AD-A078 699 ARMY CONCEPTS ANALYSIS AGENCY BETHESDA MD F/G 15/6
USERS' GUIDE FOR THE NUCLEAR FIRE PLANNING AND ASSESSMENT MODEL--ETC(U)
NOV 79 D WU
UNCLASSIFIED CAA-D-79-4 NL

1 OF 2
AD-
A078699



ADA078699

CAA-D-79-4

(U) DISCLAIMER

The findings of this report are not to be construed as an official Department of the Army position, policy, or decision unless so designated by other official documentation. Comments or suggestions should be addressed to:

Commander
US Army Concepts Analysis Agency
ATTN: Director of War Gaming
8120 Woodmont Avenue
Bethesda, MD 20014

CAA-D-79-4

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: CAA-D-79-4	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle): Users' Guide for the Nuclear Fire Planning and Assessment Model II and Related Routines (NUFAM II Guide)	5. TYPE OF REPORT & PERIOD COVERED
	6. PERFORMING ORG. REPORT NUMBER: CAA-D-79-4
7. AUTHOR(s): MAJ Daniel Wu	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS: US Army Concepts Analysis Agency, 8120 Woodmont Avenue, Bethesda, MD 20014	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: US Army Concepts Analysis Agency, 8120 Woodmont Avenue, Bethesda, MD 20014	12. REPORT DATE: Nov[illegible] 1979 / 13. NUMBER OF PAGES: 134
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	12 136
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)	
18. SUPPLEMENTARY NOTES	
19. KEY WORDS (Continue on reverse side if necessary and identify by block number): Fire planning; FORTRAN V; Graphic display; Nuclear; Nuclear fire planning; Nuclear requirement; Nuclear model; Routines; Run stream; Target acquisition; Target aggregation; Target coverage; Target detection; Subunit Status File; War games; GASP IV; Modeling; Simulation	
20. ABSTRACT (Continue on reverse side if necessary and identify by block number): This guide documents information pertaining to the application of the Nuclear Fire Planning and Assessment Model II (NUFAM II), as well as some of its external support routines. *NUFAM II* simulates two-sided tactical nuclear exchange by simulating fire planning, nuclear detonations, and damage assessments. These functions are performed based on the program logic, input data, and files provided by external support routines. At the conclusion of the simulation, the model provides information on numbers of nuclear warheads expended, personnel casualties, equipment damage, and other selected information.	

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

390996

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

DOCUMENTATION
CAA-D-79-4

USERS' GUIDE FOR THE NUCLEAR FIRE PLANNING AND ASSESSMENT MODEL II AND RELATED ROUTINES (NUFAM II GUIDE)

NOVEMBER 1979

Accession For
NTIS GRA&I
DDC TAB
Unannounced
Justification
By
Distribution/
Availability Codes
Dist. | Avail and/or special
A

Prepared by

War Gaming Directorate

US Army Concepts Analysis Agency
8120 Woodmont Avenue
Bethesda, Maryland 20014

DDC
RECEIVED
DEC 26 1979
D

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

CONTENTS

CHAPTER		Page
1	INTRODUCTION	1-1
	Purpose	1-1
	Background	1-1
	NUREM II Analyses	1-1
	Assumptions	1-5
	Applications	1-6
2	FIRE UNIT/TARGET ACQUISITION ROUTINE (FUNTAR)	2-1
	General	2-1
	Limitations	2-2
	Weapons Yield Data File	2-3
	Target Acquisition Data File	2-3
	FUNTAR Users' Runstream	2-3
3	PROBABILITY OF OPERATIONAL TARGET ACQUISITION ROUTINE (POTAR)	3-1
	General	3-1
	Limitations	3-3
	POTAR Input Data File	3-3
	POTAR Users' Runstream	3-4
	POTAR Output Data	3-4
4	TARGET COVERAGE ROUTINE (TCR)	4-1
	General	4-1
	TCR Calculations	4-1
	Limitations	4-6
	TCR Input Data File	4-6
	TCR Users' Runstream	4-8
	TCR Output Data	4-8
5	NUCLEAR FIRE PLANNING AND ASSESSMENT MODEL II (NUFAM II)	5-1
	General	5-1
	Limitations	5-6
	Fire Planning and Assessment Data File	5-7
	NUFAM II Users' Runstream	5-10
	NUFAM II Output Data	5-10

CHAPTER		Page
6	GRAPHIC PLOT ROUTINES.....	6-1
	General.....	6-1
	Detected Target Plot.....	6-1
	Population Center Plot.....	6-4
	Actual Ground Zero Plot.....	6-5
	Subunit Status File Plot.....	6-6
APPENDIX		
A	Logic Flowcharts for Models and Routines.....	A-1
B	Weapons Yield Data File (Unclassified Sample).....	B-1
C	Weapons Yield Data File (Preparation Instructions).....	C-1
D	Target Acquisition Data File (Unclassified Sample).....	D-1
E	Target Acquisition Data File (Preparation Instructions).....	E-1
F	FUNTAR Runstream (Unclassified Sample).....	F-1
G	Target Coverage Routine Data File (Unclassified Sample).....	G-1
H	Target Coverage Routine Data File (Preparation Instructions).....	H-1
I	Fire Planning and Assessment Data File (Unclassified Sample).....	I-1
J	Fire Planning and Assessment Data File (Preparation Instructions).....	J-1
K	NUFAM II Runstream (Unclassified Sample).....	K-1
L	Probability of Operational Target Acquisition Data File (Unclassified Sample).....	L-1
M	Probability of Operational Target Acquisition Data File (Preparation Instructions).....	M-1

APPENDIX Page

N References..... N-1

GLOSSARY OF TERMS..... Glossary-1

FIGURES

FIGURE

1-1 Flowchart of SUSF, FUNTAR, TCR, and NUFAM II Relationships..... 1-3

3-1 Basic Coverage Patterns (ground radar, standoff, penetrate FEBA)..... 3-2
3-2 Sample Output of POTAR..... 3-5

4-1 TCR Calculations--Case 1 ($D \geq (R_t + R_e)$)..... 4-2
4-2 TCR Calculations--Case 2 ($D \leq (R_e - R_t)$)..... 4-3
4-3 TCR Calculations--Case 3 ($D > X$)..... 4-4
4-4 TCR Calculations--Case 4 ($D \leq X$)..... 4-7
4-5 Sample Output of Target Coverage Routine (TCR)..... 4-9

A-1 Logic Flowchart for Fire Unit/Target Acquisition Routine (FUNTAR)..... A-3
A-2 Logic Flowchart for Target Coverage Routine (TCR)..... A-5
A-3 Logic Flowchart of Events for Nuclear Fire Planning and Assessment Model II (NUFAM II)..... A-7
A-4 Logic Flowchart for Probability of Target Acquisition Routine (POTAR)..... A-9

TABLES

TABLE

5-1 Available Options for NUFAM II Executions..... 5-12

J-1 Type Entries for GASP IV Data (cards 3 through 29)..... J-28

USERS' GUIDE FOR THE NUCLEAR FIRE PLANNING AND ASSESSMENT MODEL II AND RELATED ROUTINES (NUFAM II GUIDE)

CHAPTER 1

INTRODUCTION

1-1. PURPOSE. The purpose of this users' guide is to document information pertaining to the application of the Nuclear Fire Planning and Assessment Model II (NUFAM II) as well as some of its external support routines. The related Fire Unit/Target Acquisition Routine (FUNTAR), Target Coverage Routine (TCR), Probability of Operational Target Acquisition Routine (POTAR), and associated graphic plot routines are described in this guide. Other support programs such as the Subunit Status File (SUSF) routine and the Nuclear Requirements Extrapolator (NUREX) Model are referenced to appropriate publications.

1-2. BACKGROUND. NUFAM II is an integral part of the Nuclear Requirements Methodology II (NUREM II). The original NUREM was promulgated in December 1974 by the US Army Concepts Analysis Agency (CAA) in response to a study directive, Tactical Nuclear Weapons Requirement Methodology (TANREM), from Headquarters, Department of the Army, Office of the Deputy Chief of Staff for Operations and Plans (ODCSOPS).[2] On 31 January 1978, analysts at CAA completed the Nuclear Requirements Methodology II (NUREM II) Study.[5] That study was conducted to fulfill a requirement from ODCSOPS (letter, DAMO-SSN, 28 July 1977) to refine Army analyses of tactical nuclear weapons issues.

1-3. NUREM II ANALYSES. The NUREM II processes include, in part, a conventional war game and nuclear combat sample analyses. An overview of the NUREM II approaches was published in the NUREM II Study Report. There is no prescribed procedure for conducting the conventional war game. However, the chosen procedure should have no larger than daily game intervals to facilitate determination of the time at which tactical nuclear weapons should be employed. Additionally, the conventional war game should have resolution to at least brigade- and division-size units. This level of resolution is needed to define and reflect changes to unit locations with respect to population centers and terrain, distributions of military personnel and equipment, quantities of military personnel and equipment, and the forward edge of the battle area (FEBA). The conventional war game used in developing NUREM II was TARTARUS IV. The use of the TARTARUS IV war game is explained in the

TARTARUS IV N/COCO Players and Technical Manual.[7] Models and routines used in the nuclear combat sample analyses include the SUSF routine, FUNTAR, NUFAM II, and the TCR. The relationships of these programs are depicted in Figure 1-1.

a. SUSF Routine. Once the time for employing tactical nuclear weapons has been selected, it is necessary to convert the battlefield representation of units (brigades or divisions) to subunits normally representing company-size elements. Based on a series of stylized arrays, assembled on the basis of the conventional war game, the SUSF routine creates a data file which defines all company-size maneuver, support, and nuclear-capable subunits under consideration. Up to 5,000 subunits can be defined to represent both sides on a hypothesized battlefield. This file can be modified to reflect terrain orientation of the subunits. The file created by the SUSF routine is normally in the form of a tape known as the SUSF data file--an input to FUNTAR. The SUSF routine requires approximately 60K words of computer main memory for execution. Explanations and guides for the applications of the SUSF routine can be found in the Applications Guide for the Subunit Status File and Related Programs.[5]

b. FUNTAR. In order to complete the description of the battlefield for nuclear applications, the FUNTAR program assimilates and updates the SUSF with additional data. FUNTAR logic processes the input data provided by the SUSF, target acquisition, and the weapons yield files to create a file of specific firing subunits and subunits which are detected as potential nuclear targets. This output data file is normally in the form of a tape known as the FUNTAR data file which is an input to NUFAM II. The FUNTAR requires approximately 63K words of computer main memory for execution. Explanations and guides for the applications of FUNTAR are given in Chapter 2.

c. POTAR. The detected target file created by FUNTAR is based on input data reflecting the probabilities of detection for the two opposing forces by type subunit and zone. Prior to NUREM II, the percent of knowledge (POK) values were used. NUREM II incorporated the Probability of Operational Target Acquisition (POTA) values as part of the methodology. POTA was manually calculated in the original Target Acquisition Study (TAS).[4] A follow-on effort, Target Acquisition Study II (TAS II), provided clarification and improvements to the original POTA methodology. A routine, POTAR, was also developed during TAS II. POTAR is an off-line routine which processes the battlefield description data, sensor performance data, and the target description data to provide a specific set of POTA values for a specific segment of the battlefield.

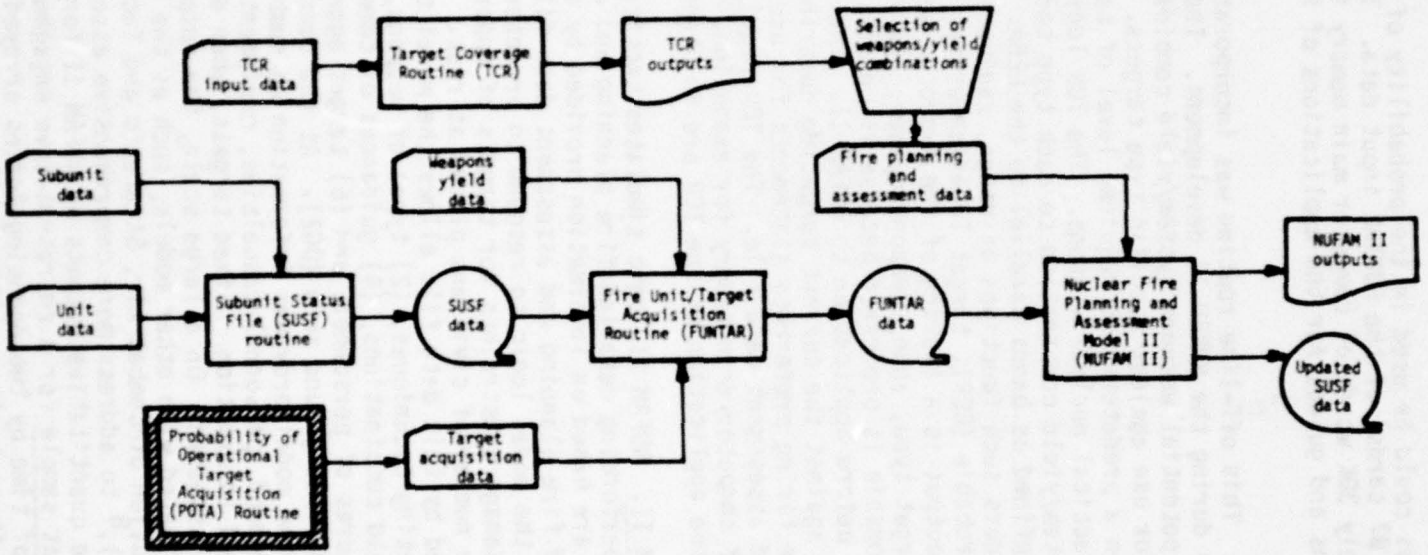


Figure 1-1. Flowchart of SUSF, FUNTAR, TCR, and NUFAM II Relationships

CAA-D-79-4

Those values could be used in the probability of detection sets (LRNK Ø7 cards) of the FUNTAR input data. The POTAR requires approximately 30K words of computer main memory for execution. Explanations and guides for the applications of POTAR are given in Chapter 3.

d. TCR. This off-line routine was incorporated as part of the methodology during the NUREM II development. The TCR provides a listing of potential weapons system/yield combinations which are preferred for use against specific type targets. The selections are based on a predetermined required level of target coverage and damage by tactical nuclear weapons. The TCR logic compares each weapons system/yield combination to each type target by zone. Zones are defined as bands parallel to the FEBA. The routine logic considers such functions as range, radius of effects, circular error probable (CEP), target location error (TLE), and target size. The output is a listing of the expected percentage of coverage by target type, zone, weapons system, and yield. The off-line relationship is preferred because it permits a user to review the results before application to NUFAM II. The TCR output should be reviewed against the current targeting doctrine and constraints to determine firing preference statements for use with the fire planning and assessment data file. The TCR requires approximately 10K words of computer main memory for execution. Explanations and guides for the application of the TCR are in Chapter 3.

e. NUFAM II. NUFAM II logic simulates tactical nuclear exchanges by performing detailed fire planning and damage assessments which are based on information provided by the FUNTAR data file and the fire planning and assessment data file. The latter file allows the model logic to respond to predetermined civilian collateral damage constraints for targets of opportunity and to estimate the number of civilians placed at risk. Other information provided by this data file allows the model to simulate: (1) varied targeting techniques, (2) types of weapons, (3) weapons system/warhead combinations, (4) guidances of commanders, (5) protective postures of personnel, and (6) target aggregations and offsets of desired ground zero (DGZ). At the conclusion of the simulation, the model provides information on numbers of nuclear warheads expended, personnel casualties, equipment damaged, and other selected information. Fixed targets, when defined in the SUSF, can be assessed. On a large scale, the output of NUFAM II can be coordinated with other models, such as the Flexible Operational Resolution of Combat Air, Strategic and Tactical Model II (FORECAST II),[8] to address more comprehensive assessments of fixed targets. The quantitative outputs of NUFAM II form a part of the nuclear combat sample for a representative engagement over a variable period of time by two opposing forces arrayed in specific conditions. These nuclear combat samples must be converted to

combat sample results through qualitative analysis whenever used as a method of evaluation in a study. NUFAM II requires approximately 65K words of computer main memory for execution. Explanations and guides for the applications of NUFAM II are presented in Chapter 4.

f. NUREX. Two methods are provided by NUREM II to extend the number of nuclear strike applications. First, the nuclear combat sample results from one or more iterations of NUFAM II can be extrapolated by using the NUREX Model (see Vol IV of Reference 2). Second, the NUREM II processes can be recycled by translating the combat sample results of the first iteration to impact on an excursion with the conventional war game or simulate additional nuclear strikes without an intervening conventional war game. After NUFAM II has been used repeatedly for all sectors of the hypothesized battlefield, a spectrum of simulations and associated combat sample results is produced. Either a capabilities or a requirements analysis, usually at theater-level, can be performed at that time.

1-4. ASSUMPTIONS. As a part of the NUREM II, NUFAM II processes are based on the following assumptions:

a. Actions within a combat sample are independent of actions within other combat samples.

b. Military subunits can be placed in geometric arrays which are representative of conditions on a hypothesized nuclear battlefield. The arrays can be terrain-oriented and can incorporate fixed targets.

c. Military personnel and equipment (usually resolved to company-level subunits) can be uniformly distributed within rectangles for assessment purposes.

d. Movement of subunits on the stylized battlefield can be approximated by:

(1) Updating locations for arrayed subunits (revising the SUSF data file).

(2) Applying computed target location errors.

(3) Simulating the loss of potential targets of opportunity (detected subunits).

e. The assessment of damage by a detonated nuclear round can

be estimated by circle/rectangle overlap calculations. The percentage of the target rectangle which is overlapped by the effects circle corresponds to the percentage of the personnel or equipment losses assessed against the subunit.

1-5. APPLICATIONS. As a part of the NUREM II processes, NUFAM II is used to conduct the following types of analyses:

a. Requirements. In a requirements analysis, NUFAM II logic draws from an unconstrained stockpile of warheads during the fire planning and warhead launch processes of the simulation. The number of rounds expended to achieve a predefined goal can be used to determine nuclear requirements for a specific scenario.

b. Capabilities. In a capabilities analysis, NUFAM II logic draws from a specified number of warheads during the fire planning and warhead launch phases of the simulation. The number of rounds expended are accounted for during the simulation. Based on the results of the simulation, the capabilities of the specified numbers and distributions of warheads can be determined for a specific scenario.

CHAPTER 2

FIRE UNIT/TARGET ACQUISITION ROUTINE (FUNTAR)

2-1. GENERAL. The FUNTAR updates the SUSF to generate a FUNTAR data file for input to NUFAM II. The FUNTAR data file provides the same basic information as the SUSF plus descriptive information concerning nuclear-capable firing subunits and potential nuclear targets. FUNTAR logic accomplishes this by applying simulations of the following three broad functions to the SUSF, weapons yield, and target acquisition data files. A logic flowchart for FUNTAR is shown in Appendix A.

a. Weapons System and Firing Subunit Identification. Nuclear-capable weapons systems are identified by side, range, and location. The FUNTAR also collates the weapons systems with the nuclear-capable firing subunits, the numbers of type warheads, and available yields.

b. Assignment of Subunits to Zones. Subunits in the SUSF are assigned by the FUNTAR logic to one of four target detection zones based on the shortest normal distance from the center of the subunit to a series of line segments representing the FEBA. The four zones, identified in terms of distances from the FEBA, are established in the target acquisition data file. These zone distances are used as a basis for the selection of potential targets.

c. Selection of Potential Targets. All subunits of a given type designation within each target detection zone are considered for selection as potential targets. The FUNTAR simulates the net effects of the target detection process by applying given probabilities of detection for the two opposing forces, by type subunit and zone, using the expected value technique. Probabilities of detection are expressed as cumulative acquisition levels. Intervals (multiple cycles) and cycles from 1 to 24 hours can be simulated. The probability of detection assumes evaluated target information. Either Percent of Knowledge (POK)[1] values produced by the Office of the Assistant Chief of Staff for Intelligence or Probability of Operational Target Acquisition (POTA)[4] data developed by CAA represents an acceptable format for the application of target acquisition factors in FUNTAR. POTA values can be derived through application of the Probability of Operational Target Acquisition Routine, as described in Chapter 3. Other probabilities of detection are usable when the aggregated expressions are based on: (1) functions of target acquisition effectiveness for each force, (2) the type and vulnerability of subunits under surveillance, and (3) the locations of subunits to be detected with

respect to the FEBA. In FUNTAR, subunits detected in a previous interval are retained on the potential target list for the current interval. Subunits which have been moved by off-line operations between intervals are subjected to revised expected values for detection. Detected subunits will be identified in the FUNTAR data file for possible selection as targets in NUFAM II. The following descriptors apply to such subunits:

(1) Perceived location based on input values for error in distance and direction from the actual location.

(2) Flee time--a predicted time at which the potential target is assumed to be lost for fire planning and warhead launch purposes.

(3) Location by side and zone.

(4) Priority for targeting based on predetermined input data.

(5) Time the potential target was detected based on random selection.

2-2. LIMITATIONS. The FUNTAR has the following limitations:

a. The routine does not simulate individual target acquisition systems. Introduction of a new target acquisition system would require separate evaluation of probabilities of target detection prior to application to FUNTAR.

b. Flee time is computed from time zero and influenced by a random factor. This time can preclude fire planning but the actual location of the subunit does not change before assessment in NUFAM II.

c. Quality of intelligence is assumed to be such that the potential target size is known for each detected subunit.

d. Programing changes are required to alter the following data element limitations:

(1) Two sides (Red and Blue).

(2) Four target zones in depths from the FEBA.

(3) Fifty FEBA points for the combat sample.

(4) Ten types of nuclear delivery systems per side.

(5) Five nuclear yields per delivery system.

(6) Nine launchers/artillery pieces/aircraft per firing subunit.

(7) One type of delivery system per subunit.

2-3. WEAPONS YIELD DATA FILE. This file provides the basic weapons data for the FUNTAR logic to correlate the firing subunits in the SUSF with the appropriate weapon systems and warhead yields. Further, these data control the quantities and yields of warheads available for use in the simulation. An unclassified version of this file is stored in the CAA computer (UNIVAC 1108) under file and element name UNCLASSIFIED*88DATABASE.TARYLDFLE. A classified version of this file is stored in SECRET*80DATABASE.FUNTARYLDFLE. Read/write keys are required to gain access to the classified file. An unclassified sample of this type of file is shown in Appendix B while detailed information and instructions for its preparation are shown in Appendix C.

2-4. TARGET ACQUISITION DATA FILE. This file provides the basic information required by the FUNTAR to simulate the target detection process. These data consist of probabilities and tables required to make the decisions for selection of potential targets as described in paragraph 2-1c, above. An unclassified version of this file is in the CAA computer under file and element names UNCLASSIFIED*88DATABASE.TARINDATA. A classified version of this file is stored in SECRET*80DATABASE.FUNTARINDATA. Read/write keys are required to access the classified file. An unclassified sample of this type file is shown in Appendix D. Seventeen different types of entries are required to create this data file which is made in a punch card format. Detailed information and instructions for the preparation of this file are shown in Appendix E.

2-5. FUNTAR USERS' RUNSTREAM. The FUNTAR is executed at CAA on the UNIVAC 1108 computer. The FUNTAR users' runstream is a set of computer control statements which will initiate the FUNTAR and instruct the computer to perform certain required sequential actions. Therefore, the runstream discussed in this guide is applicable only to UNIVAC systems. The current file element which contains the runstream to execute FUNTAR is START*80RUN.FUNTARRUN. Appendix F depicts the contents of this runstream element. Items underlined in the runstream must be replaced with the appropriate information for the particular execution desired by the user. Desired options should be entered with the "XQT" (execute) statement

of the runstream. A combination of two options is permitted. The first option may be either "T" or "K"; Option "T" denotes that target detection probabilities will be in the format of POTA values. "K" denotes values in the POK format. The second option may be either "A" or "B"; Option "A" produces a potential target list on which a given subunit is listed once, regardless of the number of detections. For Option "B," the potential target list includes repeated detections of a given subunit. After the runstream and data files have been created or updated, only four card images are required to execute the FUNTAR from a demand mode. An example of these card images is as follows:

```
@RUN A180,E1821P7167,UNCLASSIFIED
@ASG,A START*8ORUN
@START START*8ORUN.FUNTARRUN
@FIN
```

CHAPTER 3

PROBABILITY OF OPERATIONAL TARGET ACQUISITION ROUTINE (POTAR)

3-1. GENERAL. The POTAR logic does not compute probability of single element detection for individual sensors. It does take such probability values as input and applies them against a specific set of degradation factors. This routine does not provide a target list unilaterally, but only that data indicating the susceptibility of a target complex to detection. The POTA concept does take into consideration detectable target elements and detectable target complexes. Target elements are physical objects (e.g., personnel, tanks, trucks) which make up a target complex. POTA values are not expressed as a function of time. They are expected values for a random short period of time.

a. Probability of Operational Target Acquisition (POTA). As defined in the original TAS, POTA is the probability of detecting, identifying, and locating various types of potential targets at a prescribed distance from the FEBA during a random, but limited, period of time in a day of intense combat.

b. Force and Scenario Consideration. Prior to actual application of the routine, a force scenario based on the battlefield description phase of the NUREM II methodology is selected in order to generate the required battlefield description data. Normally, this scenario is to match the set of arrays required for the SUSF. This information is necessary to determine the size of the battlefield, size and type of units involved, characteristics of combat operations, and terrain environment.

c. Program Logic. A logic flowchart for POTAR is shown in Appendix A. The POTAR logic accomplishes the following broad functions in deriving the POTA values.

(1) Target Elements at Risk to Detection. For some systems to be effective against a target element, the target element must be moving or out in the open. These target activities and terrain environment factors are considered for the determination of the quantities of target elements susceptible to detection within each target complex type.

(2) Probability of Coverage. Probability of coverage for each type of target acquisition system employed is determined for each type of target element within each type of target complex. Single and multiple coverages for each target acquisition system type are considered, based on the quantity and performance

characteristics of the systems involved. Three basic coverage patterns are considered (Figure 3-1).

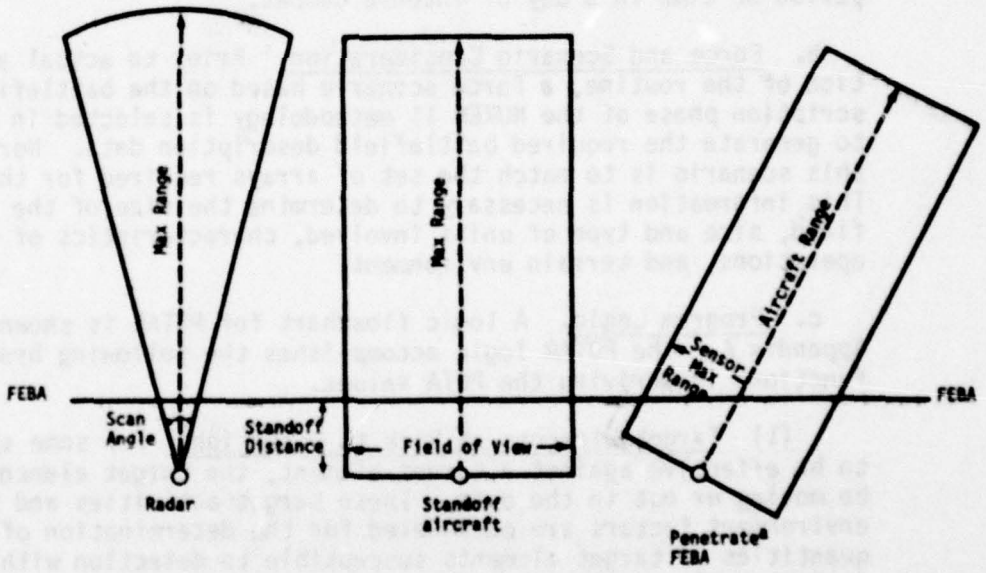


Figure 3-1. Basic Coverage Patterns (ground radar, standoff, penetrate FEBA)

(3) Operational Probability of Detection. The technical design of a target acquisition system provides an inherent detection capability expressed as a probability. When the system is operationally employed in a tactical environment, during an intense day of combat, certain operational factors could degrade the inherent designed capability. The performance of the system could be affected by operational factors such as availability, survivability, line-of-sight, crew performance, weather, smoke, and terrain. These factors are considered in deriving the operational probability of detection for each target element type by each type of target acquisition system.

(4) Probability of Detecting a Target Complex. The detection of a target complex is based on the aggregated quantity of target elements susceptible to detection. The quantity of elements required in determining the detection of a target complex is derived from the available elements within a target complex, treated against all target activity factors (i.e., moving or stationary) and all target environment factors (i.e., in woods or in the open) of the target arrays being considered. The final probability of detecting a target complex is based on these aggregated quantities.

3-2. LIMITATIONS. This routine has the limitations indicated below. Minor programing changes would be required to expand these limitations.

a. Up to 30 sensor types for a force at one time.

b. Up to 10 target surveillance zones.

c. Up to 30 unit types of the opposing force.

d. Up to 5 element types for each unit type being considered.

3-3. POTAR INPUT DATA FILE. The input data required by the POTAR is divided into three sets. An unclassified sample of this file is shown in Appendix L. Instructions for the preparation of these data are given in Appendix M.

a. The initial set of data describes the size of the battlefield, number of sensor types, number of unit types, and the target surveillance zones.

b. The second set describes the performance and degradation characteristics of each sensor type considered.

c. The final set describes the target elements, terrain environment, and probable activities of each unit type considered.

3-4. POTAR USERS' RUNSTREAM. The following runstream will execute the POTAR in the demand mode on the UNIVAC 1108 computer at CAA. Items underlined in the runstream must be replaced with the appropriate information for the particular execution desired by the user.

```
@RUN A188,E1831P9200,UNCLASSIFIED
@SYM PRINT$.,,PR
@HDG  ** BLUE POTA **
@ASG,A 88POTAU.
@ASG,A 88POTAR.
@USE 17.,88POTAU.
@XQT,A 88POTAR.ABS
@ADD,L 88POTAR.USDATA
@FIN
```

3-5. POTAR OUTPUT DATA. A typical output of this routine is shown in Figure 3-2.

	ZONE I	ZONE II	ZONE III	ZONE IV	ZONE V
MSL 1 UNIT	.0000	.0000	.5550	.4446	.3331
MSL 2 UNIT	.0000	.0000	.5559	.4447	.3338
ANTY UNIT	.9998	.8888	.7777	.6666	.0000
GROUND UNIT	.9999	.6662	.4440	.2220	.0999
POTAR PLT	.7555	.2555	.1555	.0000	.0000
MAJOR HQ CP	.0000	.9111	.3111	.1111	.0111
MSL HQ CP	.0000	.0000	.1999	.0999	.0099
AD FRC SITE	.0000	.0000	.4888	.3888	.1888
LOWER HQ CP	.0777	.2777	.1777	.1777	.0777
ANTY CP	.0000	.1666	.0666	.0066	.0006
RESUPPLY PT	.4555	.5555	.4555	.3555	.2555
AMMO PT	.0000	.0000	.0000	.0444	.0044
MAINT PT	.0000	.0000	.2333	.0333	.0033
SPT TRAIN	.0000	.0000	.0222	.0022	.0002
AD POSITION	.0000	.0000	.1111	.0111	.0011

Figure 3-2. Sample Output of POTAR

CHAPTER 4

TARGET COVERAGE ROUTINE (TCR)

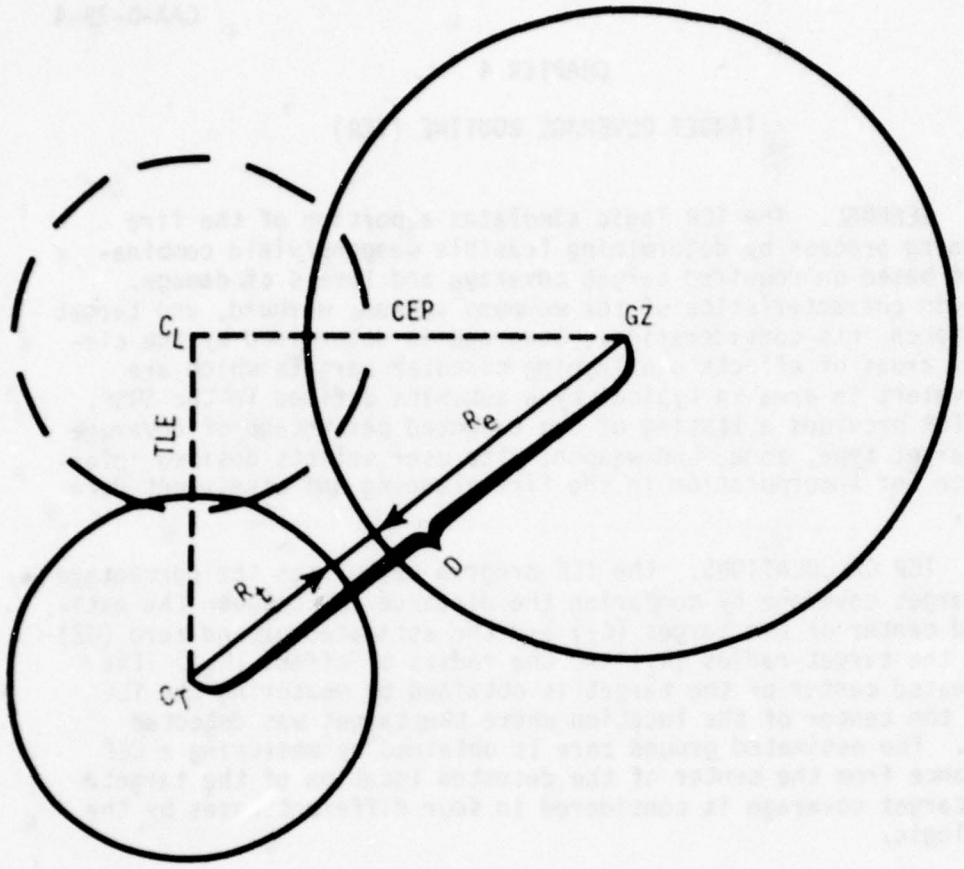
4-1. GENERAL. The TCR logic simulates a portion of the fire planning process by determining feasible weapons/yield combinations based on required target coverage and levels of damage. Certain characteristics of the weapons system, warhead, and target are taken into consideration. Coverage is determined by the circular areas of effects overlapping circular targets which are equivalent in area to typical type subunits defined in the SUSF. The TCR provides a listing of the expected percentage of coverage by target type, zone, and weapon. The user selects desired information for incorporation in the fire planning and assessment data file.

4-2. TCR CALCULATIONS. The TCR program calculates the percentage of target coverage by comparing the distance (D) between the estimated center of the target (C_T) and the estimated ground zero (GZ) with the target radius (R_t) and the radius of effect (R_e). The estimated center of the target is obtained by measuring the TLE from the center of the location where the target was detected (C_L). The estimated ground zero is obtained by measuring a CEP distance from the center of the detected location of the target. The target coverage is considered in four different cases by the TCR logic.

a. Case 1. The distance between the estimated center of the target and the estimated ground zero is greater than or equal to the sum of the target radius and the radius of effects. There is no overlap in this case as shown in Figure 4-1.

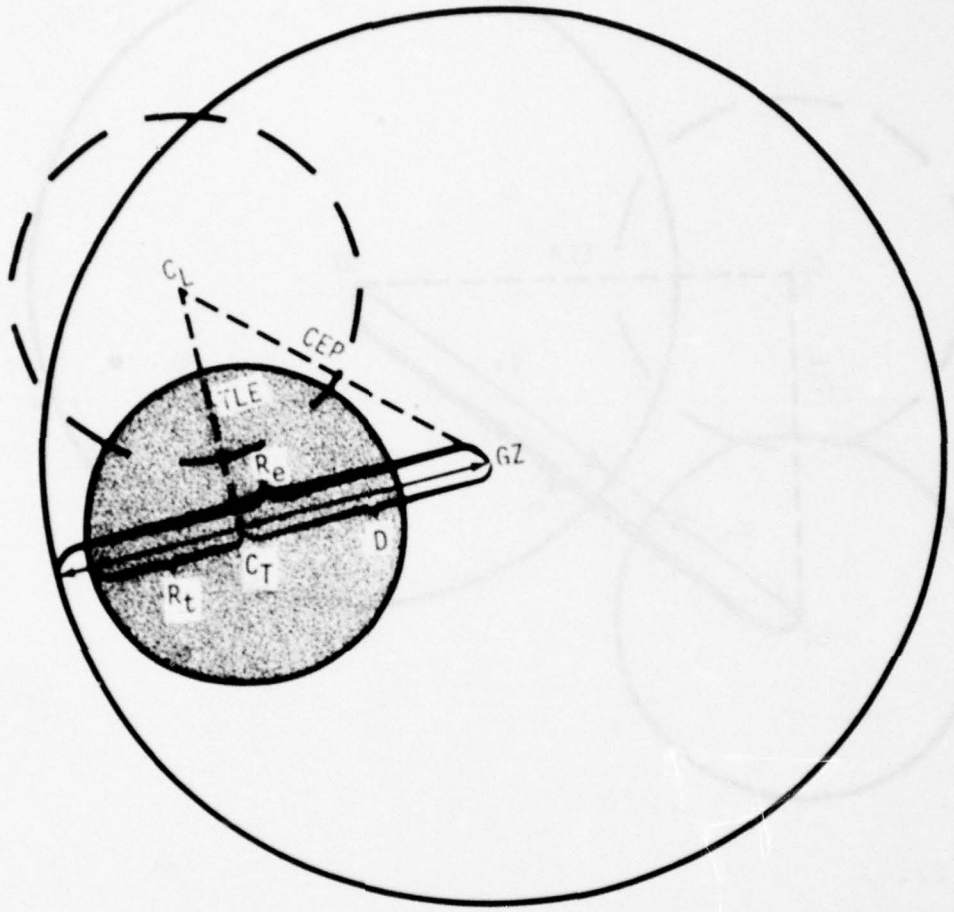
b. Case 2. The distance between the estimated center of the target and the estimated ground zero is less than or equal to the difference between the radius of effects and the target radius. The target in this case is completely overlapped by the circular area of effects as shown in Figure 4-2.

c. Case 3. The distance between the estimated center of the target and the estimated ground zero is greater than the normal distance (X) from the estimated ground zero to a line (Y) connecting the two points where the target circle and the area of effects circle intersect. The overlap in this case is less than 50 percent of the target area as shown in Figure 4-3.



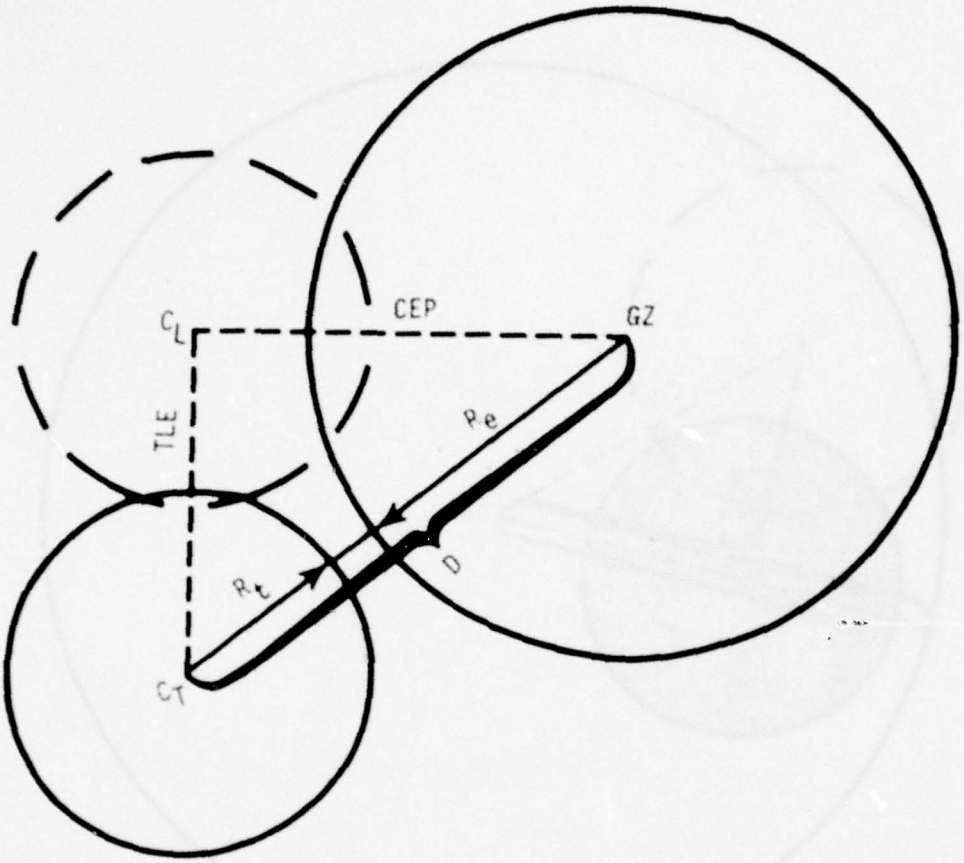
CEP = circular error probable
C_L = center of detected target location
C_T = center of estimated target location
D = distance between C_T and GZ
GZ = estimated ground zero
R_e = radius of effect
R_t = radius of target
TLE = target location error

Figure 4-1. TCR Calculations--Case 1 ($D \geq (R_t + R_e)$)



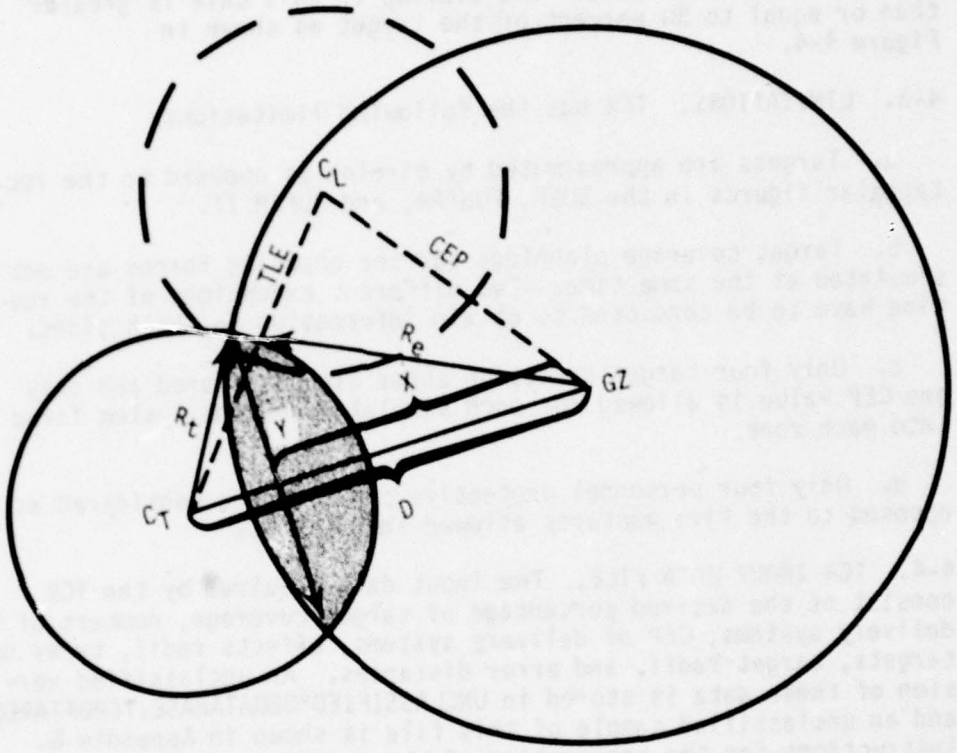
CEP = circular error probable
C_L = center of detected target location
C_T = center of estimated target location
D = distance between C_T and GZ
GZ = estimated ground zero
R_e = radius of effect
R_t = radius of target
TLE = target location error

Figure 4-2. TCR Calculations--Case 2 ($D \leq (R_e - R_t)$)



CEP = circular error probable
C_L = center of detected target location
C_T = center of estimated target location
D = distance between C_T and GZ
GZ = estimated ground zero
R_e = radius of effect
R_t = radius of target
TLE = target location error

Figure 4-1. TCR Calculations--Case 1 ($D \geq (R_t + R_e)$)



CEP = circular error probable
C_L = center of detected target location
C_T = center of estimated target location
D = distance between C_T and GZ
GZ = estimated ground zero
R_e = radius of effect
R_t = radius of target
TLE = target location error
X = normal distance from GZ to Y
Y = line connecting points of intersections

Figure 4-3. TCR Calculations--Case 3 (D>X)

d. Case 4. The distance between the estimated center of the target and the estimated ground zero is less than or equal to the normal distance (X) from the estimated ground zero to a line (Y) connecting the two points where the target circle and the area of effects circle intersect. The overlap in this case is greater than or equal to 50 percent of the target as shown in Figure 4-4.

4-3. LIMITATIONS. TCR has the following limitations:

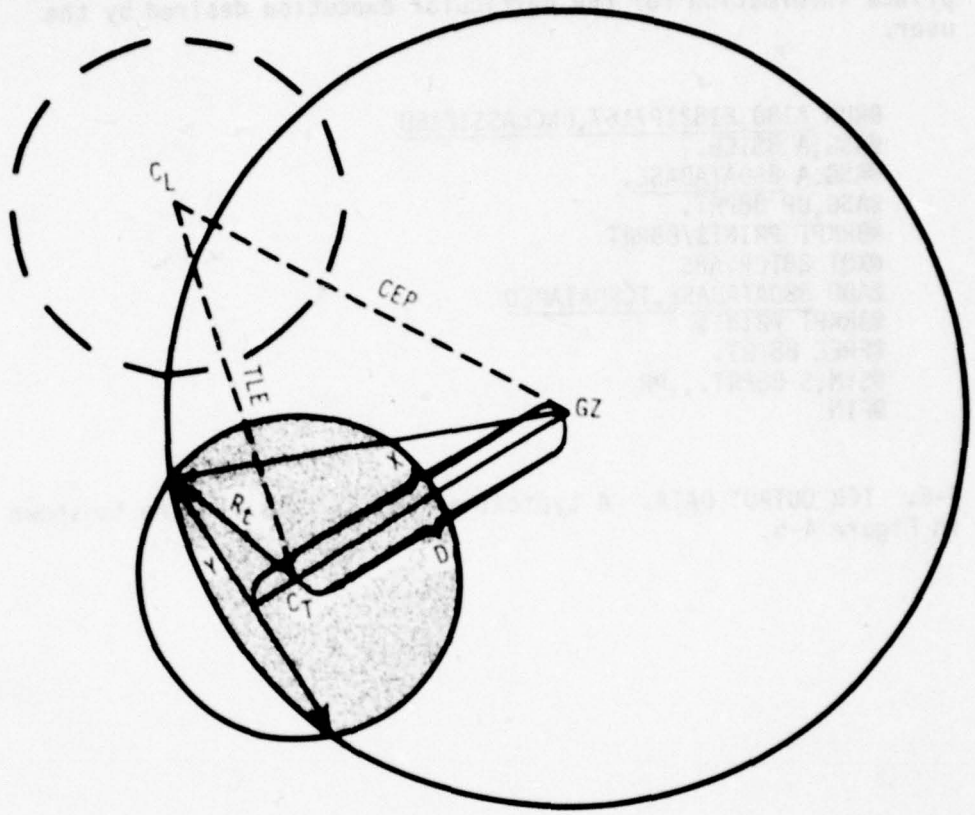
a. Targets are approximated by circles as opposed to the rectangular figures in the SUSF, FUNTAR, and NUFAM II.

b. Target coverage plannings for the opposing forces are not simulated at the same time. Two different executions of the routine have to be conducted to obtain information for both sides.

c. Only four target detection zones are considered and only one CEP value is allowed for each simulated weapons system fired into each zone.

d. Only four personnel protective postures are considered as opposed to the five postures allowed in NUFAM II.

4-4. TCR INPUT DATA FILE. The input data required by the TCR consist of the desired percentage of target coverage, numbers of delivery systems, CEP of delivery systems, effects radii, types of targets, target radii, and error distances. An unclassified version of these data is stored in UNCLASSIFIED*88DATABASE.TCRDATARED, and an unclassified sample of this file is shown in Appendix G. Instructions for the preparation of these data are given in Appendix H.



CEP = circular error probable
C_L = center of detected target location
C_T = center of estimated target location
D = distance between C_T and GZ
GZ = estimated ground zero
R_e = radius of effect
R_t = radius of target
TLE = target location error
X = normal distance from GZ to Y
Y = line connecting points of intersections

Figure 4-4. TCR Calculations--Case 4 ($D \leq X$)

4-5. TCR USERS' RUNSTREAM. The following runstream will execute the TCR in the demand mode on the UNIVAC 1108 computer at CAA. Items underlined in the runstream must be replaced with the appropriate information for the particular execution desired by the user.

```
@RUN A180,E1821P7167,UNCLASSIFIED
@ASG,A 88TCR.
@ASG,A 88DATABASE.
@ASG,UP 88PRT.
@BRKPT PRINT$/88PRT
@XQT 88TCR.ABS
@ADD 88DATABASE.TCRDATARED
@BRKPT PRINT$
@FREE 88PRT.
@SYM,S 88PRT.,,PR
@FIN
```

4-6. TCR OUTPUT DATA. A typical output of this routine is shown in Figure 4-5.

COVERAGE OF RED WEAPONS ON BLUE TARGETS
CUTOFF = .500

TARGET MRCD

ZONE	WEAPON	COVERAGE BY YIELD				
1	1	.638	1.000			
1	2	1.000	1.000			
1	3	.638	1.000			
1	4	1.000	1.000			
1	5	.579	1.000	1.000	1.000	1.000
1	6	1.000	1.000	1.000		
1	7	.566	.885	1.000	1.000	
1	8	.652	1.000	1.000	1.000	1.000
1	9	1.000	1.000	1.000	1.000	1.000
RECOMMENDED WEAPON/YIELD IS 1/ 1						
ZONE	WEAPON	COVERAGE BY YIELD				
2	1	.520	1.000			
2	2	1.000	1.000			
2	3	.517	1.000			
2	4	1.000	1.000			
2	5	.554	1.000	1.000	1.000	1.000
2	6	1.000	1.000	1.000		
2	7	.522	.857	1.000	1.000	
2	8	.621	1.000	1.000	1.000	1.000
2	9	1.000	1.000	1.000	1.000	1.000
RECOMMENDED WEAPON/YIELD IS 1/ 1						
ZONE	WEAPON	COVERAGE BY YIELD				
3	1	.931	1.000			
3	2	1.000	1.000			
3	3	.935	1.000			
3	4	.000	.000			
3	5	.533	1.000	1.000	1.000	1.000
3	6	1.000	1.000	1.000		
3	7	.504	.832	1.000	1.000	
3	8	.594	.993	1.000	1.000	1.000
3	9	1.000	1.000	1.000	1.000	1.000
RECOMMENDED WEAPON/YIELD IS 1/ 2						
ZONE	WEAPON	COVERAGE BY YIELD				
4	1	.000	.000			
4	2	.000	.000			
4	3	.273	1.000			
4	4	.000	.000			
4	5	.972	1.000	1.000	1.000	1.000
4	6	1.000	1.000	1.000		
4	7	.928	.759	1.000	1.000	
4	8	.519	.955	1.000	1.000	1.000
4	9	.983	1.000	1.000	1.000	1.000
RECOMMENDED WEAPON/YIELD IS 3/ 2						

Figure 4-5. Sample Output of Target Coverage Routine (TCR) (each column under "Coverage by Yield" represents a percentage of coverage for one of five yields per weapons system)

CHAPTER 5

NUCLEAR FIRE PLANNING AND ASSESSMENT MODEL II (NUFAM II)

5-1. GENERAL. The NUFAM II program simulates combat action over a discrete portion of a tactical nuclear battlefield. Model logic applies two-sided, discrete event, Monte Carlo gaming techniques to a combat sample (normally a Blue corps with opposing Red forces) to simulate tactical nuclear exchanges. Typical NUFAM II simulations might consist of a Blue corps defending against an attacking Red army. A logic flowchart for the model events is shown in Appendix A. The seven discrete events in NUFAM II are generated continuously. These events are scheduled at specified simulation times and executed within the framework of the model logic. The NUFAM II events are: (1) target of opportunity, (2) immediately available target, (3) preplanned target, (4) fire, (5) flee, (6) graphics, and (7) conclusion. At a given simulation time, all scheduled events are tested for currency. Current events will be accomplished prior to the advancement of simulation time. Also, these events will be tested for certain predefined or model generated conditions which can create a conclusion event to terminate the execution of the model. NUFAM II logic performs the simulation by applying the input data from the FUNTAR and the fire planning and assessment data files to accomplish the following three broad functions:

a. Fire Planning. Simulation of the fire planning function is accomplished in two separate operations--control of battle scope and intensity and nuclear fire order generation.

(1) Control of Battle Scope and Intensity. The primary method of controlling the scope and intensity of the nuclear exchange is through control of the automated selection of potential targets of opportunity. The user determines the number and type of subunits input into the SUSF and ultimately into the FUNTAR. The target detection parameters, selected by the user and applied through the FUNTAR logic, control the number of potential targets from among the SUSF subunits. The number of selected potential targets implicitly controls the number of nuclear shots the model logic will attempt to generate against the available set of targets. The second method for controlling the scope and intensity of the nuclear exchange is by user introduction of preplanned targets. Examples of such targets are those selected off-line when simulating the preclusion-oriented method (POM) of targeting.

(a) Target of Opportunity Event. NUFAM II logic treats the potential target list furnished by the FUNTAR data file as a

time-sequenced list of external events. A target of opportunity event will be generated using predetermined priorities and detection times. The model logic will perform detailed fire planning within limits based on predefined parameters. Additionally, the model logic will attempt to aggregate acquired targets (within predefined target priorities) in the vicinity of the primary target whenever prescribed military effects can be assured without reducing the specified level of expected damage to the primary target below a set goal. Related logic will then offset the DGZ from the primary target, as necessary, to meet civilian collateral damage and troop minimum safe distance (MSD) constraints. As a result of fire planning, other events can be generated. A potential target can be cancelled for varied reasons before the simulated warhead is launched. These reasons are described in paragraph 4-3b.

(b) Flee Event. All potential targets furnished by the FUNTAR data file have a simulated flee time. If a fire event cannot be generated during fire planning or the fire event execution time is later than the "flee" time, the decision logic of the model does not allow a nuclear shot to be delivered against that primary target of opportunity.

(c) Preplanned Target Event. This is an external, time-sequenced event (gamer specified DGZ). Preplanned targets can be used to strike specific fixed targets or to support preclusion-oriented targeting techniques. The gamer considers troop safety and civilian collateral damage avoidance when selecting the DGZ and weapons system/warhead combinations. The model logic will generate a fire order. However, target aggregation and DGZ offsets will not be attempted. The model logic will not cancel shots for these targets as a result of estimated civilian collateral damage or loss of target acquisition (flee event). Preplanned targets will be cancelled because of unavailable weapon systems or insufficient quantities of warheads.

(d) Graphics Event. As an option, gamers can use computer graphics in an interactive mode with the NUFAM II processes. In essence, the battlefield "snapshots" are generated at either predefined simulation times or model events. The gamer may receive or enter information by means of a cathode ray tube (CRT) and can influence subsequent decisions made by the simulation. After gamer adjustments, controls are returned to the model logic. The gamer can use the CRT display in the following two graphics modes:

1. Zoom-in Mode. The user can zoom in on a small portion of the battlefield (e.g., a battalion sector) to interactively observe specific targets. The CRT graphically represents

targets of opportunity (rectangles), preplanned targets (triangles), nuclear shots (circles), combat ineffective military subunits (X), and civilian population centers (pentagons). Using this information, the gamer can accept, modify, or cancel a previously generated fire order. The fire order can be modified by displacing the DGZ and/or selecting an alternative weapon and/or yield. The user cannot generate a new fire order.

2. Zoom-out Mode. The user can zoom out to a larger portion of the battlefield (e.g., brigade, division or corps sector) to observe the overall situation. The user can determine geographic areas in which proposed nuclear shots should be cancelled or modified and review the locations of nuclear shots.

(2) Nuclear Fire Order Generation. The number of generated fire orders is controlled by the input data and model events which are interrelated as shown in Appendix A. The following activities can occur as a result of a fire order:

(a) Fire Event. Based on a series of decision rules, the model logic automatically attempts to generate fire events. To do this, model logic must first allocate a specific firing subunit, weapons system, and nuclear warhead for use against each target. This determination is governed principally by the characteristics of the weapons systems, target/weapon system distances, target/warhead preferences, MSD constraints, and civilian collateral damage avoidance criteria.

(b) Immediately Available Target Event. If a scheduled shot cannot be delivered (i.e., if the firing subunit is made combat ineffective by the opposing forces or the weapon system fails reliability tests), the model logic will attempt to locate another firer and generate a new fire order. This action develops a model event known as an immediately available target.

b. Damage Assessments. The model logic estimates damage inflicted on the subunits and fixed targets on the hypothetical battlefield by simulating the launch and detonation of each nuclear warhead. System set-up time and reliability, as well as command and control efficiency, govern the launcher responses. The CEP values further compound the uncertainties in the location of the actual ground zero (AGZ) when compared to the actual location of the targeted subunit. Damage to both the targeted subunit and all other fixed or mobile elements that are within the weapon effects area are measured through circle/rectangle overlap calculations. The extent to which each of several particular effects radii overlap the stylized rectangles, which represent the uniform distributions of personnel and equipment in subunits, is computed

as a percentage. The numbers of lost personnel and damaged equipment are then directly proportional to these percentages. Results of nuclear strikes on military subunits are described in terms of immediate permanent and immediate transient casualties, military equipment damaged, and combat ineffective subunits. Levels of damage to fixed targets (points) are commensurate with the associated radii of effects for the given type targets provided the target locations fall within the area of effects for the detonated weapon.

(1) Military Personnel Losses. Two effects radii for assessing military personnel losses are permitted. Normally, immediate permanent and immediate transient casualties are assessed. Double counting is avoided by automatically subtracting the number of immediate permanent casualties from the immediate transient. Casualties against each of the five protective postures given in FM 101-31-2 are assumed to provide the total loss estimates.

(a) Immediate permanent casualties (8,000 rad) are produced against personnel in designated postures. Affected personnel will be incapacitated within 5 minutes of exposure and, for physically demanding tasks, will remain incapacitated until death. Death will occur in from 1 to 2 days.

(b) Immediate transient casualties (3,000 rad) are produced against personnel in designated postures. Affected personnel will be incapacitated within 5 minutes of exposure and will remain so from 30 to 45 minutes. Personnel will then partially recover but will be functionally impaired until death. Death will occur in from 4 to 6 days.

(c) Personnel exposed to latent lethality (650 rads) are not counted because of the time delay before combat ineffectiveness is manifest.

(2) Combat Ineffectiveness ("broken" subunit). When the immediate permanent and immediate transient casualties combined reach a predetermined level for subunits, those subunits which have excessive casualties are flagged as combat ineffective. When firing subunits are so affected, those subunits are precluded from carrying out scheduled fire missions or receiving additional orders. A different cutoff level can be input, by side, to simulate the reactions of defending or attacking forces.

(3) Military Equipment Damage. The assessment process for equipment damage is essentially the same as that for personnel loss assessments. However, the hypothetical size of the subunit can be different for the two types of assessments, and the radius of effects circle varies to relate the nuclear effects of a specific warhead to the hardness of the equipment being assessed.

(4) Multiple Target Damages. During the damage assessment process, the distance from the center of each potential target in the data base to the AGZ of each shot is computed. If that separation distance is greater than the "largest" effects radius, the damage assessment process is not executed for that target. Otherwise, the calculations are performed as described above.

c. Civilian Collateral Damage. Based on a series of decision rules and the population data base, the model logic will observe civilian collateral damage avoidance criteria and predict the numbers of civilians placed at risk during the fire planning phase. Civilians placed at risk will be assessed after the AGZ has been determined.

(1) Collateral Damage Avoidance. The model logic accepts avoidance radii for particular warheads and yields. Normally, all civilians are assumed to be in the basements of one-story masonry buildings in an urban environment. Radii are selected to avoid five percent occurrence of hospitalizing injuries when predicted by the governing blast, thermal, or radiation values. Shots are cancelled if, after attempting to offset the DGZ and still attain prescribed damage to military subunits, civilian collateral damage avoidance constraints cannot be observed. Preplanned fires, which are preevaluated off-line by gamers, are exceptions to this logic and are not cancelled automatically.

(2) Prediction of Civilians at Risk. Generally, the blast and radiation radii for each nuclear warhead and yield are augmented by a safety distance (e.g., 2 CEP) in order to predict the number of civilians placed at risk. Population centers (represented as circles) containing more than a preselected number of inhabitants are chosen for avoidance of all but a small percentage of the civilians being placed at risk. These automated risk predictions are made only for target of opportunity events.

(3) Assessment of Civilians at Risk. For each delivered simulated round, an assessment is made of the numbers of civilians placed at risk. The 2-CEP distances, which were added for predictions, are removed, and the blast, thermal, and radiation radii are applied from the AGZ. The total assessment is based on the highest of the figures assessed--blast, thermal, or radiation--and a combined cumulative total for all firings.

(4) Population Distribution. A population data base is essential for the NUFAM II fire planning process. The data, when used in NUFAM II, must depict population areas in terms of P_{95} circles (the area in which approximately 95 percent of a population cluster can be found) with an associated population value and

geographic coordinates. When, for example, more than one circle is needed to cover the built-up area of a city, the population is divided among the P_{95} circles for that city. The fine-grain population data base for the Federal Republic of Germany is frequently used.[6]

5-2. LIMITATIONS. The NUFAM II has the following limitations:

a. The model logic does not simulate firing of multiple shots against a single target of opportunity; however, multiple shots can be fired as preplanned targets.

b. The model logic does not account for the replacement of personnel or equipment during a simulation period.

c. The model logic does not consider the effects of rainout or fallout.

d. The model logic does not assess casualties for cumulative doses; assessments are limited to two individual dose levels.

e. The model logic does not allow the generation of new fire orders while in the interactive mode.

f. Significant programing changes are required to alter the dimensions for the following data elements:

(1) One hundred brigade- or division-size units on the battlefield.

(2) Two sides (Red and Blue).

(3) One hundred types of subunits.

(4) Four target zones in depth from the FEBA.

(5) Ten types of nuclear delivery systems per side.

(6) Five nuclear yields per delivery system.

(7) Nine launchers/artillery pieces/aircraft per firing subunit.

(8) Five personnel protective postures.

(9) Fifty FEBA points.

g. Minor programing changes are required to alter the following data element limitations:

(1) Five thousand subunits on the battlefield.

(2) One thousand nuclear fire orders per side.

(3) Sixty sets of damage assessment radii.

5-3. FIRE PLANNING AND ASSESSMENT DATA FILE. The fire planning and assessment data file is the prime input data to NUFAM II. This file provides the model with the required information for firing guidance, employment constraints, weapon and warhead ballistics, and warhead terminal effects. An unclassified version of this file is stored in the CAA computer under file and element names UNCLASSIFIED*88DATABASE.NUFAMDATA. A classified version of this data is stored in SECRET*80DATABASE.NUFAMINDATA. Read/write keys are required to access the classified file. An unclassified sample of this information is in Appendix I, and instructions for preparing this file are shown in Appendix J. The fire planning and assessment data file consists of the following data subsets:

a. Firing Guidance of Commanders. This subset enables the user to control the intensity of the nuclear exchange. The input parameters for target selection determine the number of detected subunits to be selected for nuclear fire planning. These parameters include target selection period, firing period, lowest priority of target to be considered, maximum number of targets to be considered, and maximum target distance from the FEBA.

b. Fire Planning Data. This data subset provides the model with preferred weapons system/yield combinations based on existing doctrine and constraints. Selection of preferred weapons system/yield combinations for a particular type target is based in part on the percentage of coverage provided by the TCR. Any given preference statement provides up to five weapons system/yield combinations in order of preference. Each target is associated with a specific preference statement for each target zone. This association is provided by the weapon/target allocation data. A given firing preference statement may be associated with any number of target types. When the model logic selects a target for fire planning, it will attempt to select a weapons system/yield combination from the five preference statements. If unable to match the target with a weapons system/yield combination, a cancelled fire event will occur. There are nine reasons for a cancelled fire event to occur. These reasons are:

(1) Target is lost to observation during the command, control, and communications time.

(2) Target is lost to observation after a fire order is created.

(3) No firer is available for a target of opportunity.

(4) No firer is available for a preplanned target.

(5) No firer is available for an immediately available preplanned fire.

(6) No firer is available for an immediately available target of opportunity.

(7) Target is not engaged because a fire order was cancelled by the user through the CRT.

(8) Target is not engaged because no firer can be found to meet civilian collateral damage constraints.

(9) Target is cancelled because no firer can be found to achieve the required percentage of target coverage.

c. Weapons Characteristics Data. The weapons characteristics data subset consists of data describing each delivery system to be simulated by the model. Specific information concerning the delivery systems includes: range capability, system reliability, command and control time, set-up time, available yields, CEP, height of burst (HOB), and troop MSD. This data subset also provides part of the information necessary for selection or rejection of a weapons system/yield combination for engaging a particular target. A cancelled fire event can also occur based on limitations provided by command and control time and MSD.

d. Graphics. The graphics data subset consists of seven card images. The first two images control the NUFAM II simulations in the graphics mode. The subsequent images in the subset provide instructions concerning use or non-use of the graphics mode, project security classification markings, and graphic plotting sizes.

e. Assessment Data. This data subset provides information to the model logic concerning personnel protective postures for given type subunits, radii of effects, subunit breakpoints, and attrition and loss data for casualty and equipment damage assessments. The model logic calculates the percentage of overlap caused by the effects circle on any subunits located in the vicinity of the AGZ. The program then considers input data from this subset to produce assessments in the following areas:

(1) Personnel Casualties. Personnel are assessed at two individual dose levels. Normally, immediate permanent or immediate transient casualties are estimated based on five personnel

protective postures. The different postures for personnel within a subunit are:

(a) Exposed personnel.

(b) Personnel in open foxholes.

(c) Personnel in armored personnel carriers.

(d) Personnel in tanks.

(e) Personnel in earth shelters.

The sum of the casualties inflicted against personnel in each of the five postures gives the total number of subunit casualties.

(2) Subunit Breakpoint. When the percentage of personnel casualties in a given subunit reaches an input breakpoint value, that subunit is identified as "broken" (combat ineffective). A "broken" nuclear-capable firing subunit is not permitted to carry out scheduled fire orders or receive additional fire orders.

(3) Equipment Damage. The equipment damage assessments are similar to the personnel casualties assessments. The radii of effects are used to establish the effects circles to determine overlap on the rectangles representing the equipment dispositions within the subunits. The percent of overlap is considered the damage level. There are seven radii of effects which can be applied to assess subunit equipment.

f. General Activity Simulation Program IV (GASP IV) Data. This data subset provides input for the GASP IV portion of the model. The GASP IV package of FORTRAN routines comprises the framework for integrating the FUNTAR output into NUFAM II. Events (e.g., fire, flee, preplanned target, conclusion, immediately available target, and target of opportunity) are treated as temporary entities by the GASP IV simulation until time for execution of the particular event. The GASP IV program also generates histograms depicting the use of event data storage by event type and simulation time.

g. Preplanned Target Data. This data subset allows the gamer to exercise greater control over the simulation by using preplanned fires against mobile targets. Also, model logic allows nuclear strikes against fixed targets such as bridges, road junctions, railheads, and other fixed point targets, provided such facilities are predefined in the SUSF. This subset permits gamers to input DGZ and weapons system choices in support of the POM

method for nuclear targeting. Data required for entering pre-planned targets are:

(1) Firing side (Red or Blue).

(2) Desired ground zero.

(3) Desired delivery system.

(4) Desired yield.

(5) Earliest nuclear weapons system firing time.

(6) Latest nuclear weapons system firing time.

(7) Earliest time a firing subunit can set up to fire at a target.

5-4. NUFAM II USERS' RUNSTREAM. NUFAM II is executed at CAA on the UNIVAC 1108 computer. The user runstream is a set of computer control statements which will initiate the NUFAM II program and instruct the UNIVAC 1108 computer to take certain sequential actions. The current file element, UNCLASSIFIED*72NUFAM, contains the NUFAM II program. A version of the runstream to execute NUFAM II, is stored in START*88RUN.NUFAMRUN. Appendix K shows the contents of this runstream element. Items underlined in the runstream must be replaced with appropriate information for any particular execution. There are 19 options which can be used in executing NUFAM II. Desired options should be entered with the "XQT" (execute) statement of the runstream. Available options with descriptions are listed in Table 4-1. After the runstream and model input data have been updated for the appropriate execution, only four card images are required to execute NUFAM II. Sample images for a demand mode of execution are as follows:

```
@RUN A188,E1821P7167,UNCLASSIFIED
@ASG,A START*88RUN.
@START START*88RUN.NUFAMRUN
@FIN
```

5-5. NUFAM II OUTPUT DATA. Outcomes from the detailed fire planning and damage assessment routines of NUFAM II are reported in several formats. First, the SUSF data are updated to reflect given subunit losses of personnel and equipment and a designation as to whether or not that subunit has been made combat ineffective. Second, printed output provides data by sides and by units--divisions or brigades. Comparative quantities of personnel and

selected equipment are given for prestrike and poststrike conditions. Casualties (by type), equipment damaged (by type), and the subunit effectiveness of preselected types of subunits are reported. Further, the percentages of personnel casualties and equipment damaged, as a result of a specified weapon system/warhead combination, are given. Most of the preceding data elements, except for percentages, are also aggregated by target detection zones; the results from preplanned fires are segregated from the zone summaries. In addition, civilian casualty reports provide predictions and assessments of civilians placed at risk in centers rated as above or below a predetermined population threshold. Weapon system performances (e.g., shots programed or cancelled) are recorded.

Table 5-1. Available Options for NUFAM II Executions

Option	Description
A	Limit the number of rounds a system can fire.
B	Limit the number of rounds a firing subunit can fire.
C	Interject an interrupted firing period after a certain number of rounds.
D	Continue the simulation without printing intermediate results.
E	Punch AGZ cards for the AGZ plot routine.
F	Punch AGZ and weapons cards for use in the FORECAST II Model.
G	Do not print the current unit status report.
H	List omitted fires.
I	Adjust strengths of personnel and equipment in subunits prior to firing. This reflects attrition from causes external to the NUFAM II logic.
K	Consider the numbers of civilians predicted to be placed at risk as a constraint for Red firings.
M	Consider minimum-size population centers.
O	Offset the DGZ for aggregation, if possible.
P	Consider the numbers of civilians predicted to be placed at risk as a constraint for Blue firings.
Q	Use interactive graphics mode.
R	Check limits for the maximum numbers of civilians predicted to be placed at risk per shot.
S	Check limits for the maximum cumulative numbers of civilians placed at risk by side.
T	Search model queue for the number of targets used with multiple detection cycles in FUNTAR.
V	Do not print GASP IV summary and histogram data.
X	Write program debug statements.

CHAPTER 6

GRAPHIC PLOT ROUTINES

6-1. GENERAL. Several mechanical plotter products are associated with the NUREM II processes. The plot routines give analysts further insights to the outcomes of simulated combat. In particular, such information is essential to the final determination of the combat sample results from NUFAM II, analysis of the distribution of potential targets, and the evaluation of the impacts of nuclear strikes on the maneuver capabilities of major units. Further, the Detected Target Plot (DETGTPLOT) and Population Center Plot (POPPLOT) routines can be used to support the POM nuclear targeting techniques for which preplanned targets must be developed off-line by the gamers. These two plots illustrate the selected potential targets and the contents of the population data base over specified geographic areas. By analysis of likely avenues of approach, troop safety distances, and civilian collateral damage avoidance criteria, the desired yield/delivery systems and DGZ for preplanned targets can be developed for input to NUFAM II. The Actual Ground Zero Plot (AGZPLOT) routine can be employed to facilitate poststrike analyses of the NUFAM II outcomes. Other plots associated with the SUSF enhance gamer perceptions of the opposing forces deployed to company level.

6-2. DETECTED TARGET PLOT

a. This routine results in plots of potential targets (detected subunits) over predetermined geographic areas and at varied map scales. Plots of multiple geographic areas are permissible. All or portions of the potential targets selected by the FUNTAR logic can be plotted. The number of potential targets to be plotted can be controlled through input data entries--the lowest priority of potential targets to be considered and the time of detection. Geographic locations of these detected subunits are based on the perceived locations established in the FUNTAR data file. The file element UNCLASSIFIED*72PLOT.DETGTPLOT contains the current program. A version of the runstreams to execute this routine is stored in file element START*88RUN.DETGTPLOTRUN.

b. At least one set of cards (data images) is required by this routine. The set consists of three plot cards and a terminator card, all of which follow immediately after the "XQT" statement in the runstream. Card formats are:

First Plot Card

Column	Entry
2-12	UTM grid coordinate of point 1. (see note)
14-24	UTM grid coordinate of point 2. (see note)
27-32	Plot length in meters.
33-39	Map scale.
40-63	Any desired title or comment.

Note: The distance in meters between points 1 and 2 must not exceed

$$\frac{\text{scale} \times 28}{39.37}$$

The area to be plotted would be on the left hand if one were to move from point 1 to point 2. The length leg is normal to the line 1-2 at point 2 and extends to the left.

1

Plot area

2

length

Second Plot Card

Column	Entry
11-14	Earliest time of detection for which subunits are to be plotted.
17-20	Latest time of detection for which subunits are to be plotted.

Third Plot Card

Column	Entry
2-3	Lowest priority potential targets on side Blue to be plotted.
5-6	Lowest priority potential targets on side Red to be plotted.
9-11	Total number of potential targets selected by the FUNTAR logic.

Terminator Card

Column	Entry
2-3	99 - mandatory entry

c. The following runstream produces a geographic area plot containing the potential targets as selected by the FUNTAR program. Items underlined in the runstream must be replaced with appropriate information for each particular execution.

```
@RUN A188P,E1831P8182,UNCLASSIFIED
@ASG,T 11.,F///500
@ASG,A 72PLOT.
@ASG,T 10.,F///500
@ASG,T FUNTAR.,8C9,3304R
@MOVE FUNTAR.,3
@COPY,GC FUNTAR.,10.
@ASG,T 15.,F///500
@COPY,GC FUNTAR.,15.
@FREE FUNTAR.
@ASG,T 12.,F///500
@ASG,T PLOTTER.,8C,SAVEW
@MSG SAVEW IS A PLOT TAPE
@USE 16.,PLOTTER.
@XQT 72PLOT.DETGTPLOTABS
 32UMB300600 32UMA300300  200000 100000
             0630  1030
   8 10  335
 32UMB300900 32UMV300600  200000 100000
             0630  1030
   8 10  335
```

```
 99
@FREE 16.
@MSG PLEASE PLOT TWO FRAMES OF SAVEW
@MSG PLEASE USE ACETATE AND BLACK INK
@FIN
```

6-3. POPULATION CENTER PLOT

a. This routine provides plots of independent population centers represented by P_{95} circles having areas in which approximately 95 percent of a population cluster can be assumed evenly distributed. Varied predetermined map scales can be used. The file element containing the current program is UNCLASSIFIED*72PLOT.POPPLOT. A version of the runstream to execute this routine is stored in file element START*80RUN.POPPLOT.

b. One set of cards (data images) is required for this routine. Two plot cards and a terminator card represent one set which follows immediately after the "XQT" statement. Card formats are as follows:

First Plot Card

Use the same format as for the first card of the DETGTPLOT routine.

Second Plot Card

Column	Entry
6-11	Minimum-size population cluster to be plotted.

Terminator Card

Use the same format and data as for this card used in the DETGTPLOT routine.

c. The following runstream executes the POPPLOT routine to produce a geographic area plot containing population centers as represented in the population data file (POPDATA). Items underlined in the runstream must be replaced with appropriate information for each particular execution.

```
@RUN A580P,E1831P8182,UNCLASSIFIED
@ASG,A 72PLOT.
@ASG,A 80POPDATA.
@USE 10.,80POPDATA.
@ASG,T 11.,F/100//500
@ASG,T 12.
@ASG,T PLOTTER.,8C,SAVEW
@MSG SAVEW IS A PLOT TAPE
@USE 16.,PLOTTER.
@XQT 72PLOT.POPPLOTABS
 32UMB300500 32UMA300100  300000 250000
       1000
 99
@FREE 16.
@MSG PLEASE PLOT ONE FRAME OF SAVEW
@MSG PLEASE USE RED INK
@FIN
```

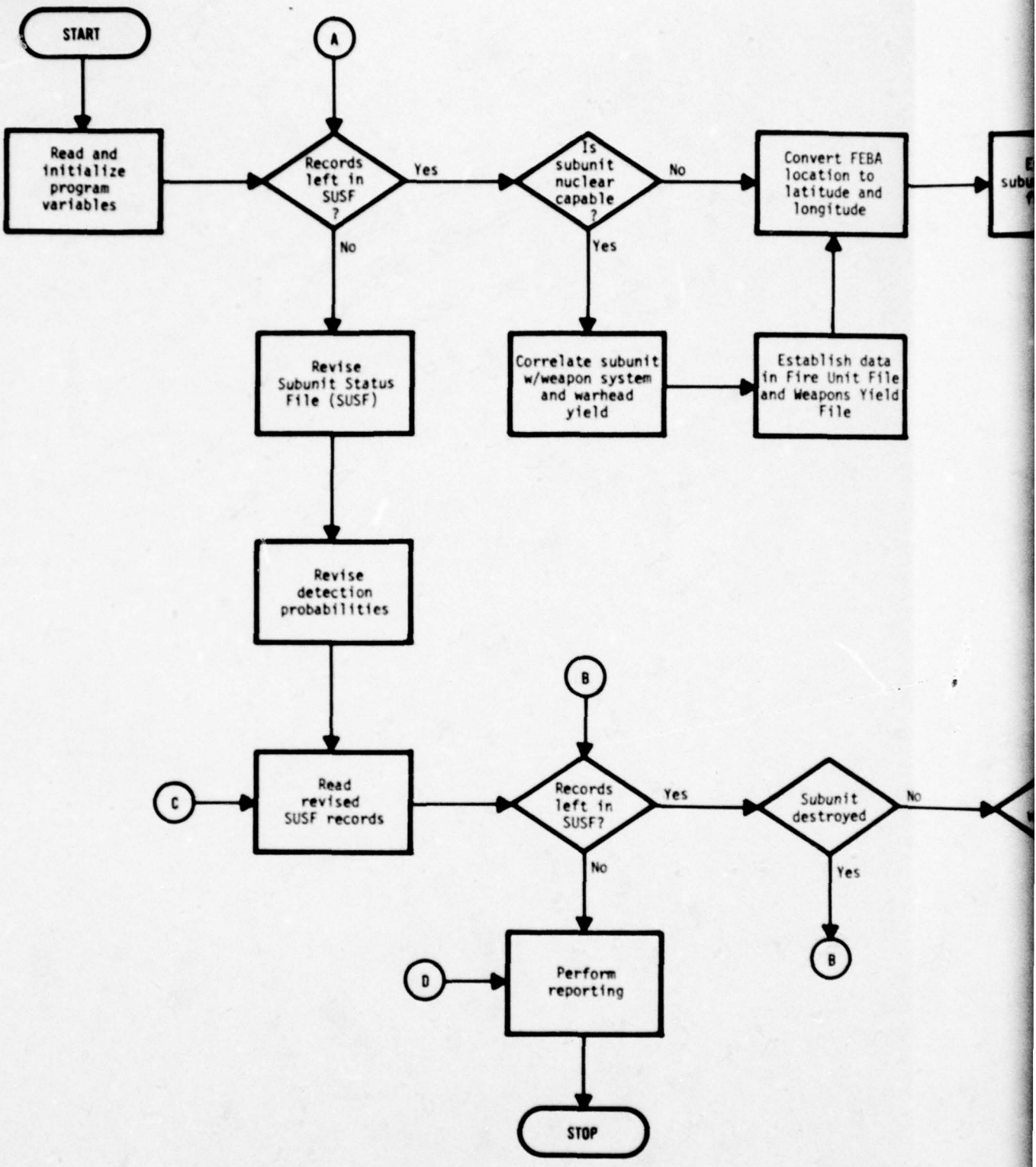
6-4. ACTUAL GROUND ZERO PLOT. This routine provides plots of the actual locations of subunits as defined by the SUSF as well as the locations of the AGZ of nuclear strikes with certain associated radii of effects. Multiple plots, if required, can be generated for given geographic areas and predetermined map scales. Three different plots can be obtained from this routine through the application of varied options with the "XQT" statement in the runstream. Use of option "A" will result in a plot of only the associated effects radii around the AGZ points. Option "U" yields a plot of only the SUSF subunits. A blank entry for the option will result in a plot of the associated effects radii about the AGZ points as well as the SUSF subunits, all within prescribed geographic areas. The file element UNCLASSIFIED*72PLOT.AGZPLOT contains the current program to execute this routine. One plot card is required for each geographic area to be plotted. This type card is identical to the first card used with the DETGTPLOT routine. The AGZ cards provided from using option "F" in the NUFAM II runstream must follow immediately after the first plot card. A spacer card with "98" in Columns 1-2 is required after these AGZ cards. Next, additional plot cards, if required, are entered as a group and then followed by a terminator card identical to that for the DETGTPLOT routine. The following runstream executes the AGZPLOT routine:

```
@RUN A188P,E1831P8182,UNCLASSIFIED
@SYM PRINT$.,,PR
@HDG PLOT SUBUNITS AND AGZ WITH RADII
@ASG,A 72PLOT
@ASG,T 10.,F///500
@ASG,T 11.,F///500
@ASG,T 12.,F///500
@ASG,T INSUSF.,8C9,3810R
@MOVE INSUSF.,1
@COPY,G INSUSF.,10.
@ASG,T PLOTTER.,8C,SAVEW
@USE 16.,PLOTTER.
@XQT,A 72PLOT.AGZPLOTABS
 32UMB300600 32UMA300300  200000 100000
32UNA413909          800.         1500.        2
           ...
           ... (AGZ cards from NUFAM II)
           ...
98
 32UMA300900 32UMV300600  200000 100000
 99
@FIN
```

6-5. SUBUNIT STATUS FILE PLOTS. Plot routines are available to provide graphic representaions of all the subunits describing the battlefield situation in a combat sample. Also, plots can be made to represent the selected units which comprise a given combat sample. Procedures for developing both types of graphic displays are discussed in the SUSF Documentation[3].

APPENDIX A

LOGIC FLOWCHARTS FOR MODELS AND ROUTINES


START
A
Read and initialize program variables
Records left in SUSF ?
Yes
No
Is subunit nuclear capable ?
No
Yes
Convert FEBA location to latitude and longitude
Revise Subunit Status File (SUSF)
Correlate subunit w/weapon system and warhead yield
Establish data in Fire Unit File and Weapons Yield File
Revise detection probabilities
B
C
Read revised SUSF records
Records left in SUSF?
Yes
Subunit destroyed
No
Yes
No
B
D
Perform reporting
STOP

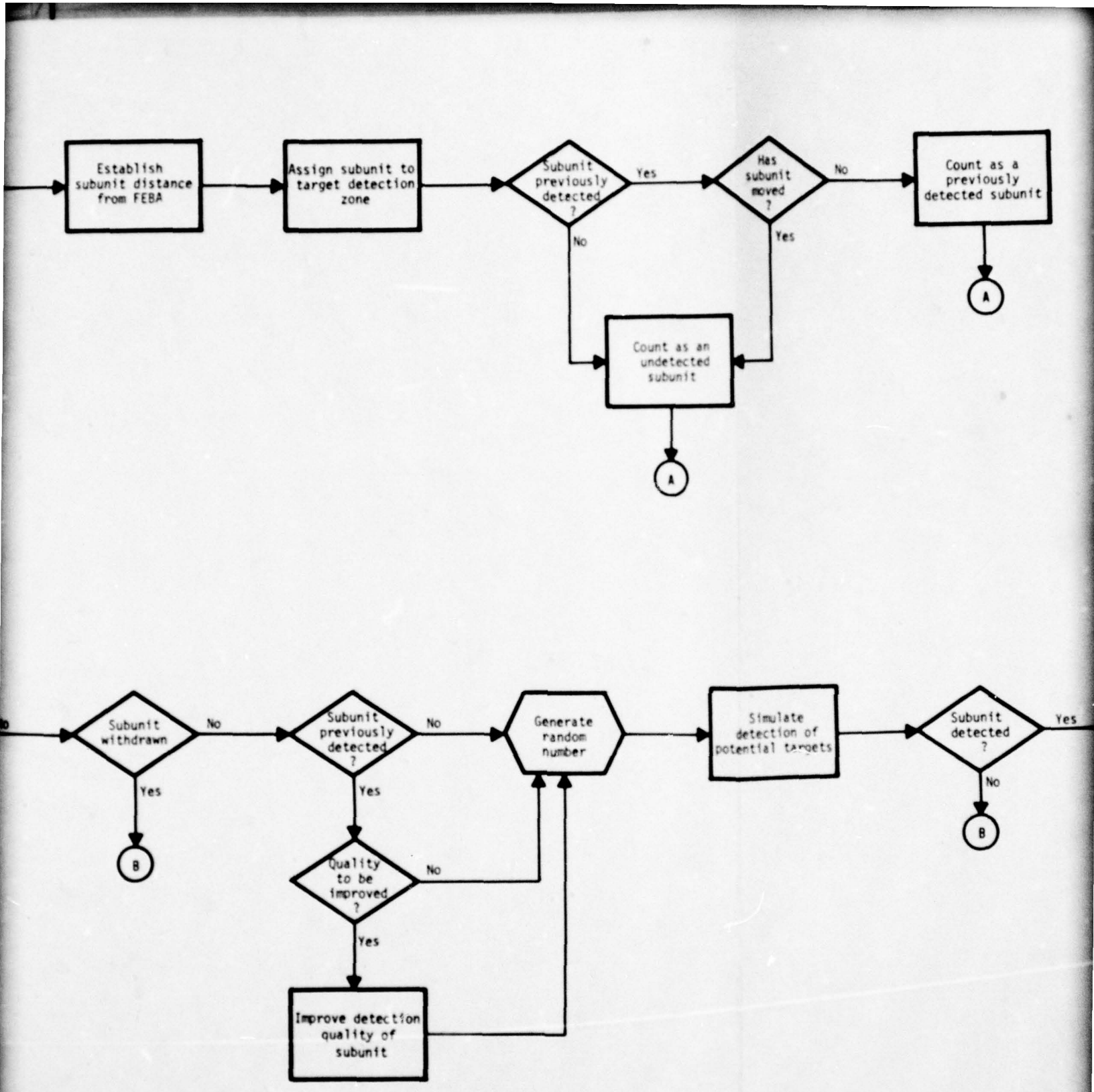
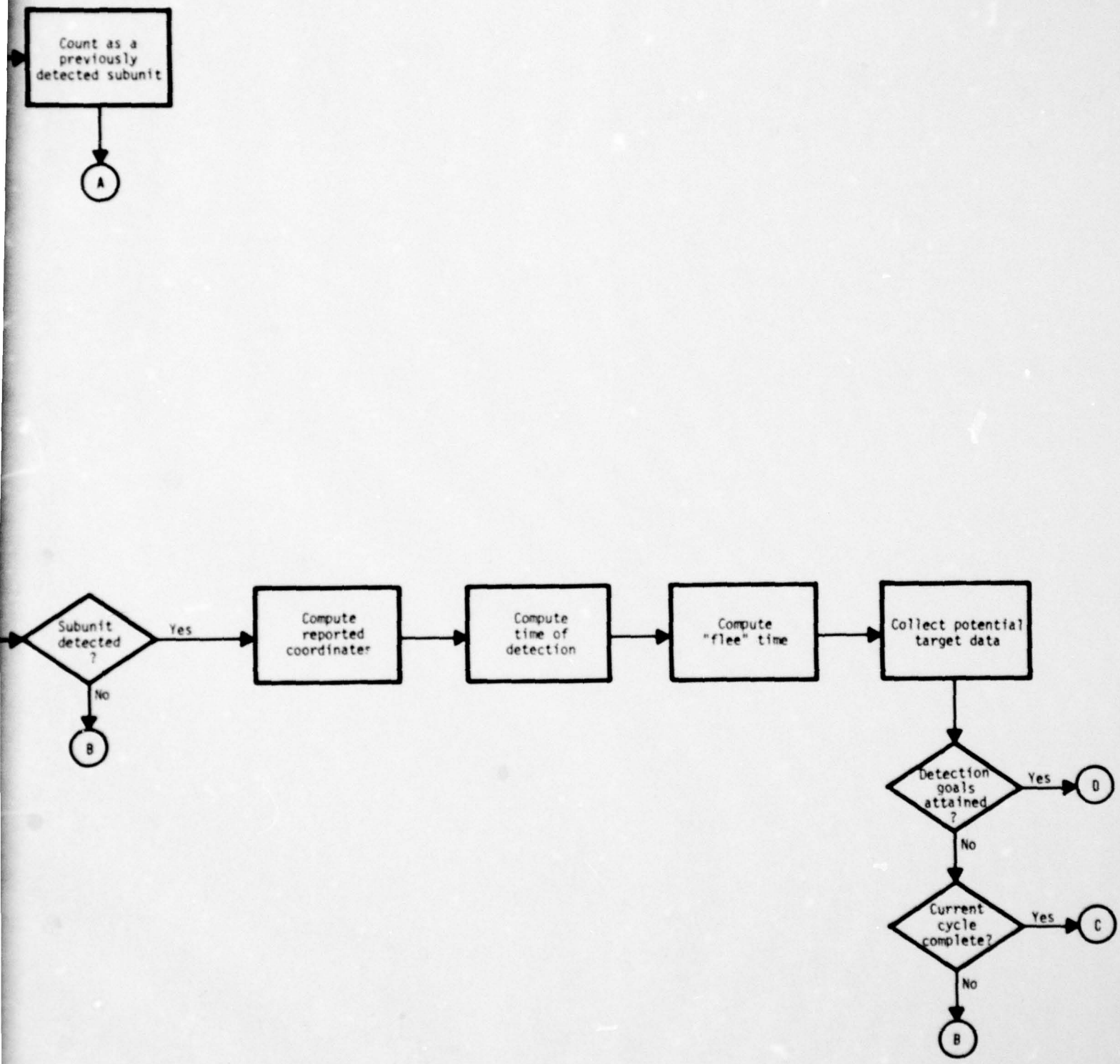


Figure A-1. Logic Flowchart for Fire Unit/Target Acquisition Routine (FUNTAR)


Count as a previously detected subunit
A
Subunit detected ?
Yes
No
B
Compute reported coordinater
Compute time of detection
Compute "flee" time
Collect potential target data
Detection goals attained ?
Yes
D
No
Current cycle complete?
Yes
C
No
B

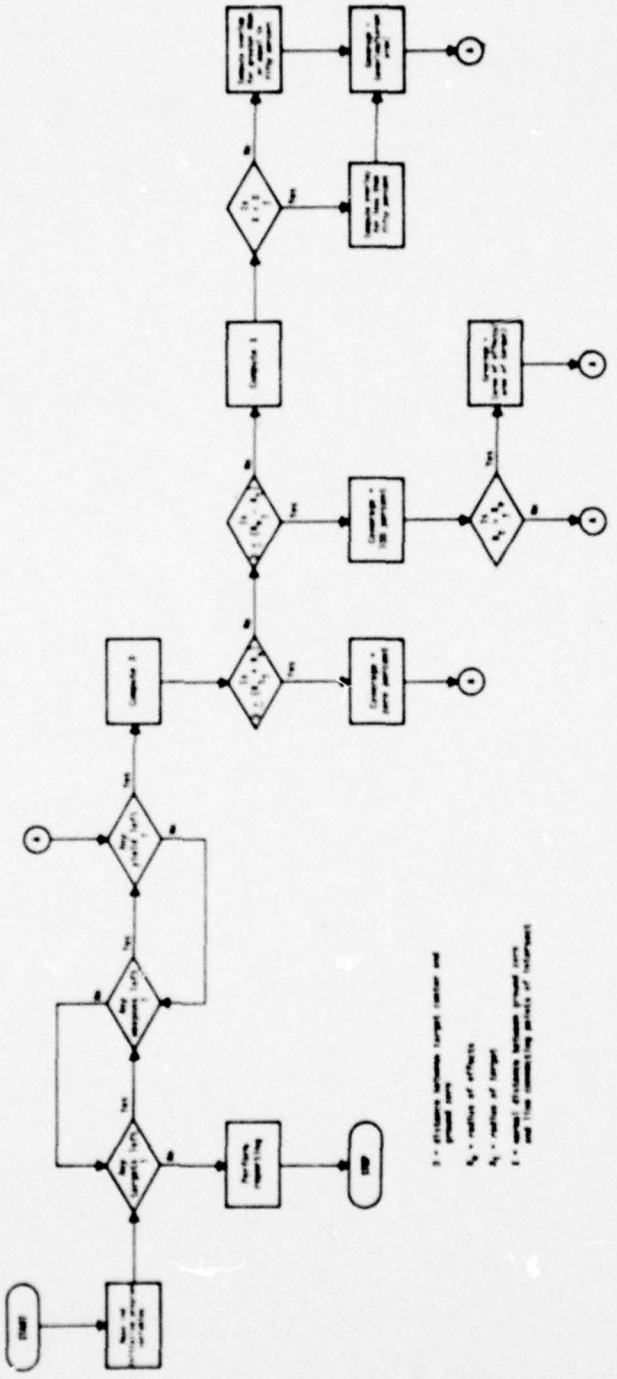
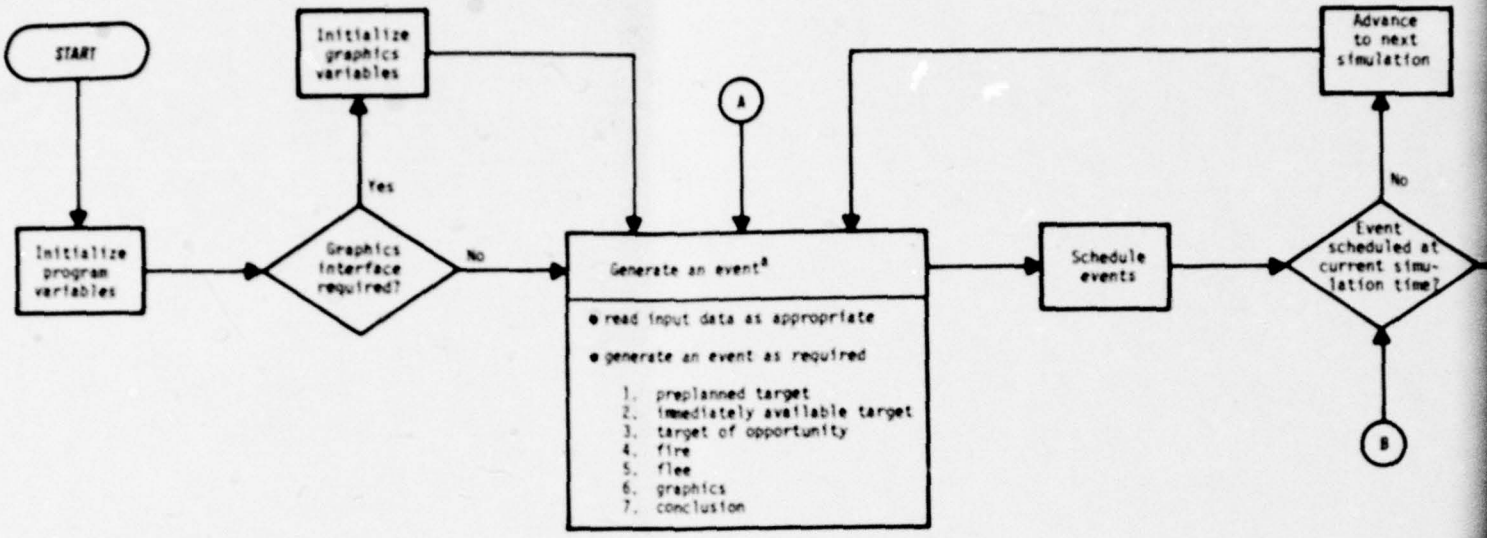


Figure A-2. Logic Flowchart for Target Coverage Routine (TCR)



[a]At each entry to this process, any of the designated subfunctions are performed as required.

Figure A-

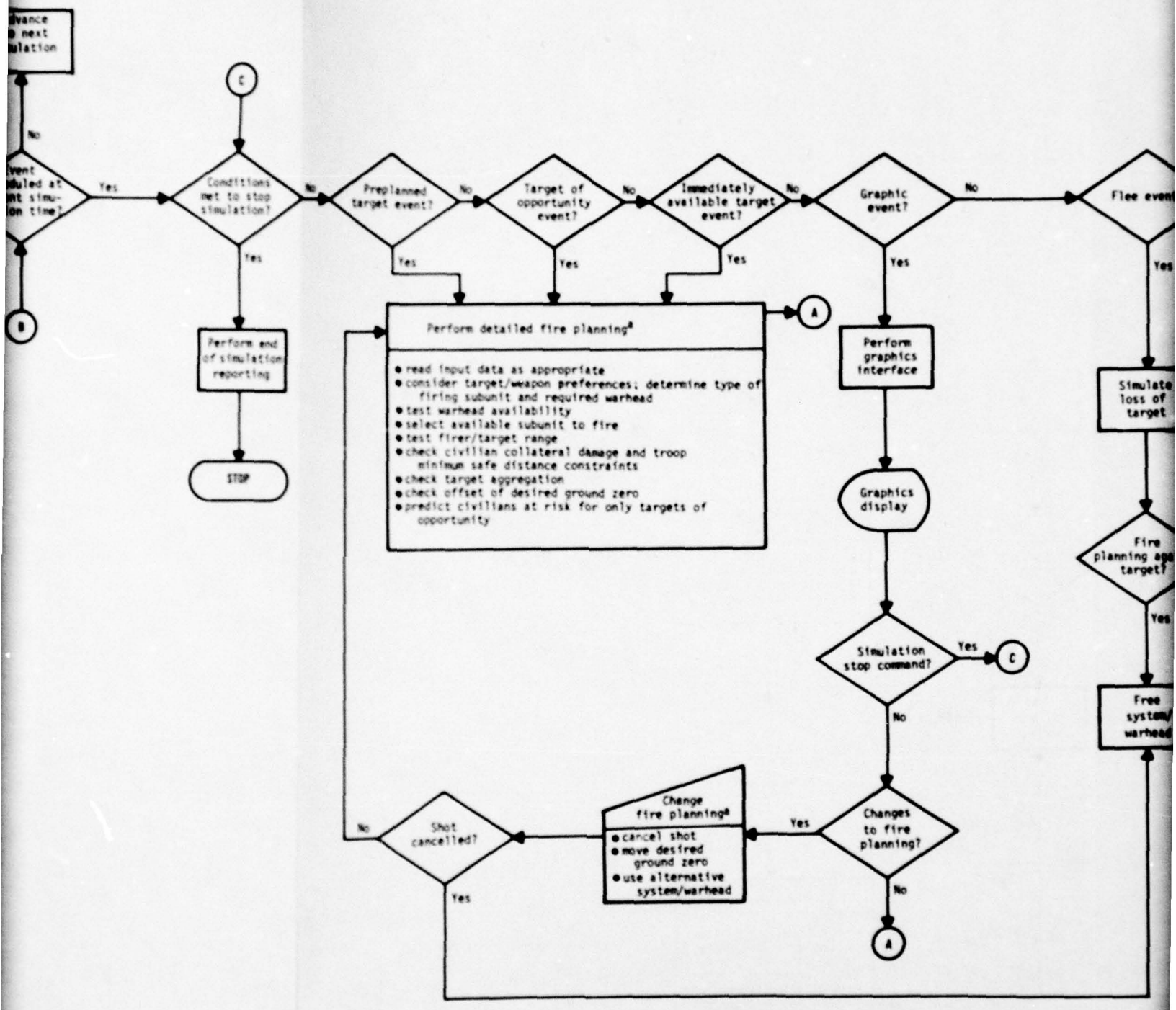
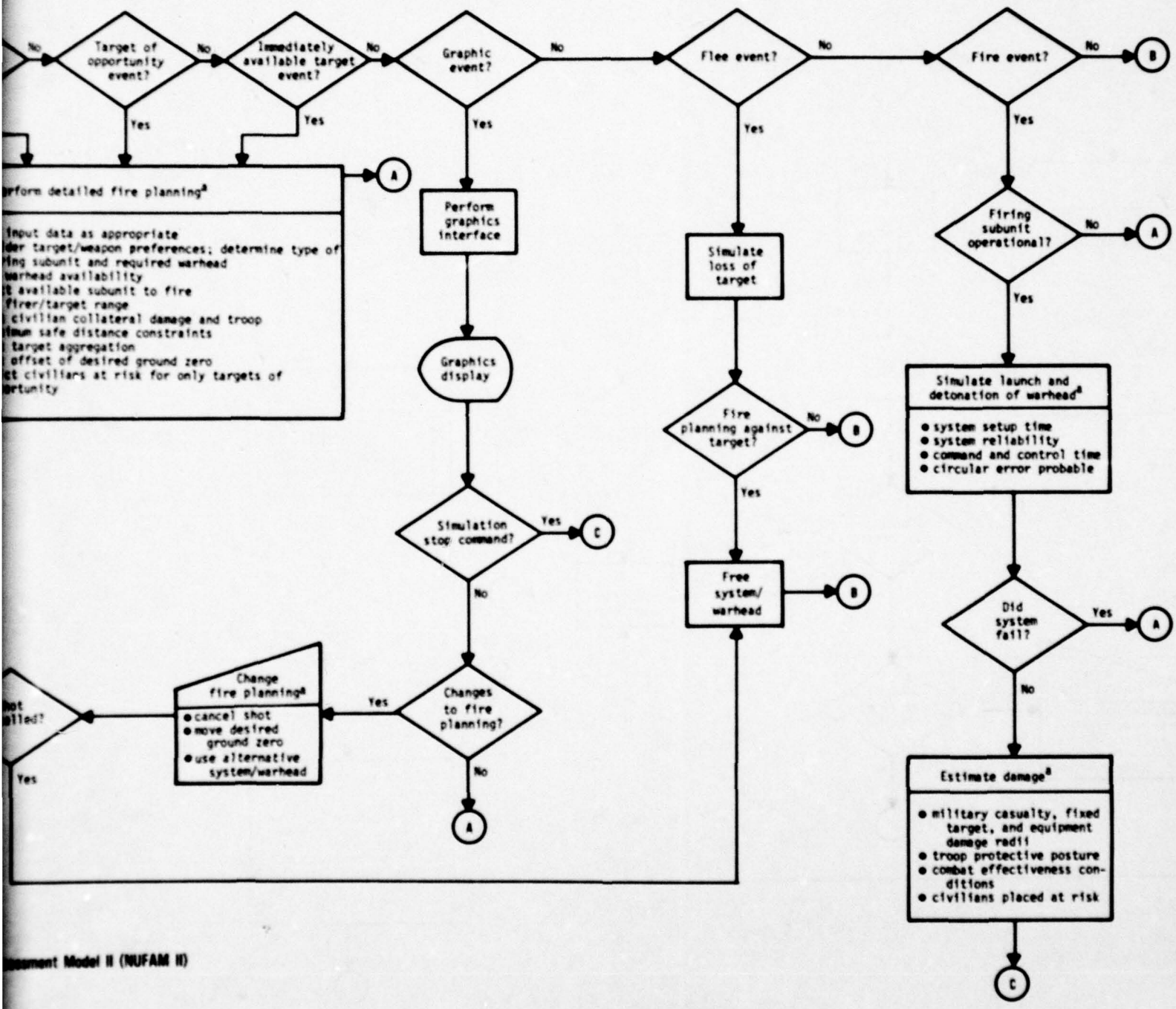


Figure A-3. Logic Flowchart of Events for Nuclear Fire Planning and Assessment Model II (NUFAM II)



sessment Model II (NUFAM II)

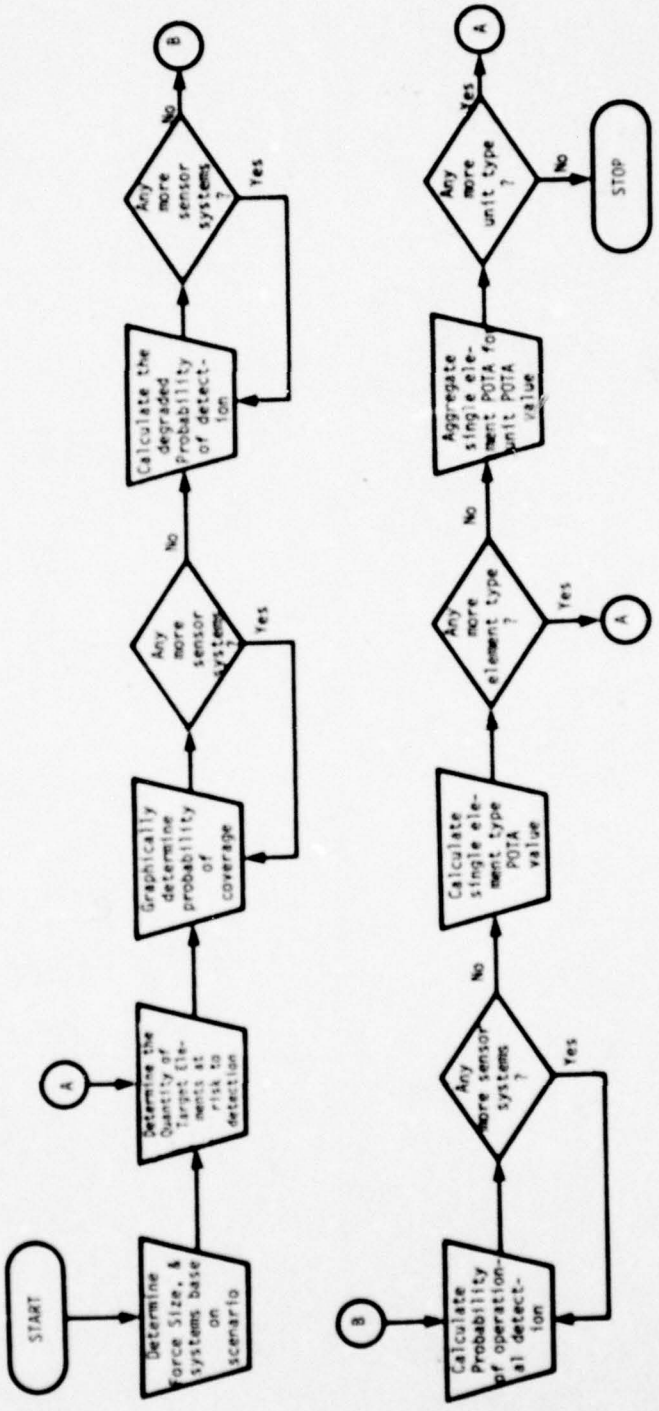


Figure A-4. Logic Flowchart for Probability of Target Acquisition Routine (POTAR)

APPENDIX B

WEAPONS YIELD DATA FILE (UNCLASSIFIED SAMPLE)

```
B    W0N1 3     .00      .1     1.5                    1
0    W0N2 5     .33     1.1     2.0     8.0    10.0    1
0    M3L0 4      .5      5.5                            1
0    0A1M 3      .7      2.0    10.0                    1
M    W0N3 1      .1                                     1
M    MA1M 7     3.0     10.0    20.0    70.0            1
M    M3LM 3   300.0    500.0   800.0                    1
M    MA1M 5     5.0     15.0    30.0    90.0   100.0    1
1
```

APPENDIX C

WEAPONS YIELD DATA FILE (PREPARATION INSTRUCTIONS)

These card images provide yield data for the nuclear-capable weapons systems to be simulated in the combat sample. One card image is required for each system. Up to 10 weapons systems for each side can be used. The last data card must be followed by a terminator card with an "X" in Column 1.

Column	Entry
1	"R" or "B" - side identifier.
3-8	Weapons system identifier (must agree with system identifiers used in the SUSF).
10	Number of yields for the weapons system (maximum of five).
12-17	First yield for weapons system.
19-24	Second yield for weapons system.
26-31	Third yield for weapons system.
33-38	Fourth yield for weapons system.
40-45	Fifth yield for weapons system.
47	Enter "1" if warhead quantities are unconstrained in the simulation. Columns 49-67 require no entries when "1" is used. Enter "2" if warhead quantities are constrained in the simulation.
49-51	Number of rounds available for first yield.
53-55	Number of rounds available for second yield.
57-59	Number of rounds available for third yield.
61-63	Number of rounds available for fourth yield.

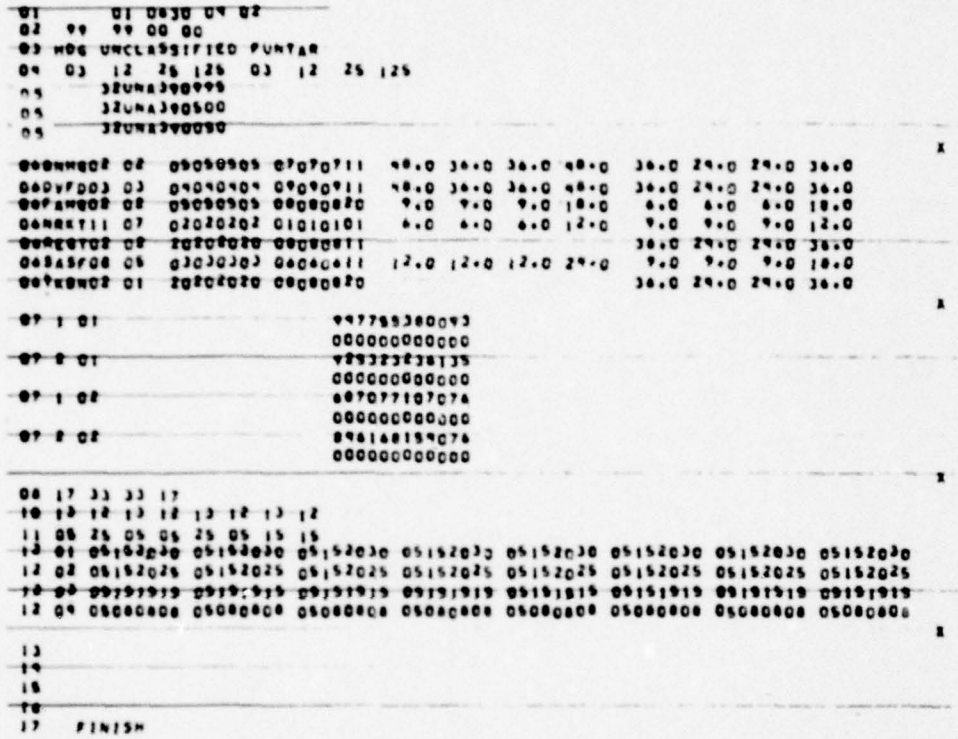
65-67	Number of rounds available for fifth yield.
69	Enter the number of artillery pieces/launchers/aircraft per firing subunit (maximum of nine per subunit).

Terminator Card

Column	Entry
1	X

APPENDIX D

TARGET ACQUISITION DATA FILE (UNCLASSIFIED SAMPLE)



APPENDIX E

TARGET ACQUISITION DATA FILE (PREPARATION INSTRUCTIONS)

Data in this file control the processes for selecting potential targets of opportunity for use in NUFAM II. The card images (referred to as cards) necessary to establish this data file are identified and explained below. Each punch card image is identified by a level rank (LRNK numbers from Ø1 to 17) which must appear in the first two columns.

LRNK Ø1 Card

This card specifies: (1) which probability of detection category is to be used from the LRNK Ø7 cards for the acquisition process, (2) the time at which the process will start, (3) the interval for target acquisition, and (4) the length of the target acquisition cycle. Eight probability of detection categories are possible. These categories can represent changes in target detection probabilities over days of combat. One interval cannot exceed 24 hours or cross over days, e.g., the process cannot start at 2300 hours and have an interval of 4 hours.

Column	Entry
1-2	Ø1 - card identifier.
9-10	Probability of detection category (Ø1 through Ø8) to be selected from the LRNK Ø7 cards for use in the simulation.
12-15	Military time at which to start target acquisition.
17-18	Target acquisition interval in hours. This interval divided by the duration of the target acquisition cycle must be a whole number.
20-21	Duration of the target acquisition cycle in hours.

LRNK Ø2 Card

This card provides the combat surveillance effectiveness for both sides, the probability of improvement in the target location error for a previously detected potential target, and the probability of improvement in the quality of intelligence for a previously detected potential target.

Column	Entry
1-2	Ø2 - card identifier.
4-6	Percentage of effectiveness for Blue surveillance assets.
8-10	Percentage of effectiveness for Red surveillance assets.
12-13	Probability of improvement in the potential target location error for a previously detected subunit (assumed to be the same for both sides). If this feature is not used, enter ØØ in Columns 12-13.
15-16	Probability of improvement in the quality of intelligence for previously detected subunits (assumed to be the same for both sides). If this feature is not used, enter "ØØ" in Columns 15-16.

LRNK Ø3 Card

This card designates any title information desired on the printouts.

Column	Entry
1-2	Ø3 - card identifier.
4-80	Any heading desired by the user. Security classification markings should be included.

LRNK Ø4 Card

This card defines the rear boundary for each of the four target detection zones measured in kilometers from the FEBA. Red and Blue boundaries need not be the same.

Column	Entry
1-2	Ø4 - card identifier.
4-6	Distance from the FEBA to the rear boundary of Blue Zone 1.

8-10	Distance from the FEBA to the rear boundary of Blue Zone 2.
12-14	Distance from the FEBA to the rear boundary of Blue Zone 3.
16-18	Distance from the FEBA to the rear boundary of Blue Zone 4.
20-22	Distance from the FEBA to the rear boundary of Red Zone 1.
24-26	Distance from the FEBA to the rear boundary of Red Zone 2.
28-30	Distance from the FEBA to the rear boundary of Red Zone 3.
31-34	Distance from the FEBA to the rear boundary of Red Zone 4.

LRNK Ø5 Card

These cards define the FEBA trace and enable the FUNTAR logic to calculate the zone in which a given subunit is located. Cards must represent points which are joined by line segments in sequence, e.g., from north to south or east to west. A separate image is required for each FEBA point. A maximum of 50 points can be used. The last data card must be followed by a terminator card with an "X" in Column 80.

Column	Entry
1-2	Ø5 - card identifier.
8-18	Universal Transverse Mercator (UTM) grid coordinates of a FEBA point.

Terminator Card

Column	Entry
80	X

LRNK Ø6 Card

These cards provide information concerning the detection susceptibility, firing priority, and "flee" time of varied type subunits. A maximum of 100 cards can be entered. One card is required for each type of subunit to be detected. The last data card must be followed by a terminator card with an "X" in Column 80.

Column	Entry
1-2	Ø6 - card identifier.
3-6	Subunit identifier (matches subunit type designators in the SUSF).
7-8	Probability of detection set number to be used with this type of subunit. Set number entered is matched with the LRNK Ø7 card images.
10-11	Error distance class applicable to this type of subunit. The class selected as an entry assigns the subunit to the error distance class defined by one of the LRNK 12 card images.
14-15	Red firing priority against this type of Blue potential target in Zone 1.
16-17	Red firing priority against this type of Blue potential target in Zone 2.
18-19	Red firing priority against this type of Blue potential target in Zone 3.
20-21	Red firing priority against this type of Blue potential target in Zone 4.
23-24	Blue firing priority against this type of Red potential target in Zone 1.
25-26	Blue firing priority against this type of Red potential target in Zone 2.
27-28	Blue firing priority against this type of Red potential target in Zone 3.

29-30	Blue firing priority against this type of Red potential target in Zone 4.
33-36	Mean "flee" time in hours for this type of Blue potential target in Zone 1.
38-41	Mean "flee" time in hours for this type of Blue potential target in Zone 2.
43-46	Mean "flee" time in hours for this type of Blue potential target in Zone 3.
48-51	Mean "flee" time in hours for this type of Blue potential target in Zone 4.
54-57	Mean "flee" time in hours for this type of Red potential target in Zone 1.
59-62	Mean "flee" time in hours for this type of Red potential target in Zone 2.
64-67	Mean "flee" time in hours for this type of Red potential target in Zone 3.
69-72	Mean "flee" time in hours for this type of Red potential target in Zone 4.

Terminator Card

Column	Entry
80	X

LRNK Ø7 Cards

These cards are used to specify the probability of detection [illegible]s by detection category, side, and zone. Each detection ca[illegible]ory can be used to represent changes in the detection probab[illegible]ity in terms of days of combat. However, only one set is used in a given computer run. Each detection set number (Columns 7-8, LRNK Ø6 card) requires four cards, two for each side. Cards for Blue precede those for Red. A maximum of 50 sets of four cards can be input. The last data card must be followed by a terminator card with an "X" in Column 80.

First and Third Card for Each Set

Column	Entry
1-2	Ø7 - card identifier.
4	Side identifier. Enter "1" for Blue or "2" for Red.
6-7	Probability of detection set number.
28-30	Probability of detection for Category Ø1 in Zone 1.
31-33	Probability of detection for Category Ø1 in Zone 2.
34-36	Probability of detection for Category Ø1 in Zone 3.
37-39	Probability of detection for Category Ø1 in Zone 4.
41-52	Probability of detection for Category Ø2 in four zones (same format as for Columns 28-39).
54-65	Probability of detection for Category Ø3 in four zones (same format as for Columns 28-39).
67-78	Probability of detection for Category Ø4 in four zones (same format as for Columns 28-39).

Second and Fourth Card for Each Set

Column	Entry
28-39	Probability of detection for Category Ø5 in four zones (same format as for first card).
41-52	Probability of detection for Category Ø6 in four zones (same format as for first card).
54-65	Probability of detection for Category Ø7 in four zones (same format as for first card).
67-78	Probability of detection for Category Ø8 in four zones (same format as for first card).

Terminator Card

Column	Entry
80	X

LRNK 0/8 Card

This card is used to indicate the probability that a newly detected subunit will be assigned to one of four intelligence quality classes. Four quality levels--1 denotes less error than 2--influence the degree of error in the estimated location of a potential target. The sum of the four probabilities must equal 100.

Column	Entry
1-2	Ø8 - card identifier.
4-5	Probability for intelligence quality Class 1.
7-8	Probability for intelligence quality Class 2.
10-11	Probability for intelligence quality Class 3.
13-14	Probability for intelligence quality Class 4.

LRNK Ø9 Card

This card is currently undefined, and no cards are required for input.

LRNK 1Ø Card

This card specifies the probability that the direction of the target location error (TLE) of a newly detected subunit will be keyed to one of eight error direction classes. The sum of the probabilities must equal 100.

Column	Entry
1-2	1Ø - card identifier.
4-5	Probability that the TLE will be to the north.
7-8	Probability that the TLE will be to the northeast.

10-11	Probability that the TLE will be to the east.
13-14	Probability that the TLE will be to the southeast.
16-17	Probability that the TLE will be to the south.
19-20	Probability that the TLE will be to the southwest.
22-23	Probability that the TLE will be to the west.
25-26	Probability that the TLE will be to the northwest.

LRNK 11 Card

This card specifies the probabilities that the magnitude of the TLE will be keyed to one of the error distance categories. The sum of the probability must equal 100. The magnitude of each of the error distance categories is defined by data on the LRNK 12 cards. If this feature is not used, enter a card with only the card identifier to prevent an error abort of the computer run.

Column	Entry
1-2	11 - card identifier.
4-5	Probability that the magnitude will be keyed to error distance category Ø1.
7-8	Probability that the magnitude will be keyed to error distance category Ø2.
10-11	Probability that the magnitude will be keyed to error distance category Ø3.
13-14	Probability that the magnitude will be keyed to error distance category Ø4.
16-17	Probability that the magnitude will be keyed to error distance category Ø5.
19-20	Probability that the magnitude will be keyed to error distance category Ø6.
22-23	Probability that the magnitude will be keyed to error distance category Ø7.

25-26 Probability that the magnitude will be keyed to error distance category Ø8.

LRNK 12 Card

These cards define the magnitude of the TLE by potential target type (LRNK Ø6) and error distance category (LRNK 11). One card must be input for each LRNK Ø7 card. Magnitudes are the same for both sides. The error is entered in decameters. The last data card must be followed by a terminator card with an "X" in Column 80.

Column	Entry
1-2	12 - card identifier.
4-5	Error distance class (LRNK Ø6).
7-14	Error magnitudes in decameters for four zones in error distance category Ø1 (two digits for each zone).
16-23	Error magnitudes in decameters for four zones in error distance category Ø2 (two digits for each zone).
25-32	Error magnitudes in decameters for four zones in error distance category Ø3 (two digits for each zone).
34-41	Error magnitudes in decameters for four zones in error distance category Ø4 (two digits for each zone).
43-50	Error magnitudes in decameters for four zones in error distance category Ø5 (two digits for each zone).
52-59	Error magnitudes in decameters for four zones in error distance category Ø6 (two digits for each zone).
61-68	Error magnitudes in decameters for four zones in error distance category Ø7 (two digits for each zone).
70-77	Error magnitudes in decameters for four zones in error distance category Ø8 (two digits for each zone).

Terminator Card

Column	Entry
80	X

LRNK 13 and 14 Cards

These two cards are currently undefined. However, two cards with only the card identifier are required to prevent an error abort of the computer run.

Column	Entry
1-2	"13" or "14" - card identifier.

LRNK 15 and 16 Cards

These cards are currently undefined. However, two cards with only the card identifier are required to prevent an error abort of the computer run.

Column	Entry
1-2	"15" or "16" - card identifier.

LRNK 17 Card

Four types of cards comprise the LRNK 17 data set to provide various data to describe the weapon systems. One weapons system card must be input for each firing subunit type entry on the LRNK 15 and LRNK 16 cards. A maximum of five yield cards can be entered for each weapons system card. Sufficient range/MSD cards must be entered to satisfy the range/MSD combinations listed in Columns 12-13 of the yield card. The last data card must be followed by a terminator card with "FINISH" entered in Columns 1-6.

Column	Entry
1-2	17 - card identifier.
4	"R" or "B" - side identifier.

6-11	Weapon system name - must agree with the weapon names in the SUSF.
13-18	Maximum range in meters.
20-24	Minimum range in meters.
27	Number of yields.

Yield Card (one card for each yield)

Column	Entry
5-10	Warhead yield to one decimal place.
12-13	Number of range/MSD combinations to follow (maximum of 18).

Range/MSD Cards (maximum of three cards)

Column	Entry
10-14	First, seventh, or thirteenth range in meters.
16-19	First, seventh, or thirteenth MSD in meters.
21-25	Second, eighth, or fourteenth range in meters.
27-30	Second, eighth, or fourteenth MSD in meters.
32-36	Third, ninth, or fifteenth range in meters.
38-41	Third, ninth, or fifteenth MSD in meters.
43-47	Fourth, tenth, or sixteenth range in meters.
49-52	Fourth, tenth, or sixteenth MSD in meters.
54-58	Fifth, eleventh, or seventeenth range in meters.
60-63	Fifth, eleventh, or seventeenth MSD in meters.
65-69	Sixth, twelfth, or eighteenth range in meters.
71-74	Sixth, twelfth, or eighteenth MSD in meters.

Terminator Card

Column	Entry
1-6	FINISH

APPENDIX F

FUNTAR RUNSTREAM (UNCLASSIFIED SAMPLE)

```
@RUN,/TSB [redacted]
@SYP  PRINTS,,,99
@MSG UNCLASSIFIED FUNTAR
@ASG,T  3,,F18/R/TRK                                  @UNO3
@ASG,T  4,,F18/12/TRK                                 @UNO4
@ASG,T  8,,F18///SDC
@ASG,T  9.                                            @ARRAYS
@ASG,T 10.                                            @INUNITS
@ASG,T 11,,F///SDC                                    @OUTUNITS
@ASG,T 12,,F18///SDC                                  @FUNFILE
@ASG,T 13.                                            @TEMPFILE
@ASG,T 14.                                            @YLD FILE
@ASG,T 15,,F///SDC                                    @TGT FILE
@ASG,T 777,,F///ALO
@SETC 10
@ASG,T INSUSF,,ACR,[redacted]                         @SUSF TAPE REQUIRED.
@COPY,GC INSUSF,,9.
@COPY,GC INSUSF,,10.
@FREE INSUSF.
@ASG,A SECRET*PRODATABASE/ /  .                       @PACK DATA BASE
@COPY,S [redacted]
@COPY,S [redacted]
@FREE [redacted]
@ASG,A 77ABSOLUTE/ /  .
@COPY,A 77ABSOLUTE,TABABS,777.
@COPY,A 77ABSOLUTE,SUSFABS,777.
@COPY,A 77ABSOLUTE,SORTGTABS,777.
@FREE 77ABSOLUTE.
@XQT,F  777,SUSFABS
@ADD,P 777,UNCLASTLOFILE
@ASG,T [redacted]
@COPY,GMC 17,,SAVTAP.
@COPY,GMC 16,,SAVTAP.
@FREE 17.
@SETC 7
@ASG,T TGTS,,F///SDC
@USE 17,,TGTS.
@FIT,UBD 777,UNCLASINDATA,,**
-1,1
01      01 0610 04 02
@END **
@XQT,T 777,TABABS
@ADD,P 777,UNCLASINDATA
@COPY,GMC 4,,SAVTAP.
@COPY,GMC 11,,SAVTAP.
@COPY,GMC 15,,SAVTAP.
@CLOSE SAVTAP.
@FREE SAVTAP.
@XQT 777,SORTGTABS
@FIN
```

APPENDIX G

TARGET COVERAGE ROUTINE DATA FILE (UNCLASSIFIED SAMPLE)

```
COVERAGE OF RED WEAPONS ON BLUE TARGETS
.5
 9
 21   21   52 9999
 11   20   26 9999
 31   31   41   64
 13   23 9999 9999
800  800  800  800
630  630  630  630
600  600  600  600
630  630  630  630
440  440  440  440
  2    2    2    2    5    3    4    5    5
  1  190  250  230  400
  2  510  660  610  960
  3  510  660  610  960
  4  630  820  760 1200
  5  190  250  230  400
  6  510  660  610  960
  7  510  660  610  960
  8  740  960  900 1500
  9  740  960  900 1500
 10  960 1170 1100 1850
 11 1100 1430 1370 2300
 12 1430 1860 1820 3100
 13 1970 2560 2600 4350
 14 1970 2560 2600 4350
 15 2345 3050 3095 5160
 16 2460 3225 3780 5400
 17  510  660  610  960
 18  630  820  760 1200
 19  830 1060 1010 1700
 20 1240 1610 1550 2600
 21  560  730  670 1050
 22  740  960  900 1500
 23  960 1170 1100 1850
 24 1430 1860 1820 3100
 25 1970 2560 2600 4350
 26  630  820  760 1200
 27  830 1060 1010 1700
 28 1020 1325 1250 2100
 29 1170 1520 1470 2450
 30 1430 1860 1820 3100
 17
HRCD    2 1954 1954  000  000   50  150  200  300
HRCR    2  000  423  423  000   50  150  200  300
HRMC    2   50   50   50  000   50  150  200  300
HRRE    2  000  000  000 1128   50  150  200  300
ARCD    1 1954 1954  000  000   50  150  200  300
ARCR    1  000  423  423  000   50  150  200  300
ARMC    1   50   50   50  000   50  150  200  300
ARRE    1  000  000  000 1128   50  150  200  300
ACCD    2  564  564  000  000   50  150  200  300
ACCR    2  564  564  564  564   50  150  200  300
ACMC    2   50   50   50   50   50  150  200  300
ACRA    2  000  000  000  000   50  150  200  300
```

APPENDIX H

TARGET COVERAGE ROUTINE DATA FILE (PREPARATION INSTRUCTIONS)

These data images (referred to as cards) control the production of data which is analyzed by gamers who select preferred nuclear weapons/yields combinations for use against given type subunits. The chosen outcomes are input to NUFAM II as part of the fire planning and assessment data file.

Data Title Card

This card allows the user to identify the file.

Column	Entry
1-60	Any title desired by the user to distinguish the files for each set of data.

Coverage Card

This card establishes the percentage of desired coverage to be considered by the routine logic.

Column	Entry
4-5	Percentage of desired coverage.

Weapons Systems Card

This card establishes the number of weapons systems to be considered by the routine.

Column	Entry
4-5	Number of systems to be considered (not to exceed 15).

CEP Cards

One CEP card is required for each weapon system to be considered. A maximum of 15 CEP cards can be entered. Each CEP card has four range considerations. These four range considerations should correspond to the target detection zones used in FUNTAR and NUFAM II.

If a weapon system is not to be considered for a particular zone, an entry of "9999" must be made. The order of the CEP cards must be in a sequence of preferences for cases of equal coverage.

Column	Entry
2-5	CEP in meters for Zone 1.
7-10	CEP in meters for Zone 2.
12-15	CEP in meters for Zone 3.
17-20	CEP in meters for Zone 4.

Weapons Yield Card

This card defines the number of yields per weapon system to be considered. The order of entries must correspond to the order of the CEP cards representing the particular weapons system. A maximum of 15 entries is allowed.

Column	Entry
5	Number of yields for weapon system number one.
10	Number of yields for weapon system number two.
15	Number of yields for weapon system number three.
20	Number of yields for weapon system number four.
25	Number of yields for weapon system number five.
30	Number of yields for weapon system number six.
35	Number of yields for weapon system number seven.
40	Number of yields for weapon system number eight.
45	Number of yields for weapon system number nine.
50	Number of yields for weapon system number ten.
55	Number of yields for weapon system number eleven.
60	Number of yields for weapon system number twelve.

65	Number of yields for weapon system number thirteen.
70	Number of yields for weapon system number fourteen.
75	Number of yields for weapon system number fifteen.

Effects Radius Card

One effects radius card is required for each weapon yield to be considered. Each effects radius card has four entries representing the radii of damage in meters for a particular yield against four different personnel protective postures which are predefined by the user. The order of the effects radius cards must be in sequence to correspond with the weapons yields.

Column	Entry
2-5	Numerical sequence of the radius of effects cards.
7-10	Radius of effects for personnel protective posture one.
12-15	Radius of effects for personnel protective posture two.
17-20	Radius of effects for personnel protective posture three.
22-25	Radius of effects for personnel protective posture four.

Target Cards

Two types of cards are required to define the targets to be considered. One target type quantity card defines the number of target types to be considered. The second type card, the target description card, defines the personnel protective posture, target radius, and error distance by type target. The number of target description cards must equal the quantity entered on the target type quantity card.

Target Type Quantity Card

Column	Entry
1-5	Number of target types to be considered.

Target Description Card

Column	Entry
3-6	Target type (subunit identifier as used in SUSF).
11	"1", "2", "3", or "4". One of the four types of personnel protective postures predefined by the user. This entry is to be associated with one of the four radii of effects defined by the effects radii cards.
13-16	Target radius in meters for Zone 1.
18-21	Target radius in meters for Zone 2.
23-26	Target radius in meters for Zone 3.
28-31	Target radius in meters for Zone 4.
33-36	Error distance in meters for Zone 1.
38-41	Error distance in meters for Zone 2.
43-46	Error distance in meters for Zone 3.
48-51	Error distance in meters for Zone 4.

APPENDIX I

FIRE PLANNING AND ASSESSMENT DATA FILE (UNCLASSIFIED SAMPLE)

```
  715
      555
8 15.0  6.5  500  10  125000      50 11.0 13.0    0
X
8 15.0  6.5  500   8  125000      50 11.0 13.0    0
X
001 8     2.0  GUN2   0.6  RATR   .55  GUN2   0.1  GUN1   .06  GUN1
201 8     0.1  GUN1   1.0  RATR   5.0  RATR  10.0  RATR
   X
  ADAS  001 001 002 002   201 201 202 202
  ARTY  001 001 002 002   201 201 202 202
  XXXX
WEAPON DECK
  GUN1 8  15000 3000 75  1.0  1.0 1  500
 CEP   GUN1   6000  50  8000  75 12000 100 15000 150
 CEP   GUN1
 HOB   GUN1     .06   5300  60  8000  60 12000  80 15000 120
 HOB   GUN1     .06
 MSD   GUN1     .06   8000 500  8000 600 10000 700 10700 800 12000 900
 MSD   GUN1     .06  1000001000 15000011000
 MSD   GUN1     .06
 MSD   GUN1     .06                                                        50  500
 HOB   GUN1      .1   7000  50  9000  75 11000 100 15000 150
 HOB   GUN1      .1
 MSD   GUN1      .1   8000 500  8000 600 10000 700 10700 800 12000 900
 MSD   GUN1      .1  1000001000 15000011000
 MSD   GUN1      .1
 MSD   GUN1      .1                                                        50  500
FINISH
   X
   .5001
GRAPHICS DECK
     0
     0
                UNCLASSIFIED
ASSESSMENT DECK
  OPTION
?
?
X
  POSTUP
 ADAS                  60   81
 ARTY 15               72   28
X
  BOTT
   .05      40   500   500   500   500   500   500   500   500   500   500
   500   500   500   500   500   500   500   500 1330
   .1       60   500   500   500   500   500   500   500   500   500   500
   500   500   500   500   500   500   500   500 1500
Y
  POINT CARD
 10  8 15.5 15.5  70  50 70 70  6    11 701111   1111    10 999999 999999 9999
Y
```

```
 LOSSES
  50000 | 50000   57777   57777   57777   57777   57777   57777
  500   500   500   577   577   577   577   577
  500   500
*
  UNITS
                                                    ATTRIT
ADEF MFC1 ARM1 CVC1 MPLT INF1 SPTU SIG1 AMS1 RATE MFC2 ARM2 ARM3 CAV1 TPLT CSPT
OVMN RFGT  INC  MRC RTN1 N2MT DMCN  RCP MORT RWCN  SAM DVFD SAMM RATE MPLT SIG2
ANMO AR21 FAMO FNDT NGUN S3SF S4SR AIAS CMOS MORT MFD2
     R
    TANK    APC   GUN1   GUN2   MSL+    177   CHAP   RMD1    BC2   MSS1
       1.00   1.00   1.77   1.77   1.77   1.77   1.77   1.77   1.77   1.77
       1.00   1.00   1.77   1.77   1.77   1.77   1.77   1.77   1.77   1.77
       1.00   1.00
     R
    TANK  1TANK    177   RWTR    177   GUN1   S-67   SA-6  TRUCK    SAM
       1.00   1.00   1.77   1.77   1.77   1.77   1.77   1.77   1.77   1.77
       1.00   1.00   1.77   1.77   1.77   1.77   1.77   1.77   1.77   1.77
       1.00   1.00
*
  END DATA
  UNCLASNUFAM      A21    71    17 1978     1777777777777777
     6     2     8     0     1     2  600    25     1 9990     0     0     0
TYP 1     1TGTO NUM
TYP 1     2FIRE NUM
TYP 1     3KILL NUM
TYP 1     4EVTS NUM
TYP 1     5FIREQTIM
TYP 1     6FLEEQTIM
TYP 4     1FIREQTIM          1.7
TYP 4     2FLEEQTIM          1.7
TYP 5     1TGTO NUM             24          1.7          1.0
TYP 5     2FIRE NUM             24          1.7          1.0
TYP 5     3KILL NUM             24          1.7          1.0
TYP 5     4EVTS NUM             47          1.7         17.0
TYP 5     5FIREQTIM             24          1.7          1.0
TYP 5     6FLEEQTIM             24          1.7          1.0
TYP 5     7FLEERA               24          1.7          1.0
TYP 5     7FLEERA               24          1.7          1.0
TYP6A     1EVENTS 0                    17     2          1.5
TYP6B     11FIRE EV     3     3          3.7         50.3
TYP6B     22TMTGT EV    1     1          1.7         50.0
TYP6B     33TGTO  EV    1     1          1.7         50.0
TYP6B     66FIRE  EV    1     1          1.7         50.0
TYP6B     55FLEE  EV    1     1          1.7         50.0
TYP6B     66FL-1  EV    1     1          1.7         50.0
TYP6B     77FL-2  EV    1     1          1.7         50.0
TYP6B     88FL-3  EV    1     1          1.7         50.0
TYP6B     99FL-4  EV    1     1          1.7         50.0
TYP6B    10TALL EVTS    1     1          1.7         50.0
     2
     1
     1    1    1    0         3.3         25.3    1631836539?
*
  33UPA900700    1.5   GUN1   11.5   12.5   13.0   10000 PREPLANNED
```

APPENDIX J

FIRE PLANNING AND ASSESSMENT DATA FILE (PREPARATION INSTRUCTIONS)

The data in this file comprise one of the fundamental inputs to NUFAM II. As such, this information controls the detailed fire planning, damage assessments, and civilian collateral damage aspects of NUREM II. Required data images (referred to as cards) are described below.

Random Number Generator Seed Card

This card provides data to seed the random number generator for the model (right justified entry).

Column	Entry
1-5	A whole number - random number generator seed.

FUNTAR Target Card

This card establishes the number of potential targets to be considered. The entry must agree with the total number of potential targets selected by the FUNTAR logic (right justified entry).

Column	Entry
6-9	Number of potential targets detected by FUNTAR.

Firing Parameters Cards

Two sets of cards are required, one for each side. More than one card can be used for each side. These cards specify various firing constraints to be used in the model (right justified entries). Two "X" images are needed, one to separate the two sets, and one after the second set. The "X" is in Column 1.

Columns	Entry
1	Target side ("R" for Red or "B" for Blue).
3-6	Latest time at which the detected subunits of this side will be selected as targets (expressed in hours and tenths of hours).

8-11	Earliest time at which the detected subunits of this side will be selected as targets (expressed in hours and tenths of hours).
13-16	Maximum number of potential targets of this side to be considered in the simulation.
18-20	Lowest priority potential target of this side to be considered in the simulation.
22-28	Maximum distance (in meters from the FEBA) at which a target of this side can be engaged.
30-35	Minimum distance (in meters from the FEBA) at which a target of this side can be engaged.
37-40	Earliest time at which an enemy weapon can be fired against targets of this side. Entries are expressed in hours and tenths of hours. The earliest permissible time is the earliest time of potential target detection; the latest permissible time is 999.9 hours
42-45	Latest time at which an enemy weapon can be fired against targets of this side. Entries are expressed in hours and tenths of hours. The latest permissible time is 999.9 hours.
50	"Ø" is entered if only one firing parameters card is used per side.

X Cards (two each)

Column	Entry
1	X

Firing Preference Statement Cards

These cards establish up to five delivery system/yield combinations which can be employed against a target or a group of targets. At least one card is required for each side. A maximum of 400 cards can be used. Yields are input in kilotons (KT) and will be read to two decimal places. Data images must be consistent with the system/yield combinations used elsewhere (right justified entries). The last data card must be followed by a terminator card with an "X" in Column 5.

Column	Entry
1-3	Card sequence number. Blue cards should start at "001". Red cards should start at "201".
5	Firing side ("R" for Red or "B" for Blue).
7-12	Yield of weapons system one.
13-18	System name of weapons system one.
19-24	Yield of weapons system two.
25-30	System name of weapons system two.
31-36	Yield of weapons system three.
37-42	System name of weapons system three.
43-48	Yield of weapons system four.
49-54	System name of weapons system four.
55-60	Yield of weapons system five.
61-66	System name of weapons system five.

Terminator Card

Column	Entry
5	X

Weapon/Target Allocation Cards

These cards are used to assign a firing preference statement, as defined in the firing preference statement card, to each type of potential target by zone. A given firing preference statement can be assigned to any number of potential target/zone combinations. A maximum of 100 cards is allowed. The last data card must be followed by a terminator card with "XXXX" in Columns 3-6.

Column	Entry
3-6	Subunit identifier from the subunit designator dictionary for SUSF.
9-11	Three digit firing preference statement number for Blue potential targets of this type located in Zone 1.
13-15	Same as above for potential targets located in Zone 2.
17-19	Same as above for potential targets located in Zone 3.
21-23	Same as above for potential targets located in Zone 4.
27-29	Three digit firing preference statement number for Red potential targets of this type located in Zone 1.
31-33	Same as above for potential targets located in Zone 2.
35-37	Same as above for potential targets located in Zone 3.
39-41	Same as above for potential targets located in Zone 4.

Terminator Card

Column	Entry
3-6	XXXX

Weapons Characteristics Header Card

This card provides a title to distinguish the weapons characteristics section from other portions of the data.

Column	Entry
1-11	WEAPON DECK

Delivery System Cards

These cards provide data concerning the delivery systems. One card is required for each delivery system to be simulated (right justified entries).

Column	Entry
1-6	Delivery system name.
8	Firing side ("R" for Red or "B" for Blue).
10-15	Maximum range of system in meters.
17-20	Minimum range of system in meters.
22-23	Firing system reliability. Enter an integer percentage.
25-28	Command and control time expressed in hours and tenths of hours. This time represents the difference between the time a potential target is acquired and the time a fire order is generated. Intelligence processing, decisionmaking, and communicating delays are accounted for by this entry.
30-33	Set-up time expressed in hours and tenths of hours. This figure represents the time between the receipt of a fire order and the launch of a warhead by the firing subunit. Warhead assembly and technical fire direction delays are accounted for by this entry.
34-35	The number of yields available to the delivery system. A set of HOB and MSD cards must be prepared for each yield.
37-40	Maximum number of rounds available for this system.

CEP Cards

Two CEP cards are required for each delivery system. Up to five sets of range/CEP values can be entered on each card. The last entry will reflect the CEP at the maximum range of the delivery system. Range independent systems require only one range/CEP entry reflecting the CEP at maximum range. In that case, the second card must reflect the card title (CEP) and the delivery system name (right justified entries).

Column	Entry
2-4	CEP - card identifier.
6-11	Delivery system name.
13-18	Range one in meters.
19-22	CEP for range one in meters.
23-28	Range two in meters.
29-32	CEP for range two in meters.
33-38	Range three in meters.
39-42	CEP for range three in meters.
43-48	Range four in meters.
49-52	CEP for range four in meters.
53-58	Range five in meters.
59-62	CEP for range five in meters.

HOB Cards

Two HOB cards are required for each delivery system and yield to be used in the simulation. Up to five sets of range/HOB values can be entered on each card. The last entry will reflect the HOB at the maximum range of the system. The second card must reflect the card title (HOB), delivery system name, and the yield (right justified entries). A maximum of 60 HOB sets can be used in the model.

Column	Entry
2-4	HOB - card identifier.
6-11	Delivery system name.
13-19	Yield in KT. Yield entries must be consistent with yield entries for the same delivery system in the weapons yield data file.

21-26	Range one in meters.
27-30	HOB in meters for range one.
31-36	Range two in meters.
37-40	HOB in meters for range two.
41-46	Range three in meters.
47-50	HOB in meters for range three.
51-56	Range four in meters.
57-60	HOB in meters for range four.
61-66	Range five in meters.
67-67	HOB in meters for range five.

MSD Cards

A set of four MSD cards is required for each yield of each delivery system. Up to 20 different range/MSD combinations for each yield of a delivery system can be used (with five range/MSD entries on each card). The fourth MSD card of each set has two additional entries, starting in Columns 71 and 76. These entries are required for the target aggregation subroutine. A maximum of 60 MSD sets can be used in the model. When less than four cards are needed to represent range/MSD conditions for a particular yield, the remaining cards must have title, delivery system name, and yield entries. The fourth card must always have the required additional entries starting in Columns 71 and 76 for minimum CEP and radius effects. The last data card must be followed by a terminator card with "FINISH" in Columns 1-6.

Column	Entry
2-4	MSD - card identifier.
6-11	Delivery system name.
13-19	Yield expressed in KT. Yield entries must be consistent with other yield entries for the same delivery system in the weapons yield data file.

21-26	Range one in meters.
27-30	MSD in meters for range one.
30-36	Range two in meters.
37-40	MSD in meters for range two.
41-46	Range three in meters.
47-50	MSD in meters in range three.
51-56	Range four in meters.
57-60	MSD in meters for range four.
61-66	Range five in meters.
67-70	MSD in meters for range five.

Card types 1, 2, and 3 are prepared in the same manner as described above. The fourth card uses the same columns for MSD/range entries plus the following additional entries.

MSD Cards (added to only the fourth card)

Column	Entry
71-75	Minimum CEP in meters for the system.
76-80	Radius of effects, expressed in meters, which is to be used in computing MSD. Normally, the radius associated with immediate permanent (8,000 rads) casualties among personnel in the median posture (i.e., personnel in armored personnel carriers (APC)) is used.

Terminator Card

Column	Entry
1-6	FINISH

Iteration Control Card

The entry "1" is required to control one iteration of the simulation in the model.

Column	Entry
5	1 - computer program requirement.

Simulation Events Control Card

The entry ".5001" is required to control the simulation of events in the model.

Column	Entry
6-10	.5001 - computer program requirement.

Graphics Header Card

This card provides a title to distinguish the graphics section from other portions of the input data.

Column	Entry
1-13	GRAPHICS DECK

Graphics Switch Card

This card data acts as a switch to instruct the model logic to execute or bypass the graphics code.

Column	Entry
6	"Ø" - for graphics off. "1" - for graphics on.

Real-time Switch Card

These card data serve to instruct the model logic to execute or bypass the real-time graphics code. Use of real time requires prior coordination with computer support personnel.

Column	Entry
6	"Ø" - for real time off. "1" - for real time on.

Classification Card

This card provides the project security classifiction for use in the graphics execution by the model logic.

Column	Entry
18-29	UNCLASSIFIED, CONFIDENTIAL, SECRET, as applicable.

Plot Size Card

This card provides the plotting instructions for the remote mechanical plotter.

Column	Entry
12-16	Plot size in inches.

Assessment Header Card

This header card identifies the assessment portion of the input data.

Column	Entry
1-15	ASSESSMENT DECK

Origin Cards

Two cards are required. The first card requires one entry--"ORIGIN". The second card contains an 11 character UTM grid coordinate to establish the approximate center of the battlefield.

First Card

Column	Entry
3-8	ORIGIN

Second Card

Column	Entry
1-11	UTM grid coordinates representing the approximate center of the battlefield (e.g., 32UNA400600).

FEBA Point Card

This card establishes the number of FEBA points to be considered by the model logic. No more than 50 FEBA points can be used.

Column	Entry
1-2	Number of FEBA points.

FEBA Coordinate Cards

One FEBA coordinate card is required for each FEBA point. The total number of FEBA coordinates must equal the number entered on the FEBA point card. The FEBA coordinates must represent joined line segments in the order of the FEBA trace, and agree with the FEBA trace in the target acquisition data file. The last data card must be followed by a terminator card with an "X" in Column 1.

Column	Entry
1-11	UTM grid coordinates of a FEBA point (e.g., 32UNA400600).

Terminator Card

Column	Entry
1	X

Posture Data Set

This set of cards specifies the levels of protection (from nuclear blast or thermal effects) attained by personnel in a given subunit by type. Personnel may be placed in any of five protective postures, with the portion of personnel in the varied postures expressed as a percentage of the subunit strength. The sum of the various posture percentages must equal 100. Equipment hardness is gamed for 15 types of equipment. The model logic can assess seven different classes of equipment by hardness. One posture card is prepared for each type of gamed subunit. The same postures are applied to subunits of that type on both sides. The first card of the posture data set is a header description. The last data card must be followed by a terminator card with an "X" in Column 1.

Posture Header Card

Column	Entry
3-8	POSTURE

Individual Posture Card

Column	Entry
2-5	Four-character subunit identifier. This identifier must be consistent with subunit identifiers used in the other data files.
7-8	The number of the equipment assessment radius (from the effects radius card) to be used in assessing damage to equipment in this type of subunit. Radii 11 through 17 on the radius card for a given system/yield can be used.
10-13	Posture One. The percentage of personnel to be found exposed.
15-18	Posture Two. The percentage of personnel to be found in open foxholes.
20-23	Posture Three. The percentage of personnel to be found in APC.
25-28	Posture Four. The percentage of personnel to be found in tanks.

30-38 Posture Five. The percentage of personnel to be found in earth shelters.

Terminator Card

Column	Entry
1	X

Effects Radii Data Set

One effects radii data set, consisting of two cards, must be prepared for each yield/HOB combination found in the weapons characteristics deck. A maximum of 60 sets can be entered. Eighteen effects radii constitute each data set. The first card contains radii (1 through 10) for personnel loss assessments; the second provides radii (11 through 17) to assess equipment damage. The eighteenth radius (last radius on the second card) is the civilian collateral damage avoidance radius. The first card image of the effects radii data set is a header card which is followed by individual effects radii cards for different yield/HOB combinations. The last data card must be followed by a terminator card with an "X" in Column 1.

Effects Radii Header Card

Column	Entry
3-7	RADII

Individual Radii Cards

Column	Entry
4-9	Yield of the weapon expressed in KT. Yield entries must conform to those used elsewhere in the data.
11-14	Height of burst expressed in meters. Height of burst entries must be consistent with those used elsewhere in the data.

AD-A078 699 ARMY CONCEPTS ANALYSIS AGENCY BETHESDA MD F/G 15/6
USERS' GUIDE FOR THE NUCLEAR FIRE PLANNING AND ASSESSMENT MODEL--ETC(U)
NOV 79 D WU
UNCLASSIFIED CAA-D-79-4 NL

2 OF 2
AD-
A078699



END
DATE
FILMED
1-80
DDC

16-20 Effects radius, expressed in meters, which is associated with immediate permanent casualties among exposed personnel (Radius 1). If another criterion is used, this radius, as well as subsequent entries on these cards, must be consistent.

22-26 Effects radius, expressed in meters, which is associated with immediate transient casualties among exposed personnel (Radius 2).

28-32 Effects radius, expressed in meters, which is associated with immediate permanent casualties among personnel in foxholes (Radius 3).

34-38 Effects radius, expressed in meters, which is associated with immediate transient casualties among personnel in foxholes (Radius 4).

40-44 Effects radius, expressed in meters, which is associated with immediate permanent casualties among personnel in APC (Radius 5).

46-50 Effects radius, expressed in meters, which is associated with immediate transient casualties among personnel in APC (Radius 6).

52-56 Effects radius, expressed in meters, which is associated with immediate permanent casualties among personnel in tanks (Radius 7).

58-62 Effects radius, expressed in meters, which is associated with immediate transient casualties among personnel in tanks (Radius 8).

64-68 Effects radius, expressed in meters, which is associated with immediate permanent casualties among personnel in earth shelters (Radius 9).

70-74 Effects radius, expressed in meters, which is associated with immediate transient casualties among personnel in earth shelters (Radius 10).

Equipment Radii Cards

Column	Entry
2-6	Effects radius, expressed in meters, which is associated with moderate damage to tanks (Radius 11).
8-12	Effects radius, expressed in meters, which is associated with moderate damage to wheeled vehicles (Radius 12).
14-18	Effects radius, expressed in meters, which is associated with moderate damage to towed artillery pieces (Radius 13).
20-24	Effects radius, expressed in meters, which is associated with severe damage to cargo helicopters, randomly parked (Radius 14).
26-30	Effects radius, expressed in meters, which is associated with severe damage to radios and fire control equipment (Radius 15).
32-36	Effects radius, expressed in meters, which is associated with severe damage to supply depots (Radius 16).
38-42	Effects radius, expressed in meters, which is associated with severe damage to surface-to-air missiles (Radius 17).
44-48	Effects radius, expressed in meters, which is associated with the governing effect when considering civilian collateral damage avoidance (Radius 18).

Terminator Card

Column	Entry
1	X

Subunit Breakpoint and Target Aggregation Card

The data entries on this card are used to define varied targeting constraints. The last data card must be followed by a terminator card with an "X" in Column 1.

Header Card

Column	Entry
3-18	BREAKPOINT CARD

Data Card

Column	Entry
2-3	Lowest priority of secondary target considered for target aggregation when Blue fires on Red targets.
5-6	Lowest priority of secondary target considered for target aggregation when Red fires on Blue targets.
8-10	Factor (in hundredths of CEP) required to assure specified primary target coverage when Blue fires on Red targets.
12-14	Factor (in hundredths of CEP) required to assure specified primary target coverage when Red fires on Blue targets.
16-18	Percentage of desired target (primary and secondary) coverage, Blue firing on Red targets.
20-22	Percentage of desired target (primary and secondary) coverage, Red firing on Blue targets.
24-25	Percentage of personnel in a Red subunit to remain unaffected in order for the subunit not to be considered combat ineffective.
27-28	Percentage of personnel in a Blue subunit to remain unaffected in order for the subunit not to be considered combat ineffective.
30-31	Percentage of a population center that is an upper limit for predicted numbers of civilians placed at risk (Blue doctrine).
33-38	Upper limit for predicted numbers of civilians placed at risk by any one shot (Blue doctrine).
40-45	Upper limit for cumulative numbers of predicted civilians placed at risk in the combat sample (Blue doctrine).

47-52	Minimum size of population center to be considered (Blue doctrine).
54-59	Percentage of a population center that is an upper limit for predicted numbers of civilians placed at risk (Red doctrine).
61-66	Upper limit for predicted numbers of civilians placed at risk by any one shot (Red doctrine).
68-73	Upper limit for cumulative numbers of predicted civilians placed at risk in the combat sample (Red doctrine).
75-80	Minimum size of population center to be considered (Red doctrine).

Terminator Card

Column	Entry
1	X

Stop Flag Data Set

This data set is used to establish game stop flags when considering personnel losses, damaged equipment, and maximum numbers of rounds fired. The first card is a header for this section of the data; and it is followed by cards for personnel losses, combat ineffective subunits, and expended rounds. The last data card must be followed by a terminator card with an "X" in Column 1.

Column	Entry
3-8	LOSSES

Personnel Losses Card

Column	Entry
3-8	Maximum number of military personnel Blue may lose in Zone 1 before stopping the game.
11-16	Maximum number of military personnel Blue may lose in Zone 2 before stopping the game.

19-24	Maximum number of military personnel Blue may lose in Zone 3 before stopping the game.
27-32	Maximum number of military personnel Blue may lose in Zone 4 before stopping the game.
35-40	Maximum number of military personnel Red may lose in Zone 1 before stopping the game.
43-48	Maximum number of military personnel Red may lose in Zone 2 before stopping the game.
51-56	Maximum number of military personnel Red may lose in Zone 3 before stopping the game.
59-64	Maximum number of military personnel Red may lose in Zone 4 before stopping the game.

Broken Subunits Card

Column	Entry
3-6	Maximum number of combat ineffective subunits for Blue in Zone 1 prior to stopping the game.
9-12	Maximum number of combat ineffective subunits for Blue in Zone 2 prior to stopping the game.
15-18	Maximum number of combat ineffective subunits for Blue in Zone 3 prior to stopping the game.
21-24	Maximum number of combat ineffective subunits for Blue in Zone 4 prior to stopping the game.
27-30	Maximum number of combat ineffective subunits for Red in Zone 1 prior to stopping the game.
33-36	Maximum number of combat ineffective subunits for Red in Zone 2 prior to stopping the game.
39-42	Maximum number of combat ineffective subunits for Red in Zone 3 prior to stopping the game.
45-48	Maximum number of combat ineffective subunits for Red in Zone 4 prior to stopping the game.

Expended Rounds Card

Column	Entry
3-6	Maximum number of rounds Blue may expend before stopping the game.
9-12	Maximum number of rounds Red may expend before stopping the game.

Terminator Card

Column	Entry
1	X

Units Data Set

This data set is used to provide input for the attrition of personnel and equipment in designated type subunits from the SUSF prior to the employment of nuclear weapons. The first card is a header card which is followed by three subsets. These subsets identify the model subprogram to be used and the types of subunits and equipment to be considered for attrition. The first subset consists of a single card. For the second subset, three cards define the types of subunits to be affected. Each card has an allowable entry of 16 subunit types for either side--a total of 48 subunit types. The third subset data first defines the Blue equipment types considered for attrition--up to 10 types. Then, a similar definition is made for Red equipment where up to 10 types can be considered. The last data image must be followed by two terminator cards--one with "X" in Column 1 and one with "END DATA" in Columns 3-10.

Units Header Card

Column	Entry
3-7	UNITS

Attrition Program Subset Card

Column	Entry
45-50	ATTRIT

Subunit Identification Subset Cards

Column	Entry
2-5	Subunit type identified for possible attrition of personnel and equipment (subunit designators from SUSF). Three cards are required.
7-10	Same as above.
12-15	Same as above.
17-20	Same as above.
22-25	Same as above.
27-30	Same as above.
32-35	Same as above.
37-40	Same as above.
42-45	Same as above.
47-50	Same as above.
52-55	Same as above.
57-60	Same as above.
62-65	Same as above.
67-70	Same as above.
77-80	Same as above.

Factors Subset Cards

Factors Identification Card

Column	Entry
7	"B" for Blue or "R" for Red.

Equipment Identification Card

Column	Entry
4-9	Equipment type identified for possible attrition (equipment designators from SUSF).
11-16	Same as above.
18-23	Same as above.
25-30	Same as above.
32-37	Same as above.
39-44	Same as above.
46-51	Same as above.
53-58	Same as above.
60-65	Same as above.
67-72	Same as above.

Attrition Factor Cards

Column	Entry
6-12	Fraction of personnel to remain in specified subunits in Zones 1, 2, and 3.
13-19	Fraction of personnel to remain in specified subunits in Zone 4.
20-26	Fraction of first equipment type listed on equipment identification card to remain in specified subunits in Zones 1, 2, and 3.

27-33	Fraction of first equipment type listed in equipment identification card to remain in specified subunits in Zone 4.
34-40	Fraction of second equipment type listed on equipment identification card to remain in specified subunits in Zones 1, 2, and 3.
41-47	Fraction of second equipment type listed on equipment identification card to remain in specified subunits in Zone 4.
48-54	Fraction of third equipment type listed on equipment identification card to remain in specified subunits in Zones 1, 2, and 3.
55-61	Fraction of third equipment type listed on equipment identification card to remain in specified subunits in Zone 4.
62-68	Fraction of fourth equipment type listed on equipment identification card to remain in specified subunits in Zones 1, 2, and 3.
69-75	Fraction of fourth equipment type listed on equipment identification card to remain in specified subunits in Zone 4.

Up to two additional attrition factor cards might be necessary to match the number of equipment types listed for a side on the equipment identification card. The second and third cards are completed in the same manner as the first. However, three cards of this type are required per side. When required to complete the group, "1.00" must be assigned to the first two data fields of these type cards. Factors subset cards for Blue precede those for Red.

Terminator Cards

Column	Entry
1	X
3-10	END DATA

GASP IV Data Set

The GASP IV data set (32 cards) is used to provide a computer run identification, limitations imposed by array size for certain variables, and a simulation stop time. Collection and display of data in the form of histograms is also controlled by entries in this subset. Program changes are required to eliminate any of these cards (References 2 and 9). Although Option "V" will suppress the printing of GASP IV summaries and histograms, data are collected in several routines in NUFAM II. Thus, the following cards and those shown in Table J-1 are required.

Card 1

Column	Entry
1-12	Any title desired by the user.
16-20	Model number.
21-25	Numeric value of the month in which the simulation is being performed.
26-30	Day of the month when the simulation is being performed.
31-35	Year the simulation is being performed.
36-40	Number of simulations to be made in this execution. Normally, "1" is entered in Column 40.
41-55	Read and print suppression keys (15). For NUFAM II this entry should be "000000000009999". The first 11 digits are zeroes indicating to GASP IV the required data types which are described below. The last four digits--nines--denote that data types 12 through 15 are not used in NUFAM II.

Card 2

Column	Entry
5	This value prescribes the number of statistic sets to be collected for the histograms and is based on the events desired. For NUFAM II, the entry is "6".

10 This value prescribes the number of "queue time" type statistics to be gathered for the histograms. For NUFAM II, this entry is "2".

15 This value prescribes the number of histograms to be reported. For NUFAM II, the entry is "8".

20 This value prescribes the number of parameter sets--a feature not used in NUFAM II. Therefore, this entry is "Ø".

25 This value prescribes the number of tables to be reported in support of the histograms. For NUFAM II, this entry is "1".

Note: Based on the entries in Columns 1-25 of the second card, 27 GASP IV data cards are required for entry after the second card in the subset. For NUFAM II, there are six GASP IV data cards of type 3, two of type 4, eight of type 5, one of type 6A, and ten of type 6B. The formats for each type card are shown in Table J-1.

26-30 Number of random number streams. For NUMFAM II, this entry should be "2" in Column 30.

31-35 Maximum number of events allowable in the queue at any one time during the simulation. This has been previously tested with allocations for 300 and 500 events using 5,000 and 10,000 words of core storage. For NUFAM II, this entry is normally "4ØØ".

36-40 Maximum number of attributes per event in the queue. An attribute is defined as a variable associated with an event. For NUFAM II, this entry is "21".

41-45 Number of files in the queue. For NUFAM II, this entry is "1" in Column 45.

46-50 Size of queue in terms of words for storing the data generated during the simulation. For NUFAM II, this entry is normally "999Ø".

55 Number of derivative equations. Derivative equations are not used in NUFAM II. This entry is "Ø".

60 Number of derivative equations defining state levels. Derivative equations are not used in NUFAM II. This entry is "Ø".

65 Number of state condition flags employed when using derivative equations. Derivative equations are not used in NUFAM II. This entry is "Ø".

Card 30

Column	Entry
5	Event attribute to be used for prioritizing event executions when multiple events are scheduled at the same time. In NUFAM II, the type of event is used for execution ranking. The second attribute of an event defines the event type; therefore, this entry is "2" for NUFAM II.

Card 31

Column	Entry
5	Key for defining the priority specified on the third card. For NUFAM II, enter "1" to specify that a low value has high priority.

Card 32

Column	Entry
5	Key for termination of the simulation. Use "Ø" to end the simulation only at the time specified by the firing parameter card. Use "1" to end the simulation at the time when any model-generated conclusion event would cause termination (e.g., insufficient warheads or firing subunits, excessive numbers of civilians placed at risk by side, a graphics interrupt) in keeping with data on the firing parameter card.
10	Key for specifying statistics arrays in the program during initialization. For NUFAM II, this entry is normally "1". Use "Ø" for not clearing the statistics arrays prior to the accumulation of statistics. Use "1" for clearing the statistics arrays prior to the accumulation of statistics.

15	Key for specifying the initializing target detection time. For NUFAM II, this entry is normally "1". Use "Ø" to not initialize the target detection time prior to the simulation.
20	Key for specifying the card type to be used in the next simulation. This feature is not used in NUFAM II. An entry of "Ø" is required.
28-30	Value to be used in initializing target detection times. Because target detection time is now specified on the firing parameters card, an entry of "Ø" must be used for NUFAM II.
35-40	Ending time for the simulation. For NUFAM II, this entry is normally "25.Ø" to constrain the simulation to within a 24-hour period.
45	Key for initializing the event file. For NUFAM II, this entry is normally "1". Use "Ø" to not initialize the event file prior to the simulation. Use "1" to initialize the event file prior to the simulation.
46-50	First random number seed for use in the GASP IV program.
51-55	Second random number seed for use in the GASP IV program.

Preplanned Target Cards

Preplanned targets as selected by the user are entered at this point. All entries are right justified. Time entries exceeding 24.0 hours must be carried as a continuation, e.g., 26.0, 34.6 hours. One card is required for each preplanned target. The last data card must be followed by a terminator card with an "X" in Column 1. The terminator card is also required when preplanned targets are not used.

Column	Entry
1	Target side - "B" for Blue or "R" for Red.
3-13	UTM grid coordinates of the target location.
15-20	Warhead yield for the desired preplanned target.

23-27	Delivery system (designator from SUSF).
29-33	Time at which the firing subunit is to be dedicated to the preplanned target and unavailable for other fire missions.
35-39	Earliest permissible firing time.
41-45	Latest permissible firing time.
47-53	Target distance from FEBA (for MSD purpose) expressed in meters.

Terminator Card

Column	Entry
1	X

Additional Input for New Postprocessor

This data set follows after the preplanned target terminator card. The new postprocessor provides a summary of each desired TARTARUS unit as a result of nuclear exchange. One unit header card is required for each TARTARUS unit if a summary is desired.

Unit Header Card

Column	Entry
1	Unit side--"B" for Blue or "R" for Red.
2-5	TARTARUS unit number.
7-30	Unit designation of TARTARUS unit.
3-42	Mission or order of battle for this TARTATUS unit.
43-66	Any desired remarks pertaining to this nuclear exchange.
67-72	Earliest firing time.
73-78	Latest firing time.

Terminator Card

Column	Entry
1	X

Blue MOE Unit Data Card

Three cards maximum, 16 units per card.

Column	Entry
2-5	Subunit identifier designated as an MOE unit.
7-10	Same as above
12-15	Same as above
17-20	Same as above
22-25	Same as above
27-30	Same as above
32-35	Same as above
37-40	Same as above
42-45	Same as above
47-50	Same as above
52-55	Same as above
57-60	Same as above
62-65	Same as above
67-70	Same as above
72-75	Same as above
77-80	Same as above

Terminator Card

Column	Entry
1	X

Red MOE Unit Data Set

Same format as Blue unit data set; limit up to three cards followed by a terminator card.

Equipment Data Set

Five cards are required. First three cards are for general equipment other than indirect fire type equipment. Tanks and APC must be included in the first three cards. The fourth and fifth cards are for indirect fire equipment (Blue firing equipment card and Red firing equipment card).

General Equipment Card

Column	Entry
1-6	Equipment type described for display in unit summary report (right justified). Entry for equipment type should be same as equipment designators from SUSF.
7-12	Same as above
13-18	Same as above
19-24	Same as above
25-30	Same as above
30-36	Same as above
37-42	Same as above
43-48	Same as above
49-54	Same as above
55-60	Same as above
61-66	Same as above
67-72	Same as above

Blue Artillery Card

Column	Entry
1-6	Conventional artillery equipment to be included in the nonnuclear artillery category of the summary report (right justified). Entry for equipment type should be same as equipment designators from SUSF.
7-12	Same as above
13-18	Same as above
19-24	Same as above
25-30	Same as above
31-36	Same as above
37-42	Same as above
42-48	Same as above
49-54	Nuclear capable artillery equipment to be included in this category of the summary report (right justified). Entry for equipment type should be same as equipment designators from SUSF.
55-60	Same as above
61-66	Same as above
67-72	Same as above

Red Artillery Card

Same format as Blue artillery card. This card is required.

Terminator Card

Column	Entry
1	X

Table J-1. Type Entries for GASP IV Data
(cards 3 through 29)

Data type	Data columns						
	1-5	9-19	25	28-30	34-35	38-40	46-49
3	TYP 3	1TGTO NUM					
	TYP 3	2FIRE NUM					
	TYP 3	3FLEE NUM					
	TYP 3	4EVTS NUM					
	TYP 3	5FIREQTIM					
	TYP 3	6FLEEQTIM					
4	TYP 4	1FIREQTIM		0.0			
	TYP 4	2FLEEQTIM		0.0			
5	TYP 5	1TGTO NUM		24		0.0	1.0
	TYP 5	2FIRE NUM		24		0.0	1.0
	TYP 5	3FLEE NUM		24		0.0	1.0
	TYP 5	4EVTS NUM		40		0.0	10.0
	TYP 5	5FIREQTIM		24		0.0	1.0
	TYP 5	6FLEEQTIM		24		0.0	1.0
	TYP 5	7FLEE8B		24		0.0	1.0
	TYP 5	7FLEE8R		24		0.0	1.0
6A	TYP6A	1EVENTS Q			10	2	0.5
6B	TYP6B	11PFIRE EV	0	0		0.0	50.0
	TYP6B	22IMTGT EV	0	0		0.0	50.0
	TYP6B	33TGTO EV	0	0		0.0	50.0
	TYP6B	44FIRE EV	0	0		0.0	50.0
	TYP6B	55FLEE EV	0	0		0.0	50.0
	TYP6B	66FL-1 EV	0	0		0.0	50.0
	TYP6B	77FL-2 EV	0	0		0.0	50.0
	TYP6B	88FL-3 EV	0	0		0.0	50.0
	TYP6B	99FL-4 EV	0	0		0.0	50.0
	TYP6B	10TALL EVTS	0	0		0.0	50.0

APPENDIX K

NUFAM II RUNSTREAM (UNCLASSIFIED SAMPLE)

```
@RUN,/T FR A(NAME,P,N2)P7LET,UNCLASSIFIED,127,500/532
@SYM [illegible]                                        . DIRECTS PRINTOUT
@MSG UNCLASSIFIED NUFAM
@ASG,T  2.                                              . WOR STORAGE FILE
@ASG,T  5.                                              . CFP STORAGE FILE
@ASG,T  6.                                              . WSO STORAGE FILE
@ASG,T  7.                                              . CIVIL ASSESSMENT WORK FILE
@ASG,T 10.                                              . MISC DATA STORAGE FILE
@ASG,T 13,,F//3//205/4                                  . FIRE UNIT WORK FILE
@ASG,T 14,,F//3//205/4                                  . YIELD WORK FILE
@ASG,T 15,,F//3//205/4                                  . TARGET WORK FILE
@ASG,T 16.                                              . FUN/YLD DATA STORAGE FILE
@ASG,T 17.                                              . FIRING PREF. STORAGE FILE
@ASG,T 18.                                              . EVENT HISTORY WORK FILE
@ASG,T 19.                                              . POPULATION DATA WORK FILE
@ASG,T 21.                                              . TGTS FIRED STORAGE FILE
@ASG,T 22.                                              . TGTS FIRED/SORT STORAGE FILE
@ASG,T 23.                                              . BROKEN UNIT STORAGE FILE
@ASG,T 24.                                              . WPNS SYS SUM STORAGE FILE
@ASG,T 25.                                              . POPULATION DATA STORAGE FILE
@ASG,T 26,,F//3//205/4                                  .
@ASG,T 51.                                              . FIRED TGT DATA STORAGE FIL
@ASG,T 80,,F100//300                                    . SUSF STORAGE FILE
@ASG,T 81,,F100//300                                    . UPDATED SUSF WORK FILE
@ASG,T 90.                                              . FINAL SUSF STORAGE FILE
@ASG,T ARRAYWORK1.                                      . SUSF ARRAY STORAGE FILE
@ASG,T ABS,F///5//0                                     . 72ABS STORAGE FILE
@ASG,T 72TEMPGAME,,F///5//0                             . 80-DATABASE STORAGE FILE
@ASG,T FUNTAP,,9C,9,BWIS                                . ASSIGNS PROPER FUNTAR TAPE
@COPY,OC FUNTAP,,17.                                    . COPIES FUNTAR TO FILE 17
@COPY,OC FUNTAP,,16.                                    . COPIES FUNTAR TO FILE 16
@COPY,OC FUNTAP,,ARRAYWORK1.                            . COPIES FUNTAR TO ARRAYWORK
@COPY,OC FUNTAP,,80.                                    . COPIES FUNTAR TO FILE 80
@COPY,OC FUNTAP,,15.                                    . COPIES FUNTAR TO FILE 15
@FREE FUNTAP.
@ASG,ARY 72SPOPDATA.                                    . ASSIGN POPULATION DATA FILE
@COPY 72SPOPDATA,,25.                                   . COPIES POP DATA TO FILE 25
@FREE 72SPOPDATA.
@ASG,ARY SECRET*PRIDATABASE/ /.                         . ASSIGNS DATA BASE FILE.
@COPY,S SECRET*ARMYTAMEC,UNCLASDATA,72TEMPGAME,DATA
@FREE SECRET*ARMYDATABASE.
@ASG,ARY SECRET*72ABS/ /.                               . ASSIGNS ABSOLUTE FILE
@COPY,A SECRET*72ABS,NUFAMABS,ABS,APPLICATION           . COPIES ABS TO STORAGE FILE
@COPY,A SECRET*72ABS,SORT1ABS,ABS,ABS1                  . COPIES ABS TO STORAGE FILE
@COPY,A SECRET*72ABS,SORT2ABS,ABS,ABS2                  . COPIES ABS TO STORAGE FILE
@COPY,A SECRET*72ABS,SORT3ABS,ABS,ABS3                  . COPIES ABS TO STORAGE FILE
@COPY,S SECRET*72ABS,RUNCIV,ABS,RUNCIV                  . COPIES ABS TO STORAGE FILE
@FREE SECRET*72ABS.
@FIL*UID 72TEMPGAME,DATA,,**                            . CALLS FIT PROCESSOR
-1*1
 A11
```

```
@
@END ..
@RUN.AYMOPRSYU ABS.AGGREGATION                . EXECUTES AGGREGATION
@ADD.A I2TEMPGAME.DATA                        . ADDS DATA BASE TO RUN
@RUN ABS.ABS8                                 . EXECUTES ABS8
@ADD ABS.QUNCIV                               . ADDS ABS TO RUN
@RUN ABS.ABS7                                 . EXECUTES ABS7
@FREE 7*.                                     . FREES FILE
@RUN ABS.ABS1                                 . EXECUTES ABS1
@ASG.T OTAPE.,AC9,SAVEU                       . ASSIGNS SAVE TAPE
@COPY.GH ARRAYUORK1..OTAPE.                   . COPIES FILE TO TAPE
@COPY.GH 9D..OTAPE.                           . COPIES FILE TO TAPE
@CLOSE OTAPE.                                 . CLOSES TAPE
@FIN
```

APPENDIX L

PROBABILITY OF OPERATIONAL TARGET ACQUISITION DATA FILE

```
 15  5 1.  5  1  0
 140       3.    12.    25.   100.   200.
   .960 .950 .600 0r
0.10 0.02 .000 .000 .000 .000 .000 .000 .000 .000 .000
  18     1. .007    .000
  .90    .50
      3.    5.    9.    0.    0.
.770 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
.920 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
.830 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
.000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
.000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
   .300 .300 .200 .200
   .350 .190 .290 .170
   .300 .300 .200 .200
   .330 .130 .230 .310
   .300 .300 .200 .200
   .280 .130 .240 .350
   .300 .300 .200 .200
   .310 .100 .190 .400
   .300 .300 .200 .200
   .300 .070 .170 .460
   0   0  31  31  31   0   0   0   0   0
   .080 .080 .080 .080 .080
   .920 .920 .920 .920 .920
   .080 .080 .080 .080 .080
   .920 .920 .920 .920 .920
   0   0   7   7   7   0   0   0   0   0
   .080 .080 .080 .080 .080
   .920 .920 .920 .920 .920
   .080 .080 .080 .080 .080
   .920 .920 .920 .920 .920
   0   0   0   0   0   0   0   0   0   0
   .080 .080 .080 .080 .080
   .920 .920 .920 .920 .920
   .080 .080 .080 .080 .080
   .920 .920 .920 .920 .920
   0   0   1   1   1   0   0   0   0   0
   .080 .080 .080 .080 .080
   .920 .920 .920 .920 .920
   .080 .080 .080 .080 .080
   .920 .920 .920 .920 .920
   0   0   0   0   0   0   0   0   0   0
   .080 .080 .080 .080 .080
   .920 .920 .920 .920 .920
   .080 .080 .080 .080 .080
   .920 .920 .920 .920 .920
```

APPENDIX M

PROBABILITY OF OPERATIONAL TARGET ACQUISITION DATA FILE (PREPARATION INSTRUCTIONS)

These data images (referred to as cards) comprise the input data required for the POTAR. As such, this information controls the production of target acquisition data required as input to the FUNTAR (LRNK Ø7 card of the Target Acquisition Data File). These input data are divided into three sets. They are the Battlefield Data Set, Sensor Data Set, and the Unit Data Set.

Battlefield Data Set

This initial set of data describes the size of the battlefield, number of sensor types, number of unit types, and target surveillance zones. This set of data is comprised of the two cards, the unit/sensor card and the battlefield description card.

Unit/Sensor Card

This card allows the user to define the quantity of units and sensors to be considered. Only one card is required.

Column	Entry
2-3	Number of unit types to be considered by the routine (not to exceed 30).
5-6	Number of target element types (i.e., tanks, trucks, personnel, etc.) to be considered by the routine (not to exceed 5).
8-9	Number of sensor types to be considered by the routine (not to exceed 30).
11-12	Number of target surveillance zones (range bands) to be considered by the routine (not to exceed 10).

Battlefield Description Card

This card defines the length of the FEBA and the rear boundary for each of the target surveillance zones (range bands) measured as kilometers from the FEBA. Only one card is required.

Column	Entry
2-4	Length of the FEBA for the particular sector under consideration.
9-12	Distance from the FEBA to the rear boundary of Zone 1.
15-18	Distance from the FEBA to the rear boundary of Zone 2.
21-24	Distance from the FEBA to the rear boundary of Zone 3.
27-30	Distance from the FEBA to the rear boundary of Zone 4.
33-36	Distance from the FEBA to the rear boundary of Zone 5.
39-42	Distance from the FEBA to the rear boundary of Zone 6.
45-48	Distance from the FEBA to the rear boundary of Zone 7.
51-54	Distance from the FEBA to the rear boundary of Zone 8.
57-60	Distance from the FEBA to the rear boundary of Zone 9.
63-66	Distance from the FEBA to the rear boundary of Zone 10.

Sensor Data Set

This set of data specifies the performance and degradation characteristics of each sensor type considered. Six types of cards are required to constitute a set of data for each sensor type. These cards are the sensor degradation card, sensor visibility card, sensor employment card, sensor availability/survivability card, sensor range capability card, and sensor detection capability card. One sensor data set is required for each type of sensor considered. Only one card of each type is required within each set, except the sensor detection capability card. The number of sensor detection capability cards within each set is based on the number of element types considered. Each sensor data set should be input in an identifiable logical sequence to the user. The total number of sensor data sets must be equal to the number of sensor types entered in the unit/sensor card.

Sensor Degradation Card

Column	Entry
4-7	Probability this sensor type would not be affected by weather during the period under consideration (expressed as a decimal value).
9-12	Probability this sensor type would not be affected by smoke during the period under consideration (expressed as a decimal value).
14-17	Probability this sensor type would not be affected by poor crew performance during the period under consideration (expressed as a decimal value).
19-20	System type identifier. Enter "1" for countermortar/counterbattrey type radar. Enter "2" for ground surveillance radar or forward observers. Enter "3" for reconnaissance systems which operate parallel to the FEBA. Enter "4" for reconnaissance systems which penetrate the FEBA.

Sensor Visibility Card

Column	Entry
1-4	Probability that a target element in Zone 1 would be visible to this sensor type.
6-9	Probability that a target element in Zone 2 would be visible to this sensor type.
11-14	Probability that a target element in Zone 3 would be visible to this sensor type.
16-19	Probability that a target element in Zone 4 would be visible to this sensor type.
21-24	Probability that a target element in Zone 5 would be visible to this sensor type.

26-29	Probability that a target element in Zone 6 would be visible to this sensor type.
31-34	Probability that a target element in Zone 7 would be visible to this sensor type.
36-39	Probability that a target element in Zone 8 would be visible to this sensor type.
41-44	Probability that a target element in Zone 9 would be visible to this sensor type.
46-49	Probability that a target element in Zone 10 would be visible to this sensor type.

Sensor Employment Card

Column	Entry
2-4	Quantity of this sensor type employed for consideration.
7-10	Setback distance from the FEBA, in kilometers, for the employment of this sensor type.
13-16	Sensor scan angle for ground radars and forward observer type radars. Value is entered in radians.
19-22	Swath angle for system penetrating the FEBA. Value is entered in radians.

Sensor Availability/Survivability Card

Column	Entry
2-5	Sensor availability factor, expressed as a percent of time the sensor type is expected to be available during the period under consideration.
8-11	Sensor survivability factor, expressed as a percent of time this sensor type is expected to survive during the period under consideration.

Sensor Range Capability Card

Column	Entry
3-6	Sensor range capability for target element type 1
8-11	Sensor range capability for target element type 2
13-16	Sensor range capability for target element type 3
18-21	Sensor range capability for target element type 4
23-26	Sensor range capability for target element type 5

Sensor Detection Capability Card

One card is required for each target element type considered. The number of target element detection cards for each sensor type must be equal to the number of target element types entered in the unit/sensor card. Values entered in this card are the probability of detection due to the inherent capability of the system under ideal conditions.

Column	Entry
1-4	Inherent probability of detection for this sensor type against a specific target element type in Zone 1.
6-9	Inherent probability of detection for this sensor type against a specific target element type in Zone 2.
11-14	Inherent probability of detection for this sensor type against a specific target element type in Zone 3.
16-19	Inherent probability of detection for this sensor type against a specific target element type in Zone 4.
21-24	Inherent probability of detection for this sensor type against a specific target element type in Zone 5.
26-29	Inherent probability of detection for this sensor type against a specific target element type in Zone 6.
31-34	Inherent probability of detection for this sensor type against a specific target element type in Zone 7.

36-39	Inherent probability of detection for this sensor type against a specific target element type in Zone 8.
41-44	Inherent probability of detection for this sensor type against a specific target element type in Zone 9.
46-49	Inherent probability of detection for this sensor type against a specific target element type in Zone 10.

Unit Data Set

This set of data describes the target elements, terrain environment, and probable activities of each unit type considered. This set of data is comprised of two subsets, the troop posture and unit environment subset and the target element data subset.

Troop Posture and Unit Environment Posture Subset

This subset consists of two cards which describes the troop postures and the target environment postures for the units under consideration. The first type card describes the troop posture for the type unit being considered. The second card describes the activity and physical environment of the type unit being considered. The troop posture being considered should correlate with the postures being considered in the target coverage routine. The unit environment should be determined through close examination of the terrain oriented arrays created as an input to the SUSF. One subset is required for each target surveillance zone being considered. The sum of the factors within each card should be equal to "1.00."

Troop Posture Card

Column	Entry
4-7	Posture one factor. The percentage of personnel to be found standing exposed in this zone.
9-12	Posture two factor. The percentage of personnel to be found prone exposed in this zone.
14-17	Posture three factor. The percentage of personnel to be found in foxholes in this zone.

19-22	Posture four factor. The percentage of personnel to be found in vehicles in this zone.

Unit Environment Posture Card

Column	Entry
4-7	Posture one factor. The percentage of this type unit to be found moving in the open in this zone.
9-12	Posture two factor. The percentage of this type unit to be found moving in towns or wooded areas in this zone.
14-17	Posture three factor. The percentage of this type unit to be found not moving in the open in this zone.
19-22	Posture four factor. The percentage of this type unit to be fund not moving in towns or wooded areas in this zone.

Target Element Data Subset

This subset consists of five cards, with one target element quantity card and four target activity/environment cards. One subset is required for each target element type considered for each unit type. The total number of subsets required for each unit type being considered must be equal to the number of element types entered in the unit/sensor card.

Target Element Quantity Card

Column	Entry
2-4	Quantity of target elements for this unit type expected to be in Zone 1.
6-8	Quantity of target elements for this unit type expected to be in Zone 2.
10-12	Quantity of target elements for this unit type expected to be in Zone 3.

14-16	Quantity of target elements for this unit type expected to be in Zone 4.
18-20	Quantity of target elements for this unit type expected to be in Zone 5.
22-24	Quantity of target elements for this unit type expected to be in Zone 6.
26-28	Quantity of target elements for this unit type expected to be in Zone 7.
30-32	Quantity of target elements for this unit type expected to be in Zone 8.
34-36	Quantity of target elements for this unit type expected to be in Zone 9.
38-40	Quantity of target elements for this unit type expected to be in Zone 10.

Target Element Activity Card Type 1

Column	Entry
4-7	Target element moving factor in Zone 1. (The percentage of this target element expected to be found moving in this Zone.)
9-12	Target element moving factor in Zone 2.
14-17	Target element moving factor in Zone 3.
19-22	Target element moving factor in Zone 4.
24-27	Target element moving factor in Zone 5.
29-32	Target element moving factor in Zone 6.
34-37	Target element moving factor in Zone 7.
39-42	Target element moving factor in Zone 8.
44-47	Target element moving factor in Zone 9.
49-52	Target element moving factor in Zone 10.

Target Element Activity Card Type 2

Column	Entry
4-7	Target element stationary factor in Zone 1. (The percentage of this target element found stationary in this Zone. It should be the complement of the moving factor.)
9-12	Target element stationary factor in Zone 2.
14-17	Target element stationary factor in Zone 3.
19-22	Target element stationary factor in Zone 4.
24-27	Target element stationary factor in Zone 5.
29-32	Target element stationary factor in Zone 6.
34-37	Target element stationary factor in Zone 7.
39-42	Target element stationary factor in Zone 8.
44-47	Target element stationary factor in Zone 9.
49-52	Target element stationary factor in Zone 10.

Target Element Environment Card Type 1

Column	Entry
4-7	Target element in the open environment factor in Zone 1. (The percentage of this target element found in the open in this Zone.)
9-12	Target element in the open environment factor in Zone 2.
14-17	Target element in the open environment factor in Zone 3.
19-22	Target element in the open environment factor in Zone 4.
24-27	Target element in the open environment factor in Zone 5.

29-32	Target element in the open environment factor in Zone 6.
34-37	Target element in the open environment factor in Zone 7.
39-42	Target element in the open environment factor in Zone 8.
44-47	Target element in the open environment factor in Zone 9.
49-52	Target element in the open environment factor in Zone 10.

Target Element Environmental Card Type 2

Column	Entry
4-7	Target element in town or wooded environment factor in Zone 1. (The percentage of this target element found in town or wooded area in this Zone. It should be the complement of the open environment factor.)
9-12	Target element in town or wooded environment factor in Zone 2.
14-17	Target element in town or wooded environment factor in Zone 3.
19-22	Target element in town or wooded environment factor in Zone 4.
24-27	Target element in town or wooded environment factor in Zone 5.
29-32	Target element in town or wooded environment factor in Zone 6.
34-37	Target element in town or wooded environment factor in Zone 7.
39-42	Target element in town or wooded environment factor in Zone 8.

44-47 Target element in town or wooded environment factor in Zone 9.

49-52 Target element in town or wooded environment factor in Zone 10.

APPENDIX N

REFERENCES

DEPARTMENT OF THE ARMY

Assistant Chief of Staff for Intelligence

1. Letter, subject: (S) Percent of Knowledge (POK) Matrices (U), Aug 76

US Army Concepts Analysis Agency

2. Report CAA-SR-74-21, (S) Tactical Nuclear Weapons Requirements Methodology (TANREM), Phase II: Methodology Development (U), Vol I, II, III, and IV, Dec 74

3. Document CAA-D-76-2, (U) Applications Guide for the Subunit Status File and Related Programs, Apr 76

4. Document CAA-TP-76-2, (S) Target Acquisition Study (TAS) (U), May 76

5. Report CAA-SR-78-1, (S/RD) Nuclear Requirements Methodology II (NUREM II) (U), Jan 78

MISCELLANEOUS

6. Document CAA-TP-79-4 (S/NOFORN) Target Acquisition Study II (TAS II) (U), Aug 79.

7. Document, Stanford Research Institute, SRI Project 2240, subject: (U) A Fine-grained Population Data Base for West Germany, Oct 73

8. Document, US Army Strategy and Tactics Analysis Group, subject: (U) TARTARUS IV N/COCO Players and Technical Manual, undated

9. Document, US Army Strategy and Tactics Analysis Group, subject: (U) FORECAST II Players and Technical Manual, Mar 71, with changes

10. Document, Pritsker & Associates, Inc., subject: (U) The GASP IV User's Manual, Mar 74

GLOSSARY OF TERMS

1. ABBREVIATIONS, ACRONYMS, AND SHORT TERMS

APC	armored personnel carrier
CAA	US Army Concepts Analysis Agency
CEP	circular error probable
DGZ	desired ground zero
FEBA	forward edge of the battle area
FORTRAN	Formula Translation (a scientific programing language for computers)
HOB	height (depth) of burst
K	thousand
km	kilometer
KT	kiloton
MSD	minimum safe distance
ODCSOPS	Office, Deputy Chief of Staff for Operations and Plans
UTM	universal transverse mercator (grid)

2. ADDITIONAL TERMS USED IN THIS DOCUMENT

AGZ	actual ground zero
C_L	center of detected target location
C_T	center of estimated target location
CRT	cathode ray tube
D	distance between C_T and GZ
GZ	estimated ground zero
POK	percent of knowledge

POM	preclusion-oriented targeting method
POPDATA	population data file
POTA	probability of operational target acquisition
R_e	radius of effect
R_t	radius of target
TANREM	Tactical Nuclear Requirements Methodology Study
TLE	target location error
X	normal distance from GZ to Y
Y	line connecting intersections of circles having R_e and R_t

3. MODELS, ROUTINES, AND SIMULATIONS

AGZPLOT	Actual Ground Zero Plot Routine
DETGTPLOT	Detected Target Plot Routine
FORECAST II	Flexible Operational Resolution of Combat Air, Strategic and Tactical Model II
FUNTAR	Fire Unit/Target Acquisition Routine
GASP IV	General Activity Simulation Program IV
NUFAM II	Nuclear Fire Planning and Assessment Model II
NUREM II	Nuclear Requirements Methodology II
NUREX	Nuclear Requirements Extrapolator Model
POPPLOT	Population Center Plot Routine
POTAR	Probability of Operational Target Acquisition Routine
SUSF	Subunit Status File Routine
TARTARUS IV	A theater-level, computer-assisted war game
TCR	Target Coverage Routine