3 assets. The division C^3 assets
               calculated by using variable FCLWL are used not
               only by the division effectiveness augmentation,
               but also by the nuclear delivery system avail-
               ability augmentation and the target acquisition
               processing delay time augmentation described in
               later sections.

The following subroutines calculate or use division combat effectiveness
parameters EFFDD(ID) and EFFDA(ID):

          GC   within DO loop 2525
          FEBAMT   within DO loop 520
          TC   within DO loop 4520 and DO loop 9020
          TIMET   following CONTINUE 820

The explicit code changes in these subroutines to incorporate the
division effectiveness factor due to C^3/D are given in appendix A.

10

3.2 Nuclear Delivery System Availability Augmentation

In the TACWAR nuclear model, the nuclear delivery systems available for each combatant side are assembled into three major echelons associated with command control: division, corps-sector, and theater delivery systems. A count is kept of the number of delivery systems available at each echelon for each side. This count of availability is modified by a C^3/D reduction factor that reflects the decrease in availability due to a failure to complete special nuclear authorization and release (A/R) messages. The C^3/D reduction factor is determined from a functional relationship between the loss of special A/R messages and the degradation of C^3 assets within each command control echelon.

The degradation of C^3 assets is to be determined by using a weighted degradation of surrogate assets already modeled within TACWAR and associated with each of the three echelons. Specifically, the following assets will be used as surrogates for C^3 assets at the different echelons:

Division

Division weapons systems (using the same technique as that described in the previous section for division combat effectiveness)

Corps-sector

Forward sector airbase assets
Belt SAM sites
Forward sector medium-range SSM sites
Forward sector long-range SSM sites

Theater

Rear sector airbase assets
Communication zone (COMMZ) airbase assets
Rear region long-range SAM sites
COMMZ long-range SAM sites
Rear sector long-range SSM sites

As these assets are degraded at the several echelons, a weighted proportion is assumed to correspond to the degradation of C^3 assets within the same echelon. The general flow of logic beginning with the degradation of explicitly modeled echelon assets and resulting in the C^3/D factor for the availability of nuclear delivery systems at that echelon is shown in figure 2.
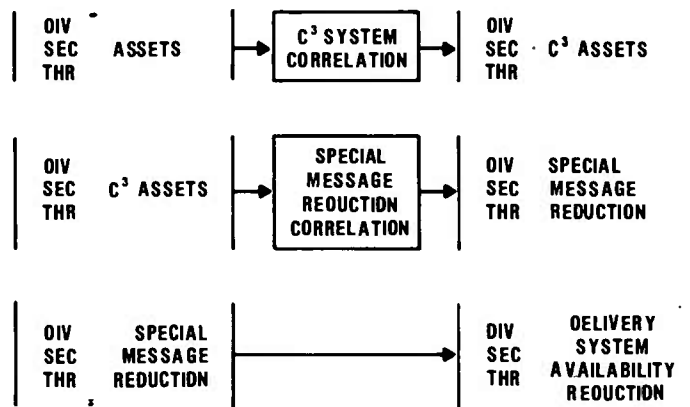
DIV ASSETS: DIVISION WEAPONS

SEC ASSETS: FORWARD AIRBASES
               BELT SAM'S
               MEDIUM RANGE SSM'S
               LONG RANGE SSM'S (FORWARD)

THEATER   REAR AND COMMZ AIRBASES
ASSETS: REAR AND COMMZ SAM'S
               LONG RANGE SSM'S (REAR)

C³ SYSTEM*
CORRELATION

$$C^3/D = \sum_{ASSET} F_{ASSET} \times \left(\frac{W^{CUR}}{W^{INIT}}\right)_{ASSET}$$

*AIRBASE ASSETS DYNAMICALLY ADJUSTED

Figure 2.   Logic flow algorithm for C^3
degradation of nuclear delivery
system availability.

The changes necessary in TACWAR to include the degradation of nuclear delivery system availability as a result of C^3/D are given in appendix A and are discussed below.

Twenty-one new array variables are required to hold the user input functional relationships, the surrogate asset weighting factors, the initial numbers of explicitly modeled echelon assets, and the nuclear delivery system degradation factors. The array variables are consolidated in two common blocks labeled TNFSC1 and TNFSC2.

  INABF(IS,L)   contains the initial number of forward area
    IS = 1 to 8   airbases in sector indexed IS for combatant side
    L = 1 to 2   indexed L.

INABR(IS,L)   contains the initial number of rear area airbases
  IS = 1 to 8   in sector indexed IS for side indexed L.
  L = 1 to 2

INABZ(L)   contains the initial number of COMMZ airbases for
  L = 1 to 2   side indexed L.

NC3SD(L)   contains the number of function pairs XC3SD and
  L = 1 to 2   YC3SD that describe the functional relationship
                     between the fractional degradation of nuclear
                     delivery system availability and the degradation
                     of C^3 assets at each echelon for combatant side
                     indexed L.

XC3SD(I,L)   contains the Ith abscissa point for the function
  I = 1 to 8   associated with NC3SD(L). The abscissae are
  L = 1 to 2   fractions of C^3 assets remaining in a particular
                     echelon.

YC3SD(I,L)   contains the Ith ordinate point for the function
  I = 1 to 8   associated with NC3SD(L). The ordinates are
  L = 1 to 2   fractional reductions in nuclear delivery system
                     availability at a particular echelon.

FDDSAD(IS,L)   contains the current C^3/D fractional reduction in
  IS = 1 to 8   the nuclear delivery system availability for the
  L = 1 to 2   division echelon in sector IS for side L.

FSDSAD(IS,L)   contains the current C^3/D fractional reduction in
  IS = 1 to 8   nuclear delivery system availability for the
  L = 1 to 2   corps-sector echelon in sector IS for side L.

FTDSAD(IS,L)   contains the current C^3/D fractional reduction in
  IS = 1 to 8   nuclear delivery system availability for the
  L = 1 to 2   theater echelon in sector IS for side L.

FABDCC(L)   contains the weighting factor to correlate the
  L = 1 to 2   corps-sector and theater C^3 assets with
                     surrogate airbase assets located within the two
                     respective echelons for side L.

ABSFCC(IS,L)   contains the fractional asset degradation of a
  IS = 1 to 8   notional (average) airbase in the forward area
  L = 1 to 2   of sector IS for side L.

ABSRCC(IS,L)   contains the fractional asset degradation of a
 IS = 1 to 8   notional airbase in the rear area of sector IS
  L = 1 to 2   for side L.

ABCZCC(L)   contains the fractional asset degradation of a
 L = 1 to 2   notional airbase in the COMMZ for side L.

FSSMCC(L)   contains the weighting factor to correlate the
 L = 1 to 2   corps-sector and theater C^3 assets with
                 surrogate SSM sites located within the two
                 respective echelons for side L.

TSSMIR(IS,L)   contains the initial number of theater echelon
 IS = 1 to 8   long-range SSM sites located in the rear area of
  L = 1 to 2   sector IS for side L. TSSMIR is set to the
                 initial value of the variable SSMSRS(IS,L)
                 already incorporated in TACWAR.

SSSMIM(IS,L)   contains the initial number of corps-sector
 IS = 1 to 8   echelon medium-range SSM sites in the forward
  L = 1 to 2   area of sector IS for side L. SSSMIM is set to
                 the initial value of the variable SSMSFS
                 (1,IS,L) already incorporated in TACWAR.

SSSMIL(IS,L)   contains the initial number of corps-sector
 IS = 1 to 8   echelon long-range SSM sites in the forward area
  L = 1 to 2   of sector IS for side L. SSSMIL is set to the
                 initial value of the variable SSMSFS (2,IS,L)
                 already incorporated in TACWAR.

FSAMCC(L)   contains the weighting factor to correlate the
 L = 1 to 2   corps-sector and theater C^3 assets with
                 surrogate SAM sites located within the two
                 respective echelons for side L.

TSAMIR(IR,L)   contains the initial number of theater echelon
 IR = 1 to 3   long-range SAM sites in the rear area of region
  L = 1 to 2   IR for side L. TSAMIR is set to the initial
                 value of the variable ALRSR(1,IR,L) already
                 incorporated in TACWAR.

TSAMIZ(L)   contains the initial number of theater echelon
 L = 1 to 2   long-range SAM sites in the COMMZ for side L.
                 TSAMIZ is set to the initial value of variable
                 ALRSZ(1,L) already incorporated in TACWAR.

SSAMIF(IR,L)   contains the initial number of corps-sector
    IR = 1 to 3   echelon belt SAM sites in the forward area of
    L = 1 to 2   region IR for side L. SSAMIF is set to the
                   initial value of variable BMRS(1,IR,L) already
                   incorporated in TACWAR.

In addition to the new array variables described above, two new subroutines have been created as part of the C^3/D augmentation of nuclear delivery system availability. These two subroutines, named DSDEG and NUCCCD, are given in appendix A and are briefly described below.

Subroutine DSDEG calculates the fractional decrease in the availability of nuclear delivery systems controlled by the three echelons for each sector IS and for each side L. These fractional values are stored in variables FTDSAD, FSDSAD, and FDDSAD for later use by subroutine NWHINV. The calculations are performed by using the following algorithm:

● Determine the SAM region IR associated with sector IS.

● Adjust the surrogate weighting factors for airbase assets as required.

● Determine the fractional C^3 equipment degradation from the weighted fractional degradation of the surrogate at each echelon.

● Determine the fractional degradation of the nuclear delivery system availability at each echelon from the functional relationship between the decrease in availability and the degradation of the echelon C^3 assets.

In addition, subroutine DSDEG holds the calculated corps-sector and theater C^3 asset degradation for use in the nuclear escalation state authorization delay and target acquisition processing delay augmentations described in later sections.

One special procedure in DSDEG should be noted on the calculation for the division echelon C^3 assets. The total degradation of C^3 assets for this echelon is taken as the geometric mean of both the corps-sector and the division C^3 degradation. This procedure more realistically simulates the corps-to-division C^3 measures actually used.

Subroutine NUCCCD determines the current values of the airbase assets for forward area, rear area, and COMMZ notional airbases for each sector IS and for each side L. These airbase assets are stored in array variables ABSFCC, ABRSCC, and ABCZCC, respectively. They are calculated from the current values of the operation capability OCNUC(IAB) of the

15

actual airbases comprising the notional, where IAB is the index identifying the actual airbase.

Much of the code for subroutine NUCCCD is extracted from subroutine DEG (already a part of TACWAR) that performed a similar function using variable OCNUC(IAB). Moreover, to correctly determine the operating capability of each actual airbase, the variable OCNUC is now computed in subroutine DAMEVL. Subroutine NUCCCD also performs the task of initializing the variables INABF, INABR, and INABZ.

Subroutines DSDEG and NUCCCD are called once every nuclear or chemical subcycle from subroutine TMAIN. The results from DSDEG are used in subroutine NWHINV to make the actual modifications to the nuclear delivery system availability variables due to C^3/D.

3.3 Nuclear Escalation State Authorization Delay Augmentation

Presently in TACWAR, depending on the current tactical status, immediate escalation to a combat state may occur in which nuclear and chemical weapons can be used. This ability to escalate instantaneously is typically not a faithful nuclear combat simulation since it precludes the proper authorization by high-level authorities for each combatant side. Consequently, TACWAR has been modified to simulate the nuclear request and authorization procedures as a processing and decision-making delay time between the time that a nuclear escalation state is desired within a sector (as a function of the current tactical status of that sector) and the time that the escalation can, in fact, occur. This processing delay time is a function of C^3/D occurring for each side, especially in the theater and corps-sector echelons of the battlefield.

The changes necessary in TACWAR to include the nuclear escalation processing delay as a result of C^3/D are given in appendix A and are discussed below.

Nine new array variables are required to hold the user input functional relationships, the theater and corps-sector C^3 assets, and the escalation state processing flags. These array variables are consolidated in a common block labeled TNFSC4.

NEDLY(L)   contains the number of function pairs XEDLY
 L = 1 to 2   and YEDLY that describe the functional
                     relationship between the fractional
                     degradation of C^3 assets in the theater and
                     corps-sector echelons and the processing
                     delay time for nuclear escalation for
                     combatant side L.

16

XEDLY(I,L)
I = 1 to 8
L = 1 to 2

contains the Ith abscissa point for the function asociated with NEDLY(L). The abscissae are fractions of C^3 equipment assets remaining in a theater or corps-sector echelon for side L.

YEDLY(I,IF,L)
I = 1 to 8
IF = 1 to 2
L = 1 to 2

contains the Ith ordinate point for two functions (IF = 1 and IF = 2) associated with NEDLY(L). The ordinate is nuclear A/R processing times (in hours) for each side L. The function corresponding to IF = 1 describes the delay time associated with the first A/R cycle for each side L and typically reflects the enhanced decision-making delay for first use of nuclear weapons. The function corresponding to IF = 2 describes the delay time associated with all A/R cycles following the first.

JESC(IS,ITC,L)
IS = 1 to 8
ITC = 1 to 3
L = 1 to 2

contains the desired escalation state for side L within sector IS against target category ITC. This variable will reflect the nuclear escalation state to which side L will advance following the completion of the required processing delay.

IWAUT(IS,L)
IS = 1 to 8
L = 1 to 2

contains the control flags that are set whenever side L within sector IS is waiting for nuclear release authorization.

IFPLS(IS,L)
IS = 1 to 3
L = 1 to 2

contains the control flags that are set following the first authorization to a nuclear state by side L in sector IS.

TEQPD(L)
L = 1 to 2

contains the current fractional decrease in theater C^3 assets for side L. These variables are determined from the identical surrogate theater assets described in section 3.2 for the degradation of nuclear delivery system availability.

SEQPD(IS,L)
IS = 1 to 8
L = 1 to 2

contains the current fractional decrease of corps-sector C^3 assets within sector IS for side L. These variables are determined from identical surrogate corps-sector assets used for the degradation of nuclear delivery system availability.

17

CTIME(IS,L)   contains the current waiting time (in hours)
    IS = 1 to 8   following the onset of a nuclear escalation
    L = 1 to 2   request by side L in sector IS. This time is
                      updated every nuclear or chemical subcycle
                      until the appropriate delay has been
                      achieved.

In addition to the nine new array variables, one new subroutine, named EDELAY, has been created as part of the augmentation to delay the nuclear escalation process. EDELAY is given in appendix A and is briefly described below.

EDELAY uses the above array variables to calculate and update a processing delay time and the current waiting time before a desired nuclear escalation state can be realized by each side in each combat sector IS. EDELAY uses an algorithm shown in the flow diagram in figure 3. Specifically, for each side and for each sector,

● Calculate the fractional C^3 equipment assets (associated with nuclear A/R) degraded in each sector. These assets correspond to the geometric mean of the theater and corps-sector echelon C^3 assets since the authorization process occurs through a theater to corps-sector chain of command.

● Determine the desired escalation state.

● If not already waiting, reset the waiting time and set the waiting flag.

● Determine the current delay time as a function of C^3/D.

● Update the current waiting time.

● If the waiting period is complete, set the current escalation state to the desired state, reset the waiting flag, and reset the desired escalation state.

EDELAY is called from subroutine NUC1 immediately following the call to ESCLAT.

3.4 Nuclear or Chemical Target Acquisition Processing Delay

Presently in TACWAR the target acquisition (TA) model provides for the acquisition by each combatant side against active and reserve division subunit targets of the opposite side. Using ground sensor, army-air sensor, and air force sensor assets, the following three quantities are determined against each target type:

18

Total probability of detection by all available TA assets
Root-mean-square TA error
Weighted average processing time for TA information

The first two quantities are primarily functions of the number and operating characteristics of the TA sensors and are negligibly influenced by C^3/D. However, the third quantity, TA processing time, is greatly influenced by C^3/D. Consequently, TACWAR is augmented to include the increase in TA processing time due to the degradation of C^3 assets within the area where the TA sensors are controlled. This additional processing time is then added to the nominal processing time (already a part of TACWAR) to give a total processing time for the TA information against each target type.

AT EACH NUCLEAR SUBCYCLE (2 HR)
FOR EACH SIDE
FOR EACH SECTOR

DETERMINE CURRENT ESCALATION STATUS ------ FUNCTION OF

PREEMPTIVE STRIKE
TACTICAL SITUATION
NUCLEAR ROUNDS RECEIVED
CHEMICAL ROUNDS RECEIVED

ESCALATION DESIRED — NO
YES

REQUEST PENDING — NO
YES

RESET REQUEST WAIT TIME

SET REQUEST PENDING FLAG

DETERMINE CURRENT DELAY TIME ---- FUNCTION OF

SECTOR AND THEATER
C^3 EQUIPMENT DEGRADATION

UPDATE REQUEST WAIT TIME

WAIT COMPLETE — NO
YES

SET CURRENT ESCALATION STATE

RESET REQUEST PENDING FLAG

Figure 3.   Logic flow diagram of C^3 degradation of nuclear escalation process.

19

In TACWAR, the TA processing time currently calculated is not effectively used by the other subroutines of TACWAR. In particular, the TA processing time becomes an important quantity in the overall combat simulation when the simulation also includes movement of the targets. Thus, if TA processing is excessively long against an acquired target, then that potential target may move to another location before being attacked by nuclear or chemical munitions. The effects of subsequent nuclear or chemical strikes would then be partially or completely negated. Since TACWAR presently has no simulation of the movement of subunit targets and does not use the TA processing times against these subunit targets, the effects of C^3/D, especially as they modify TA processing times, will have minimal impact on the outcome of the combat simulation. Consequently, it is recommended that TACWAR be modified to include the necessary target subunit movement capability. However, such a modification would be outside the scope of this work.

The changes necessary in TACWAR to include the nuclear or chemical TA processing delay as a result of C^3/D are given in appendix A and are described below.

Nine new array variables are required to hold the user input functional relationships between C^3 equipment degradation and increased TA processing times. These array variables are consolidated in a common block labeled TNFSC5.

NGSFD(L) L = 1 to 2	contains the number of function pairs XGSFD and YGSFD that describe the functional relationship between the increase in the TA processing time for division ground sensors and the degradation of division C^3 assets for side L.
XGSFD(I,L) I = 1 to 8 L = 1 to 2	contains the Ith abscissa point for the function associated with NGSFD(L). The abscissae are fractions of C^3 assets remaining in a division.
YGSFD(I,L) I = 1 to 8 L = 1 to 2	contains the Ith ordinate point for the function associated with NGSFD(L). The ordinates are increased TA processing times (in hours) for the division ground sensors for side L.
NAAFD(L) L = 1 to 2	contains the number of function pairs XAAFD and YAAFD that describe the functional relationship between the increase in the TA processing time for army-air sensors and the

degradation of forward corps-sector C^3 assets
for side L.

XAAFD(I,L) I = 1 to 8 L = 1 to 2	contains the Ith abscissa point for the function associated with NAAFD(L). The abscissae are fractions of C^3 assets remaining in the forward corps-sector of side L.
YAAFD(I,L) I = 1 to 8 L = 1 to 2	contains the Ith ordinate point for the function associated with NAAFD(L). The ordinates are increased TA processing times (in hours) for army-air sensors for side L.
NAFFD(L) L = 1 to 2	contains the number of function pairs XAFFD and YAFFD that describe the functional relationship between the increase in the TA processing time for air force sensors and the degradation in the forward region C^3 assets for side L.
XAFFD(I,L) I = 1 to 8 L = 1 to 2	contains the Ith abscissa point for the function associated with NAFFD(L). The abscissae are fractions of C^3 assets remaining in the forward region of side L (as determined by the average of the fractional C^3 assets remaining in the corps-sectors that comprise the region).
YAFFD(I,L) I = 1 to 8 L = 1 to 2	contains the Ith ordinate point of the function associated with NAFFD(L). The ordinates are increased TA processing times (in hours) for air force sensors for side L.

The three functional relationships given above describe the influence of C^3/D on TA processing times for each of the three types of TA assets-- ground, army-air, and air force, respectively. The degradation of C^3 assets within each of the three areas that control these different TA assets is calculated in a manner identical for that of the earlier sections. Specifically, the degradation of divisional C^3 assets that control the ground sensors is determined from surrogate weapons systems assets as described in section 3.1. Similarly, the degradation of C^3 assets that control army-air sensors in corps-sector IS = 1 to 8 is contained in the array variable SEQPD described in section 3.3. The degradation of C^3 assets that control air force sensors in regions IR = 1 to 3 is determined as an average of the C^3 asset degradations (SEQPD) for all corps-sectors comprising the regions.

In sections in subroutines TADPAR and TARACA (already a part of TACWAR), the above functions are used and the increase in TA processing times is calculated (app A).

3.5 Ancillary Modifications to TACWAR

In addition to the modifications described in sections 3.1 to 3.4, several ancillary modifications are required in TACWAR to support the above modifications. Specifically, a user data input subroutine, named TNFINP, and a data initialization BLOCK DATA subroutine have been created to initialize the array variables described in sections 3.1 to 3.4. Both TNFINP and the BLOCK DATA subroutines are given in appendix A. Also, the single call to subroutine TNFINP is made at the beginning of subroutine TMAIN.

4. LIMITATIONS

In constructing the augmentations to TACWAR described in section 3, no attempt was made to minimize the additional required storage to hold the new data variables and code. In particular, no overlay structure was developed that would conform to that of the later versions of TACWAR.* Similarly, the data for the new variables are input through a rather rudimentary set of READ instructions in subroutine TNFINP, and no attempt was made to include this data input into the rather extensive input phase of TACWAR. One consequence of this is that the augmentations do not support the "restart" capability described by the Defense Communications Agency.† Another consequence is the requirement for the augmented data to be in a definite sequence for proper interpretation by subroutine TNFINP.

5. USER DATA INPUT

For the most part, the user data necessary to initialize the new array variables (sect. 3) are (1) the weighting factors used to transform an explicitly modeled area asset into an equivalent C^3 asset for the same area or echelon and (2) the functional relationships describing the influence of C^3/D on the several combat simulations.

The surrogate assets for the division level C^3 equipment are the weapons systems within the divisions (up to 10 such system types are allowed for each division). An initial approximation would be to assume

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*TACWAR Core Reduction, Defense Communications Agency CCTC Letter Report, Task Order 634 Subtask 1 (17 April 1978).

†TACWAR Restart Capability, Defense Communications Agency CCTC Letter Report, Task Order 534 Subtask 2 (14 December 1977).

that one c^3 asset is associated with each weapons system; thus, the weighting factors for division c^3 assets would be the initial number of weapons systems at the beginning of the simulation for each combatant side. These, in fact, are the weighting factors used in the examples of section 6. However, it is probably a better simulation of reality to assume one c^3 asset (in arbitrary units) to each division subunit. The number of weapons systems in each of the subunit types would then determine the appropriate c^3 asset weighting factor.

The surrogate assets for corps-sector and theater c^3 equipment are airbase assets, SSM assets, and SAM assets. The weighting factors to transform these into equivalent c^3 assets may be determined by the following rationale. Airbase assets may be roughly equated with fixed-site hardened c^3 facilities; SSM sites may be roughly equated with mobile nuclear "soft" c^3 assets; SAM sites may be roughly equated with semimobile nuclear hardened c^3 assets. The appropriate mix of the group will depend upon the specific theater of conflict. For the examples given in section 6, the following corps-sector and theater weighting factors are used for each side:

Airbase	0.30
SSM	0.40
SAM	0.30

The functional relationships between c^3/D and the several aspects of the augmentations are provided according to the following assumptions:

a. The functional relationship between the degradation of division-level c^3 assets and the reduction of division-level messages is obtained from the results of TACNET (a discrete event simulation of a theater-level communications model developed by Egon Marx[2]). The explicit relationship is shown in figure 4 and assumed applicable for each side.

b. The functional relationship between the reduction of division-level message traffic and the decreased division effectiveness is obtained from consultation with personnel at the U.S. Army Training and Doctrine Command (TRADOC) Systems Analysis Activity (TRASANA). This relationship is shown in figure 5 and is assumed applicable for each side.

c. The functional relationship between the degradation of corps-sector and theater c^3 assets and the reduction of "special" messages associated with the availability of nuclear delivery systems was taken from the Marx report.[2] This relationship is shown in figure 6 and is assumed applicable for each side.

---

[2]*Egon Marx, TACNET, A Model of the Army's Tactical Communications Networks in Europe, Harry Diamond Laboratories HDL-TR-1913 (January 1980).*
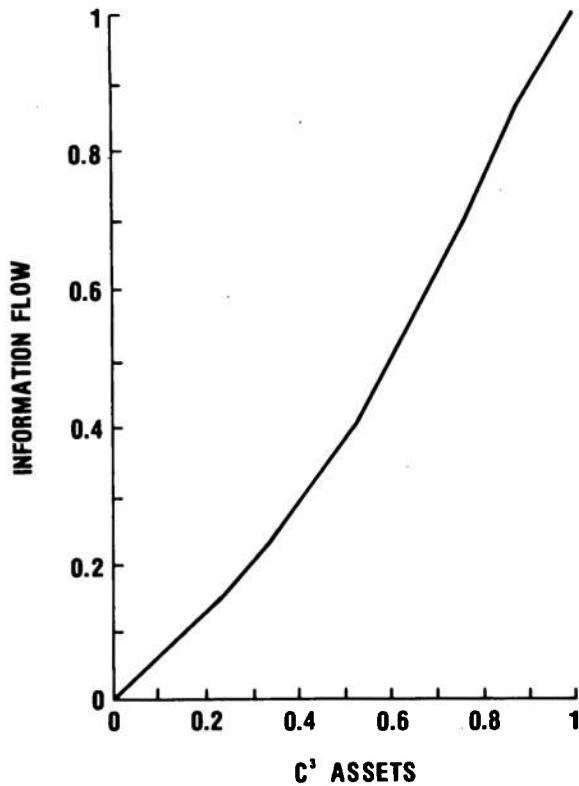
Figure 4. Fraction of information available within division as function of fraction of C^3 assets remaining within division.

Figure 5. Division effectiveness as function of fraction of information messages available within division.
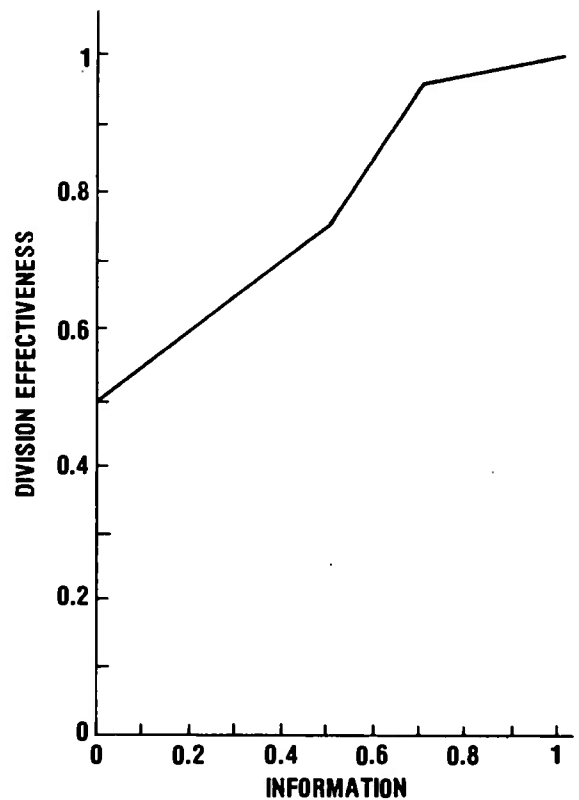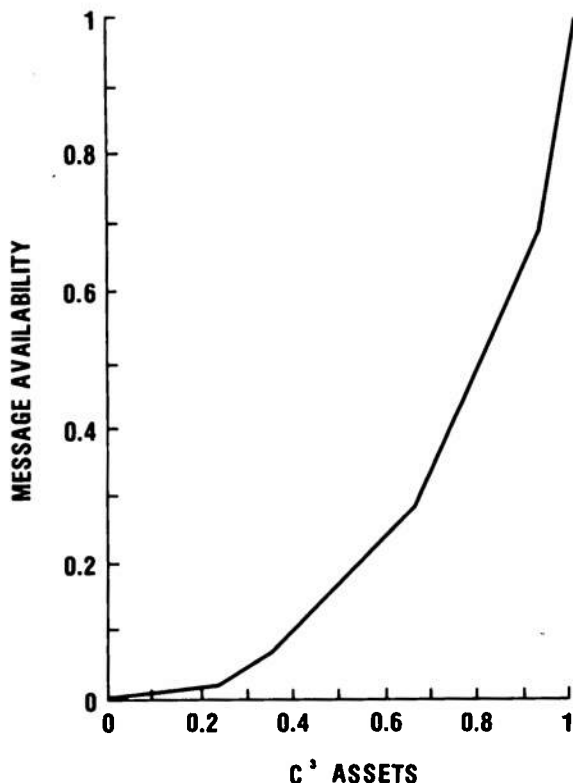
Figure 6. Fraction of nuclear authorization and release messages available as function of remaining C^3 assets.

d. The functional relationships between the degradation of corps-sector and theater C^3 assets and the nuclear escalation authorization delay times are shown in figure 7(a, b) for side L = 1 (blue) and side L = 2 (red). These data are initial estimates used to exercise the augmentations more than for accurate representations of reality.

e. The functional relationships between the degradation of division, corps-sector, and regional C^3 assets and the increased TA processing time are shown in figure 8(a, b, c) and are assumed applicable for each side. These data are primarily to exercise the augmentations.

Figure 9 illustrates a sample data deck used as input for subroutine TNFINP described in section 3.5. It is imperative that the data cards follow in correct sequence.

25
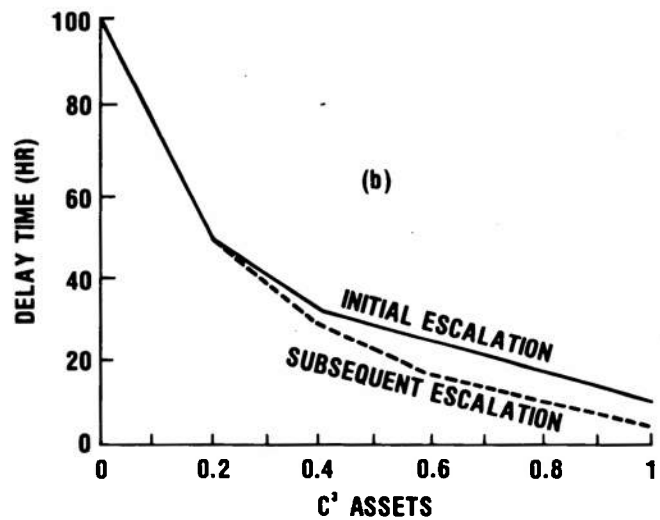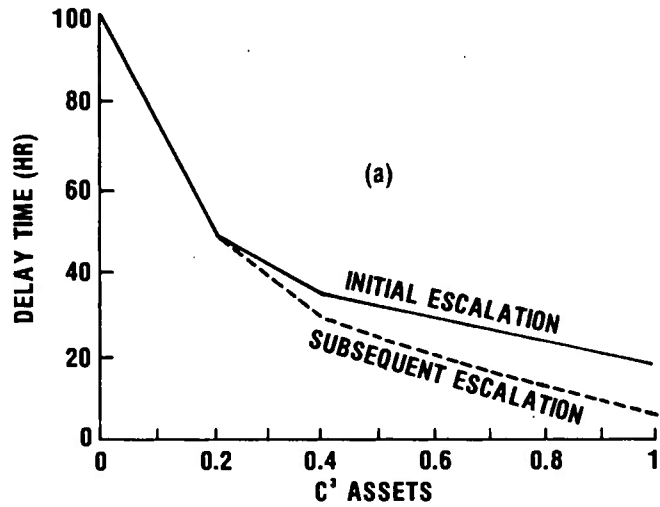
Figure 7. Nuclear escalation delay
time as function of
remaining C^3 assets: (a)
blue side and (b) red
side.
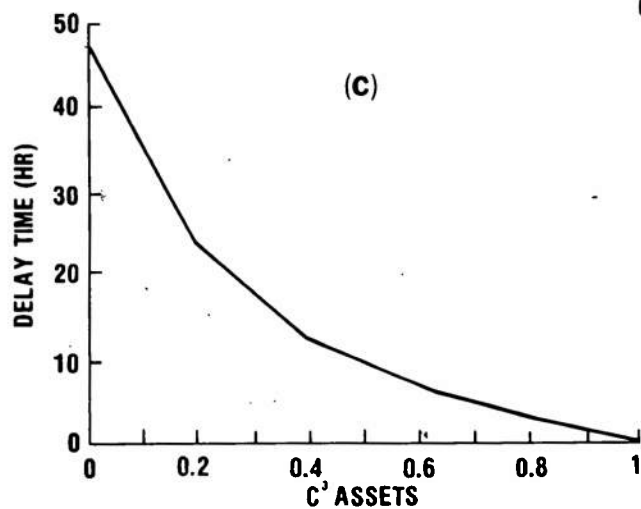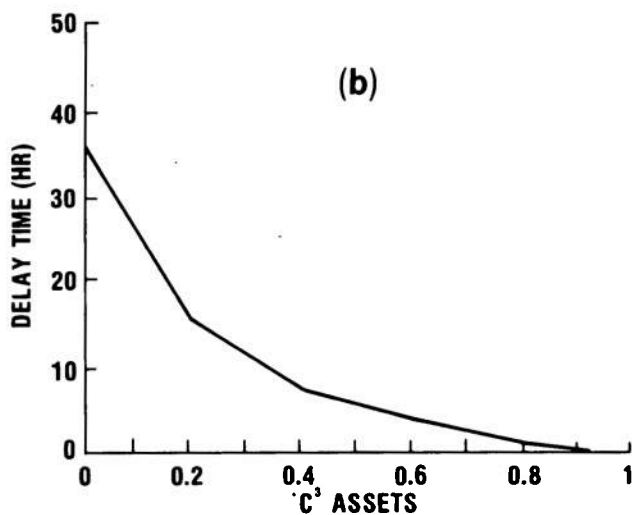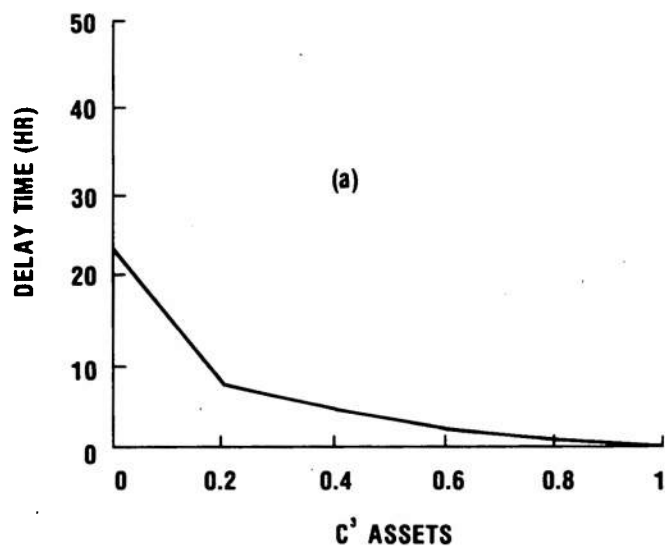
Figure 8. Target acquisition delay time as function of remaining C^3 assets: (a) ground sensors, (b) army-air sensors, and (c) air force sensors.

Figure 9. TNFINP input data.

28

Figure 9. TNFINP input data (Cont'd).

29

6. RESULTS OF SAMPLE RUNS

The C^3/D modified TACWAR model has been exercised for several sets of input data tó validate the augmentations described in section 3 and to determine the degree of sensitivity of the overall combat simulation to these augmentations. These sample simulation runs were made by using an unclassified benchmark data base obtained from CCTC. For the different sample runs, the values of the parameters in this data base remained constant except those parameters used to control the overall operation of the simulation such as the total number of 12-hr cycles involved and the inclusion of nuclear combat capability. The additional parameters associated with the C^3/D augmentation were varied from run to run in order to make the sensitivity determination.

Although the parameters in the benchmark data base and the parameters associated with C^3/D augmentation are reasonable, they are not necessarily an accurate reflection of current combat capabilities of U.S. or adversary forces. Consequently, the results of the sample runs have no direct significance in an actual environment.

6.1 Conventional Warfare--Influence of C^3/D on Division Effectiveness

The first series of sample runs involved opposing forces constrained to conventional warfare only, with no possibility of nuclear or chemical escalation. These runs were used to exercise the C^3/D augmentation to division effectiveness and subsequent combat results such as weapon system losses, personnel casualties, and FEBA movement. The sample runs included two cases:

- Side 1 (blue) alone suffers C^3/D.
- Side 2 (red) alone suffers C^3/D.

The simulations were run for twenty-five 12-hr cycles (12.5 days), and detailed results were obtained for all eight sectors of the theater. However, the results of only a typical sector (sector 6) were subjected to a detailed analysis.

Figure 10 shows the personnel casualties incurred by side 1 (blue) in sector 6 for the two cases. If only the last values of the casualties had been given for analysis instead of the entire time history, one might have logically concluded that the results disagreed with practical intuition. Specifically, after cycle 14, the blue casualties are less when the blue side suffers C^3/D than when the red side suffers C^3/D. However, a more detailed analysis of the entire picture of the combat resolves this apparent contradiction. Thus, when the blue side alone suffers C^3/D, the red side at the beginning of the

simulation becomes the sector attacker and maintains this attack posture throughout the entire simulation. The blue side (defending) assumes several different defense postures such as delay, prepared defense, hasty defense, and breakthrough, as shown in figure 10. Each of these defense postures has a different personnel attrition rate associated with it, which is the major cause of the abrupt change in slope in the figure. On the other hand, when the red side alone suffers C^3/D, it again begins the simulation as the sector attacker. However, after cycle 14, the red side stops attacking and shifts to a holding posture; the blue side likewise shifts from defense to holding. Since the personnel attrition rate for a holding posture is greater than that for the delay defense posture, the blue casualty lines for the two cases cross shortly after cycle 14, and the apparent inconsistency is explained. Consequently, it is advisable when analyzing the results of TACWAR simulations (including those associated with C^3/D augmentation) not to reject as wrong or in error any result that, on the surface, appears to contradict logical intuition.
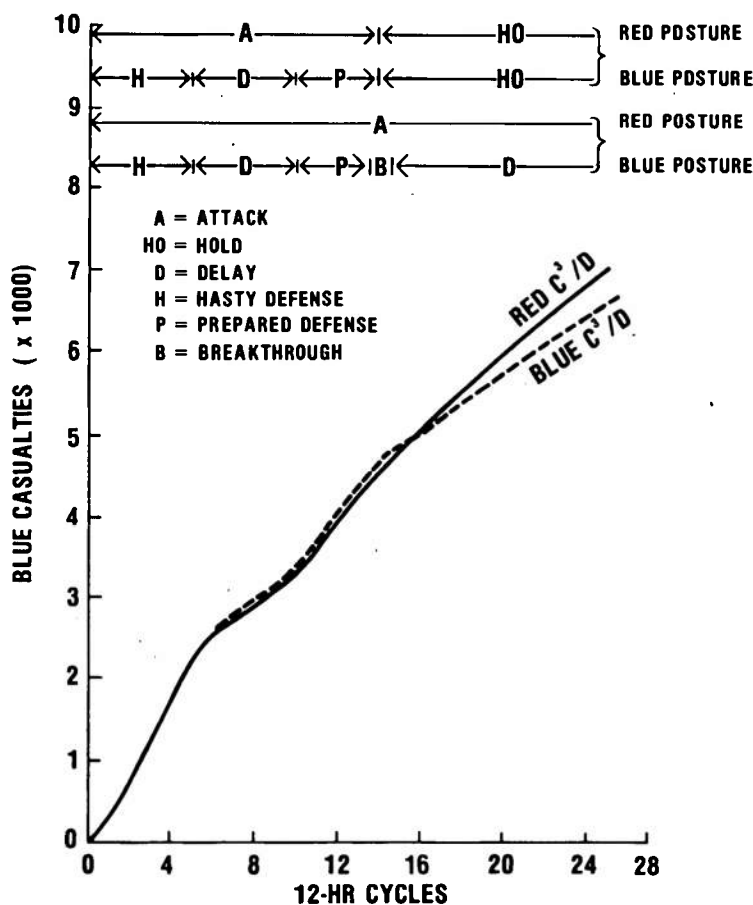
Figure 10. Blue casualties for C^3/D reduction of division effectiveness.

Figure 11 shows the counterpart casualties incurred by side 2 (red) for the two cases. For this situation, there is no inconsistency in what is to be intuitively expected (at least to the point where the simulation run was ended). These results show approximately a 10-percent maximum difference for the two extreme cases of C^3/D, that is, blue alone versus red alone.
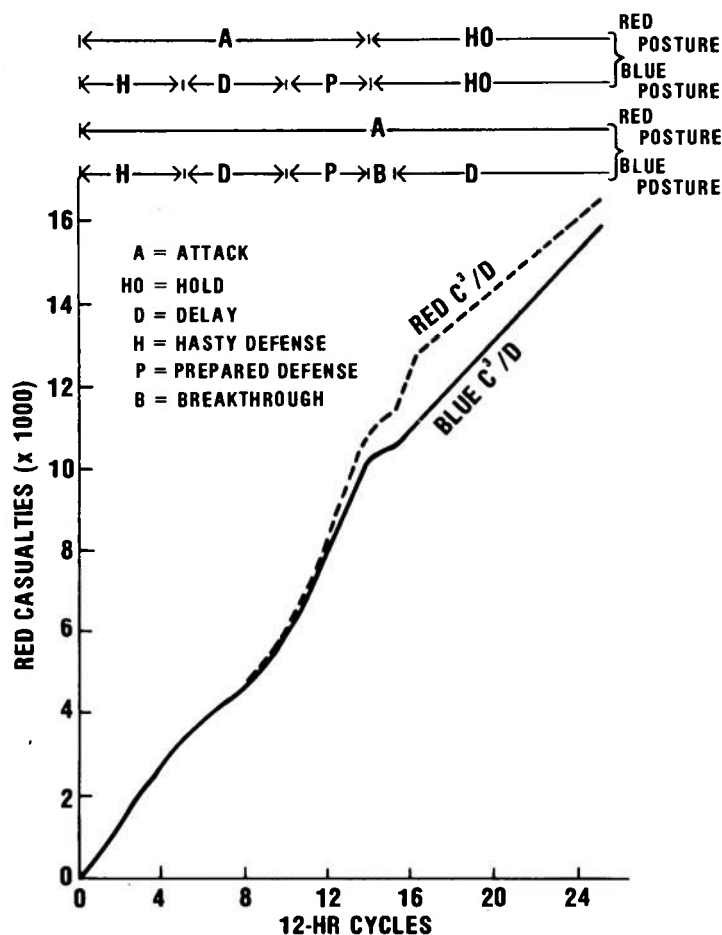
Figure 11. Red casualties for C^3/D reduction of division effectiveness.

Figure 12 shows the relative FEBA movement in sector 6 for the two cases. This figure illustrates the fact that C^3/D can dramatically affect some of the results of combat. The detailed analysis of all aspects of the simulation is required for full understanding of the reason for this behavior. Thus, with blue alone suffering C^3/D, the red side maintains its attack posture throughout the simulation. After cycle 14, when the blue side assumes a delay defensive posture and the terrain interval allows a fast FEBA movement, the slope of the FEBA movement line abruptly increases. On the other hand, when the red side alone suffers C^3/D, its attack stalls after cycle 14, and the FEBA movement does not increase further.
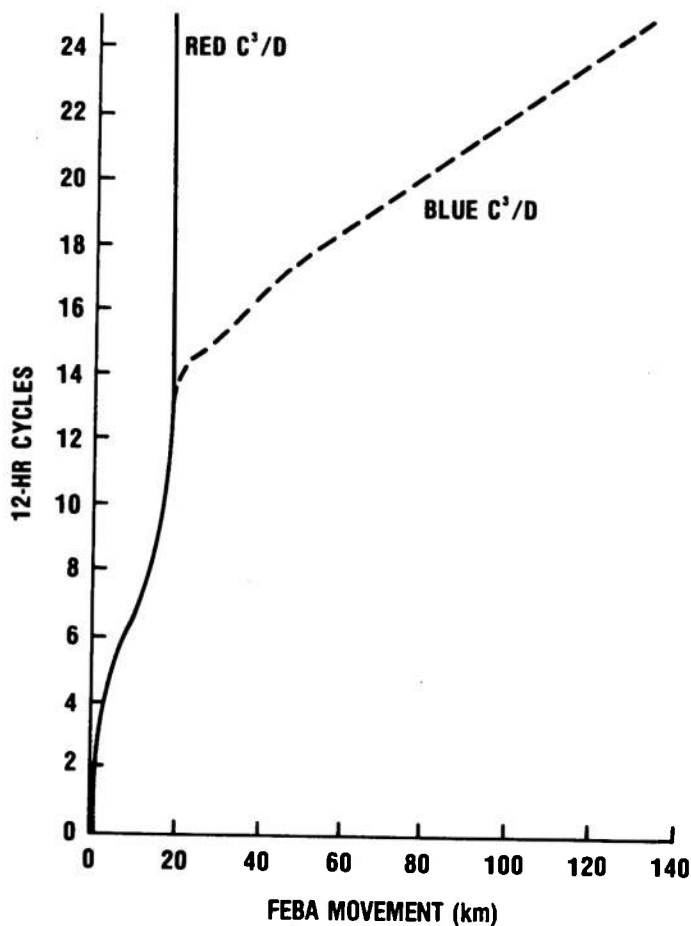
Figure 12. Forward edge of battle area movement for C^3/D reduction of division effectiveness.

33

6.2 Nuclear Warfare--Influence of C^3/D on Nuclear Delivery System Availability

The next series of sample runs involved opposing forces engaged in a combined conventional and nuclear warfare environment. Nuclear warfare was played by assuming that a new escalation state could be initiated every 12-hr cycle. As a consequence of the benchmark data base used, a restricted set of escalation criteria was used in the sample runs. Specifically, preemptive strike escalation was allowed from cycle 0 through cycle 4. Following cycle 4, the only criterion for allowed nuclear escalation was the FEBA movement past a critical threshold. Consequently, the number of nuclear escalation attempts was limited for both sides.

As in section 6.1, sample runs included simulations in which side 1 (blue) alone suffered C^3/D and in which side 2 (red) alone suffered C^3/D. The simulations were run to twenty 12-hr cycles (10 days), and detailed results were obtained for all eight sectors of the theater. Again only sector 6 was analyzed in detail.

Figures 13 to 15 show the fraction of nuclear delivery system availability due to C^3/D for division, corps-sector, and theater echelons, respectively. The strong decrease in the availability of corps-sector delivery systems reflects the active nuclear combat being played as a result of preemptive attacks. After cycle 4, the change is much slower because only conventional warfare is being waged during this time. The changes occurring at cycle 14 are due to reallocation of assets from the theater to the corps-sector echelon. The availability of theater delivery systems shows a more gradual decrease due primarily to conventional attrition by aircraft attack. Lastly, the decrease to zero of the blue side division availability between cycles 8 and 16 is an "artifact" resulting when the supplies inventory for the blue divisions is depleted and the divisions are forced to withdraw out of the active battle area. When new supplies are allocated to these divisions, they again achieve a finite delivery system availability.

In conclusion, although the availability factors within each echelon are strongly influenced by C^3/D, the total number of nuclear rounds fired by each side remained essentially the same as when no C^3/D occurred for either side. They are similar because of the large number of potential delivery systems available at each echelon and the restricted nuclear combat being played; that is, the number of potential nuclear targets remained small with or without C^3/D.
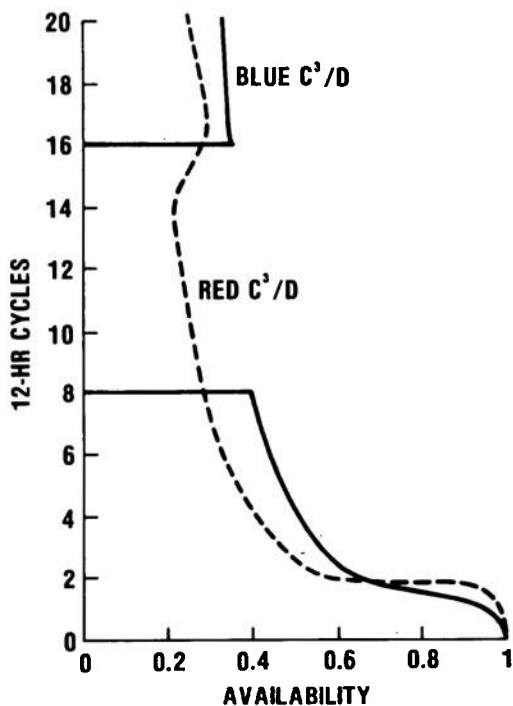
Figure 13. Reduced nuclear delivery system availability for division echelon due to C^3/D.

Figure 14. Reduced nuclear delivery system availability for corps-sector echelon due to C^3/D.

35
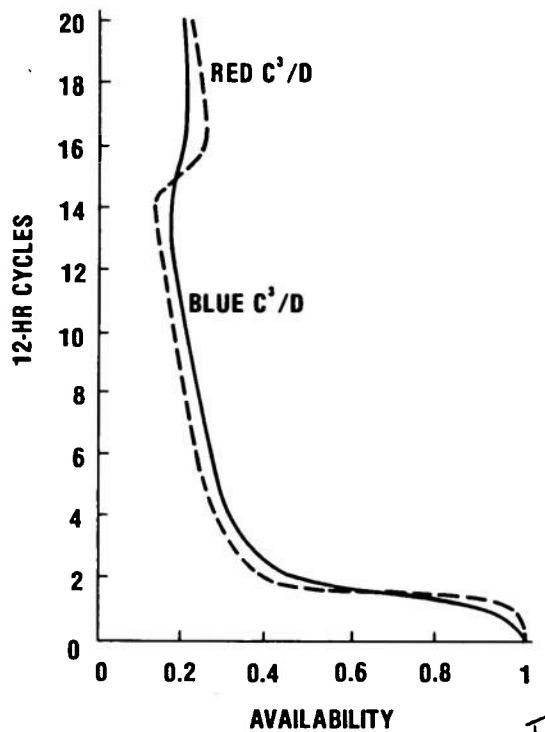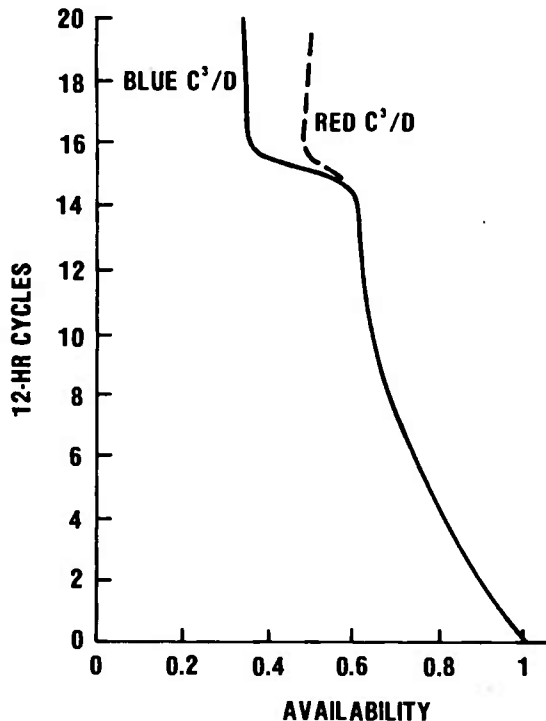
Figure 15. Reduced nuclear delivery system availability for theater echelon due to C^3/D.

6.3 Nuclear Warfare--Influence of C^3/D on Nuclear Escalation

This series of sample runs involved opposing forces engaged in a combined conventional and nuclear warfare environment. In contradistinction to warfare described in section 6.2, in which nuclear escalation could occur at the beginning of each 12-hr cycle, the present section includes the nuclear escalation authorization delay process in which a desired nuclear escalation state is reached only after a delay time influenced by C^3/D.

The sample runs were made for the simulation in which both side 1 (blue) and side 2 (red) suffer C^3/D. As in section 6.2, the simulation continued out to twenty 12-hr cycles (10 days). However, in the present set of runs, each 12-hr cycle was subdivided into six 2-hr subcycles in which possible nuclear escalation could occur. This subdivision defines better the overall escalation delay process.

Figure 16 compares the FEBA movement in sector 6 for (1) C^3/D delayed nuclear escalation, (2) 12-hr nuclear escalation, and (3) nonnuclear combat. It is seen in figure 16 that the C^3/D delayed escalation process greatly constrains nuclear combat compared with the 12-hr escalation and causes the C^3/D delayed FEBA movement to lie in a region approximately halfway between the 12-hr escalation and nonnuclear combat.

36
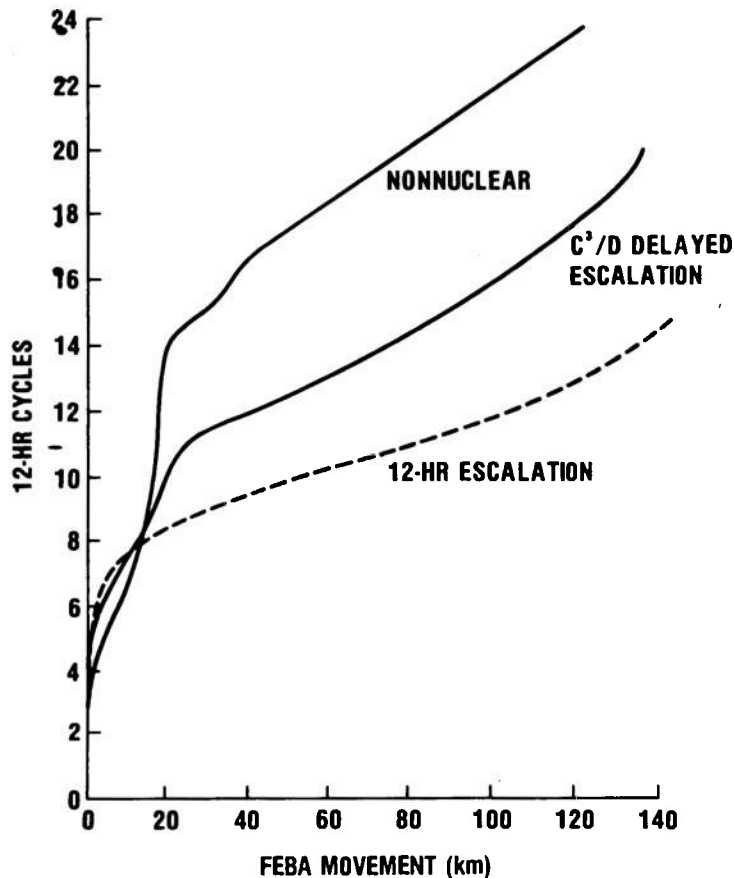
Figure 16.   Forward edge of battle
             area movement for
             different nuclear
             escalation processes.

6.4   Target Acquisition--Influence of C^3/D on Target Acquisition
      Processing Delay Time

       A series of sample runs was made to validate the code changes
in the TACWAR model used to increase the TA processing delay time due to
C^3/D.   However, the augmentation of the TA processing delay does not
manifest itself in any overall change in combat results since the TA
delay time quantity is not presently used in the other TACWAR routines.

37

7. SUMMARY AND CONCLUSIONS

The TACWAR theater-level combat simulation model has been augmented to include command, control, and communications degradation effects in four important areas of the combat simulation:

Division effectiveness
Nuclear delivery system availability
Nuclear escalation authorization delay
Target acquisition processing delay

Sample runs made using a benchmark data base show noticeable changes in overall combat results (such as personnel casualties and FEBA movement) when these C^3/D augmentations are included in the simulation (except the TA processing delay as mentioned in sect. 6.4).

APPENDIX A.--COMPUTER CODE CHANGES TO IMPLEMENT TACWAR AUGMENTATIONS FOR COMMAND, CONTROL, AND COMMUNICATIONS DEGRADATION

CONTENTS

This appendix contains the actual computer code changes that are used to implement the TACWAR augmentations for command, control, and communications degradation (C^3/D). Lines of new computer code that have been inserted into the original versions of TACWAR are indicated by the mnemonic I JCI001 in the sequence field (columns 73 to 80) of the instruction line. Similarly, lines of computer code that have been modified in the original version of TACWAR are indicated by the mnemonic C JCI001 in the sequence field. For brevity, the long common block that holds the dynamic parameters of the original version of TACWAR is indicated in any computer listing as COMMON/BBB/ enclosed between two lines of asterisks.

The appendix has five sections corresponding to the four major areas of augmentation and an ancillary or general area of augmentation:

A-1. Division Effectiveness
A-2. Nuclear Delivery System Availability
A-3. Nuclear Escalation Delay
A-4. Target Acquisition Processing Delay
A-5. Input and Main Control

A-1. DIVISION EFFECTIVENESS

This section partially lists those subroutines that calculate division effectiveness factors, namely, FEBAMT, GC, TC, and TIMET.

```
      SUBROUTINE FEBAMT
C* * * * * * * 3 * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C      FEBAMT COMPUTES FEBA MOVEMENT AS A FUNCTION OF FORCE RATIO,
C        POSTURE, TERRAIN, AND MOBILITY.
C        CALLED BY GROUND
C        CALLS CVFW
C* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      REAL NSUTD,NTSUDT,INTDA,INTDE,INTOS
**************************************************************************************
      COMMON/BCB/
**************************************************************************************
      COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),                    I JCI001
     *              NCOMD(2),XCOMD(8,2),YCOMD(8,2),                    I JCI001
     *              FCLWL(10,2)                                        I JCI001
      COMMON/GCFM/ INDRAW(8,2)
      DIMENSION  VDDSF(140),KVDDC(140)
      DIMENSION  SUMM(10),ISUMM(8),ITDWDS(8)
      MOT=JCON
```

APPENDIX A

```
C    ------------------------------------------------------------------
C    5) COMPUTE EFFECTIVENESS OF ALL DIVISIONS.
C    ------------------------------------------------------------------
      IF ()PRD.NE.II GO TO 15
      WRITE(MOT,18) ICYCLE
   18 FORMAT('0','***OUTPUT FROM SUBROUTINE FEBAMT. CYCLE = ',13I
   15 CONTINUE
C       SKIP THIS SECTION IF SECURITY FORCE RATIO IS NOT TO BE USED
      IF(IUSFRC.EQ.DI GO TO 599
C     WVDDC = ACTUAL DIVISION WEAPON VALUE ON DEFENSE
C     PPS = DIVISION FRACTIONAL PERSONNEL STRENGTH
C     DSH = DAYS SUPPLY ON HAND
      N2=0
      LIM=ND(1)+ND(2I+MAD(11+MAD(2I
      DO 500 ID=I,LIM
      WVCDC(ID)=0.
      EFFDD(ID)=0.
      VDDSF(1DI=0.
  500 CONTINUE
      DO 550 L=I,2
      NI=I+N2
      N2=N2+ND(LI
      N3=NW(LI
      DO 52D ID=NI,N2
      IT=)TD()DI
      WVDDC(ID)=0.
      COMD=0.                                                       I JCIOOI
      DO 505 IW=I,N3
      WVDDC(ID)=WVDDC(IO)+VIWOSF(IW,L)+WDIV(IW,ID)
      TOEW=TWD(IW,ITI                                               I JCIDOI
      IF(TOEW.GT.0.1COMD=COMD+FCLWL(IW,L)+WDIV(IW,ID)/TOEW          I JCIOOI
  505 CONTINUE
      PPS=PO)V()DI/TPO()T)
C       COMPUTE PERSONNEL EFFECTIVENESS
      CALL CVFW(NEOEF(L),XDEF(1,L),YOEF(1,L),PPS,PEO)
      DSH=SDIV()DI/PCSD()T)
C       COMPUTE SUPPLY EFFECTIVENESS FACTOR
      CALL CVFW(NSEFF(LI,XSEFF(1,LI,YSEFF(1,L),DSH,SEF)
C.... COMPUTE C**3 DEGRADATION                                      I JCIOOI
      CALL CVFW(NCOMD(L),XCOMD(),L),YCOMD(1,L),COMO,CCCD)           I JCIOOI
C.... COMPUTE C**3/D EFFECTIVENESS FACTOR                           ) JC)OOI
      CALL CVFW(NC3DD(1,L),XC3DD(1,L),YC3DD(1,L),CCCD,EFFC3)        I JC)OOI
C       COMPUTE DIVISION EFFECTIVENESS AND COMBAT VALUE ON DEFENSE
      EFFDD(ID)=EFFC3+SEF+AMINIC(WVDDC(IO)/WVDDTS(ITII,PEO)         C JCIODI
      IF (IDMU.ED.3.OR.IDMU.EO.5I GO TO 6908
      EFFDD(1DI=EFFCD(1DI+FDEFCP(IDI
 6908 CONTINUE
      VDDSF(ID)=EFFDD(ID)+WVDDTS(IT)
  520 CONTINUE
      N2=N2+MAD(LI
  550 CONTINUE
C
      IF(IPRD.NE.1) GO TO 599
      WRITE(MOT,II7)
      N3=ND(1)+ND(2)+MAD(1)
      DO 580 ID=1,N3
      IT=ITO(ID)
      WRITE(MOT,12) IO,WVDDC(ID),WVDDTS(IT),EFFDD(ID),VDDSF(ID)
  580 CONTINUE
  599 CONTINUE
C    --------- ----- ..
```

```
      SUBROUTINE GC
C* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C     GC COMPUTES ATTRITION TO PEOPLE AND WEAPONS CAUSED BY GROUND FIRE
C         AND CAS AND ALSO COMPUTES WEAPONS REPAIRABLE AND SUPPLY LOSSES.
C         CALLED BY GROUND
C         CALLS EIGENV,CVFW,MPROD,CNTRYC
C* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      REAL NSUTD,NTSUDT,INTOA,INTDE,INTDS
```

44

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••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
      COMMON/BBB/
••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••••
      COMMON/TNFSC3/NC3DD(2),XC300(8,2),YC3DD(8,2),                   I JC100
     •              NCOMD(2),XCOMO(8,2),YCOMO(8,2),                   I JC)00
     •              FCLWL(1D,2)                                       I JC100
      COMMON/GCFM/  IWDRAW(8,2)
      OIMENSION EDAXSR(200),EDDXSR(200),VOAC(200),VDDC(200)
      OIMENSION  WS(10,2),AAWA(10,10,2),AAWO(10,10,2),
     I PWAKW(ID,10,2),PWDKW(10,10,2),AAMA(6,10,2),
     A AAMD(6,10,2),PAAKW(7,10,2),PADKW(7,10,2),
     2 BSUM(100),RSUM(100),VIWACF(10,2),VIWOCF(10,2),
     3 VIAACF(1D,2),VIADCF(10,2),WVOAT(10),TYPCAF(8),TYPCOF(8),
     4 VLS(2),WVOOT()0),WVOAC(2D0),WVODC(200),PCS(2),SUMM(10),
     5 TSC(2),PLS(8,2),WLS()0,2),GKGS(10,10,2),
     6 AKGS(7,1D,2),IHOLD(2)
      DIMENSION  TSL(8,2),TWS(2)
      DIMENSION  WLDAS(1D,8,2),CDACS(8,2)
      MDT=JCON
C     ------------------------------------------------------------------
C  4) ADJUST THE STANDARD ALLOCATION.
C     ------------------------------------------------------------------
C     THIS SECTION EXECUTED ONLY ON FIRST CYCLE OF GAME
      IF(ICYCLE.NE.1) GO TO 499
      OO 450 L=),2
      N3=NW(L)
      K=3-L
      N4=NW(K)
      N5=NAM(LI                                                       C JC100
      OO 430 KW=1,N4
      IF(PWSF(KW,KI.EQ.0.0) GO TO 4)5
      DO 405 )W=1,N3
      SAWA(IW,KW,LI=SAWA(IW,KW,L)/PWSF(KW,K)
      SAWD(IW,KW,L)=SAWD(IW,KW,L)/PWSF(KW,K)
  405 CONTINUE
      OO 410 IAM=),N5
      SAMA((AM,KW,L)=SAMA()AM,KW,L)/PWSF(KW,K)
      SAMD(IAM,KW,L)=SAMD(IAM,KW,L)/PWSF(KW,K)
  4)0 CONTINUE
      GO TO 430
  415 DO 420 IW=1,N3
      SAWA(IW,KW,L)=0.0
      SAWD(IW,KW,L)=0.0
  42D CONTINUE
      OO 425 IAM=1,N5
      SAMA((AM,KW,L)=0.0
      SAMD(IAM,KW,L)=0.0
  425 CONTINUE
  430 CONTINUE
  45D CONTINUE
C
      OO 2503 )W=1,N3
      WVOAT(IT)=WVOAT(IT)+V(WACF()W,L)*TWD(IW,IT)
      WVODT()T)=WVOOT(IT)+VIWOCF(IW,L)*TWO(IW,IT)
 25D3 CONTINUE
 2504 CONTINUE
      DO 2525 IDS=N1,N2
      ID=(DLABA(IOS,IS)
      IT=ITD(IO)
      WVOAC((OI=0.
      WVOOC((IO)=0.
      COMO=0.                                                        I JC)001
      OO 2505 (W=1,N3
      WVOAC((ID)=WVOAC(ID)+V)WACF(IW,L)*WOIV(IW,ID)
      WVODC(10)=WVODC(ID)+VIWOCF(IW,L)*WOIV(IW,)D)
      TOEW=TWD(IW,)T)                                                I JC)001
      (F(TOEW.GT.O.)COMO=COMD+FCLWL(IW,L)*WDIV(IW,IO)/TOEW          I JC1001
 2505 CONTINUE
C     CALCULATE EFFECTIVENESS OF PERSONNEL.
      PPS=POIV(ID)/TPO(IT)
```

```
        CALL CVFW(NEAEF(L),XAEF(I,L),YAEF(1,L),PPS,PEA)
        CALL CVFWINEDEF(L),XDEF(I,L),YDEF(I,L),PPS,PEO)
        EDAXSR(ID)=AMINI((WVDAC(ID)/WVDAT(IT)),PEA)
        EDDXSR(ID)=AMINI((WVDDC(ID)/WVDDT(IT)),PED)
C       CALCULATE EFFECTIVENESS REDUCTION DUE TO SUPPLY SHORTAGE.
        DSH=SDIV(ID)/PCSDIIT)
        CALL CVFW(NSEFF(L),XSEFF(I,L),YSEFF(1,L),DSH,SEF)
C....   COMPUTE C**3 DEGRADATION                                      I JCI001
        CALL CVFW(NCOMD(L),XCOMD(I,L),YCOMD(1,L),COMD,CCCD)          I JCI001
C....   COMPUTE C**3/D EFFECTIVENESS FACTOR                           I JCI001
        CALL CVFW(NC3DD(L),XC3DD(I,L),YC3DD(I,L),CCCD,EFFC3)         ) JCI001
C       CALCULATE DIVISION EFFECTIVENESS AND GROUND VALUES
        EFFDA(ID)=EFFC3*SEF*EDAXSR(ID)                              C JCI001
        EFFDD(ID)=EFFC3*SEF*EDDXSR(ID)                              C JCI001
        IF(IOMU.EQ.3.OR.IOMU.EQ.5) GO TO 6908
        EFFDA(ID)=EFFDA(ID)*FDEFCP(ID)
        EFFDD(ID)=EFFDD(ID)*FDEFCP(ID)
 6908 CONTINUE
        VDAC(ID)=EFFDA(ID)*WVDAT()T)
        VDDC(ID)=EFFDD(ID)*WVDDT()T)
        VGABA(IS,L)=VGABA(IS,L)*VDAC(ID)
        VGDBA(IS,L)=VGDBA(IS,L)*VDDC(ID)
C
        )F(IPRD.NE.1) GO TO 2525
        WRITE(MOT,IIO)
        WRITE(MOT,)0) )D,IT
        WRITE(MOT,III)
        WRITE(MOT,22) WVDAC()D),WVDDC(ID),WVDAT(IT),WVDDT()T),EDAXSR(ID),
     X       EDDXSR(ID),EFFDA(IDI,EFFDD(ID),VDAC(ID),VDDC()D)
        WRITE(MOT,)I2I
        WRITE(MOT,22) PEA,PED,DSH,SEF
 2525 CONTINUE
 2530 CONTINUE
        IF()PRD.NE.)) GO TO 3000
        WRITE(MOT,I13)
        WRITE(MOT,22) ((VGABA()S,L),VGDBA(IS,L)),L=1,2)
C       ------------------------------------------------------------
C 30)  CALCULATE AIR VALUES ON ATTACK AND DEFENSE
C       ------------------------------------------------------------
 3000 DO 302D L=),2
        VAABA()S,L)=0.




        SUBROUTINE TC
C* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C       SUBROUTINE TC IS THE MAJOR THEATER CONTROL PROGRAM AND HANDLES
C       A MAJOR PORTION OF THE BOOKEEPING EFFORT REQUIRED BY TACWAR.
C       CALLED BY TMAIN. CALLS AIRASG, APORTN, CNTRYC, CVFW, IIBA, MSREAD,
C       MSWRIT, NXDIV, SECKTH, TAG
C       ALSO CALLS 2ND HALF OF ORIGINAL ROUTINE (TCXX)
C* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
        REAL NSUTD,NTSUDT,INTDA,INTDE,INTDS
********************************************************************************
        COMMON/HRD/
********************************************************************************
        COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),              I JCI001
     *             NCOMD(2),XCOMD(8,2),YCOMD(8,2),                 I JCI001
     *             FCLWLIID,2)                                     I JCI001
        COMMON/TCQ/SDDIV(140),SDSN(95),SDA8FS(8),SDABRS(8),
     *           ITESCI8,6),ITEML(8,3,2),
     *           IWORKI(30),IWORK2(3D),IWORKI30,2),RWNABA(10,1,2),
     *           RPNABA(1,2),VDDSF(140),SUMM(10),WNDABA(10,140),
     *           PNDABA(140),IDDABA(I4D),
     *           STOR1(3,8,2),STOR2(3,0,2),
     *           IABAST(8I,
     *           DISTBP(8),FRACDS(8),P2LONG(8),
     *           WVDDC(140),WVDAC(140),IRDABA(2),TWNDIV(10),
     *           SUNDIVI7),SUA(7)
        DIMENSION ASIDE(2)
```

```
C      ---------------------------------------------------------------
C 451 COMPUTE EFFECTIVENESS OF ALL DIVISIONS.
C      ---------------------------------------------------------------
       N2=0
C      FOR EACH SIDE L DIVISION
       DO 4550 L=1,2
       N1=1+N2
       N2=N2+ND(L)
       N3=NW(L)
       DO 4520 ID=N1,N2
       IT=ITD(ID)
       WVDAC(ID)=0.
       WVDDC(ID)=0.
       COMD=0.                                                       I JC1001
C      COMPUTE WEAPONS VALUE ON ATTACK AND ON DEFENSE.
       DO 4505 IW=1,N3
       WVDAC(ID)=WVDAC(ID)+VIWASF(IW,L)*WDIV(IW,ID)
       WVDDC(ID)=WVDDC(ID)+VIWDSF(IW,L)*WDIV(IW,ID)
       TOEW=TWD(IW,IT)                                               I JC1001
       IF(TOEW.GT.0.)COMD=COMD+FCLWL(IW,L)*WDIV(IW,ID)/TOEW          I JC1001
 4505  CONTINUE
C      USE PERCENT PERSONNEL STRENGTH )PPS) TO DETERMINE PERCENT
C      COMBAT EFFECTIVENESS ON ATTACK AND ON DEFENSE.
       PPS=PDIV(ID)/TPD(IT)
       CALL CVFW(NEAEF(L),XAEF(1,L),YAEF(1,L),PPS,PEA)
       CALL CVFW(NEDEF)L),XDEF(1,L),YDEF(1,L),PPS,PED)
C      USE DAYS OF SUPPLIES ON HAND TO DETERMINE SUPPLY EFFECT. FACTOR.
       DSH=SDIV(ID)/PCSD(IT)
       CALL CVFW(NSEFF(L),XSEFF(1,L),YSEFF(1,L),DSH,SEF)
C....  COMPUTE C**3 DEGRADATION                                     I JC1001
       CALL CVFW(NCOMD(L),XCOMD(1,L),YCOMD(1,L),COMD,CCCD)          I JC1001
C....  COMPUTE C**3/D EFFECTIVENESS FACTOR                          I JC1001
       CALL CVFW(NC3DD(L),XC3DD(1,L),YC3DD(1,L),CCCD,EFFC3)         I JC1001
C      COMPUTE EFFECTIVENESS OF DIVISION (IN ATTACK AND ON DEFENSE.
       EFFDA(ID)=EFFC3*SEF*AMIN1((WVDAC(ID)/WVDATS(IT)),PEA)        C JC1001
       EFFDD(ID)=EFFC3*SEF*AMIN1((WVDDC(ID)/WVDDTS(IT)),PED)        C JC1001
       IF)IDMU.EQ.3.OR.IDMU.EQ.5) GO TO 6908
       EFFDA(ID)=EFFDA(ID)*FDEFCP(ID)
       EFFDD(ID)=EFFDD(ID)*FDEFCP(ID)
 6908  CONTINUE


C      ---------------------------------------------------------------
C 901 COMPUTE EFFECTIVENESS OF DIVISIONS AND ORDER DIVISIONS IN FIRST
C      INACTIVE BATTLE AREA ACCORDINGLY.
C      ---------------------------------------------------------------
       N2=0
       DO 9050 L=1,2
       N1=1+N2
       N2=N2+ND(L)
       N3=NW(L)
C..... DETERMINE EFFECTIVNESS OF DIVISION ON ATTACK AND DEFENSE.
       DO 9020 ID=N1,N2
       IT=ITD(ID)
       WVDAC(ID)=0.
       WVDDC(ID)=0.
       COMD=0.                                                       I JC1001
C      COMPUTE WEAPONS VALUE ON ATTACK AND ON DEFENSE.
       DO 9005 IW=1,N3
       WVDAC(ID)=WVDAC(ID)+VIWASF(IW,L)*WDIV(IW,ID)
       WVDDC(ID)=WVDDC(ID)+VIWDSF(IW,L)*WDIV(IW,ID)
       TOEW=TWD(IW,IT)                                               I JC1001
       IF)TOEW.GT.0.)COMD=COMD+FCLWL(IW,L)*WDIV(IW,ID)/TOEW          I JC1001
 9005  CONTINUE
'C     USE PERCENT PERSONNEL STRENGTH )PPS) TO DETERMINE PERCENT
C      COMBAT EFFECTIVENESS ON ATTACK AND ON DEFENSE.
       PPS=PDIV(ID)/TPD(IT)
       CALL CVFW(NEAEF(L),XAEF(1,L),YAEF(1,L),PPS,PEA)
       CALL CVFW(NEDEF)L),XDEF(1,L),YDEF)1,L),PPS,PED)
C      USE DAYS OF SUPPLIES ON HAND TO DETERMINE SUPPLY EFFECT. FACTOR.
       DSH=SDIV()ID)/PCSD(IT)
       CALL CVFW)NSEFF)L),XSEFF(1,L),YSEFF)1,L),DSH,SEF)
```

47

APPENDIX A

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C.... COMPUTE (**3 DIGRADATION                                           I JC1001
      CALL CVFW(NCOMD(L),X(UMD(1,L),YCOMO(1,L),COMD,CCCD)              I JC1001
C.... COMPUTE C**3/D EFFECTIVENESS FACTOR                             I JC1001
      CALL CVFW(NC3DD(L),XC3DD(1,L),YC3DD(1,L),CCCO,EFFC3)            I JC1001
C     COMPUTE IFFECTIVENESS OF DIVISION ON ATTACK ANO ON DEFENSE.
      EFFOA(ID)=EFFC3*SEF*AMIN1((WVDAC(IO)/WVDATS(IT)),PEA)             C JC1001
      EFFDD(IO)=EFFC3*SEF*AMIN1(WVDDC(IID)/WVDOTS(IT)),PED)            C JC1001
      IF(IDMU.EU.3.OR.IDMU.EQ.5) GO TO 6909
      EFFOA(ID)=EFFOA(ID)*FDEFCP(ID)
      EFFDD(IO)=EFFDD(IO)*FOEFCP(ID)
 6909 CONTINUE


      SUBROUTINE TIMET
C        THEATER CONTROL ROUTINE FOR I/O
C* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C     TIMET PROCESSES ALL RESOURCE CHANGES THAT OCCUR DURING THE WAR
C        CALLED BY TMAIN
C     CALLS ASSIGN, MSREAD, MSWRIT, CVFW
C* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      REAL NSUTD,NTSUDT,INTDA,INTDE,INTDS
**********************************************************************
      COMMON/BBB/
**********************************************************************
      DIMENSION IREC(21),ZREC(21),ZEPO(1),IVAL(15),ZVAL(15)
      COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),                    I JC1001
     *              NCOMD(2),XCOMD(8,2),YCOMO(8,2),                    I JC1001
     *              FCLWL(10,2)                                        I JC1001
      EQUIVALENCE (IREC(1),ZREC(1)),(IDN,IREC(1)) ,(IFN,IREC(2)),
     * (KBA,IREC(8)),(KREG,IREC(10)),(KSA,IREC(9)),(IT,IREC(7)),
     * (IREC(4),IIDI,
     * (ICDOE,IREC(3)),(IST,IREC(4)),(ITO,IREC(5)),(IINC,IREC(6)),
     * (IVAL(1),IREC(7)),(IVAL(1),ZVAL(1)),(NEPO(1),ZEPO(1))
      ITT=ITTO
      ITT=15
C     -----------------------------------------------------------------
C 10) READ TIME-T INPUTS
C     -----------------------------------------------------------------


C
      WVDD=0.
      COMO=0.                                                          I JC1001
      DO 910 IW=1,MM
      WVDO=WVDO+VIWDSF(IW,L)*WDIV(IW,IIO)
      TDEW=TWD(IW,IT)                                                  I JC1001
      IF(TDEW.GT.O.)COMD=COMD+FCLWL(IW,L)*WDIV(IW,IIO)/TDEW            I JC1001
 910  CONTINUE
C     COMPUTE DIVISION EFFECTIVENESS
      PPS=PDIV(IID)/TPO(IT)
      CALL CVFW(NEDEF(L),XDEF(1,L),YOEF(1,L),PPS,PED)
      DSH=SDIV(IID)/PCSD(IT)
      CALL CVFW(NSEFF(L),XSEFF(1,L),YSEFF(1,L),DSH,SEF1)
C.... COMPUTE C**3 DEGRADATION                                        I JC1001
      CALL CVFW(NCOMD(L),XCOMD(1,L),YCOMD(1,L),COMD,CCCO)             I JC1001
C.... COMPUTE C**3/D EFFECTIVENESS FACTOR                             I JC1001
      CALL CVFW(NC3DD(L),XC3DD(1,L),YC3DD(1,L),CCCD,EFFC3)           I JC1001
      EFFDD(IIO)=EFFC3*SEF*AMIN1((WVDD/WVODTS(IT)),PED)               C JC1001
      IF(IDMU.EQ.3.OR.IDMU.EQ.5) GO TO 6908
      EFFDD(IIO)=EFFDD(IID)*FDEFCP(IID)
 6908 CONTINUE
C     ASSIGN DIVISION TO A PARTICULAR LOCATION IN THEATER
      CALL ASSIGN(IDN,IIO,KBA,KSA,KREG,L)
      IBALD(IIO)=KBA
      NDIBA(KSA,L)=NDIBA(KSA,L)+1
      J=NDIBA(KSA,L)
      IDLIBA(J,KSA,L)=IID
      GO TO 87
 81   CONTINUE
      RETURN
      END
```

48

A-2. NUCLEAR DELIVERY SYSTEM AVAILABILITY

This section completely lists subroutine DSDEG, which determines the several delivery system degradation factors; subroutine NUCCCD, which determines the C^3/D factors of airbase assets; and function NWHINV, in which the delivery system degradation factors are used. Also included is that portion of subroutine DAMEVL that is modified to include adjustment to actual airbase operating capabilities.

```
      SUBROUTINE DSDEG
C                                                                        I JC1001
C     DSDEG DETERMINES THE FRACTIONAL DECREASE IN DIVISION, SECTOR, AND  I JC1001
C     THEATRE WEAPONS SYSTEMS BASED OF DECREASES IN DIVISION, SECTOR     I JC1001
C     AND THEATER ASSETS SUCH AS WEAPONS SYSTEMS, SAM SYSTEMS, SSM       I JC1001
C     SYSTEMS, AND AIRBASES                                              I JC1001
C                                                                        I JC1001
      REAL NSUTD,NTSUDT,INTDA,INTDE,INTDS                                I JC1001
00000000000000000000000000000000000000000000000000000000000000000000000000
      COMMON/38B/
00000000000000000000000000000000000000000000000000000000000000000000000000
      COMMON/TNFSC1/INABF(8,2),INABR(8,2),INABZ(2)                       I JC1001
      COMMON/TNFSC2/NC3SD(2),XC3SD(8,2),YC3SD(8,2),                      I JC1001
     0              FDDSAD(8,2),FSDSAD(8,2),FTOSAD(8,2),                 I JC1001
     0              FABDCC(2),ABSFCC(8,2),ABSRCC(8,2),ABCZCC(2),         I JC1001
     0              FSSMCC(2),TSSMIR(8,2),SSSMIM(8,2),SSSMIL(8,2),       I JC1001
     0              FSAMCC(2),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2)          I JC1001
      COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),                      I JC1001
     0              NCOMD(2),XCOMD(8,2),YCOMD(8,2),                      I JC1001
     0              FCLWL(10,2)                                          I JC1001
      COMMON/TNFSC4/NEDLY(2),XEDLY(8,2),YEDLY(8,2,2),                    I JC1001
     0              JESC(8,3,2),IWAUT(8,2),IFPLS(8,2),                   I JC1001
     0              TEQPD(2),SEQPD(8,2),CTIME(8,2)                       I JC1001
      REAL*8 ASTYP(3)                                                    I JC1001
      DIMENSION ASIDE(2)                                                 I JC1001
      DATA ASTYP,ASIDE/'DIVISION','SECTOR  ','THEATRE ','BLUE','RED '/   I JC1001
      MOT=JCON                                                           I JC1001
      DO 2 L=1,2                                                         I JC1001
      TEQPD(L)=0.                                                        I JC1001
2     CONTINUE                                                           I JC1001
      DO 5 IS=1,NS                                                       I JC1001
      NRR=0                                                              I JC1001
      ND2=0                                                              I JC1001
      DO 10 L=1,2                                                        I JC1001
      NWS=NW(L)                                                          I JC1001
      NRT=NR(L)                                                          I JC1001
      DO 15 IR=1,NRT                                                     I JC1001
      IRT=IR+NRR                                                         I JC1001
      IF(IS.LE.NHSR(IRT))GOTO 16                                         I JC1001
15    CONTINUE                                                           I JC1001
      WRITE(6,9000)                                                      I JC1001
9000  FORMAT('I','NONRECOVERABLE DATA ERROR -- SECTOR/REGION            I JC1001
     0         'INCOMPATIBILITY IN SUBROUTINE DSDEG')                    I JC1001
      STOP                                                               I JC1001
16    CONTINUE                                                           I JC1001
      F1=FABDCC(L)                                                       I JC1001
      F2=FSSMCC(L)                                                       I JC1001
      F3=FSAMCC(L)                                                       I JC1001
      SUM=F2+F3                                                          I JC1001
```

APPENDIX A

```
      IF(INABR(IS,L).GT.O.AND.INABZ)L).GT.O)GOTO 17              I JCIOOI
      IF(INABR(IS,L).GT.O .OR.INABZ(L).GT.O)GOTO 19             I JCIOOI
      FI=0.                                                     ) JCIOOI
      F2=F2/SUM                                                 I JCIOOI
      F3=F3/SUM                                                 ) JCIOOI
      GOTO 17                                                   I JCIOOI
   19 FI=FI+FI                                                  I JCIOO)
   17 ETO=0.5*FI*(ABSRCC)IS,L)+ABCZCC)L))+F2*SSMSRS(IS,L)/TSSM)R()S,L)+  I JCIOOI
     *  0.5*F3*(ALRSR)1,)R,L)/TSAMIR)IR,L)+ALRSZ(I,L)/TSAM)Z(L))  I JCIOOI
      TEQPD(L)=TEUPO(L)+ETD                                     I JCIOOI


      FI=FABDCC(L)                                              I JCIDOI
      F2=FSSMCC(LI                                              1 JCIOOI
      F3=FSAMCC(LI                                              1 JCIOOI
      SUM=F2+F3                                                 1 JCIOOI
      IF(INABF(IS,LI.GT.D)GOTO 21                               I JCIOOI
      FI=O.                                                     I JCIOOI
      F2=F2/SUM                                                 I JCIOOI
      F3=F3/SUM                                                 I JCIDDI
   21 ESO= FI*ABSFCC(IS,L) + F3*BMRS(1,IR,L)/SSAMIF(IR,L) +     1 JCIOOI
     *  0.5*F2*(SSMSFS(1,IS,L)/SSSMIM(IS,L)+SSMSFS(2,IS,L)/SSSMIL(IS,L)) I JCIOOI
      SEQPD(IS,LI=ESD                                           1 JCIOOI
      EDD=D.                                                    I JCIOOI
      IF(NDS(IS,L).LE.D)GOTO 18                                 1 JCIDOI
      ND1=1+ND2                                                 1 JCIDDI
      ND2=ND2+NDS)IS,L)                                         T JCIOOI
      DO 2D IDS=ND1,ND2                                         I JCIOOI
      ID=IDLABA(IDS,IS)                                         ·I JCIOOI
      IT=ITD(ID)                                                I JCIOOI
      DD 22 IW=1,NWS                                            I JCIOOI
      TDEW=TWD(IW,IT)                                           I JCIOOI
      IF(TOEW.GT.O.)EDD=EDD+FCLWL(IW,L)*WDIV(IW,)O)/TOEW        1 JCIOOI
   22 CONTINUE                                                  I JCIOOI
   20 CONTINUE                                                  I JCIOOI·
      EDD=EDD/NDS(IS,L)                                         I JCIOOI
   18 CONTINUE                                                  1 JCIOOI
      EDD=SQRT(EOD*ESD)                                         1 JCIDDI
      CALL CVFWINC3SO(L),XC3SO(1,L),YC3SD(1,L),EOD,SDEG)        I JCIOOI
      FODSAD(IS,L)=SDEG                                         . 1 JCIOOI
      CALL CVFWINC3SD(LI,XC3SD(1,L),YC3SD(1,LI,ESD,SDEG)        1 JCIOOI
      FSDSAD(IS,LI=SDEG                                         T JCIOOI
      CALL CVFWINC3SD(L),XC3SD(1,L),YC3SO(1,L),ETD,SOEG)        1 JCIOOI
      FTDSAD(IS,LI=SDEG                                         I JCIOOI
      NRR=NNR+NR(L)                                             I JCIOOI
   10 CONTINUE                                                  J JCIOOI
    5 CONTINUE .                                                1 JCIOOI
      DO 3 L=1,2                                                1 JCIOOI
      TEQPO(L)=TEQPD(LI/NS                                      ) JCIDOI
   .3 CONTINUE                                                  1 JCIOOI
      IF(IPRS.NE.1IGOTO 50                                      1 JCIDOI
      WRITE(MOT,IDO)ICYCLE,INCYL                                T JCIOOI
      DO 40 L=1,2                                               I JCIOOI
      WRITE(MOT,IO1)ASIDE(L),(IS,IS=1,NS)                       I JCIDOI
      WRITE(MOT,1D2)ASTYP(1),(FDDSAD(IS,L),IS=1,NS)             I JCIDOI
      WRITE(MOT,IO2IASTYP(2),(FSDSAD(IS,L),IS=1,NS)             I JCIOOI
      WRITE(MOT,1D2)ASTYP)3),(FTDSAD(IS,L),IS=1,NS)             I JCIOOI
      WRITE(MOT,1D3I                                            I JCIOOI
   40 CONTINUE                                                  I JCIOOI
   50 RETURN                                                    I JCIOOI
  100 FORMAT('1','TABLE   N2A  CYCLE',2X,I4,I8X,'DELIVERY SYSTEM ',  1 JCIOOI
     * 'DEGRADATIUN FACTORS DUE TO CCC OEGRADATION'/10X,'SUBCYCLE',  I JCIOOI
     *2X,I4/IX,II9IIH-))                                        I JCIOOI
  IOI FORMAT)'O',A4,' SIDE',5X,'SECTOR',6X,8)I2,8X)/5)2H -)I     I JCIOOI
  IO2 FORMAT)'O',A8,' SYSTEM',8X,8(F7.3,3X))                    I JCIOOI
  103 FORMAT)////)                                              I JCIOOI
      END                                                       I JCIOOI
```

```
      SUBROUTINE NUCCCO                                               I JCI001
C     *****************************************************************I JCI001
C     NUCCCO OETERMINES THE C**3/O FACTORS FOR AIR8ASE ASSETS AT THE   I JCI001
C        ENO OF EACH NUCLEAR / CHEMICAL SUBCYCLE                       I JCI001
C     *****************************************************************I JCI001
      REAL NSUTO,NTSUOT,INTOA,INTOE,INTOS                              I JCI001
**********************************************************************************
      COMMON/8B8/
**********************************************************************************
      COMMON/TNFSCI/INABF 18,21,INABR18,2),INA8Z(2)                    I JCI001
      COMMON/TNFSC2/NC3SO(2I,XC3SO(8,2),YC3SO18,2),                    I JCI001
     *              FOOSA018,2),FSOSAO(B,2),FTOSAO(8,2),               I JCI001
     *              FA8DCC12),ABSFCC18,21,ABSRCC18,21,A8CZCC(2),       I JCI001
     *              FSSMCC12),TSSMIR1B,2),SSSMIH18,2),SSSMIL(8,2),     I JCI001
     *              FSAMCC12),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2)        I JCI001
      COMMON/TNFSC3/NC3OO(2),XC3OO(8,2I,YC3OO(8,2I,                    I JCI001
     *              NCOMD(2I,XCOMO(8,2),YCOMO(B,2),                    I JCI001
     *              FCLWL(IO,2)                                        I JCI001
      REAL*8 ATYP(3)                                                   I JCI001
      OIMENSIUN NNA8F(8,2I,NNA8R18,2),NNABZI2I,IOPTH(7I,ISIO(7)        I JCI001
      OIMENSION ASIOE12)                                              I JCI001
      OATA ATYP/'FORWARO ',' REAR  ',' COMMZ '/                       I JCI001
      OATA ASIOE/'BLUE','REO '/                                        I JCI001
      OATA NNA8F,NNA8R,NNA8Z/34*0/                                     I JCI001
      OATA IOPTH /3,2,1,4,1,2,3/                                       I JCI001
      OATA ISIO /2,2,2,0,1,I,I/                                        I JCI001
      MOT=JCON                                                         I JCI001
      OO 2 L=I,2                                                       I JCI001
      NNABZ(LI=0                                                       I JCI001
      ABCZCC(LI=0.                                                     I JCI001
      OO 3 IS=I,NS                                                     I JCI001
      NNABFIIS,LI=0                                                    I JCI001
      NNA8R(IS,L)=0                                                    I JCI001
      ABSFCC(IS,L)=0.                                                  I JCI001
      A8SRCC(IS,L)=0.                                                  I JCI001
3     CONTINUE                                                        I JCI001
2     CONTINUE                                                        I JCI001
      CALL TAGINBA,NS,IABAS,NOFA8,NORAB,ISTAT)                         I JCI001
      OO 9 I=I,NA8                                                     I JCI001
      IWORO(13,I)=100                                                  I JCI001
      IWORO(14,I)=IOO                                                  I JCI001
      LOC=IAF8AI I)                                                   I JCI001
      IS=MOD(LOC-I,NS)+1                                              I JCI001
      IST=ISTATILOCI                                                   I JCI001
      L=ISIOIISTI                                                      I JCI001
      M=IOPTH(IST)                                                     I JCI001
      CO TU 16,7,8,9),M                                                I JCI001
C     OEGSRF,R,C = OEGRAJED OPERATING CAPABILITY PER NOTIONAL BASE     I JCI001
C     (FORWARU,REAR OR COMMZ) = SUM OF OP. CAP. OF ACTUAL BASES IN     ) JCI001
C     SECIOR DIVIOED BY NO. ACTUAL BASES                              I JCI001
6     ABSFCC(IS,L)=ABSFCC(IS,L)+OCNUC(I)                             I JCI001
      NNA8FIIS,L)=NNABF(IS,L)+I                                        I JCI001
      GOTO9                                                           I JCI001
7     ABSRCC(IS,L)=ABSRCC(IS,L)+OCNUC(I)                             I JCI001
      NNABR(IS,L)=NNA8R(IS,L')+I                                       I JI1001
      GUTO9                                                           I JCI001
8     ABCZCC(L)=ABCZCC(L)+OCNUC(I)                                    I JCI001
      NNABZIL)=NNABZIL)+1                                              I JCI001
9     CONTINUE                                                        I JCI001
      OO 5 L=1,2                                                       I JCI001
      OO 4 IS=I,NS                                                     I JCI001
      IFIICYCLE.GT.I)GOTO 10                                          I JCI001
      INABF(IS,L)=NNABF(IS,LI                                          I JCI001
      INA8R(IS,LI=NNABRIIS,LI                                         I JCI001
      INA8Z(L) =NNABZ(LI                                              I JCI001
IO    CONTINUE                                                        I JCI001
      IF(INABFIIS,LI.LE.O)ABSFCC(IS,L)=0.                             I JCIO0I
      IF(INABR(IS,LI.LE.OIA8SRCC(IS,LI=0.                             I JCI001
      IFINNA8F(IS,LI.GT.OIA8SFCC(IS,LI=A8SFCC(IS,L)/NNA8F(IS,L)       I JCI001
      IFINNA8R(IS,LI.GT.OIA8SRCC(IS,LI=A8SRCC(IS,L)/NNA8R(IS,L)       I JCI001
4     CONTINUE                                                        I JCI001
```

51

```
      IF(INABZ(L).LE.0)ABCZCC(L)=0.                                    I JCI001
      IF(NNABZ(L).GT.0)ABCZCC(L)=ABCZCC(L)/NNABZ(LI                    I JCI0D1
    5 CONTINUE                                                         I JCI001
      IF(IPRS.NE.I)GOTO 2D                                             I JCI001
      WRITE(MOT,IDO)ICYCLE,INCYL                                       I JCI001
      00 40 L=1,2                                                      I JCI001
      WRITE(MOT,ID1)ASIDE(L),(IS,IS=1,NSI                              I JCI001
      WRITE(MOT,ID2)ATYP(II,((NNABF(IS,L),ABSFCC(IS,LII,IS=1,NS)       I JCI001
      WRITE(MCT,102)ATYP(2I,((NNABR(IS,L),ABSRCC(IS,LI),IS=1,NSI       I JCI0DI
      WRITE(MOT,102)ATYP(3),NNABZ(L),ABCZCC(LI                         I JCI001
   40 CONTINUE                                                         I JCID01
   20 CONTINUE                                                         I JCID01
      RETURN                                                           I JCI001
  1DO FORMAT('1','TABLE  Q1   CYCLE',2X,I4,18X,'AIRBASE DEGRAOATION ', I JCI001
     * 'FACTORS'/10X,'SUBCYCLE',2X,I4/1X,119(IH-I)                     I JCI001
  101 FORMAT('0',A4,' SIDE',5X,'SECTOR',7X,8(I2,10X)/5(2H -I,13X,      I JCI001
     * 8('#',2X,'DEGRADEO 'I)                                         I JCI001
  102 FORMAT('0',A8,'AIRBASES',6X,8(I2,2X,F5.3,3XII                    I JCI001
      ENO                                                              I JCI0D1


      FUNCTION NWHINV(IWC,IWS,KIYD,IPOS,IS,L,IFLAGI
C
C
C     ************************************************************************
C
C     ROUTINE ESTABLISHES THE CURRENT INVENTORY FOR KIYD YIELOS FOR
C     EACH WEAPON CATEGORY IN POSITION IPOS IN SECTOR IS FOR SIDE-L,
C     IT ALSO ESTABLISHES THE MAXIMUM NUMBER OF ROUNOS WHICH CAN BE
C     FIREO FROM A GIVEN POSITION ANO RETURNS THE SMALLER OF THE
C     TWO VALUES AS THE NUMBER OF ROUNOS AVAILABLE.
C     FUNCTION NWHINV IS CALLEO BY NUCWPS AND PREYLD.
C
C
C     ************************************************************************
C
      REAL NSUTD,NTSUOT,INTDA,INTOE,INTOS
************************************************************************
      COMMON/8BB/
************************************************************************
      COMMCN/LDCAL1/AIWC(3),ASIDE(2),NIWAS,NNIWAS(2),NPT(7,4,30I,
     X              IWLIDS(10D,2),IWLCOT(100,2),IWLTZN(100,2)
     1             ,IWLTLO(1DO,2),IWLBT(100,2),IWL(100,2),WLYLD(100,2)
     X      ,XIWY(42,2),KIWYF(42,2),KIWYL(42,2),NNYOS(2I
     2              ,WLCEP(100,2),IWLHOB(100,2I
      COMMON/LOCAA1/NSFRD(4,2,2),NSFRS(5,2,2I,
     1              NSFRT(5,2,2),NOT
      COMMON/AFSTF2/ AFOIM(22,4I
      COMMON/TNFSC2/NC35D(2),XC3SD(8,2I,YC3SO(8,2I,                    I JCI001
     *              FODSAD(8,2I,FSDSA0(8,2I,FTDSAD(8,2I,                I JCI001
     *              FABDCC(2I,A8SFCC(8,2I,ABSRCC(8,2I,ABCZCC(2I,        I JCI001
     *              FSSMCC(2),TSSMIR(8,2),SSSMIM(8,2I,SSSMIL(8,2I,      I JCI001
     *              FSAMCC(2),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2I         I JCI001
C
C     CHECK FOR MULTIPLE YIELD
C
      IYO=KIYD
      IF(IOLYLO(IWC,IWS,LI.EQ.1I IYD=1
      LIS=L+2*(IS-1)
C
C     DETERMINE WEAPON CATEGORY
C
      GO TO (100,200,30D),IWC
C
C     OIVISION WEAPON SYSTEMS
C
  100 NWHINV=NOWHO(IWS,IYD,LISI*FOSPOS(IWS,IPOS,L)
      IF(IFLAC.EQ.2) RETURN
C
      NNWFIR = NOWSI(IWS,IS,LI*FOSPOS(IWS,IPOS,L)*MNFRO(IWS,LI*         C JCI001
     * FODSAO(IS,LI - NSFRD(IWS,IPOS,LI                                 C JCI001
      IF(NNWFIR .LT. NWHINV) NWHINV = NNWFIR
```

52

```
C
      RETURN
C
C     SECTOR WEAPON SYSTEMS
C
  200 NWHINV=NSWHS(IWS,IYO,LIS)*FSSPOS(IWS,IPOS,L)
      IF(IFLAG.EQ.2) RETURN
C
      NNWFIR = NSWSI(IWS,IS,L)*FSSPOS(IWS,IPOS,L)*MNFRS(IWS,L)*         C JCIOOI
     *  FSOSAO(IS,L) - NSFRS(IWS,IPOS,L)                                C JCIOOI
      IF(NNWFIR .LT. NWHINV) NWHINV = NNWFIR
C
      RETURN
C
C     THEATER WEAPON SYSTEMS
C
  300 NWHINV=NTWHT(IWS,IYD,L)*FTSPOS(IWS,IPOS,L)
      IF(IFLAG.EQ.2) RETURN
C
      NNWFIR = NTWSI(IWS,IS,L)*FTSPOS(IWS,IPOS,L)*MNFRT(IWS,L)*         C JCIOOI
     *  FTOSAO(IS,L) - NSFRT(IWS,IPOS,L)                               C JCIOOI
      IF(NNWFIR .LT. NWHINV) NWHINV = NNWFIR
C
      RETURN
C
      END
```

Subroutine DAMEVL

```
      00 775 IAT = I,7
C
C........GET NUMBER OF SHELTERED ANO UNSHELTERED A/C OF TYPE IAT IN
C        PARKING AREA IPR IN OROER TO CALCULATE ACTUAL AIRCRAFT ANO
C        SHELTER KILLS.
C
      RSH=0.
      NSUM=0
      00 750 IATT=I,7
  750 )F(IPSHLA(IATT,L).LT.IPSHLA(IAT,L)) NSUM=NSUM+NACTPA(IATT,IPR)
      IF(NSUM.GT.NSHPA(IPR)) GO TO 755
      RSH   =MINO(NSHPA(IPR)-NSUM,NACTPA(IAT,IPR))
  755 RNUSH = FLOAT(NACTPA(IAT,IPR))- RSH
      APOM(IAT) = APOM(IAT) + RNUSH*DAMM(JPA)
      APOM(IAT)=APOM(IAT)+RSH*OAMS(JPA)
      APOMM(IAT) = APOMM(IAT) + RNUSH*(OAMM(JPA) - OAMA(JPA))
      APOMT(IAT)=APOMT(IAT)+RNUSH*OAMA(JPA)+RSH*OAMS(JPA)
  775 CONTINUE
C     SHELTERS OESTROYEO
      SHDM = SHDM + DAMS(JPA)*FLOAT(NSHPA(IPR))
      SHOMT = SHOMT + DAMS(JPA)*FLOAT(NSHPA(IPR))
  780 CONTINUE
  790 CONTINUE
      ARHLF = 20000000.
      OLKLC =   ARC/ARHLF                                             C CJIOOI
      IF(OLKLC .GT. 1.) OLKLC = I.
C     THIS IS NECESSARY SINCE LETHAL AREA MAY COVER MORE THAN AIRFIELO
      OLKLC = OLKLC*ARHLF*POENSS/1000000.                            ) JCIOOI
      CCTEM = CCTEM + ARC*PDENSS/1000000.                            ) JCIOOI
      CFTEM = CFTEM + ARL*POENSS/1000000.                            I JCIOOI
C
C........PRINT A SUMMARY OF OAMAGE INFLICTEO.
C
      IF(IPRS .NE. I) GO TO 6016
      WRITE(IND,6015) IAB,DLKLL,DLKLC,(APDM(IACT),IACT=1.7),SHOM,
     * THPLOW
 6016 CONTINUE
C
C........UPOATE NUMBERS OF A/C SHELTERS ANO PEOPLE ON AIRBASES
C
```

APPENDIX A

```
      DO 810 IAT=1,7
      IWORD(IAT,IAB)=IWORD(IAT,IAB)-IFIX(APDM(IAT))
      IF(IWORD(IAT,IAB).LT.0) IWORD(IAT,IAB)=0
810   CONTINUE
      IWORD(11,IAB)=IWORD(11,IAB)-IFIX(SHDM)
      IF(IWORD(11,IAB).LT.0) IWORD(11,IAB)=0
      IWORD(12,IAB)=IWORD(12,IAB)-IFIX(DLKLL)                            I JCIDDI
      IF(IWORD(12,IAB).LT.0) IWORD(12,IAB)=0                             1 JCIDDI
      IF(TPML .LT. 0.0001) GO TO 811
      TEMP=IWORD(13,IAB)
      IWORD(13,IAB)=TEMP*(1.-DLKLL/TPML) +.5
811   CONTINUE
C     CALCULATE CAPABILITY OF A)KBASE INDEXED BY IAB                    I JCIODI
      TEMP=)WORD(13,)AB)                                                I JCIODI

      TEMP=1.-TEMP/100.                                                 I JCIDDI
      CALL CVFW(NDCDPC(L2),XDCDP(1,L2),YDCDP(1,L2),TEMP,PDEG)           I JCIDDI
      ABDEG=AMIN1(PDEG,TMPLOW)                                          I JCIDDI
      DCNUC(IAB)=DCNUC(IAB)*ABDEG                                       I JCIDDI
      DO 812 IAT = 1,7
      CADAM(IAT,L2) = CADAM(IAT,L2) + APDMM(IAT)
812   CONTINUE
  220 CONTINUE
C     END OF DO-LOOP ON NUCLEAR FIRE MISSION I BEGUN IN SECTION 300
      IF(NANT .EQ. 0) GO TO 221
C     UPDATE TOTALS
      TCANAF(JS,L2) = TCANAF(JS,L2) + DLKLLT
      DO 813 IAC = 1,7
      TDSNAC(IAC,JS,L2) = TDSNAC(IAC,JS,L2) + APDMT(IAC)
      TDMNAC(IAC,JS,L2) = TDMNAC(IAC,JS,L2) + APDMM(IAC)
  813 CONTINUE
      TDSNAS(JS,L2) = TDSNAS(JS,L2) + SHDMT
      IF(IPRS .NE. 1) GO TO 6021
      WRITE(IND,6020) DLKLLT, (APDMT(IACT),IACT = 1,7),SHDMT
6021  CONTINUE
221   CONTINUE
C
```

A-3.   NUCLEAR ESCALATION DELAY

This section completely lists subroutine EDELAY, in which the delay
in the preferred nuclear escalation state is determined, and subroutine
NUC1, which calls EDELAY.

```
      SUBROUTINE EDELAY
C
C     ********************************************************************
C
C     ROUTINE DETERMINES THE PROPOSED AND CURRENT STATE OF NUCLEAR
C     ESCALATION AND THE DELAY TIME BEFORE THE PROPOSED STATE CAN BE
C     ACTIVATED.
C
C     ********************************************************************
C
      REAL NSUTD,NTSUDT,INTDA,INTDE,INTDS
********************************************************************************
      COMMON/BBB/
********************************************************************************
      COMMON/TNFSC4/NEDLY(2),XEDLY(8,2),YEDLY(8,2,2),                   I JCIODI
     *              JESC(8,3,2),IWAUT(8,2),IFPLS(8,2),                  I JCIODI
     *              TEQPD(2),SEQPD(8,2),CTIME(8,2)                      I JCIODI
      REAL*8 ADUT(8),ANONE,ADELAY,APRES                                I JCIODI
      REAL*4 ASIDE(2),DTIME(8),COMMO(8)                                 1 JCIODI
      DATA ANONE,ADELAY,APRES/' NONE ',' DELAYED',' PRESENT'/          I JCIODI
      DATA ASIDE/'BLUE ','RED '/                                       1 JCIODI
```

54

```
        INO=JCON                                                      1 JC1001
        IF(IPRS.NE.O)WRITE(INO,9000)ICYCLE,INCYL,(IS,IS=1,NS)          1 JC1001
        00 1000 L=1,2                                                  1 JC1001
        00 1200 IS=1,NS                                                1 JC1001
        OELAY=0.                                                       1 JC1001
        CDEG=SQRT(TEQPO(L)*SEQPO(IS,L))                                1 JC1001
        COMMO(IS)=CDEG                                                 1 JC1001
        00 1205 ITC=1,3                                                1 JC1001
        IF(JESC(IS,)TC,L).LT.0.OR.JESC(IS,ITC,L).GE.)ESC(IS,ITC,L))    1 JC1001
      * GOTO 1205                                                      1 JC1001
        ITMP=)ESC(IS,ITC,L)                                            1 JC1001
        IF(JESC(IS,ITC,L).NE.0))TMP=-ITMP                              1 JC1001
        JESC(IS,ITC,L)=ITMP                                            I JC1001
1205    JESC(IS,ITC,L)=0                                               J JC1001
        IF(IWAUT(IS,L).NE.0)GOTO 1215                                  I JC1001
        00 1210 ITC=1,3                                                1 JC1001
        IF(JESC(IS,ITC,L).NE.0)GOTO 1220                               1 JC1001
1210    CONTINUE                                                       1 JC1001
        CTIME(IS,L)=0.                                                 1 JC1001
        DTIME(IS)=0.                                                   1 JC1001
        GOTO 1200                                                      1 JC1001
1220    IWAUT(IS,L)=1                                                  1 JC1001
        CTIME(IS,L)=0.                                                 1 JC1001
1215    IF(IFPLS(IS,L).NE.0)GOTO 1225                                  I JC1001
        CALL CVFW(NEOLY(L),XEDLY(1,L),YEOLY(1,1,L),COEG,OELAY)         1 JC1001
        GOTO 1230                                                      1 JC1001
1225    CALL CVFW(NEDLY(L),XEOLY(1,L),YEOLY(1,2,L),COEG,OELAY)         ) JC1001
1230    CTIME(IS,L)=CTIME(IS,L)+12./NNSC                               1 JC1001
        DTIML(IS)=DILAY                                                1 JC1001
        IF(OELAY.GT.CT)ME(IS,L))GOTO 1200                              1 JC1001
        00 1235 ITC=1,3                                                1 JC1001
        JESC(IS,ITC,L)=)ABS(JESC(IS,)TC,L))                            I JC1001
1235    JESC(IS,ITC,L)=0                                               1 JC1001
        IWAUT(IS,L)=0                                                  1 JC1001
        IFPLS(IS,L)=1                                                  1 JC1001
1200    CONTINUE                                                       1 JC1001
        IF((IPRS.EQ.0)GOTO 1000                                        1 JC1001
        WRITE(INU,9005)ASIDE(L)                                        ) JC1001
        00 1020 IS=1,NS                                                1 JC1001
        AOUT(IS)=ANONE                                                 1 JC1001
        IF(IWAUT(IS,L).EQ.0)GOTO 1015                                  I JC1001
        AOUT(IS)=AOELAY                                                1 JC1001
        GOTO 1020                                                      1 JC1001
1015    00 1016 ITC=1,3                                                J JC1001
        IF((IESC(IS,ITC,L).NE.0)GOTO 1018                              ) JC1001
1016    CONTINUE                                                       I JC1001
        GOTO 1020                                                      ) JC1001
1018    AOUT(IS)=APRES                                                 1 JC1001
1020    CONTINUE                                                       1 JC1001
        WRITE(INO,9001)(AOUT(IS),IS=1,NS)                              1 JC1001
        WRITE(INO,9002)(CTIMF(IS,L),IS=1,NS)                           ) JC1001
        WRITE(INO,9003)(DTIME(IS)),IS=1,NS)                            1 JC1001
        WRITE(INO,9004)(COMMO(IS),IS=1,NS)                             I JC1001
1000    CONTINUE                                                       1 JC1001
9000    FORMAT(////1X,'TABLE NAA   CYCLE ',I4,5X,'DELAYEO ESCALATION'/10X,I JC1001
      **SUBCYCLE  ',I4/1X,119(1H-)//7X,'SECTOR',5X,8(I1,9X)/)          1 JC1001
9001    FORMAT(1X,' ESCL STATUS  '10(A8,2X))                           1 JC1001
9002    FORMAT(1X,'CURRENT TIME  '10(F8.1,2X))                         ) JC1001
9003    FORMAT(1X,'  OELAY TIME  '10(F8.1,2X))                         1 JC1001
9004    FORMAT(1X,'COMMO DEGRAO  '10(F8.4,2X))                         1 JC1001
9005    FORMAT('0',A4,' SIDE'/5(2H -))                                 1 JC1001
        RETURN                                                         1 JC1001
C
        ENO
```

APPENDIX A

```
      SUBROUTINE NUC1
C
C
C     *********************************************************************
C
C     SECONDARY CALLING PROGRAM FOR THE ROUTINES WHICH
C     DETERMINE NUCLEAR ESCALATION STATES, DETERMINE
C     THE NUMBER OF NUCLEAR WEAPON SYSTEMS, AND REALLOCATES
C     STOCKS OF NUCLEAR WARHEADS TO SUPPLY POOLS.
C     SUBROUTINE NUC1 IS CALLED BY NUC AND CALLS THE
C     FOLLOWING ROUTINES  ESCLAT, NDSYIN  AND WHINUP.
C
C
C     *********************************************************************
C
      REAL NSUTD,NTSUDT,INTDA,INTDE,INTDS
*******************************************************************************
      COMMON/BBB/
*******************************************************************************
      COMMON/LOCAL1/AIWC(3),ASIDE(2),NIWAS,NNIWAS(2),NPT(7,4,30),
     X            IWLIDS(100,2),IWLCOT(100,2),IWLTZN(100,2)
     1          ,IWLTLD(100,2),IWLBT(100,2),IWL(100,2),WLYLD(100,2)
     X    ,XIWY(42,2),KIWYF(42,2),KIWYL(42,2),NNYDS(2)
     2            ,WLCEP(100,2),IWLHOB(100,2)
      COMMON/LOCAA1/NSFRD(4,2,2),NSFRS(5,2,2),
     1            NSFRT(5,2,2),NDT
      COMMON/AFSTF2/  AFDIM(22,4)
C
      IS=KISS
C
C     -----------------------------------------------------------------
C     DETERMINE ESCLATION STATE
C     -----------------------------------------------------------------
C
C
      CALL ESCLAT
C
C     DETERMINE IF THIS CALL WAS ONLY FOR ESCLATION STATES
C
      IF(KFLAG.EQ.2) GO TO 100
C
C     -----------------------------------------------------------------
C     DETERMINE NUMBER OF NUCLEAR DELIVERY SYSTEMS
C     -----------------------------------------------------------------
C
C
      CALL EDELAY                                              I JC1001
C
      DO 10 IS=1,NS
      DO 10 ITC=1,3
      DO 10 L=1,2
      IF(IESC(IS,ITC,L).NE.0) GO TO 50
   10 CONTINUE
      GO TO 100
   50 CONTINUE
      CALL NDSYIN
C
C     -----------------------------------------------------------------
C     REALLOCATE INVENTORY OF NUCLEAR WARHEADS
C     -----------------------------------------------------------------
C
      CALL WHINUP
C
  100 CONTINUE
      RETURN
      END
```

A-4. TARGET ACQUISITION PROCESSING DELAY

This section partially lists subroutines TARACA and TADPAR, in which the target acquisition parameters for active and reserve division targets are determined.

```
      SUBROUTINE TARACA
C
C*********************************************************************
C     TARACA SIMULATES ACQUISITION OF TARGETS IN THE ACTIVE BATTLE AREA
C     OF A GIVEN SECTOR BY GROUND, ARMY-AIR ANO AIR FORCE SENSORS
C     SENSORES MAY OPERATE IN STANDOFF (FIXEO OR VERTICAL), STANOOFF
C     (MOVING) OR PENETRATING  MODE
C     SENSORS MAY BE CONTINUOUSLY OPERATING OR GLIMPSE SENSORS
C        CALLED BY TARACQ
C        CALLS TARACE
C*********************************************************************
C
      REAL NSUTO,NTSUOT,INTOA,INTDE,INTOS
*********************************************************************
      COMMON/BBB/
*********************************************************************
      COMMON/TNFSC1/INABF(8,21,INA8R(8,21,INABZ(21               I JC1001
      COMMON/TNFSC2/NC3SD(21,XC3SD(8,21,YC3SD(8,21,              I JC1001
     *             FDDSAD(8,2),FSDSAD(8,21,FTDSAD(8,21,          I JC1001
     *             FABDCC(21,ABSFCC(8,21,ABSRCC(8,21,ABCZCC(21,  I JC1001
     *             FSSMCC(21,TSSM1R(8,2),SSSMIK(8,21,SSSMIL(8,21, I JC1001
     *             FSAMCC(21,TSAM1R(3,21,TSAM1Z(21,SSAM1F(3,21   J JC1001
      COMMON/TNFSC3/NC3DD(21,XC3DD(8,21,YC300(8,21,              I JC1001
     *             NCOMD(21,XCOMD(8,21,YCOMO(8,21,               I JC1001
     *             FCLWL(10,21                                   I JC1001
      COMMON/TNFSC4/NEDLY(21,XEDLY(8,21,YEDLY(8,2,21,            I JC1001
     *             JESC(8,3,21,IWAUT(8,21,IFPLS(8,21,            I JC1001
     *             TEOPD(21,SEOPO(8,21,CTIME(8,21                I JC1001
      COMMON/TNFSC5/NGSFD(21,XGSFO(8,21,YGSFD(8,21,              I JC1001
     *             NAAFD(21,XAAFD(8,21,YAAFD(8,21,               I JC1001
     *             NAFFD(21,XAFFD(8,21,YAFFD(8,21                I JC1001
      COMMON/LOCAL3/ JS
C
C     THESE ARE WORKING VARIABLES TARGET ACQUISTION NEEOS ONLY.
      COMMON /TACQ/ VISTWZ(40,11),CEITWZ(40,11),RVLOST(6),
     1             INZBA(112), KTERTA(112)
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
      DIMENSION  PGSOT(7,4,301,PDSZOS(7,4,301,GAP(21,ASIOE(21
      LOGICAL*1 LJCI(41,MJCI(4)
      EQUIVALENCE(LJCI(1),TJCI),(MJCI(1),IJCI)
      OATA ASIDE/'BLUE','RED '/                                 1 JC1001
C-------------------------------------------------------------------
C(100)  INITIALIZE WORKING VARIABLES
C-------------------------------------------------------------------
      IJCI=0
      FNNSC=1.
      N2=0
      DO 6 L=1,2
      N1=1+N2
      N2=N2+NDS(JS,L)
      N3=NSU(L)
      N4=NZ(L)
      IF(IUTAM.EQ.1) GO TO 4
C.... TARGET ACQUISITION MODEL NOT USED, DETECTION PROB., SENSOR ERROR
C     ANO DELAY TIME ARE USER INPUT
      DO 3 IOS=N1,N2
      DO 3 ISU=1,N3
      OO 3 IZ=1,N4
      PSZDDS(ISU,IZ,IDS)=PSZD(ISU,IZ,L)
```

APPENDIX A

```
        N5=NZ(III
        N6=NW(LI                                                     I JC1001
        IJ=NDS(JS,III
        IJJ = NDS(JS,LI
C
C....  GIVEN A SENSING AND A TARGET DIVISION, COMPUTE DETECTION PROB FORI
C       EACH SENSOR TYPE(IGS) VS EACH SUBUNIT TYPE(ISU) IN EACH ZONE(IZI
   21  ILI=IDLABA(ICTSD,JSI
       IF(IL.EQ.2I ILI=IDLABA(ICTSD+IJ,JS)
       ITI=ITD(IL1)
       CDMD=D.                                                       I JC1001
       DO 211 IW=1,N6                                                I JC1001
       TDEW=TWDI(IW,IT1)                                             I JC1001
       IF(TDEW.GT.D.ICOMD=COMD+FCLWL(IW,L)*WDIV(IW,ILI)/TDEW         I JC1001
  211  CONTINUE                                                      I JC1001
       CALL CVFW(NCOMD(L),XCOMDI(I,L),YCOMD(1,L),COMD,CCCDI          I JC1001
       CALL CVFW(NGSFD(LI,XGSFDI(I,L),YGSFD(1,L),CCCD,COMDI          I JC1001
C....  TSX = LOCATION OF SENSOR GROUP
       TSX=TSX+ITFAC*DVWDTH(IT1I)/2.
       I1 = NDS(JS,11 + ICTTD
       IF(L .EQ. 21 I1 = ICTTD
       IL2 = IDLABA(ICTTD,JSI
       ITEMP = ICTTD + IJJ
       IF(I1.EQ. 2I IL2 = IDLABA(ITEMP,JS)
       IT2=ITDI(IL2I
C....  DSX = HORIZONTAL DISTANCE, SENSORS TO TARGET EDGE


C....  PASDT = PROB(PARTIC SENSOR ACQUIRES PARTIC TARGET - GLIMPSE)
       PASDT=1.-(1.-PDGE)**(GLPGS(IGS,LI*TACLI
C....  TEMP2 IS PROBABILITY OF NON-DETECTION BY ANY
   24  TEMP2=(1-PASDTI**TEMPI                                        I JC1001
       IF(TEMP2.LT.1.E-ID)TEMP2=D.                                   I JC1001
C....  SENSOR OF THIS TYPE
C....  TEMP2 = PROB(NO TYPE IGS SENSORS ACQUIRE A PARTICULAR TARGET)
C....  TEMP3 = PROB(AT LEAST 1 TYPE IGS SENSOR ACQUIRES A PARTIC TARGET)
       TEMP3=1.-TEMP2
C....  PDSZDS WILL BE USED TO COMPUTE OVERALL SENSOR ERROR AND DELAY TIME
       PDSZDS(ISU,IZ,11)=PDSZDS(ISU,IZ,11)*TEMP3
C....  FIND RUNNING VALUE OF PROBABILITY OF NON DETECTION
C....  PGSDT = PROB(NO SENSOR OF ANY TYPE ACQUIRES A PARTICULAR TARGETI
       TJCI=PGSDT(ISU,IZ,11I
       IF(TJCI.EQ.0.IGOTO 24D1
       TJCI=TJCI*TEMP2
       IF(TJCI.LT.1.E-10ITJCI=0.
       PGSDT(ISU,IZ,11I=TJCI
 24D1  CONTINUE
       DO 27 IRBST=1,NN
       IF(RANGE.LE.VHRBST(IRBST,L)I GO TO 28
   27  CONTINUE
       IRBST=NN                                                      I JC1001
C.....TAESZD AND TADSZD CONTAIN INTERMEDIATE CALCULATIONS FOR SENSOR
C        ERROR AND DELAY TIME
   28  TAESZDI(ISU,IZ,11) = TAESZD(ISU,IZ,11) + (TEMP3*TACGSR(IGS,
      * IRBST,LII**2
       TADSZD(ISU,IZ,11)=TADSZD(ISU,IZ,11)+TEMP3*(TADTGS(IGS,LI*COMD)
       IF(IIPRD.EQ.0) GO TO 25
       WRITE(JNUC,32DI DINTEG,RANGE
       WRITE(JNUC,33DI IGS,IL1,ISU,IZ,IL2
       WRITE(JNUC,20DI PASDT,TEMP3
   25  CONTINUE
       DY=DY*(PZDPTH(IZ,III*DVDPTH(IT2)/2.)
   26  CONTINUE
   3D  CONTINUE
       IF(IIPRD.EQ.0) GO TO 31
```

```
C
C------------------------------------------------------------------------
C300) TARGET ACQUISITION BY ARMY-AIR SENSORS
C------------------------------------------------------------------------
C
C.... COMPUTE DETECTION PROB FOR EACH SENSOR TYPE(IAS) ON EACH TYPE
C        ARMY-AIR CARRIER(IAC) ON EACH MISSION(IM=1 STANDOFF, =2 PENETRA-
C        TING) VS EACH TYPE SUBUNIT(ISU) IN EACH ZONE(IZ) OF EACH TARGET
C        DIVISION(IDS)
      N7=NAAC(L)
      N3=NAS(L)
      N6=NDS(JS,I)
      CEIT = CEITWZ(ITT,IWZ)
      VIST=VISTWZ(ITT,IWZ)/1000.
      CCCD=SEQPD(JS,L)                                              ) JCI001
      CALL CVFW(NAAFO(L),XAAFO(I,L),YAAFO(I,LI,CCCD,COMO)           I JCI001
C
C.... ITERATE FOR EACH DIVISION
      DO 80 IDS=1,N6
      JDS=IDS
      IF(II.EQ.2) JDS=JDS+NDS(JS,L)
      IL2=IDLABA(JDS,JS)
      IT2=ITD(IL2)
C
C.... ITERATE FOR EACH TYPE OF ARMY AIRCRAFT
      DO 77 IAAC=1,N7
C.... PC = PROB(CEILING > SENSOR ALTITUDE)
      PC=0.
      IF(AMOAAC(IAAC,L).LE.CEIT) PC=1.
C.... DSX = HORIZONTAL DISTANCE, SENSORS TO TARGET EDGE
      DSX=FDWLAC(IAAC,L)*DVWDTH(IT2)
C
C.... ITERATE OVER MODEL TYPE. IM=1 IS STANDOFF MOVING
C        IM=2 IS FORWARD AREA. 2M=3 IS DEEP AREA WHICH DOES NOT
C        APPLY TO DIVISIONS IN THE ACTIVE BATTLE AREA.
      DO 78 IM=1,2
C.... ASCP = NO. OPERATIONAL ARMY-AIR CARRIERS ON MISSION IM
      ASCP=(AACS(IAAC,JS,L)+AACDS(IAAC,JS,L))*(1-FRAACI(IAAC,L))*
     *                                        PAACAM(IAAC,IM,L)
C.... ASCD IS NUMBER OF AAC AVAILABLE ASSUME I SORTIE/CYCLE
C        ADJUST VALUES BY THE VARIABLE RAASDT   ARMY AIRCRAFT
C        HAVE ALREADY BEEN ATTRITED
C.... UPDATE RESULTS
C.... PASDT = PROB(PARTIC SENSOR ACQUIRES PARTIC TARGET - GLIMPSE)
      PASDT = 1. - (1.-POGE)**(GLPAS(IAS,L)*TACL)
C.... TEMP2 = PROB(NO TYPE IAS SENSOR ACQUIRES A PARTICULAR  TARGET)
   68 TEMP2=(1.-PASDTI**TEMP)
      IF(TEMP2.LT.1.E-10)TEMP2=0.                                  I JCID01
C.... TEMP3 = PROB(AT LEAST I IAS SENSOR ACQUIRES A PARTICULAR TARGET)
      TEMP3=1.-TEMP2
      POSZOS(ISU,IZ,JOS)=POSZOS(ISU,IZ,JOS)+TEMP3
      TJCI=PGSDT(ISU,IZ,JDS)
      IF(TJCI.EQ.0.)GOTO 6801
      TJCI=TJCI*TEMP2
      IF(TJCI.LT.1.E-1D)TJCI=0.
      PGSDT(ISU,IZ,JDS)=TJCI
 6801 DO 71 IRBST=1,NN
      IF(RANGE.LE.VHRBST(IRBST,LI) GO TO 72
   71 CONTINUE
      IRBST=NN                                                     I JCI001
   72 TAESZO(ISU,IZ,JOS) = TAESZO(ISU,IZ,JDS) + (TEMP3*TACASR(IAS,
C
C
C------------------------------------------------------------------------
C400) TARGET ACQUISITION BY AIR FORCE SENSORS
C------------------------------------------------------------------------
C
C.... COMPUTE DETECTION PROB FOR EACH SENSOR TYPE(IAFS) ON RECON A/C ON
C        EACH MISSION(IM) VS EACH SUBUNIT TYPE(ISU) IN EACH ZONE(IZ) OF
C        EACH TARGET DIVISION(IDS)
      NRI=1                                                        I JCI001
      NR2=NR(1)                                                    I JCI001
```

APPENDIX A

```
        IFIL.EQ.1)GOTO 809                                          I JC1001
        NR1=NRII)+1                                                  I JC1001
        NR2=NRI1)+NR(2)                                              I JC1001
809     DO 810 IRR=NR1,NR2                                           I JC1001
        IFIJS.GE.NHSRIIRR))GOTO 811                                  I JC1001
810     CONTINUE                                                     I JC1001
        IRR=1                                                        I JC1001
811     NR1=NLSRIIRRI                                                ) JC1001
        NR2=NHSRIIRR)                                                I JC1001
        CCCD=D.                                                      I JC1001
        DO 812 IRR=NR1,NR2                                           I JC1001
812     CCCD=CCCD+SEGPD(IRR,L)                                       I JC1001
        CCCD=CCCD/ INR2-NRI+1)                                       I JC1001
        CALL CVFWINAFFDIL),XAFFD(I,L),YAFFD(1,L),CCCD,COMD)          I JC1001
        N3=NAFS(L)
C....  PC = PROB(CEILING > SENSOR ALTI
        PC=D.
        IFIAMORACIL).LE.CEITI PC=1.
        DO 95 IDS=1,N6
        JDS=IDS
        IFIII.EQ.2) JDS=JDS+NDS(JS,L)
        IL2=IDLABA(JDS,JS)
        IT2=ITDIIL2)
C....  DSX = HORIZONTAL DISTANCE, SENSORS TO TARGET
        DSX=FDWLRAIL)+DVWDTHIIT2I
        DU 94 IM=1,2
        IF(RACAM(JS,IM,L).LT..DDD1) GO TO 94
C
C....  AVAILABILITY HAS BEEN ACCOUNTED FOR IN COMPUTING NUMBER OF
C        MISSION, RACAM.  ATTRITION FOR PREVIOUS CYCLE IS NOT IN RACAM
C        SO AN ATTRITION TERM IS NEEDED
C....  TEMP = NO. OF RECON A/C
        TEMP=RACAM(JS,IM,L)*(1.-RAAFRMIIM,L)+FRLPMA(IM,L))*SRRAC(L)/FNNSC
C
C....  PROCEED IN A MANNER EXACTLY ANALGOUS TO THE PREVIOUS SECTION
        DU 93 )AFS=),N3
        DY = D.
        IF(IM .EQ. 2) DY = DRAFT(L)
C....  TEMPI = NO. OF SENSORS PER TARGET DIVISIUN


C....  PASDT = PRUBIPARTIC SENSOR ACQUIRES PARTIC TARGET - GLIMPSEI
        PASDT=1.-(1.-PDGE)**IGLPAFS(IAFS,LI+TACLI
     BB TEMP2=(1.-PASDT)**TEMPI
        IFITEMP2.LT.1.E-10)TEMP2=0.                                  I JC1001
        TEMP3=1.-TEMP2
        PDSZDSIISU,IZ,JDS)=PDSZDS(ISU,IZ,JDSI+TEMP3
        TJCI=PGSDTIISU,IZ,JDS)
        IF(TJCI.EQ.0.)GOTU B801
        TJC)=TJC)+TEMP2
        IFITJCI.LT.1.E-10)TJCI=0.
        PGSDTIISU,IZ,JDS)=TJC)
8801    DO 91 )RBST=1,NN
        IFIRANGE.LE.VHRBSTIIRBST,L)) GO TO 92
     91 CONTINUE
        IRBST=NN.                                                    I JC1001
     92 TAESZD(ISU,IZ,JDS) = TAESZD(ISU,IZ,JDS)+(TEMP3*TACAFR(IAFS,IRBST,
      * L))**2
        TADSZDIISU,IZ,JDS)=TADSZD(ISU,IZ,JDS)+TEMP3*(TADTAF(IAFS,L)+COMD)




        SUBROUTINE TADPAR
C
C*********************************************************************
C      TADPAR SIMULATES ACQUISITION OF TARGETS TO THE REAR OF THE ACTIVE
C        BATTLE AREA BY ARMY-AIR AND AIR FORCE SENSORS
C      CALLED BY TARACO
C*********************************************************************
C
```

```
      REAL NSUTD,NISUDT,INIDA,INTDE,INTDS
C●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●
      COMMON/888/
C●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●●
      COMMON/TNFSC1/INABF(8,2),INABR(8,2),INABZ(2)                      I JCI001
      COMMON/TNFSC2/NC3SD(2),XC3SD(8,2),YC3SD(8,2),                     I JCI001
     ●              FDDSAD(8,2),FSOSAD(8,2),FTDSAD(8,2),                I JCI001
     ●              FABDCC(2),ABSFCC(8,2),ABSRCC(8,2),ABCZCC(2),        I JCI001
     ●              FSSMCC(2),TSSMIR(8,2),SSSMIM(8,2),SSSMIL(8,2),      I JCI001
     ●              FSAMCC(2),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2)         I JCI001
      COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),                     I JCI001
     ●              NCOMD(2),XCOMD(8,2),YCOMD(8,2),                     I JCI001
     ●              FCLWL(10,2)                                         I JCI001
      COMMON/TNFSC4/NFDLY(2),XEDLY(8,2),YEDLY(8,2,2),                   I JCI001
     ●              JESC(8,3,2),IWAUT(8,2),IFPLS(8,2),                  I JCI001
     ●              TEQPD(2),SEQPD(8,2),CTIME(8,2)                      I JCI001
      COMMON/TNFSC5/NGSFD(2),XGSFD(8,2),YGSFD(8,2),                     I JCI001
     ●              NAAFD(2),XAAFD(8,2),YAAFD(8,2),                     ) JCI001
     ●              NAFFD(2),XAFFD(8,2),YAFFD(8,2)                      I JCI001
      COMMON/LOCAL3/ JS
C
C     THESE ARE WORKING VARIABLES TARGET ACQUISTION NEEDS ONLY.
      COMMON /TACQ/ VISTWZ(40,11),CEITWZ(40,11),RVLOST(6),
     1              IWZBA(112), KTERTA(112)
C     TARGET ACQUISITION DEEP AREA DETECTION ROUTINE.
      DIMENSION  PDAASS(4,7), PDAFSS(4,7),ASIDE(2)
      DATA ASIDE/'BLUE','RED '/                                        I JCI001
      IF(IUTAM.EQ.1) GO TO 20
C
C-----------------------------------------------------------------------
C(100) DETECTION PROBABILITY, SENSOR ERROR AND DELAY TIME ARE USER INPUT
C      (TARGET ACQUISITION MODEL NOT USED)
C-----------------------------------------------------------------------
      DO 15 L=1,2
      NI=NSU(L)
      )=NZ(L)
      DO 10 ISU=1,NI
      PSRADS(ISU,L)=PSZD(ISU,I,L)
      TAESRA(ISU,L)=TASESZ(I,L)
      TADSRA(ISU,L)=TADTSZ(I,L)
   10 CONTINUE
   15 CONTINUE
      RETURN
C
C-----------------------------------------------------------------------
C(200) INITIALIZE WORKING VARIABLES
C-----------------------------------------------------------------------
   20 FNNSC=1.
      IND=JNUC                                                         I JCI001
      IF(IPRS.NE.0)WRITE(IND,100)ICYCLE,JS                             I JCI001
      DO 80  L=1,2
C
C
      IF(RACAM(JS,3,L).LT..0001) GO TO 65
C     RACP = NO. RECON A/C ON DEEP SEARCH
      RACP=RACAM(JS,3,L)●(1.-RAAFRM(3,L)●FRLPMA(3,L))●SRRAC(L)/FNNSC
      DO 60 IAFS=1,N4
      TEMP1=RACP●PRAFSM(IAFS,3,L)/MDIVO
      IF(TEMP1.LE..0001) GO TO 60
      DO 50 ISU=1,N3
      TEMP=SWAFDS(IAFS,ISU,L)●VELRAC(L)●TAFSSD(IAFS,L)/OAREA
      PASDT=1.-EXP(-TEMP)
      TEMP2=(1.-PASDT)●●TEMP1
      PDAFSS(IAFS,ISU)=1.-TEMP2
      PSRADS(ISU,K)=PSRADS(ISU,K)●TEMP2
   50 CONTINUE
   60 CONTINUE
   65 CONTINUE
C
C
C     SUMMARIZE AND NORMALIZE RESULTS IN SAME FASHION AS IN TARACA
C
```

```
        CCCD=SEQPD(JS,L)                                              I JCI001
        CALL CVFW(NAAFD(L),XAAFD(1,L),YAAFD(1,L),CCCD,COMDAA)         I JCI001
        NR1=1                                                         I JCI001
        NR2=NR(1)                                                     I JCI001
        IF(L.EQ.1)GOTO 809                                            ) JCI001
        NR1=NR(1)+1                                                   ) JCI001
        NR2=NR(1)+NR(2)                                               I JCI001
809     DO 810 IRR=NR1,NR2                                            1 JCI001
        IF(JS.GE.NHSR(IRR))GOTO 811                                   I JCI001
810     CONTINUE                                                      I JCI001
        IRR=1                                                         I JCI001
811     NR1=NLSR(IRR)                                                 ) JCI001
        NR2=NHSR(IRR)                                                 ) JCI001
        CCCD=0.                                                       I JCI001
        DO 812 IRR=NR1,NR2                                            ) JCI001
812     CCCD=CCCD+SEQPD(IRR,L)                                        I JCI001
        CCCD=CCCD/(NR2-NR1+1)                                         ) JCI001
        CALL CVFW(NAFFD(L),XAFFD(1,L),YAFFD(1,L),CCCD,COMDAFI         I JCI001
        DO 70 ISU=1,N3
        TSENSR=0.
        DO 66 IAS=1,N2
        TSENSR=TSENSR+PDAASS(IAS,ISU)
     66 CONTINUE
        DO 67 IAFS=1,N4
        TSENSR=TSENSR+PDAFSS(IAFS,ISU)
     67 CONTINUE
        DO 68 IAS=1,N2
        IF(TSENSR.EQ.0.) GO TO 68
        PDAASS(IAS,ISU)=PDAASS(IAS,ISU)/TSENSR
        TAESRA(ISU,K)=TAESRA(ISU,K)+(PDAASS(IAS,ISU)*SEAADA(IAS,L))**2.
        TADSRA(ISU,K)=TADSRA(ISU,K)+PDAASS(IAS,ISU)*(TADTAS(IAS,L)+COMDAA)
     68 CONTINUE
        DO 69 IAFS=1,N4
        IF(TSENSR.EQ.0.) GO TO 69
        PDAFSS(IAFS,ISU)=PDAFSS(IAFS,ISU)/TSENSR
        TAESRA(ISU,K)=TAESRA(ISU,K)+(PDAFSS(IAFS,ISU)*SEAFDA(IAFS,L))**2.
        TADSRA(ISU,K)=TADSRA(ISU,K)+PDAFSS(IAFS,ISU)*(TADTAF(IAFS,L)+
      *                 COMDAF)                                       ) JCI001
     69 CONTINUE
```

A-5. INPUT AND MAIN CONTROL

This section completely lists subroutine TMAIN, which controls the
overall flow of the TACWAR combat simulation, and subroutine TNFINP,
which controls the C^3/D input data to TACWAR.

```
        SUBROUTINE TMAIN
C
C* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C     TMAIN SETS UP A CYCLE COUNTER WHICH CONTROLS INTERMITTANT MODEL
C     FUNCTIONS. TMAIN ACTIVATES  AIR,NUCLEAR,CHEMICAL,TARGET ACQUISITON
C        GROUND,SUPPLIES AND THEATER CONTROL MODELS.
C     CALLED BY NMAIN. CALLS MSREAD AND APORTN.
C* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
        DIMENSION ARST(5)
        DATA ARST/4HSTRE,4HNTST,4HRENT,4HSTRE,4HNT  /
        COMMON /RSTRT/ NRSTRT(3)
        REAL NSUTD,NTSUOT,INTDA,INTDE,INTDS
*************************************************************************
        COMMON/BBB/
*************************************************************************
```

```
      COMMON/TNFSC2/NC3SO(2),XC3SO(8,2),YC3SO(8,2),                    ) JCI001
     *            FOOSAD(8,2),FSDSAO(8,2),FTDSAO(8,2),                 I JCI001
     *            FABDCC(2),ABSFCC(8,2),ABSRCC(8,2),ABCZCC(2),         I JCI001
     *            FSSMCC(2),TSSMIR(8,2),SSSMIM(8,2),SSSMIL(8,2),       I JCI001
     *            FSAMCC(2),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2)          I JCI001
      COMMON/TNFSC3/NC3DD(2),XC3OO(8,2),YC3DD(8,2),                    I JCI001
     *            NCOMD(2),XCOMO(8,2),YCOMD(8,2),                      I JCI001
     *            FCLWL(10,2)                                          I JCI001
C
      REAL*8 NAMES(16),QNAME                                          I JCI001
      INTEGER IPRINT(16),ICHNUC(2,2),IZZ1,IZZ2,IZZ3                   I JCI001
      OATA NAMES/'QAPORT  ','QPSAIR  ','QPSUMY  ','QAIRMO  ','QCHEM   ',I JCI001
     *           'QNUC    ','QTARAQ  ','QGND    ','OAIRGO  ','QTC     ',I JCI001
     *           'OSUPLY  ','QTIMET  ','QWRRST  ','QTNFIN  ','QDSDEG  ',) JCI001
     *           'QNUCCO  '/                                           I JCI001
      OATA IPRINT/16*7/, ICHNUC/4*7/                                  ) JCI001
100   FORMAT(10X,20I3)                                                I JCI001
101   FORMAT(A8,2X,3(I1,4XI)                                          I JCI001
C- - - - - - - - - - - - - - - - - - - - - - - - - -
C  10) INITIALIZATION
C- - - - - - - - - - - - - - - - - - - - - - - - - -
C
      IRST=17
      MOT=JCON
      REAO(5,100,ENO=25)NCYCLE,NNSC                                    1 JCI001
      REAO(5,100,END=25)IPROO                                          I JCI001
      REAO(5,100,END=25)()PRSO(I),I=1,20)                              I JCI001
      REAO(5,100,END=25))OMU                                           I JCI001
21    REAO(5,101,ENO=25)QNAME,IZZ1,IZZ2,IZZ3                          I JCI001
      DO 22 )=1,I6                                                     ) JCI001
      )F(QNAME.NE.NAMES()))GOTO 22                                     I JC)001
      IPRINT(I)=IZZI                                                   I JC)001
      IF(QNAME.NE.NAMES(5).ANO.QNAME.NE.NAMES(6))GOTO 21              I JCI001
      ICHNUC(1,I-4)=IZZ2                                               I JCI001
      )CHNUC(2,)-4I=IZZ3                                               I JCI001
      GOTO 21                                                          I JCI001
22    CONTINUE                                                         ) JCI001
C                                                                      ) JCI001
      JCON=IPRINT(14)                                                  ) JCI001
      CALL TNF)NP                                                      ) JCI001
C                                                                      I JCI001
  25 CONTINUE
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     ALLOCATE NOTIONAL AIRBASE TO REAL AIRBASES UNLESS THIS IS A
C       RESTART RUN.
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      IF(NRSTRT(1).GT.1) GO TO 10
      JCON=)PRINT(1)                                                   1 JCI001
      CALL APORTN(1)
  10 CONTINUE
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     PRINT TABLES FOR CYCLE PRECEEOING START OF GAME.
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      ICYCLE=0
      IF(NRSTRT(1).GT.1) ICYCLE=NRSTRT(3)*2-1
      JSUM=IPRINT(2)                                                   I JCI001
      CALL PSAIR
      JSUM=IPRINT(3)                                                   I JC)001
      CALL PSUMMY
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     SET GAME CYCLE COUNTER. INITIALIZE MAJOR SUPPLY CYCLE
C       COUNTER TO NCSM = NO. COMBAT CYCLES IN A MAJOR SUPPLY CYCLE.
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
```

APPENDIX A

```
   11 IIFLAG = 0
      IF(NRSTRT(1).GT.1) GO TO 900
      GO TO 901
  900 IIFLAG = 1
      ICYCLE = NRSTRT(3) * 2
      GO TO 902
  901 ICYCLE = 1
  902 CONTINUE
      ICSM=NCSM
      IF(NCSM.LE.0) GO TO 904
  903 IF(ICSM.GE.ICYCLE) GO TO 904
      ICSM = ICSM + NCSM
      GO TO 903
  904 CONTINUE
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C 201  EXECUTE AIR MODEL
C      STATEMENT 1000 IS THE STARTING POINT FOR CALCULATIONS EACH CYCLE.
C      BEGIN BY SETTING PRINT FLAG IPRD=1 (PRINT) IF CYCLE IN ARRAY IPRDD
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      IF (NRSTRT(2).EQ.1.AND.IIFLAG.EQ.1) GO TO 1015
 1000 DO 1010 II=1,5
      IF(ICYCLE.EQ.IPRDD(II)) GO TO 1015
      IF(ICYCLE.LT.IPRDD(II)) GO TO 1020
 1010 CONTINUE
      GO TO 1020
 1015 IPRD=1
      GO TO 1025
 1020 IPRD=0
 1025 CONTINUE
      IF(ICMU.EQ.7) GO TO 1021
      JCON=IPRINT(4)                                          I JC1001
      CALL AIRMOD


C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C 30)  EXECUTE NUCLEAR AND CHEMICAL MODELS
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C      ARE NUCLEAR AND CHEMICAL WEAPONS CONSIDERED ?
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      IF(ICMU.EQ.5) GO TO 700
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C      ALLOCATE NOTIONAL AIRBASES TO REAL AIRBASES
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JCON=IPRINT(11)                                         I JC1001
      CALL APORTN(1)
 1021 CONTINUE
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C      FOR NNSC SUBCYLES
C        SET FLAG AND CALL NUC AND CHEM FOR DETERMINING ESCALATION
C        STATE AND CHEMICAL EMPLOYMENT LEVEL
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      NITC=3
      KNUCH=0
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C      SET IPRS FOR SUMMARY OUTPUT
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      IPRS=0
      DO 1 II=1,30
      IF(ICYCLE.EQ.IPRSD(II)) GO TO 2
      IF(ICYCLE.LT.IPRSD(II)) GO TO 3
```

64

```
      1 CONTINUE
        GO TO 3
      2 IPRS=1
      3 IF(ICYCLE.EQ.1.OR.ICYCLE.EQ.NCYCLE) IPRS=1
        IF (IIFLAG.EQ.1) IPRS = 1
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     BEGIN CALCULATIONS FOR EACH SUBCYCLE  INCYL
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
        DO 600 INCYL=1,NNSC
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     IF NO CHEM OR NUC WEAPONS USED AFTER FIRST SUBCYCLE,LEAVE DO-LOOP.
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
CJC1  IF(INCYL.GT.1.AND.KNUCH.EQ.0) GO TO 700                    C JC1001
        KFLAG=1
        KISS=0
C                                                                1 JC1001
        JCON=IPRINT(16)                                          1 JC1001
        CALL NUCCCO                                              1 JC1001
C                                                                1 JC1001
        JCON=IPRINT(15)                                          1 JC1001
        CALL OSOEG                                               1 JC1001


C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     IF CHEM WEAPONS ARE TO BE PLAYED CHEM DETERMINES CHEMICAL
C       EMPLOYMENT LEVEL AND INITIALIZES CHEMICAL MODEL
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
        IF(IOMU.EQ.3.OR.IOMU.EQ.5) GO TO 12
        JCHEM=IPRINT(5)                                          1 JC1001
        CALL CHEM
        KFLAG=1
        KISS=0
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     IF NUC WEAPONS ARE TO BE PLAYED NUC DETERMINES ESCALATION
C       STATE AND INITIALIZES NUCLEAR MODEL
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
     12 IF(IOMU.EQ.4.OR.IOMU.EQ.5) GO TO 13
        JNUC=IPRINT(6)                                           I JC1001
        CALL NUC
     13 KFLAG = 0
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     BEGIN NUC AND CHEM CALCULATIONS FOR EACH SECTOR KISS = IS.
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
        DO 500 IS=1,NS
        KISS=IS
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     DETERMINE IF THIS SECTOR HAS A POSITIVE ESCALATION STATE
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
        DO 310 L=1,2
        DO 310 ITC=1,NITC
        IF(IESC(IS,ITC,L).GT.0) GO TO 320
    310 CONTINUE
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     NO USE OF NUCLEAR WEAPONS IN THIS SECTOR
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
        KNUC=0
        GO TO 350
```

APPENDIX A

```
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     NUCLEAR WEAPON ARE TO BE USED
C
C     KNUCH INDICATES NUCLEAR OR CHEMICAL WEAPON USE
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
  320 KNUC=1
      KNUCH=KNUCH+1
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     DETERMINE IF THIS SECTOR HAS A POSITIVE EMPLOYMENT LEVEL
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
  350 CONTINUE
      DO 360 L=1,2

      DO 360 ITC=1,NITC
      IF(IEML(IS,ITC,L).GT.0) GO TO 370
  360 CONTINUE
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     NO USE OF CHEMICAL WEAPONS IN THIS SECTOR
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      KCHEM=0
      GO TO 400
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     CHEMICAL WEAPONS ARE TO BE USED
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
  370 KCHEM=1
      KNUCH=KNUCH+1
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     IF THE ESCALATION STATE OR THE EMPLOYMENT LEVEL WAS POSITIVE
C        CONDUCT TARGET ACQUISITION IF NOT GO TO NEXT SECTOR
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
  400 CONTINUE
      IF(INCYL.GT.1) GO TO 405
      KIPRD=IPRD                                               C JCI001
CJCI  IPRD=0
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     TARACQ PERFORMS TARGET ACQUISITION CALCULATIONS
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JNUC=IPRINT(7)                                           I JCI001
      CALL TARACQ
      IPRD=KIPRD
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     DETERMINE ORDER OF USE OF WEAPONS
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
  405 CONTINUE
      IF(KNUC.EQ.0. AND. KCHEM.EQ.0) GO TO 500
      IF(IOMU.EQ.1.OR.IOMU.EQ.3.OR.IOMU.GE.6) GO TO 410
      GO TO 460
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     NUCLEAR WEAPONS ARE USED FIRST IF ALLOWED
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
  410 CONTINUE
      IF(KNUC.EQ.0) GO TO 420
```

```
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     NUC PERFORMS NUCLEAR DAMAGE CALCULATIONS IN SECTOR KISS
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JNUC=ICHNUC(1,2)                                            I JCI001
      CALL NUC
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     ARE CHEMICAL WEAPONS USED IN ADDITION TO NUCLEAR WEAPONS ?
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
  420 CONTINUE
      IF(IDMU.EQ.3) GO TO 500
      IF(KCHEM.EQ.0) GO TO 500
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     CHEM PERFORMS CHEMICAL DAMAGE CALCULATIONS IN SECTOR KISS
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JCHEM=ICHNUC(1,1)                                           I JCI001
      CALL CHEM
      GO TO 500
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     CHEMICAL WEAPONS ARE USED FIRST IF ALLOWED
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
  460 CONTINUE
      IF(KCHEM.EQ.0) GO TO 470
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     ADDITIONAL CHEMICAL DAMAGE CALCULATIONS BY CHEM
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JCHEM=ICHNUC(1,1)                                           I JCI001
      CALL CHEM
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     ARE NUCLEAR WEAPONS USED IN ADDITION TO CHEMICAL WEAPONS ?
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
  470 CONTINUE
      IF(IDMU.EQ.4) GO TO 500
      IF(KNUC.EQ.0) GO TO 500
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     ADDITIONAL NUCLEAR DAMAGE CALCULATIONS BY NUC
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JNUC=ICHNUC(1,2)                                            I JCI001
      CALL NUC
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     END OF DO-LOOP ON SECTOR IS = KISS
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
  500 CONTINUE
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     END OF DO-LOOP ON SUBCYCLE INCYL
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
C                                                                I JCI001
  600 CONTINUE
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     NUCLEAR AND CHEMICAL DAMAGE CALCS. FINISHED FOR THIS CYCLE
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

APPENDIX A

```
C
      IF(IOMU.EQ.7) GO TO 1022
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     ALLOCATE REAL AIRBASES TO NOTIONAL AIRBASES
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JCON=IPRINT(1)                                                     I JCI00I
      CALL APORTN(2)
 1022 CONTINUE
  700 CONTINUE
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C 40) EXECUTE REMAINING PARTS OF TACWAR MODEL FOR THIS CYCLE
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     GROUND PERFORMS GROUND COMBAT CALCULATIONS
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      IF(IOMU.GE.6) GO TO 1041
      JCON=IPRINT(8)                                                     I JCI00I
      CALL GROUND
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     AIRGRO PERFORMS AIR-GROUND CALCULATIONS
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JCON=IPRINT(9)                                                     I JCI00I
      CALL AIRGRD
 1041 CONTINUE
      IF (IIFLAG.EQ.II) GO TO 1026
      IF(ICYCLE.EQ.I.OR.ICYCLE.EQ.NCYCLE) GO TO 1026
      IF(IPRD.EQ.I)GO TO 1026
      DO 1027 II=1,30
      IF(ICYCLE.EQ.IPRSD(II)) GO TO 1026
      IF(ICYCLE.LT.IPRSO(II)) GO TO 1028
 1027 CONTINUE
      GO TO I028
 1026 CONTINUE
      IF(IOMU.EQ.7I GO TO 1028
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     PSAIR PRINTS AIR-GROUNO SUMMARY, AS REQUIRED
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JSUM=IPRINT(2)                                                     I JCI00I
      CALL PSAIR
 1028 CONTINUE
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     .IF ICYCLE NOT LAST CYCLE IN GAME, SET FLAGS FOR CALLS TO NUC AND
C     CHEM TO CALCULATE NUCLEAR ESCALATION STATE ANO CHEM EMPLYHT LEVEL
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      KFLAG=2
      KISS=0
      INCYL=0
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
C     NUC DETERMINES NUCLEAR ESCALATION STATE IF NUC WEAPONS ARE PLAYED
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      IF(IOMU.EQ.3.OR.IOMU.EQ.5) GO TO 14
      JCHEM=ICHNUC(2,1)                                                  I JCI00I
      CALL CHEM
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C     CHEM OETERMINES CHEMICAL EMPLOYMENT LEVEL IF CHEM WEAPONS PLAYEO.
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
```

```
   14 IF(IOMU.EQ.4.OR.IOMU.EQ.5) GO TO 15
      JNUC=ICHNUC(2,2)                                              ) JC(001
      CALL NUC
   15 KFLAG = 0
      (F((OMU.GE.6) GO TO 1090
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C    TC PERFORMS THEATER CONTROL AND BOOKKEEPING CALCULATIONS
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JCON=IPRINT(10)                                               ( JCI001
      CALL TC
      IF(ICYCLE.NE.ICSM( GO TO 1030
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C    FOR MAJOR RESUPPLY CYCLE, SUBROUTINE SUPPLY MAKES SUPPLY
C      MODEL CALCULATIONS
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JCON=(PRINT(11)                                               I JC1001
      CALL SUPPLY
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C    INCREMENT NEXT MAJOR RESUPPLY CYCLE
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      ICSM=ICSM+NCSM
 1030 IF (ICYCLE .NE. .2*IGO) GO TO 16
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C    TIMET READS INPUTS IF TIME-T VARIABLES ARE TO BE INPUT THIS CYCLE
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JCON=)PRINT(12)                                               ) JC)001
      CALL TIMET
   16 (F((((FLAG.EQ.1) GO TO 1040
      IF)(CYCLE.EQ.I.OR.ICYCLE.EQ.NCYCLE) GO TO 1040
      IF )(PRD.EQ.1) GO TO 1040
      DO 1035 II=1,30
      (F((ICYCLE.EO.)PRSO((I)) GO TO 1040
      IF((CYCLE.LT.(PRSO(II)) GO TO 1090
 1035 CONTINUE
      GO TO 1090
 1040 CONTINUE
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C    PSUMMY PRINTS SUMMARY TABLES FOR GROUND AND THEATER
C      CONTROL VARIABLES
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
      JSUM=(PRINT)3(                                                I JC1001
      CALL PSUMMY
      IIFLAG = 0
C
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C    CHECK TO DETERMINE IF THIS TACWAR RUN WILL CREATE
C      RESTART FILE. IF SO, COPY BLANK COMMON FOR EACH
C      COMBAT DAY TO THE OUTPUT RESTART FILE. (IRST = 17)
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
 1090 IF)NRSTRT(1).EQ.1.OR.NRSTRT(1).EQ.3) GO TO 1050
      GO TO 1055
 1050 IF (MOD(ICYCLE,2I.EQ.0) GO TO 1055
      NDAY = )ICYCLE + 1) / 2
      WRITE ((RST,1051)  ARST, NDAY
 1051 FORMAT(1X,A18,(4I
      JCON=IPR(NT)13(                                               I JC)001
      CALL WRRST((RST(
 1055 CONTINUE
C
```

APPENDIX A

```
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C      END OF CALCULATIONS FOR THIS CYCLE. STOP IF LAST (NCYCLE) CYCLE;
C      OTHERWISE, INCREMENT ICYCLE ANO BEGIN CALCULATIONS FOR NEW CYCLE.
C- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
C
       IF (ICYCLE.GE.NCYCLE) GO TO 1099
       ICYCLE=ICYCLE+1
       GO TO 1000
C
C
 1099 IF(NRSTRT(1).EQ.1.OR.NRSTRT(1).EQ.3) REWIND IRST
       RETURN
       ENO
```

```
       SUBROUTINE TNFINP                                                  I JCI00I
C                                                                         I JCI00I
C      TNFINP READS IN DATA ASSOCIATED WITH CCC DEGRADATION OF NUCLEAR    I JCI00I
C      RESOURCES                                                          I JCI00I
C                                                                         I JCI00I
       REAL NSUID,NTSUDT,INTOA,INTDE,INTDS                                I JCI00I
**********************************************************************************************
       COMMON/BB8/
**********************************************************************************************
       COMMON/TNFSC1/INABF(8,2),INABR(8,2),INABZ(2)                       I JCI00I
       COMMON/TNFSC2/NC3SO(2),XC3SD(8,2),YC3SO(8,2),                      I JCI00I
      *             FODSAO(8,2),FSDSAD(8,2),FTDSAD(8,2),                  I JCI00I
      *             FABDCC(2),ABSFCC(8,2),ABSRCC(8,2),ABCZCC(2),          I JCI00I
      *             FSSMCC(2),TSSMIR(8,2),SSSMIM(8,2),SSSMIL(8,2),        I JCI00I
      *             FSAMCC(2),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2)           I JCI00I
       COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),                      I JCI00I
      *             NCOMD(2),XCDMD(8,2),YCDMD(8,2),                       I JCI00I
      *             FCLWL(10,2)                                           I JCI00I
       COMMON/TNFSC4/NEDLY(2),XEOLY(8,2),YEOLY(8,2,2),                    I JCI00I
      *             JESC(8,3,2),IWAUT(8,2),IFPLS(8,2),                    I JCI00I
      *             TEQPD(2),SEQPD(8,2),CTIME(8,2)                        I JCI00I
       COMMON/TNFSC5/NGSFD(2),XGSFD(8,2),YGSFD(8,2),                      I JCI00I
      *             NAAFO(2),XAAFO(8,2),YAAFO(8,2),                       I JCI00I
      *             NAFFD(2),XAFFD(8,2),YAFFO(8,2)                        I JCI00I
       REAL*8 APARM(31)                                                   I JCI00I
       DATA APARM/'NC300   ','XC30D   ','YC300   ','NCUMO   ','XCOMO   ', I JCI00I
      *           'YCUMO   ','FCLWL   ','NC3SO   ','XC3SO   ','YC3SO   ', I JCI00I
      *           'FABDCC  ','FSSMCC  ','FSAMCC  ','TSSMIR  ','SSSMIN  ', I JCI00I
      *           'SSSMIL  ','TSAMIR  ','TSAMIZ  ','SSAMIF  ','NEOLY   ', I JCI00I
      *           'XEOLY   ','YEOLY   ','NGSFO   ','XGSFO   ','YGSFO   ', I JCI00I
      *           'NAAFO   ','XAAFO   ','YAAFO   ','NAFFD   ','XAFFD   ', I JCI00I
      *           'YAFFO   '/                                             I JCI00I
       DIMENSION ASIOE(2)                                                 I JCI00I
       DATA ASIDE/'BLUE','RED '/                                          I JCI00I
100    FORMAT(10X,20I3)                                                   I JCI00I
101    FORMAT(1X,A6,10(3X,I4))                                           I JCI00I
102    FORMAT(10X,10F6.0)                                                I JCI00I
103    FORMAT(1X,A6,10(3X,F8.3))                                         I JCI00I
104    FORMAT('0  INITIAL TNFS VALUES FOR ',A4,' SIDE')                  I JCI00I
105    FORMAT(1X,'NORMALIZED VALUES FOR FCLWL')                          I JCI00I
       MOT=JCON                                                           I JCI00I
       DO 30 L=1,2                                                        I JCI00I
       READ(5,100)                                                       I JCI00I
       WRITE(MOT,104)ASIDE(L)                                            I JCI00I
       READ(5,100,END=25,ERR=28)NC300(L)                                I JCI00I
       WRITE(MOT,101)APARM(1),NC300(L)                                   I JCI00I
       NN=NC3D0(L)                                                       I JCI00I
       READ(5,102,END=25,ERR=28)(XC300(I,L),I=1,NN)                     I JCI00I
       WRITE(MOT,103)APARM(2),(XC300(I,L),I=1,NN)                        I JCI00I
       READ(5,102,END=25,ERR=28)(YC300(I,L),I=1,NN)                     I JCI00I
       WRITE(MOT,103)APARM(3),(YC300(I,L),I=1,NN)                        I JCI00I
       READ(5,100,END=25,ERR=28)NCOMD(L)                               I JCI00I
       WRITE(MOT,101)APARM(4),NCOMD(L)                                   I JCI00I
       NN=NCOMD(L)                                                       I JCI00I
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70

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      REAO(5,102,ENO=25,ERR=28((XCOMO(I,L),I=1,NN(        I JCI001
      WRITE(MOT,103)APARM(5),(XCOMO(I,L),I=1,NN)           I JCI001
      REAO(5,102,ENO=25,ERR=28)(YCOMO(I,L(,I=1,NN)         I JCI001
      WRITE(MOT,103(APARM(6),(YCOMO(I,L),I=1,NN)           I JCI001
      NN=NW(L)                                             I JCI001
      REAO(5,102,ENO=25,ERR=28((FCLWL(I,L),I=1,NN)         I JCI001
      WRITE(MOT,103)APARM(7),(FCLWL(I,L),1=1,NN)           I JCI001
      REAO(5,100,ENO=25,ERR=28)NC3SO(L)                    I JCI001
      WRITE(MOT,10I)APARM(8),NC3SO(L)                      I JCI001
      NN=NC3SO(L)                                          I JCI001
      REAO(5,102,ENO=25,ERR=28)(XC3SO(I,L),I=1,NN)         I JCI001
      WRITE(MOT,103)APARM(9),(XC3SO(I,L),1=1,NN)           I JCI001
      REAO(5,102,ENO=25,ERR=28)(YC3SO(I,L),I=1,NN)         I JCI001
      WRITE(MOT,103)APARM(10(,(YC3SO(I,L(,1=1,NN)          I JCI001
      REAO(5,100,ENO=25,ERR=28)NEOLY(L)                    I JCI001
      WRITE(MOT,101)APARM(20(,NEOLY(L)                     I JCI001
      NN=NEOLY(L)                                          I JCI001
      REAO(5,102,ENO=25,ERR=28)(XEOLY(I,L),I=1,NN)         I JCI001
      WRITE(MOT,103)APARM(21),(XEOLY(I),L),I=1,NN)         I JCI001
      OO 10 J=1,2                                          I JCI001
      REAO(5,102,ENO=25,ERR=28)(YEOLY(1,J,L),I=1,NN)       I JCI001
      WRITE(MOT,103)APARM(22),(YEOLY(I,J,L),I=1,NN)        I JCI001
10    CONTINUE                                             I JCI001
      REAO(5,100,ENO=25,ERR=28)NGSFO(L)                    I JCI001
      WRITE(MOT,101)APARM(23(,NGSFO(L)                     I JCI001
      NN=NGSFO(L)                                          I JCI001
      REAO(5,102,ENO=25,ERR=28)(XGSFO(I,L),I=1,NN)         I JCI001
      WRITE(MOT,103)APARM(24),(XGSFO(I,L),1=1,NN)          I JCI001
      REAO(5,102,ENO=25,ERR=28)(YGSFO(I,L),I=1,NN)         I JCI001
      WRITE(MOT,103)APARM(25),(YGSFO(I,L),I=1,NN)          I JCI001
      REAO(5,100,ENO=25,ERR=28)NGSFO(L(                    I JCI001
      WRITE(MOT,101)APARM(26),NAAFO(L)                     I JCI001
      NN=NAAFO(L)                                          I JCI001
      REAO(5,102,ENO=25,ERR=28((XAAFO(I,L(,I=1,NN)         I JCI001
      WRITE(MOT,103)APARM(27),(XAAFO(I,L),1=1,NN)          I JCI001
      REAO(5,102,ENO=25,ERR=28)(YAAFO(I,L),I=1,NN)         I JCI001
      WRITE(MOT,103)APARM(28),(YAAFO(I,L),I=1,NN)          I JCI001
      REAO(5,100,END=25,ERR=28)NAFFO(L)                    I JCI001
      WRITE(MOT,101)APARM(29),NAFFO(L)                     I JCI001
      NN=NAFFO(L)                                          I JCI001
      REAO(5,102,ENO=25,ERR=28)(XAFFO(I,L),1=1,NN)         I JCI001
      WRITE(MOT,103)APARM(30),(XAFFO(I,L),1=1,NN)          I JCI001
      REAO(5,102,ENO=25,ERR=28)(YAFFO(I,L),I=1,NN)         I JCI001
      WRITE(MOT,103)APARM(31),(YAFFO(I,L,I=1,NN)           I JCI001
      REAO(5,102,ENO=25,ERR=28)FABOCC(L)                   I JCI001
      WRITE(MOT,103)APARM(11),FABOCC(L)                    I JCI001
      REAO(5,102,ENO=25,ERR=28)FSSMCC(L)                   I JCI001
      WRITE(MUT,103)APARM(12),FSSMCC(L)                    I JCI001
      REAO(5,102,ENO=75,ERR=28)FSAMCC(L)                   I JCI001
      WRITE(MOT,103)APARM(13),FSAMCC(L)                    I JCI001
      OO 40 IS=1,NS                                        I JCI001
      IF(SSMSRS(IS,L).GT.O.)TSSMIR(IS,L)=SSMSRS(IS,L)      I JCI001
      IF(SSMSFS(1,IS,L).GT.O.)SSSMIM(IS,L)=SSMSFS(1,IS,L)  I JCI001
      IF(SSMSFS(2,IS,L).GT.O.)SSSMIL(IS,L)=SSMSFS(2,IS,L)  I JCI001
40    CONTINUE                                             I JCI001
      WRITE(MOT,103)APARM(14),(TSSMIR(IS,L),IS=1,NS)       I JCI001
      WRITE(MUT,103)APARM(15),(SSSMIM(IS,L),IS=1,NS(       I JCI001
      WRITE(MUT,103)APARM(16(,(SSSMIL(IS,L),IS=1,NS)       I JCI001
      NRI=NR(L(                                            I JCI001
      OO 42 IR=1,NRT                                       I JCI001
      IF(ALRSR(I,)R,L(.GT.O.(TSAMIR(IR,L)=ALRSR(I,IR,L)    I JCI001
      IF(BMRS(1,IR,L).GT.O.)SSAMIF(IR,L)=BMRS(1,IR,L)      ( JCI001
42    CONTINUE                                             I JCI001
      IF(ALRSZ(I,L).GT.O.)TSAMIZ(L)=ALRSZ(1,L(            I JCI001
      WRITE(MOT,103)APARM(17),(TSAMIR(IR,L),IR=1,NRT)      I JCI001
      WRITE(MOT,103(APARM(18),TSAMIZ(L(                    I JCI001
      WRITE(MOT,103)APARM(19),(SSAMIF(IR,L),1R=1,NRT)      I JCI001
      NN=NW(L)                                             I JCI001
      SUMM=0.                                              I JCI001
      OO 32 I=1,NN                                         I JCI001
32    SUMM=SUMM+FCLWL(I,L(                                 I JCI001
      IF(SUMM.LE.0.)GOTO 35                                I JCI001
```

71

```
      DO 34 I=1,NN                                            I JCID01
34    FCLWL(I,L)=FCLWL(I,L)/SUMM                              I JCID01
35    WRITE(MDT,105)                                          I JCI001
      WRITE(MDT,103)APARM(7),(FCLWL(I,L),I=1,NN)              I JCID01
30    CONTINUE                                                I JC1001
25    CONTINUE                                                J JCI001
      RETURN                                                  I JCI0D1
28    WRITE(6,999)                                            J JCID01
999   FORMAT('1','*** ERROR OCCURRED IN SUBROUTINE TNFIMP ON DATA ',  I JCID01
     *              'READIN ***')                             J JCI001
      STOP                                                    I JCID01
      END
```

```
                                                             I JCID01
      BLOCKDATA                                               I JCID01
      COMMON/TNFSC2/NC3SD(2),XC3SD(8,2),YC3SD(8,2),           I JCID01
     *              FDDSAD(8,2),FSDSAD(8,2),FTDSAO(8,2),      I JCID01
     *              FABDCC(2),ABSFCC(8,2),ABSRCC(8,2),ABCZCC(2),  I JCID01
     *              FSSMCC(2),TSSMIR(8,2),SSSMIM(8,2),SSSM1L(8,2),  I JCID01
     *              FSAMCC(2),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2)  I JCI001
      COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),           I JCI001
     *              NCOMD(2),XCOMD(8,2),YCOMD(8,2),           I JCID01
     *              FCLWL(10,2)                               I JCID01
      DATA NC3DD,NCOMD,NC3SD/6*0/                             I JCID01
      DATA XC3DD,XCOMD,XC3SD/48*0./                           I JCI001
      DATA YC3DD,YCOMD,YC3SD/48*0./                           I JCID01
      DATA FCLWL/20*0./                                       I JCI001
      DATA FABDCC,FSSMCC,FSAMCC/6*0./                         I JCI001
      DATA TSSMIR,SSSMIM,SSSMIL/48*.001/                      I JCID01
      DATA TSAMIR,TSAMIZ,SSAMIF/14*.001/                      I JCID01
      DATA ABSFCC,ABSRCC,ABCZCC/34*1./                        I JCID01
      END                                                     I JCID01
      BLOCK DATA                                              I JCID01
      COMMON/TNFSC1/INABF(8,2),INABR(8,2),INABZ(2)            I JCI001
      COMMON/TNFSC2/NC3SD(2),XC3SD(8,2),YC3SD(8,2),           I JCID01
     *              FDDSAD(8,2),FSDSAD(8,2),FTDSAO(8,2),      I JCID01
     *              FABDCC(2),ABSFCC(8,2),ABSRCC(8,2),ABCZCC(2),  I JCID01
     *              FSSMCC(2),TSSMIR(8,2),SSSMIM(8,2),SSSMIL(8,2),  I JCID01
     *              FSAMCC(2),TSAMIR(3,2),TSAMIZ(2),SSAMIF(3,2)  I JCICD1
      COMMON/TNFSC3/NC3DD(2),XC3DD(8,2),YC3DD(8,2),           I JCI001
     *              NCOMD(2),XCOMD(8,2),YCOMD(8,2),           I JCID01
     *              FCLWL(10,2)                               I JCI001
      COMMON/TNFSC4/NEDLY(2),XEDLY(8,2),YEDLY(8,2,2),         I JCI001
     *              JESC(8,3,2),IWAUT(8,2),IFPLS(8,2),        I JCID01
     *              TEQPD(2),SFQPD(8,2),CTIMF(8,2)            I JCI001
      COMMON/TNFSC5/NGSFD(2),XGSFD(8,2),YGSFD(8,2),           I JCI001
     *              NAAFD(2),XAAFD(8,2),YAAFD(8,2),           ) JCID01
     *              NAFFD(2),XAFFD(8,2),YAFFD(8,2)            I JCI001
      DATA INABF,INABR,INABZ/34*0/                            I JCI001
      DATA NC3SD/2*0/                                         I JCID01
      DATA XC3SD,YC3SD,FDDSAD,FSDSAD,FTDSAO/8D*0./            I JCI001
      DATA FABDCC,ABSFCC,ABSRCC,ABCZCC/36*0./                 I JCI001
      DATA FSSMCC,TSSMIR,SSSMIM,SSSMIL/50*0./                 I JCI001
      DATA FSAMCC,TSAMIR,TSAMIZ,SSAMIF/16*0./                 I JCID0I
      DATA NC3DD,NCOMD,NEDLY,JESC,IWAUT,IFPLS/86*0/           I JCI001
      DATA XC3DD,YC3DD,XCOMD,YCOMO,XEDLY,YEDLY/112*0./        I JCI001
      DATA FCLWL,TEQPD,SEQPD,CTIME/54*0./                     I JCID01
      DATA NGSFD,NAAFD,NAFFD/6*0/                             I JCID01
      DATA XGSFD,YGSFD,XAAFD,YAAFD,XAFFD,YAFFD/96*0./         I JCID01
      END                                                     I JCID01
```

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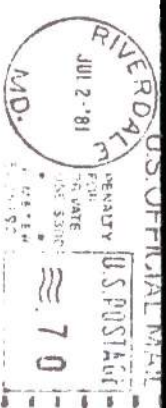ATTN HSA-CDB
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