File Copy

AD A077118

MEMORANDUM REPORT ARBRL-MR-02950

UTILIZATION OF PATCH/TRIANGULAR TARGET DESCRIPTION DATA IN BRL PARALLEL RAY VULNERABILITY ASSESSMENT CODES

Keith A. Applin

September 1979

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER MEMORANDUM REPORT ARBRL-MR-02950	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) UTILIZATION OF PATCH/TRIANGULAR TARGET DESCRIPTION DATA IN BRL PARALLEL RAY VULNERABILITY ASSESSMENT CODES		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Keith A. Applin		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS USA Ballistic Research Laboratory, ARRADCOM ATTN: DRDAR-BLV Aberdeen Proving Ground, MD 21005		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 1L162618AH80
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Research & Development Command US Army Ballistic Research Laboratory (DRDAR-BL) Aberdeen Proving Ground, MD 21005		12. REPORT DATE SEPTEMBER 1979 13. NUMBER OF PAGES 67
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

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

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Target Descriptions	GIFT Code	Parallel Ray
COMGEOM Descriptions	FASTGEN Code	
PATCH Descriptions	SHOTGEN Code	
Triangular Descriptions	Vulnerability Assessment Codes	

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

Within the DoD, two different target description methodologies have evolved and become widely used. The Army does vulnerability analyses using the Combinatorial Geometry (COMGEOM) method while the Navy and Air Force basically use the PATCH or Triangular method. To eliminate obvious duplication of target descriptions, a procedure has been developed to integrate these two methodologies at BRL. This report presents a way of utilizing the triangular target description data in the standard BRL parallel ray vulnerability assessment codes. Steps are outlined which will allow the use of the triangular description data in each of

Block 20. (cont'd)

the parallel ray vulnerability assessment codes used at BRL.

TABLE OF CONTENTS

LIST OF FIGURES

I. INTRODUCTION

As the Army's lead laboratory for vulnerability technology, the Vulnerability/Lethality Division (VLD) of the Ballistic Research Laboratory (BRL) performs vulnerability analyses for a wide variety of military systems. The vulnerability of a system is defined as a measure of susceptibility of that system to damage by a specific combat damage mechanism. Damage mechanisms may include nuclear radiation, blast, kinetic energy warheads, fragments, shaped charge warheads, incendiary devices, and lasers. The vulnerability of a system to these damage mechanisms is estimated analytically using an appropriate vulnerability assessment code.

Most of the vulnerability assessment codes used today require some type of geometric information about the target system being studied. This geometric information is in the form of shotline data. To generate this shotline data, rays are projected through the target system. A complete history of the components encountered along each ray, including thicknesses and obliquity angles, is recorded. These shotlines represent paths that the various damage mechanisms take through the target. The vulnerability assessment codes calculate what effects the damage mechanisms have on the performance of the system as they encounter the components listed on these shotlines.

II. THE TARGET DESCRIPTION

Over the years, the production of the shotline information has been computerized and different codes have evolved which produce this shotline data. Basic to all these shotline producing computer codes is the geometric target description. Essentially, a geometric target description is a three dimensional representation of the target system stated in terms the computer can understand. The location, shape, thickness, and orientation of each component of the target system is accounted for in the computerized geometric description. The complexity of the description can be widely varied depending on its intended use. To date, two different target description methodologies have evolved and have become widely used and accepted. They are the combinatorial geometry (COMGEOM) method and the triangular or PATCH method.

In the COMGEOM method of target description each target component is described as a combination of any twelve basic geometric solid types such as spheres, boxes, cones, cylinders, and ellipses.

The computer code which accepts the COMGEOM target description and produces the shotline data is the GIFT[1,2] code. The GIFT code evolved from and has replaced the MAGIC[3,4] computer code. Figure 1 presents computer drawings of some sample COMGEOM descriptions.

The PATCH method of target descriptions uses sequenced flat triangular sections (patches) to describe the surface of each component of the target. The computer code which accepts the PATCH target description and produces the shotline data is the SHOTGEN[5,6] code. Recently, the PATCH target description method has allowed the use of cylinders, cones, and spheres to represent certain target components. PATCH target descriptions with cylinders, cones, or spheres are acceptable only to the FASTGEN[7] computer code for the production of the shotline information. The PATCH target description with cones, cylinders, and spheres must be converted[8] to all triangles before being acceptable to the SHOTGEN code. Figure 2 presents some computer drawings of sample PATCH descriptions.

Within the Department of Defense, both of these target description techniques are employed. The Army performs vulnerability analyses using the COMGEOM/GIFT methodology, while the Navy and Air Force use the PATCH/SHOTGEN-FASTGEN methodology.

---

[1] *Lawrence W. Bain, Mathew J. Reisinger, "The GIFT Code User Manual; Volume I, Introduction and Input Requirements (U)," BRL Report No. 1802, July 1975. AD# B0060371.*

[2] *Gary G. Kuehl, Lawrence W. Bain, Jr., Mathew J. Reisinger, "The GIFT Code User Manual; Volume II, The Output Options (U)," USA ARRADCOM Report in preparation.*

[3] *MAGIC Computer Simulation, Volume 1, User Manual, 61JTCG/ME-71-7-1, July 1971.*

[4] *MAGIC Computer Simulation, Volume 2, Analysts Manual Parts 1 and 2, 61JTCG/ME-71-7-2-2, May 1971.*

[5] *SHOT GENERATOR Computer Program, Volume 1, User Manual, 61JTCG/ME-71-5-1, July 1970.*

[6] *SHOT GENERATOR Computer Program, Volume 2, Analyst Manual 61JTCG/ME-71-5-2, July 1970.*

[7] *FASTGEN II Target Description Computer Program, Technical Report, ASD-TR-77-24, Booz, Allen, Applied Research for ASD/XRH Wright-Patterson AFB, January 1977.*

[8] *CONVERT (PROGRAM 7054) User Manual, DATATEC, Inc., for Air Force Armament Laboratory, Eglin AFB, Florida, October 1978.*

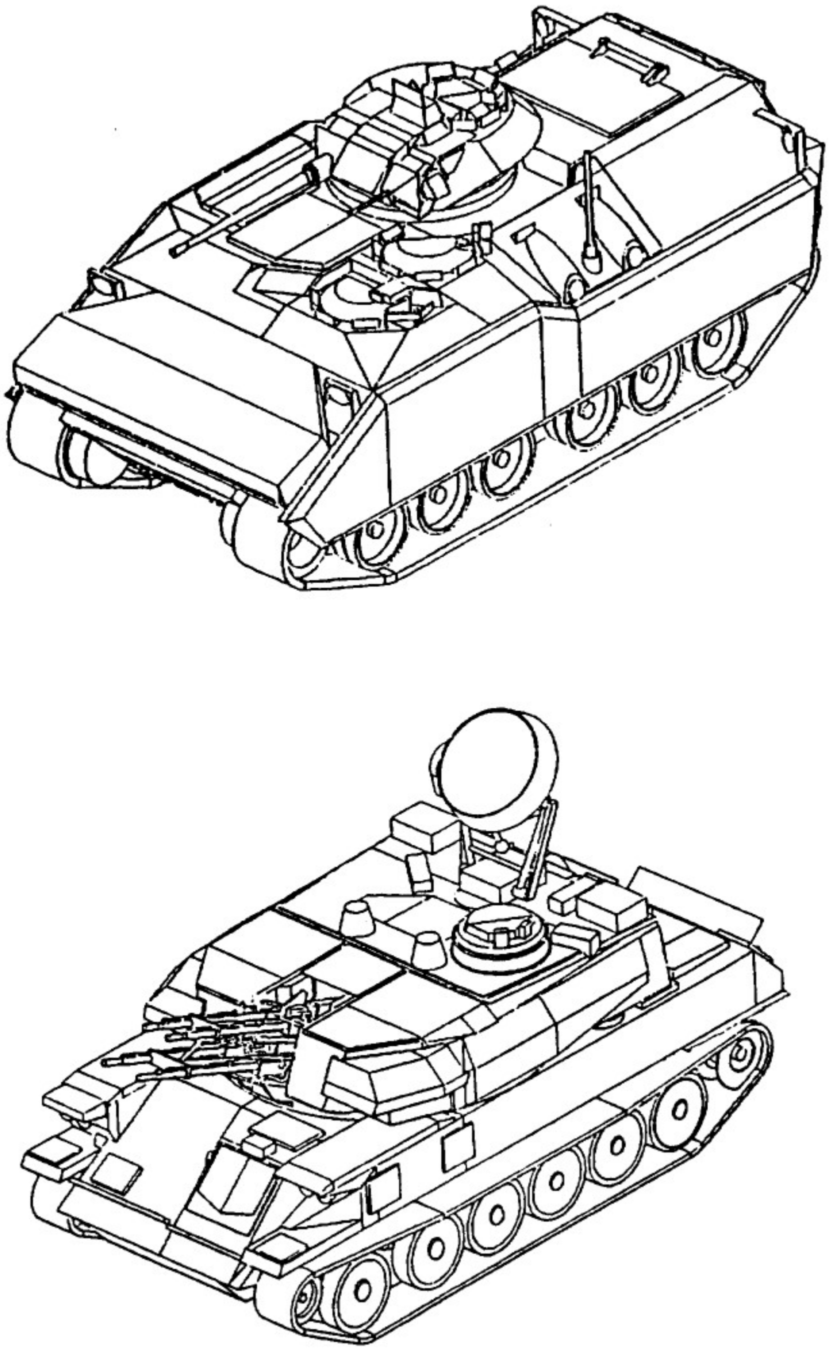


Figure 1. Examples of COMGEOM Descriptions

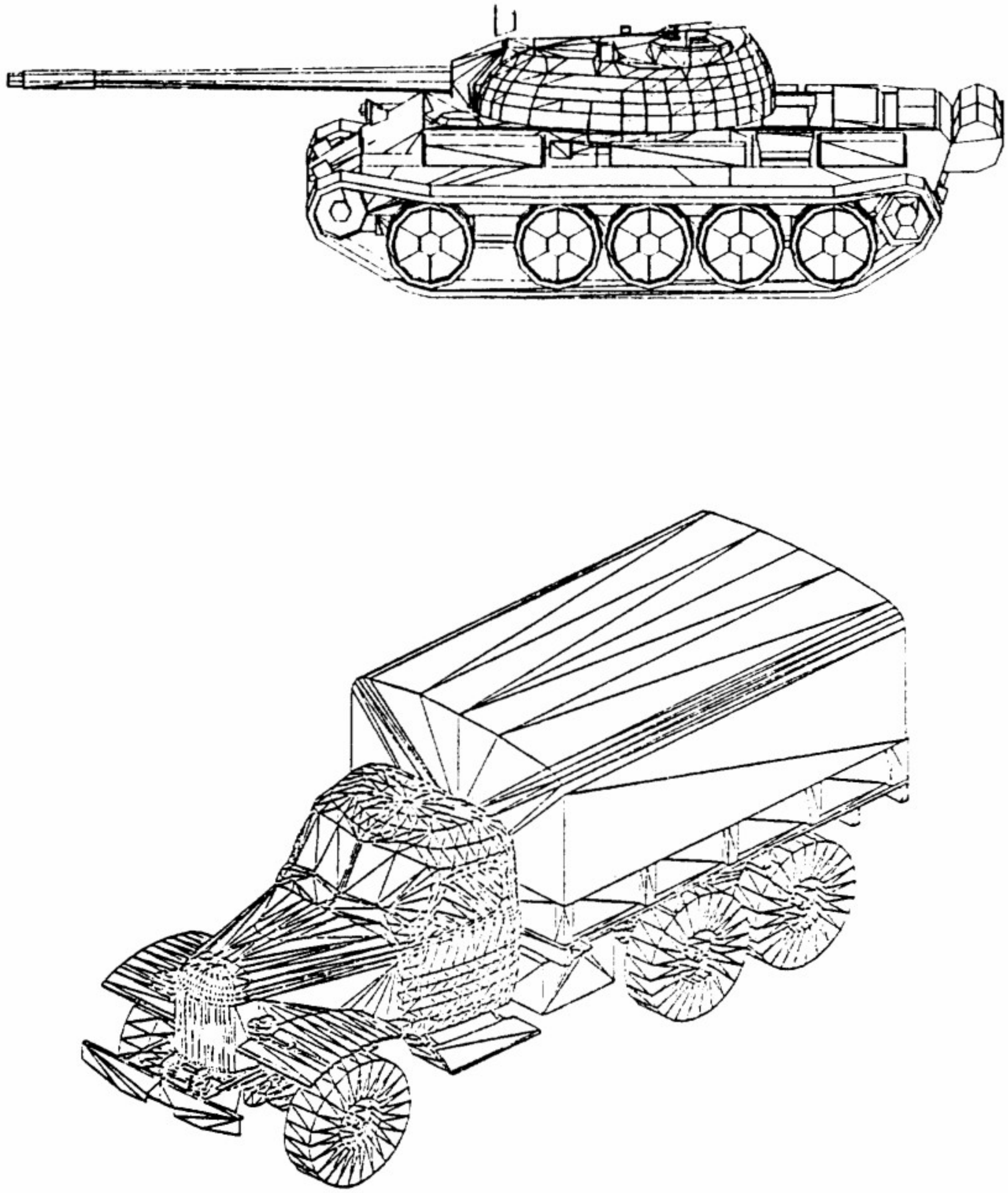


Figure 2. Examples of PATCH Descriptions

III. STATEMENT OF THE PROBLEM

With two different target description methodologies being employed in the DoD and with a total of nearly 200 targets having been described to date, there has been duplication of target description efforts. In order to reduce future duplications of effort and to realize the associated savings in time and effort, a work unit was initiated at VLD to incorporate these two target description methodologies. The most feasible way for VLD to accomplish this task was at the shotline level. That is, any shotline data, whether produced by SHOTGEN-FASTGEN or by GIFT, was made acceptable to the standard vulnerability assessment codes used at BRL. This report presents the results of this work unit and its effects when using the standard BRL parallel ray vulnerability codes. A future report will address the problem of utilizing PATCH/triangular shotline data in the BRL "point burst" vulnerability assessment code.

IV. PROCEDURE AND RESULTS

The parallel ray vulnerability assessment codes considered are the standard codes in use at the BRL and are as follows: STRIPR,[9] a modified vulnerable area (VAREA)[10,11] code; the parallel ray portion (i.e., no spall) of the VAST[12] vulnerability code; and two compartment kill models - KETANK[13] for kinetic projectiles versus tanks and CETANK[14] for chemical energy projectiles versus tanks. Either modifications

---

[9] *"A Distributed Vulnerable Area and Munition Lethal Area Methodology with Terrain Shielding Effects," G.L. Holloway, S.K. Einbinder, J.G. Bevelock, October 1975 from the BRL/ADPA Report of Proceedings of the Symposium on Vulnerability and Survivability, Volume II.*

[10] *VAREA Computer Program, Volume I, User Manual, 61JTCG/ME-71-6-1, February 1971.*

[11] *VAREA Computer Program, Volume II, Analyst Manual, 61JTCG/ME-71-6-2, February 1971.*

[12] *Thomas F. Hafer, Ann S. Hafer, "Vulnerability Analysis for Surface Targets (VAST) An Internal Point-Burst Vulnerability Model", USA ARRADCOM TR No. ARBRL-TR-02154, April 1979.* (AD #B038960L)

[13] *Howard W. Ege, Sharon M. Harvey, "Computer Program for Determining Vulnerability of Tanks to Kinetic Energy Projectiles," Volume I User Manual, Volume II Analyst Manual, BRL IMR Nos. 238, 239, June 74 (CONF)*

[14] *Howard Ege, "Computer Program for Determining Vulnerability of Tanks to Chemical Energy Projectiles," ARBRL Rpt in preparation.*

were made in the vulnerability codes to accept the different shotline data, or the shotline data were modified to be made acceptable to the vulnerability codes. All the codes mentioned in this report, whether shotline producing codes, vulnerability assessment codes, or shotline conversion codes, are now operational at BRL.

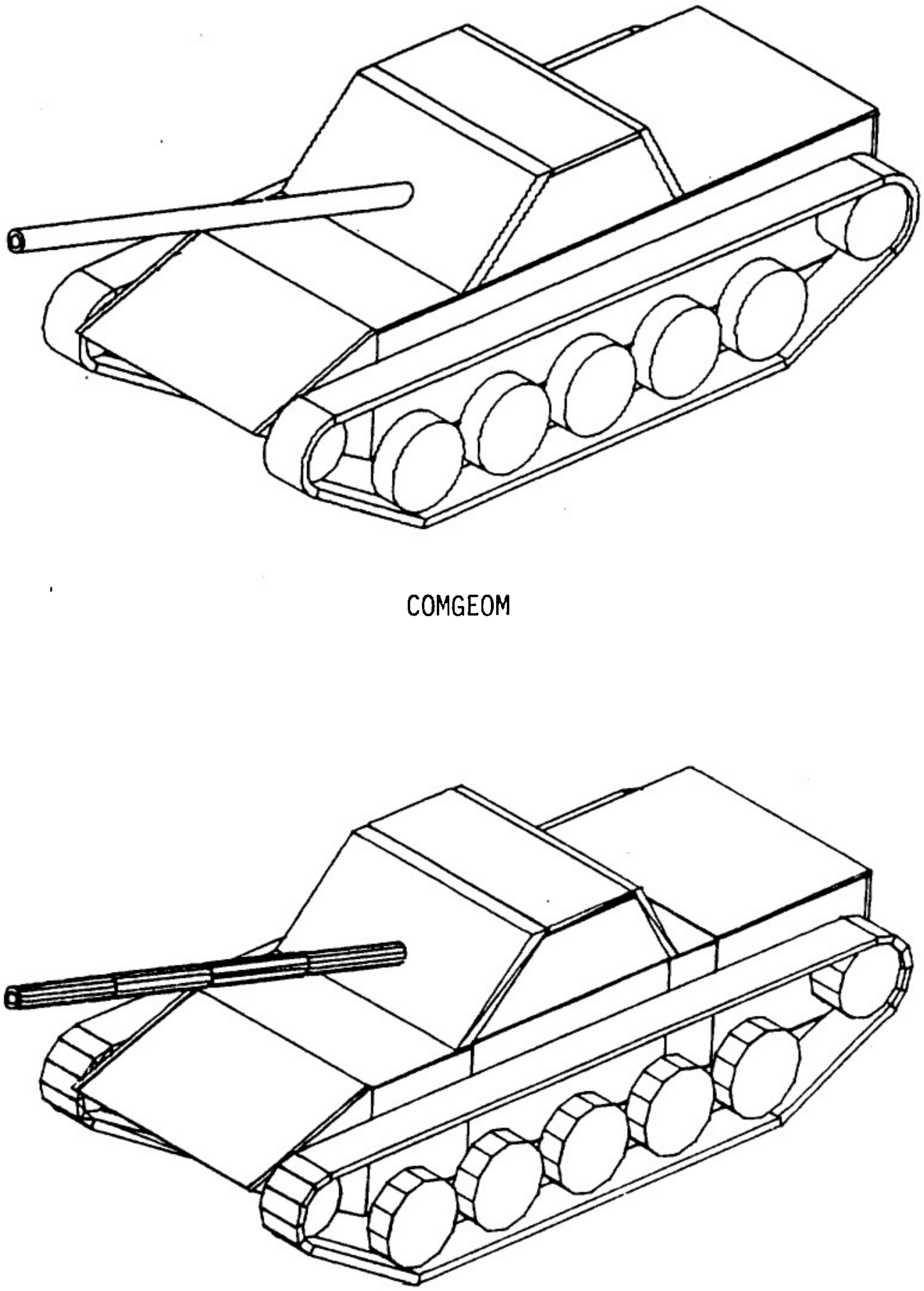
For checkout and verification purposes, two "identical" tank descriptions were produced, one using the COMGEOM method and the other the PATCH/triangular method (with cones, cylinders, and spheres). Any new codes, or changes or modifications to existing codes referenced in this report were comparison checked using these two "identical" descriptions of the same hypothetical tank. Figure 3 depicts computer drawings of an oblique view of these two descriptions. These descriptions are relatively low detail but are not considered overly simple descriptions. A more detailed discussion of these descriptions is presented in Appendix A.

In order to utilize PATCH/triangular shotline data in a BRL vulnerability code, the analyst will face one of the following four cases:

- Case (1) a PATCH description with all triangles
- Case (2) a PATCH description employing cones, cylinders, and spheres
- Case (3) only the SHOTGEN shotline data
- Case (4) only the FASTGEN shotline data

Previously at BRL, each of these four cases would have presented problems to the analyst depending on which vulnerability assessment code he intended to use. We will discuss how one would proceed in each of the above four situations for each of the standard BRL vulnerability assessment codes.

When using the vulnerable area codes, namely STRIPR and VAST, the situation is relatively simple and is depicted in Figure 4. Both the VAST and STRIPR codes previously accepted the SHOTGEN format of shotline data. Thus, in Case (1) where a PATCH description of only triangles is available, one simply uses the SHOTGEN code to produce the shotline data in an acceptable format. For Case (3), the SHOTGEN shotline data are available and acceptable for use as they are. On the other hand, neither STRIPR nor VAST accept FASTGEN shotline data. Thus, when the available target description has cones, cylinders, and spheres and is not acceptable to SHOTGEN (Case (2)) <u>or</u> when only the FASTGEN shotline data are available (Case (4)), the geometry data is unusable. To remedy this problem, both the VAST and STRIPR codes have been modified to accept the FASTGEN shotline data. These modifications are listed and discussed in Appendix B. The analyst can now proceed in Cases (2) and (4) and use the FASTGEN shotline data in the modified VAST and STRIPR codes. One other alternative to Case (2) may be to convert the description to all triangles and proceed as in Case (1), (i.e., use the SHOTGEN code). However, one must realize



COMGEOM

PATCH

Figure 3. Sample Tank Descriptions

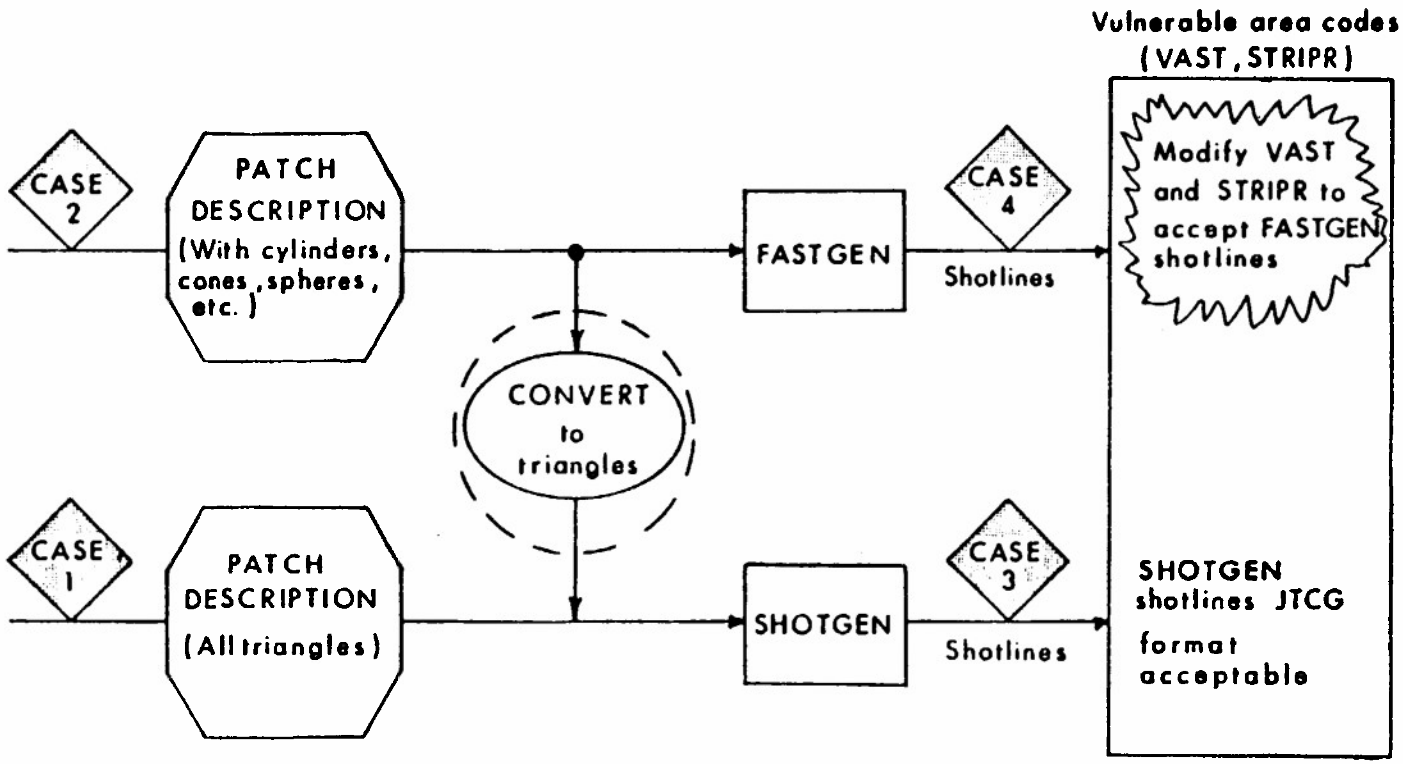


Figure 4. Using PATCH Type Descriptions in Vulnerable Area Codes

that in doing so, all the curved surfaces (cones, cylinders, and spheres) will be approximated by a series of flat triangles and this approximation may not be desirable, depending on the system being studied.

The compartment kill models of KETANK and CETANK represent a similar type of problem. Both of these codes accept only GIFT Tape 1* type shotline data. For the compartment kill models it was decided to change the shotline data for all four possible cases. Figure 5 depicts the compartment kill situation. Both the SHOTGEN and FASTGEN codes were modified by adding an option to produce GIFT Tape 1 shotline data. The modifications to SHOTGEN and FASTGEN are listed in Appendix C. The modified SHOTGEN and FASTGEN codes are both operational at BRL. Thus, Case (1) and Case (2) only require the use of Tape 1 shotline option in these modified SHOTGEN and modified FASTGEN codes, respectively, to produce GIFT Tape 1 shotlines.

For Cases (3) and (4), where one has only standard SHOTGEN and FASTGEN shotline data respectively, two conversion codes were written. The SGCVRT code converts standard SHOTGEN shotline data to GIFT Tape 1 shotline data while FGCVRT does the same for standard FASTGEN shotline data. These two conversion codes are discussed in detail and listed in Appendix D. As before, if one has a Case (2) situation (PATCH description with cones, cylinders, and spheres), the description may be converted to all triangles (Case (1)) and then proceed as in Case (1). Again, the curved surfaces will be approximated by triangular patches.

V. CONCLUSIONS

The vulnerability analyst at BRL now has the capability of using any PATCH target description or any FASTGEN or SHOTGEN produced shotline data in all the standard BRL parallel ray vulnerability assessment codes. This fact represents a possible savings in time and effort at BRL when analyzing a system that has already been described using the PATCH/triangular method and for which no COMGEOM target description exists. In effect, future duplications of target descriptions should be eliminated. It is of little consequence to an analyst whether the shotline data he uses in an analysis comes from a validated PATCH or validated COMGEOM target description. All the changes and modifications of existing codes and the new codes discussed in this report have been validated and checked using the two "identical" descriptions of a sample tank. These sample tank descriptions differ only in the fact that one description employs COMGEOM and the other uses the PATCH method. The modified SHOTGEN, FASTGEN, STRIPR, and VAST codes are operational and available at BRL.

**Tape 1 shotline data is the formatted shotline output produced by the GIFT code. This information is available in any of three formats depending on the number of components listed per line of output data. More detailed information about the GIFT Tape 1 shotline data can be found in Reference 2.*

The vulnerability codes referenced in this report represent the standard BRL codes used for analysis of ground vehicles attacked by fragments, kinetic energy warheads, and shaped charge warheads. Vulnerability assessment codes assessing other damage mechanisms (e.g., lasers) and for other types of systems (e.g., aircraft) present very similar problems. The results presented in this report will allow for the use of PATCH/SHOTGEN-FASTGEN geometric information in these cases also. In fact, any parallel ray vulnerability assessment code which uses standard GIFT shotlines will now be able to use PATCH/triangular shotline data by using the shotline conversion codes (SGCVRT and FGCVRT). The two main exceptions are the point burst code and the nuclear vulnerability code.[15] As noted, the point burst problem will be addressed later. The nuclear vulnerability assessment code used at BRL requires a COMGEOM description but does not use standard GIFT shotline data. The nuclear code uses a Monte Carlo scheme for tracing particles through a target description. The results presented in this report will not allow the use of PATCH/triangular target descriptions in the nuclear vulnerability code. Such an undertaking would require a major reworking of the ray tracing portion of the nuclear vulnerability code.

[15] *A. Rainis, R. Rexroad, "MIFT: GIFT Combinatorial Geometry Input to VCS Code," BRL Rpt No. 1967, dtd March 1977.* (AD #A037898)

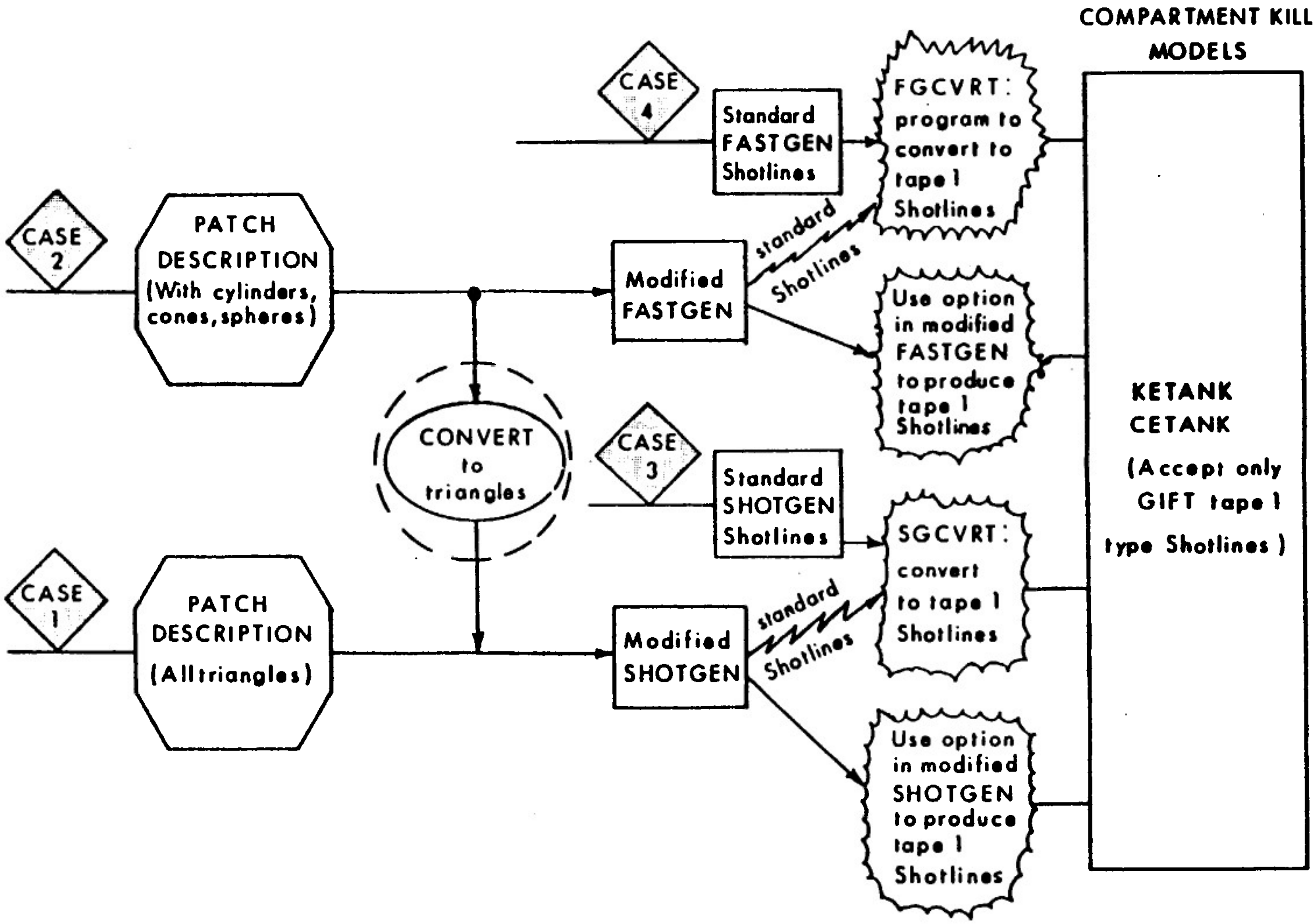


Figure 5. Using PATCH Type Descriptions in Compartment Kill Models

APPENDIX A

SAMPLE TANK DESCRIPTIONS

SAMPLE TANK DESCRIPTIONS

In order to check all the modifications made in the various codes and to verify the new codes, two target descriptions were produced of the same hypothetical sample tank, one employing the PATCH method and one the COMGEOM method. This tank definitely bears no resemblance to any real or future tank. Figure A-1 presents a cross sectional view of the tank's armor shell as it was described in both descriptions. Thicknesses and certain obliquity angles have been added to this plot. The interior of the tank includes four crew members, a fuel tank, a ballistic computer, thirty-six rounds of ammunition, and a simple engine and transmission. Figure A-2 shows an oblique view of the interior components of both descriptions. Figure A-3 shows a cut-away view of the tank depicting the placement of the interior components. Figures A-4 through A-7 present different exterior views of the two descriptions for comparison purposes. Figure A-4 presents front views, Figure A-5 presents rear views, Figure A-6 presents side views, and Figure A-7 presents top views.

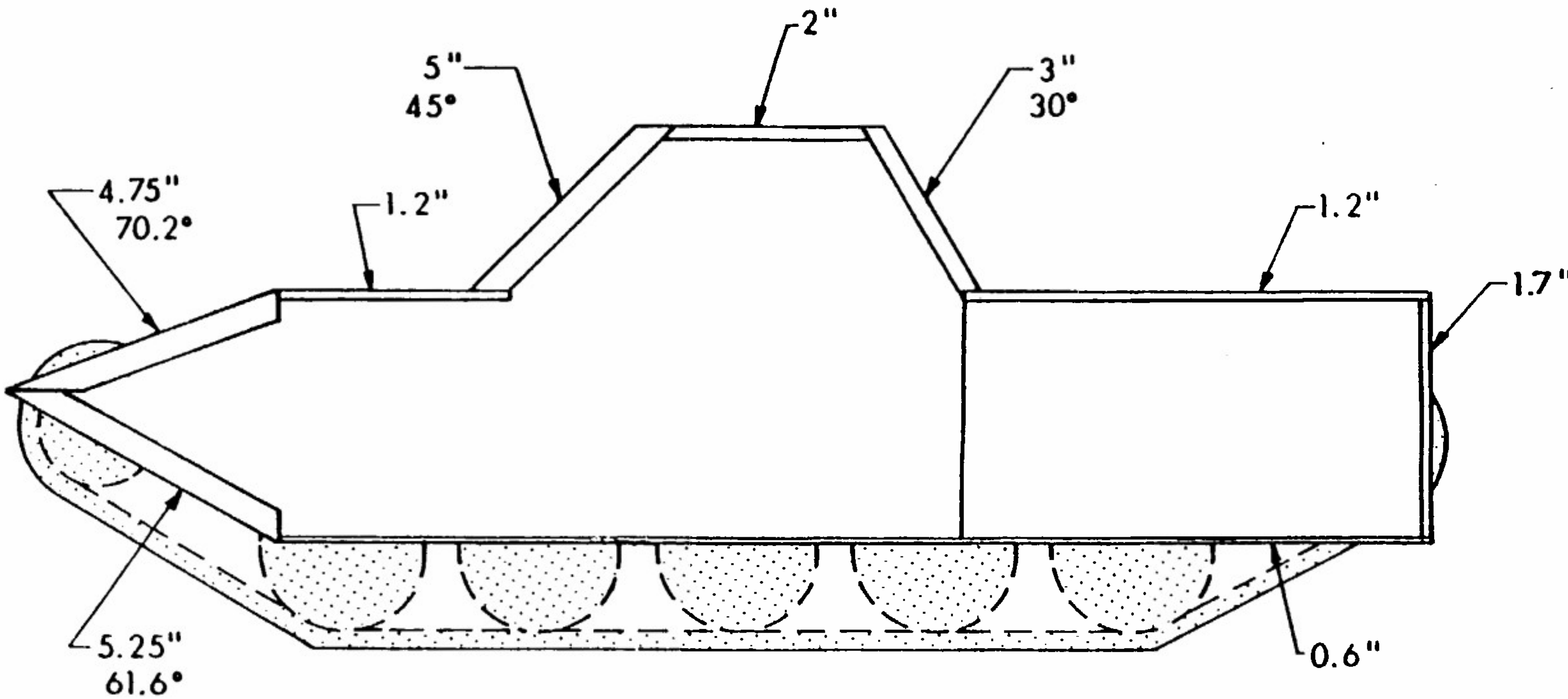


Figure A-1. Sample Tank Armor Thicknesses

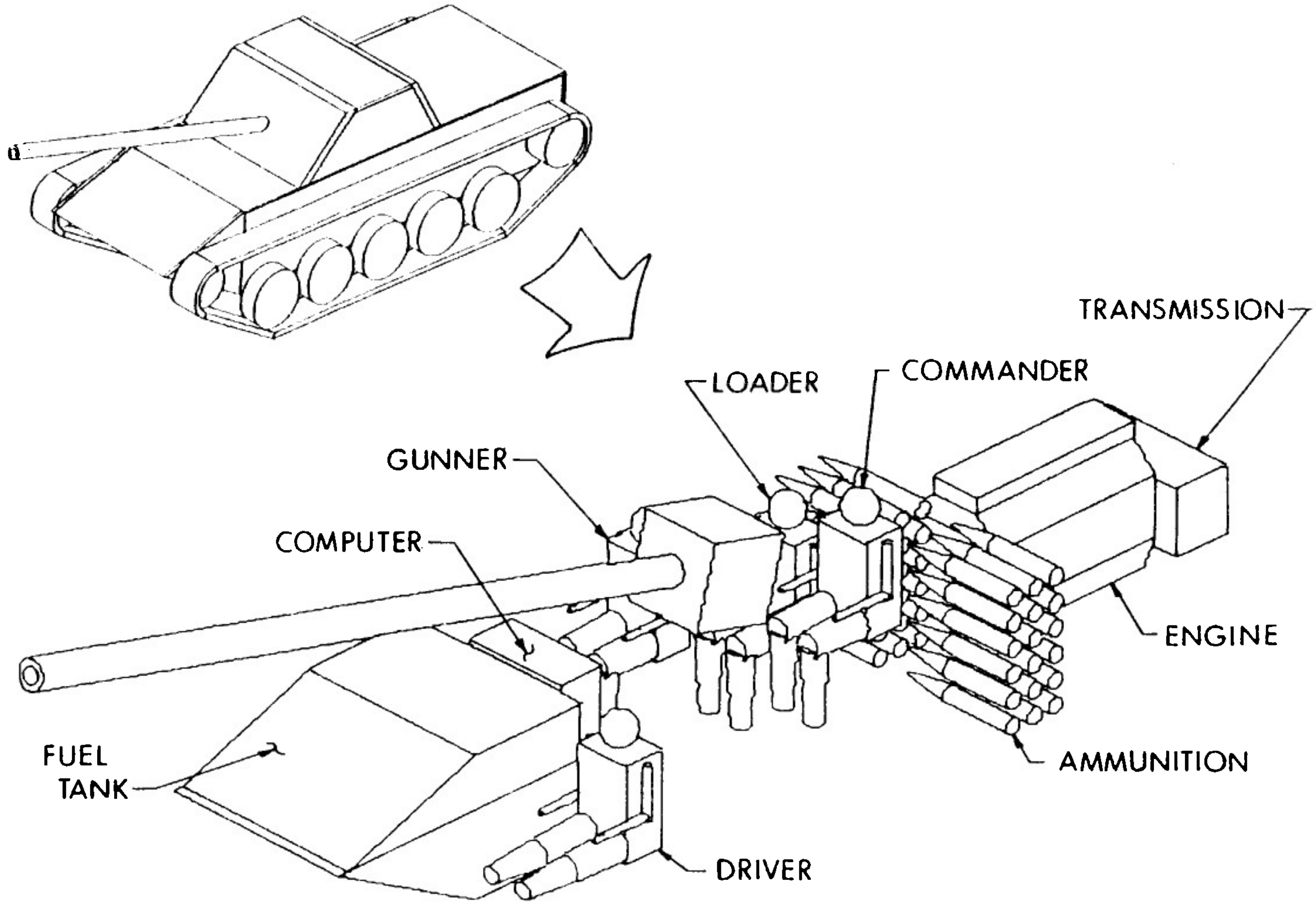


Figure A-2. Interior of the Sample Tank

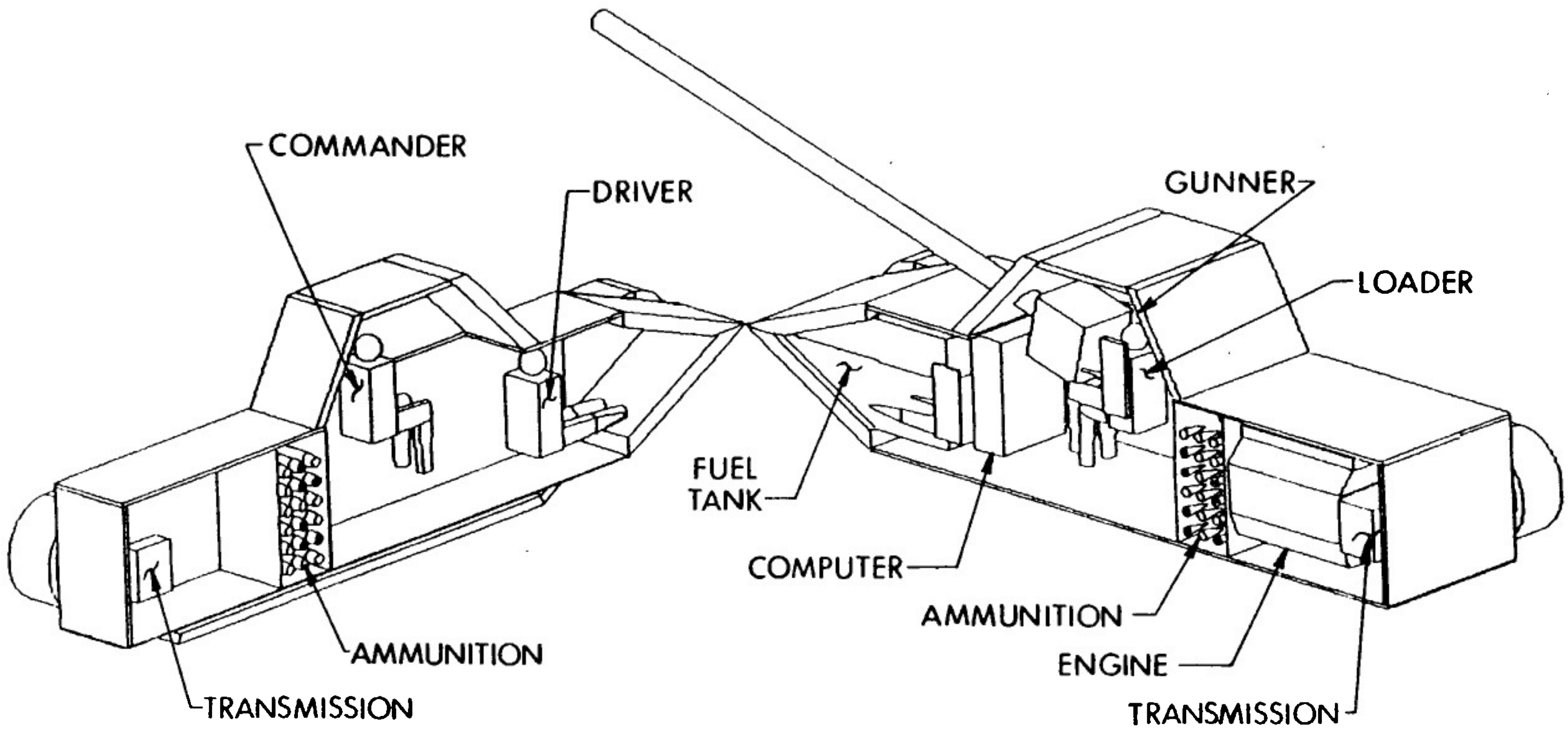
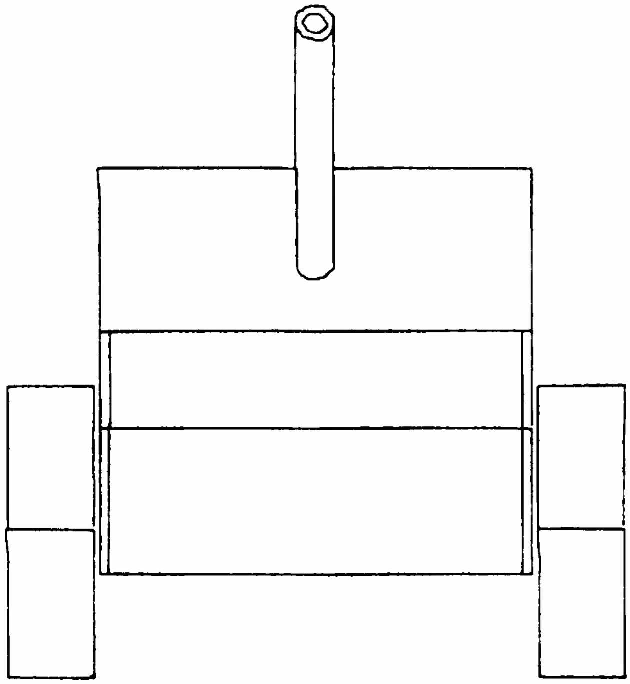
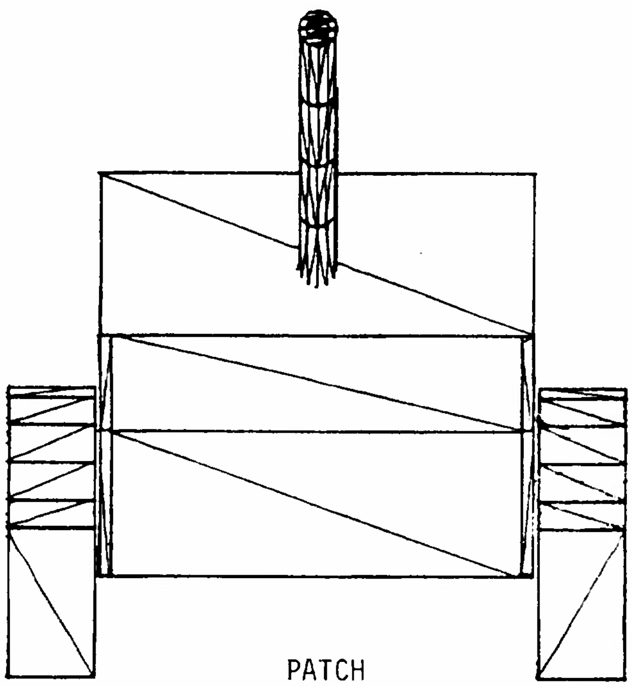


Figure A-3. Sectional Cut View of the Sample Tank



COMGEOM



PATCH

Figure A-4. Front Views of the Sample Tank Descriptions

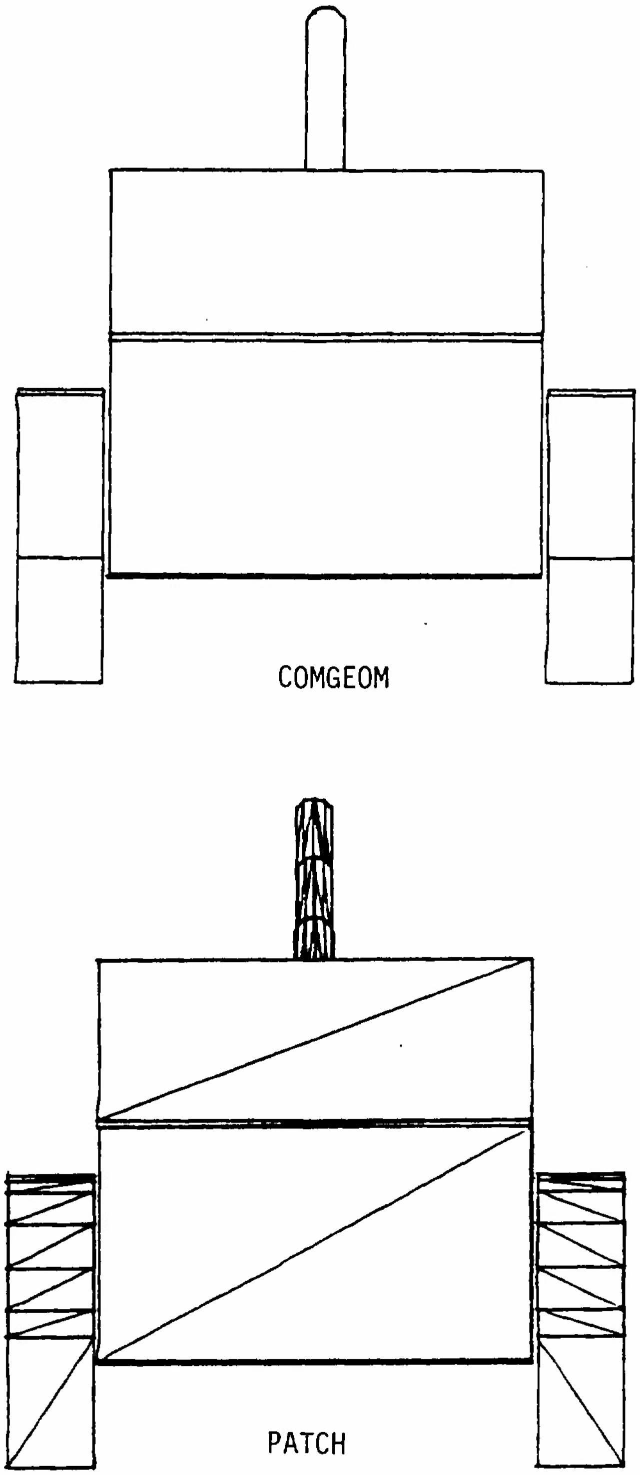
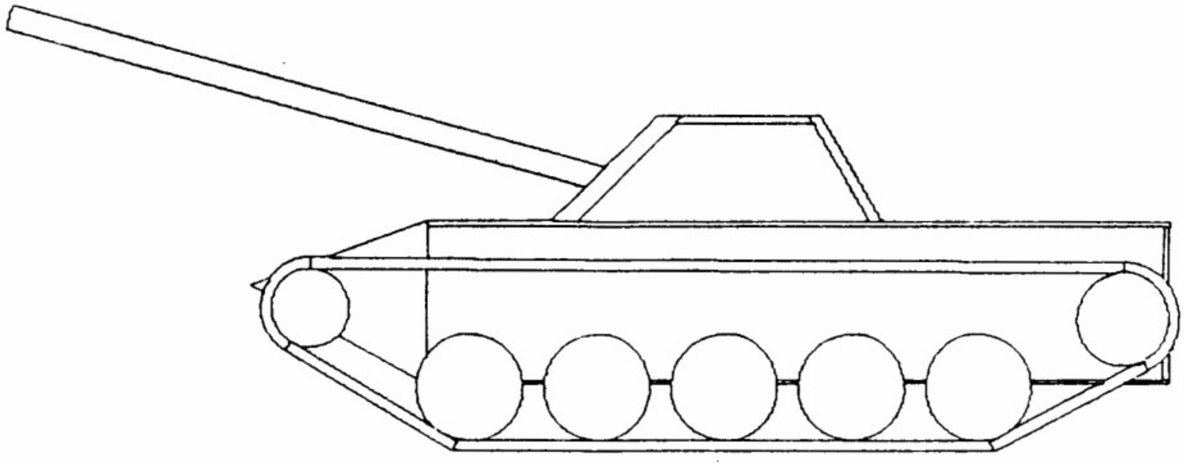
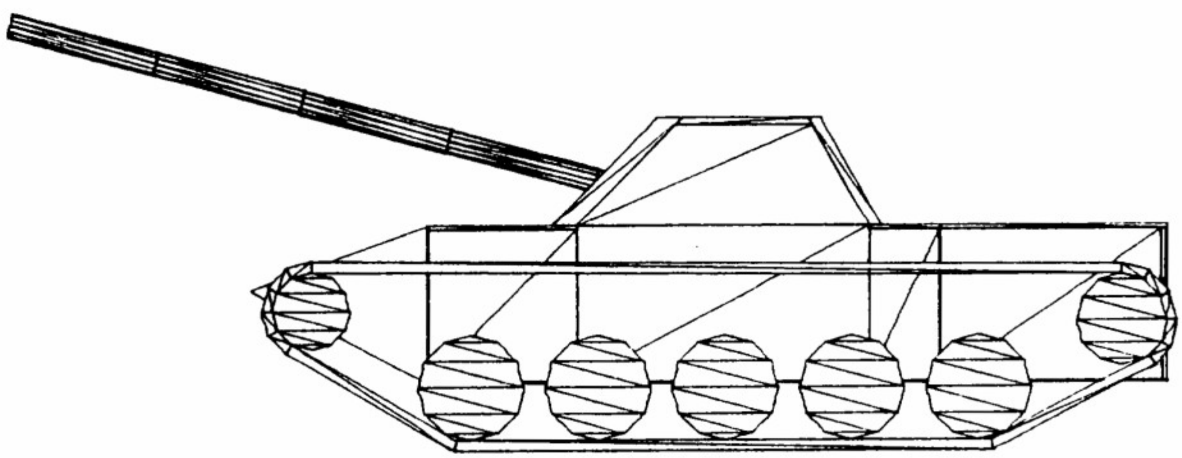


Figure A-5. Rear Views of the Sample Tank Descriptions

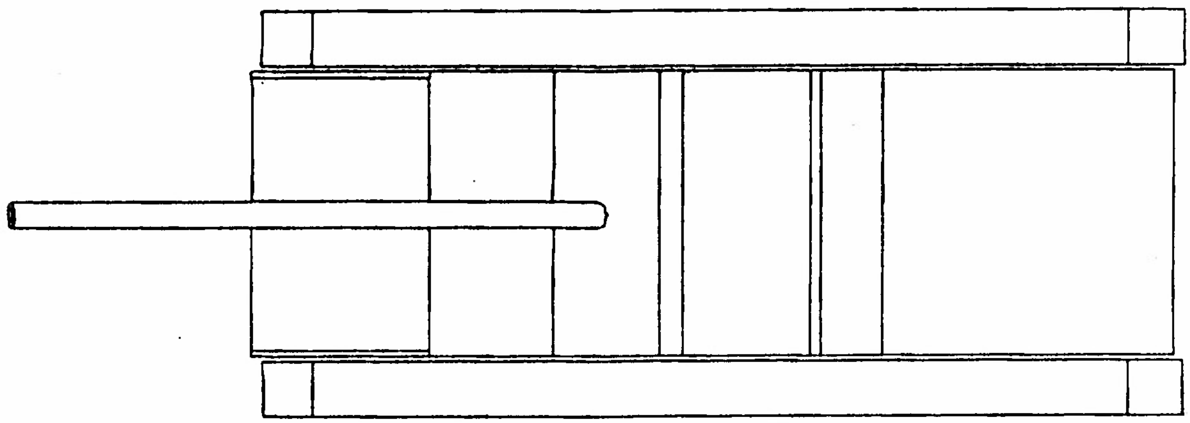


COMGEOM

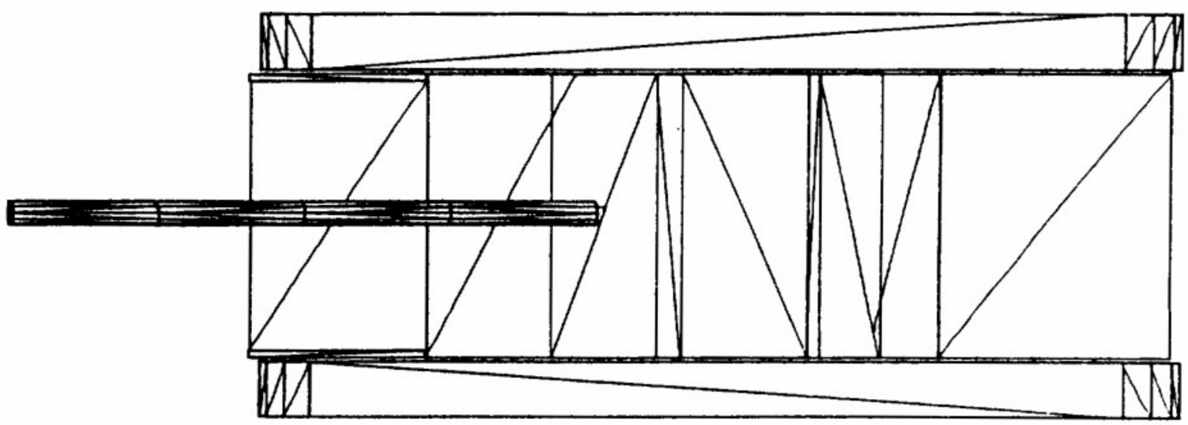


PATCH

Figure A-6. Side Views of the Sample Tank Descriptions



COMGEOM



PATCH

Figure A-7. Top Views of the Sample Tank Descriptions

APPENDIX B

MODIFICATIONS TO THE VAST AND STRIPR
VULNERABILITY ASSESSMENT CODES

MODIFICATIONS TO THE VAST AND STRIPR VULNERABILITY ASSESSMENT CODES

The STRIPR is a modified VAREA code which will produce vulnerable area estimates for different heights (strips) on the target system. This code has now been modified to accept FASTGEN shotline data. The VAST code is an internal point burst vulnerability assessment code. Being based on the STRIPR code, the VAST code has all of the STRIPR code's capabilities but also can consider the effects of behind-the-plate spall particles. The changes to the VAST code presented here are only concerned with the "no spall" portion of VAST and consequently are basically the same as those changes to STRIPR (i.e., ability to read FASTGEN type shotlines). Table B-I presents the changes to the STRIPR code while Table B-II presents the changes to the VAST code.

TABLE B-I. Changes to the STRIPR Code to Accept FASTGEN Type Shotlines

```
*ID FGINPUT
*D RV2.73
      IF(IPACK-0) 7100,160,160
 7100 N=N+1
 7110 LL=LL+1
      IF(LL.LE.170) GOTO 7120
      READ(1) (AX(L),AY(L),AZ(L),IECO(L),KCNO(L),LTH(L),
     1IES(L),IESK(L),L=1,170)
      IF(ISW1.GE.1) WRITE(6,881) (AX(L),AY(L),AZ(L),IECO(L),
     1KCNO(L),LTH(L),IES(L),IESK(L),L=1,170)
      LL=1
 7120 IF(N.GT.50) GOTO 7150
      ICNO(N)=KCNO(LL)
      IF(ICNO(N).EQ.0) GOTO 780
      TAX(N)=AX(LL)*TDIV
      TAY=AY(LL)*TDIV
      TAZ=AZ(LL)*TDIV
      TH(N)=FLOAT(LTH(LL))*TDIV/100.0
      JSC(N)=MOD(IECO(LL),10)
      SEC(N)=FLOAT(IES(LL))/1000.0
      IF(JKLL.LE.0) SEC(N)=FLOAT(IESK(LL))/1000.0
      TN(N)=TH(N)/SEC(N)
      IF(JSC(N)-9) 7100,230,230
 7150 IF(MOD(IECO(LL),10).LT.9) GOTO 7110
      GOTO 220
*I RV2.4
      DIMENSION KCNO(170),IESK(170),LTH(170)
*I RV2.398
  881 FORMAT(1H ,3F12.2,5I10)
```

TABLE B-II. Changes to the VAST Code to Accept FASTGEN Type Shotlines

```
*ID FGENIN
*I VAST.45
      COMMON /FGINPT/ IFGEN
*D VAST.69
C          66-70 - IFGEN   -   .GT. 0  SHOTLINES IN FASTGEN OUTPUT
C
*D VAST.71
     1  STRIPV,PRMET,TAP8,ISPCM,IFGEN
C     INPUT IS IN FASTGEN FORMAT IF IFGEN GT 0
      IF(IFGEN.GT.0) LPACK=.FALSE.
*D VAST.193
   80 FORMAT(12L5,2I5)
*I VAST.3770
      COMMON /FGINPT/ IFGEN
*I VAST.3997
      DIMENSION KCNO(170),IESK(170),ITH(170)
*I VAST.4005
      COMMON /FGINPT/ IFGEN
*I VAST.4011
C     IFGEN > 0  HAVE FASTGEN SHOTLINES
      IF(IFGEN.GT.0) GOTO 100
*I VAST.4077
C
C     HAVE FASTGEN SHOTLINES
C        BLOCKS OF 170 LINES - 8 WORDS PER LINE
  100 N=N+1
  200 LL=LL+1
      IF(LL.LE.170) GOTO 300
      READ(TP10) (AX(L),AY(L),AZ(L),IECO(L),KCNO(L),ITH(L),IES(L),
     1            IESK(L),L=1,170)
      LL=1
  300 IF(N.GT.MAXNCS) GOTO 400
      ICNO(N)=KCNO(LL)
      IF(ICNO(N).EQ.0) RETURN
      TAX(N)=AX(LL)
      TAY=AY(LL)
      TAZ=AZ(LL)
      TH(N)=FLOAT(ITH(LL))/100.0
      JSC(N)=MOD(IECO(LL),10)
      IF(.NOT.XITANG) SEC(N)=FLOAT(IES(LL))*.001
      IF(XITANG) SEC(N)=FLOAT(IESK(LL))*.001
      TN(N)=TH(N)/SEC(N)
      IF(JSC(N).LT.9) GOTO 100
      RETURN
  400 IF(MOD(IECO(LL),10).LT.9) GOTO 200
      IF(XITANG) WRITE(6,50) MAXNCS,TAY,TAZ
      N=MAXNCS
      JSC(N)=9
      RETURN
```

APPENDIX C

MODIFICATIONS TO THE SHOTGEN AND FASTGEN SHOTLINE CODES

MODIFICATIONS TO THE SHOTGEN AND FASTGEN SHOTLINE CODES

The SHOTGEN and FASTGEN computer codes are the shotline producing codes associated with the PATCH/triangular target description technique. Both of these codes produce shotline data in different but similar formats. The SHOTGEN code will accept target descriptions consisting of only triangles, whereas FASTGEN will also accept target descriptions comprised of triangles, cones, cylinders, and spheres. In order to use the output of these codes in the compartment kill models (KETANK and CETANK) at BRL, both SHOTGEN and FASTGEN were modified by adding the option to produce GIFT Tape 1 shotline data. Table C-I presents the changes to the SHOTGEN code, and Table C-II presents the changes to the FASTGEN code. These modified SHOTGEN and FASTGEN codes are now operational at BRL.

TABLE C-I. Changes to SHOTGEN Code to Produce GIFT Tape 1 Shotlines

```
*ID TAPE1
*D SHGEN.3,9
      1    TAPE28,TAPE29,TAPE1)
C       TAPE9 - INPUT DATA (DESCRIPTION)      (BINARY)
C       TAPE10- LINE-OF-SIGHT OUTPUT          (BINARY)
C       TAPE28- TRANSFORMED DATA              (BINARY)
C       TAPE29- OVERFLOWS                     (BINARY)
C       TAPE1 - GIFT TAPE1 2 COMPONENTS/LINE (FORMATED)
C
C       CARD 1 - JKL,JKLL,IBIN,ICOOR,KAGRID   (5I5 FORMAT) (READ BY MAIN)
*I SHGEN.18
C                    KAGRID .EQ. 0   NO TAPE1 GRID OUTPUT
C                    KAGRID .GT. 0   CREATE GIFT TAPE1 GRID OUTPUT
*D SHGEN.45,46
        READ(5,8000) JKL,JKLL,IBIN,ICOOR,KAGRID
        WRITE(6,8732) JKL,JKLL,IBIN,ICOOR,KAGRID
 8732 FORMAT(1H1,10X,'OPTIONS SELECTED FOR THIS RUN',//,
      1        10X,'JKL =    ',I5/
      2        10X,'JKLL =   ',I5/
      3        10X,'IBIN =   ',I5/
      4        10X,'ICOOR =  ',I5/
      5        10X,'KAGRID =',I5/)
*I SHGEN.53
C KAGRID.EQ.0  NO GIFT TAPE1 GRID OUTPUT
C KAGRID.GT.0  PRODUCE GRID TAPE1 GRID OUTPUT  (2 COMPONENTS/LINE)
```

TABLE C-I. Changes to SHOTGEN Code to Produce GIFT Tape 1 Shotlines (Continued)

```
*D SHGEN.58,66
C
CC     WRITE INITIAL HEADER ON TAPE1 IF NECFSSARY
C
       IF(JKL.LE.0) GOTO 7385
       CALL SKIPFE(10,JKL,1)
       CALL SKIPFE(1,JKL,0)
 7385  CONTINUE
       CALL DATE(AA)
       IF(KAGRID.GT.0) WRITE(1,7893) NUMVWS,AA,NV
 7893  FORMAT(I5,A10,'VEHICLE',I5)
*I SHGEN.55
       NUMVWS=0
       GRID=0.0
*D TRANSF.9
       IF(GRID.LE.0.0) GOTO 3927
       ENDFILE 10
       ENDV=999.9
       WRITE(1,3928) ENDV
 3928  FORMAT(F6.1,71X,'END')
       ENDFILE 1
 3927  CONTINUE
*D TRANSF.14
*I TRANSF.17
       NUMVWS=NUMVWS+1
       WRITE(6,7789) NUMVWS
 7789  FORMAT(5X,'VIEW NUMBER',I6)
```

TABLE C-I. Changes to SHOTGEN Code to Produce GIFT Tape 1 Shotlines (Continued)

```
      IF(KAGRID.GT.0) WRITE(6,7793)
 7793 FORMAT(5X,'SELECTED GIFT TAPE1 OUTPUT OPTION')
C
CC    WRITE TAPE1 HEADER LINE FOR THIS VIEW
C
      TCX = 0.0
      TCY = 0.0
      TCZ = 0.0
      IF(KAGRID.GT.0) WRITE(1,6231) AZM,ELEV,TCX,TCY,TCZ,GRID
 6231 FORMAT(2E20.8,4E10.3)
 6232 CONTINUE
*I TREAT.29
      NCOMP=0
*B SHGEN.42
      COMMON YCTR,ZCTR,NCOMP,KAGRID,NUMVWS
*B CTOBIN.6
      COMMON YCTR,ZCTR,NCOMP,KAGRID,NUMVWS
*B TRANSF.4
      COMMON YCTR,ZCTR,NCOMP,KAGRID,NUMVWS
*B CLS.5
      COMMON YCTR,ZCTR,NCOMP,KAGRID,NUMVWS
*B TREAT.4
      COMMON YCTR,ZCTR,NCOMP,KAGRID,NUMVWS
*B SORT.5
      COMMON YCTR,ZCTR,NCOMP,KAGRID,NUMVWS
*B CHECK.4
      COMMON YCTR,ZCTR,NCOMP,KAGRID,NUMVWS
```

```
*I TREAT.2
      DIMENSION XX1(50),XXW(50),ITEM(50),CLOS(50),CANGI(50),CNORM(50),
     1          KSPAC(50),SLOS(50)
*D TREAT.254
C
CC    FINISHED WITH THIS COMPONENT    FILL OUT TAPE1 ARRAYS
C
  254 CONTINUE
      IF(KAGRID.LE.0) GOTO 9254
      NCOMP=NCOMP+1
      IF(NCOMP.LE.50) GOTO 9386
      YERR=FLOAT(IFIX(SH(2,JK)/10000.0))*.01
      ZERR=FLOAT(IFIX(SH(3,JK)/1000.0))*.01
      WRITE(6,9387) YERR,ZERR
 9387 FORMAT(5X,'NUMBER COMPONENTS > 50 AT CELL ',2F10.2,5X,'STOP')
      STOP
 9386 CONTINUE
      KOMB=(SH(6,JK))+.005
      KQQ=MOD(JH(2,JK),100)
      JH1JK=(JH(1,JK)*10000)+KQQ*100
      JH2JK=(KOMB*10000)+JH(2,JK)/100
      XX1(NCOMP)=SH(1,JK)
      XXW(NCOMP)=SH(1,JK)-SH(4,JK)
      ITEM(NCOMP)=MOD(JH2JK,10000)
      CLOS(NCOMP)=SH(4,JK)
      CANGI(NCOMP)=FLOAT((MOD(JH1JK,10000))/100)
      CNORM(NCOMP)=(FLOAT(JH2JK/10000))*.01
```

TABLE C-I. Changes to SHOTGEN Code to Produce GIFT Tape 1 Shotlines (Continued)

```
      KSPAC(NCOMP)=JH1JK/10000
      SLOS(NCOMP)=0.0
      ANGKO=CANGI(NCOMP)*.01745329
      IF(CNORM(NCOMP).EQ.0.0) CNORM(NCOMP)=CLOS(NCOMP)*COS(ANGKO)
 9254 CONTINUE
      IF(J9-N5) 250,253,253
*I TREAT.259
C
CC    FINISHED THIS CELL - WRITE TAPE1 INFO
C
      IF(KAGRID.LE.0) GOTO 320
      KSPAC(NCOMP)=9
C
CC    WRITE CELL HEADER LINE.
C
      NK=NCOMP
      WRITE(1,8105) YCTR,ZCTR,XX1(1),XXW(NK),NCOMP,YCOOR,ZCOOR,AZM,ELEV
C
CC    WRITE REST OF TAPE1 CELL INFO
C
      NFK=NCOMP-1
      DO 8111 KAA=1,NFK
      IF(NCOMP.EQ.1) GOTO 8111
      SLOS(KAA)=XXW(KAA)-XX1(KAA+1)
      IF(SLOS(KAA).GT.0.010) GOTO 8111
      KSPAC(KAA)=0
      SLOS(KAA)=0.0
```

TABLE C-I. Changes to SHOTGEN Code to Produce GIFT Tape 1 Shotlines (Continued)

```
8111 CONTINUE
     DO 8112 K1=1,NK,2
     K2=K1
     IF(KSPAC(K1).EQ.9) GOTO 8113
     K2=K1+1
     WRITE(1,8103)ITEM(K1),CLOS(K1),CNORM(K1),CANGI(K1),KSPAC(K1),
    1     SLOS(K1),ITEM(K2),CLOS(K2),CNORM(K2),CANGI(K2),KSPAC(K2),
    2     SLOS(K2),K2
     GOTO 8112
8113 WRITE(1,8104)ITEM(K1),CLOS(K1),CNORM(K1),CANGI(K1),KSPAC(K1),
    1     SLOS(K1),K2
8112 CONTINUE
8103 FORMAT(2(I4,2F7.2,F6.1,I3,F7.2),7X,I4)
8104 FORMAT(I4,2F7.2,F6.1,I3,F7.2,41X,I4)
8105 FORMAT(F6.1,F7.1,3X,2F8.2,8X,I3,7X,2F9.3,1X,'A',F4.0,'E ',F4.0)
     NCOMP=0
```

TABLE C-II. Changes to FASTGEN Code to Produce GIFT Tape 1 Shotlines

```
*D FASTGEN.4
     2                TAPE27,TAPE1)
*I FASTGEN.25
C      FILE  1 FORMATTED SHOTLINE OUTPUT (GIFT TAPE1 2 COMPONENTS PER CARD)
*I FASTGEN.63
C                KAGRID > 0 PRODUCE TAPE1 FORMATTED SHOTLINES
C                       = 0 NO TAPE1
C                NUMVWS   NUMBER OF ASPECTS FOR TAPE1 (JUST PRINTED ON HEADER
C                                                  LINE OF TAPE1 ONLY)
*I FASTGEN.80
      COMMON KEITH,KAGRID
*I FASTGEN.103
      KEITH=0
*D FASTGEN.105
     1,NUMC,NCRIT,KAGRID,NUMVWS
*I FASTGEN.108
     1,NUMC,NCRIT,KAGRID,NUMVWS
      IF(KAGRID.LE.0) GOTO 777
C     WRITE INITIAL HEADER ON TAPE1
      REWIND 1
      CALL DATE(AA)
      WRITE(1,3172) NUMVWS,AA,NV
 3172 FORMAT(I5,A10,' VEHICLE',I5)
  777 CONTINUE
*D FASTGEN.140,145
      CALL SKIPFE(20,JKL,1)
*I FASTGEN.240
      COMMON KEITH,KAGRID
*I FASTGEN.288
      IF(KEITH.GT.0) ENDFILE 20
      IF(KAGRID.LE.0) GOTO 3835
      IF(KEITH.EQ.0) GOTO 3835
```

TABLE C-II. Changes to FASTGEN Code to Produce GIFT Tape 1 Shotlines (Continued)

```
      XEND=999.9
      WRITE(1,3833) XEND
 3833 FORMAT(F6.1,71X,'END')
      ENDFILE 1
 3835 CONTINUE
*I FASTGEN.289
      IF(KAGRID.GT.0) WRITE(1,3834) AZM,ELEV,TCX,TCY,TCZ,GRID
 3834 FORMAT(2E20.8,4E10.3)
      KEITH=KEITH+1
      WRITE(6,1030) KEITH,AZM,ELEV,NV
      IF(KAGRID.GT.0) WRITE(6,3331)
 3331 FORMAT(5X,'OPTION SELECTED FOR TAPE1 GRID OUTPUT')
*D FASTGEN.924
 1030 FORMAT(1H1,'VIEW NUMBER',I5,5X,'AZM=',F5.1,3X,'ELEV=',F5.1,
     15X,'VEHICLE',I5)
*I FASTGEN.967
      COMMON KEITH,KAGRID
*I FASTGEN.1054
      COMMON KEITH,KAGRID
*I FASTGEN.1100
      COMMON KEITH,KAGRID
*I FASTGEN.1316
      COMMON KEITH,KAGRID
*I FASTGEN.1614
      COMMON KEITH,KAGRID
*I FASTGEN.2044
      COMMON KEITH,KAGRID
*I FASTGEN.2129
      DIMENSION ITEM(50),CLOS(50),CNORM(50),CANG1(50),KSPAC(50),SLOS(50)
     1,XXX(50),XXW(50)
*I FASTGEN.2133
      COMMON KEITH,KAGRID
```

TABLE C-II. Changes to FASTGEN Code to Produce Gift Tape 1 Shotlines (Continued)

```
*I FASTGEN.2144
      NCOMP=0
*D FASTGEN.2281,2289
      YKAA=(FLOAT(J6+JYY)*GRID-YCON)+HAFG
      ZKAA=(FLOAT(J7+JZZ)*GRID-ZCON)+HAFG
*I FASTGEN.2386
      IF(KAGRID.LE.0) GOTO 311
      IF(IC(LAC).LE.0) GOTO 311
      NCOMP=NCOMP+1
      IF(NCOMP.LE.50) GOTO 8182
      WRITE(6,8187) NCOMP
 8187 FORMAT(5X,'NCOMP= ',I5,4X,'GT 50 - STOP')
      STOP
 8182 CONTINUE
      XXX(NCOMP)=XD(LOC)
      ITEM(NCOMP)=IC(LAC)
      CLOS(NCOMP)=FLOAT(LTH)/100.0
      XXW(NCOMP) = XD(LOC)-CLOS(NCOMP)
      CANGI(NCOMP)=57.2957795*ACOS(1000.0/FLOAT(ISEQ(LBC)))
      CNORM(NCOMP)=0.0
      CNORM(NCOMP)=CLOS(NCOMP)*COS(CANGI(NCOMP)/57.2957795)
      KSPAC(NCOMP)=ISP
      SLOS(NCOMP)=0.0
  311 CONTINUE
*I FASTGEN.2443
      KSPAC(NCOMP-1)=KSP
*I FASTGEN.2470
      IF(KAGRID.LE.0.OR.IC(LAC).LE.0) GOTO 321
      KSPAC(NCOMP)=9
C     FINISHED THIS CELL
C     WRITE CELL HEADER
      NK=NCOMP
      WRITE(1,8105) YKAA,ZKAA,XXX(1),XXW(NK),NCOMP,Y,Z,AZM,ELEV
```

```
C      WRITE REST OF CELL INFO
       NFK=NCOMP-1
       DO 312 KAA=1,NFK
       IF(NCOMP.EQ.1) GOTO312
       SLOS(KAA)=XXW(KAA)-XXX(KAA+1)
       IF(SLOS(KAA).GT..01) GOTO 312
       KSPAC(KAA)=0
       SLOS(KAA)=0.0
  312  CONTINUE
       DO 313 K1=1,NK,2
       K2=K1
       IF(KSPAC(K1).EQ.9) GOTO 316
       K2=K1+1
       WRITE(1,8103)ITEM(K1),CLOS(K1),CNORM(K1),CANGI(K1),KSPAC(K1),
     1     SLOS(K1),ITEM(K2),CLOS(K2),CNORM(K2),CANGI(K2),KSPAC(K2),
     2     SLOS(K2),K2
       GOTO 313
  316  WRITE(1,8104)ITEM(K1),CLOS(K1),CNORM(K1),CANGI(K1),KSPAC(K1),
     1     SLOS(K1),K2
  313  CONTINUE
 8103  FORMAT(2(I4,2F7.2,F6.1,I3,F7.2),7X,I4)
 8104  FORMAT(I4,2F7.2,F6.1,I3,F7.2,41X,I4)
 8105  FORMAT(F6.1,F7.1,3X,2F8.2,8X,I3,7X,2F9.3,1X,'A',F4.0,'E ',F4.0)
       NCOMP=0
  321  CONTINUE
*I FASTGEN.2496
       COMMON KEITH,KAGRID
```

APPENDIX D

THE SGCVRT AND FGCVRT SHOTLINE CONVERSION CODES

THE SGCVRT AND FGCVRT SHOTLINE CONVERSION CODES

The SGCVRT and FGCVRT codes convert SHOTGEN and FASTGEN shotline data respectively to a format identical to GIFT Tape 1 shotline data. Both the SGCVRT and the FGCVRT are executed the same way; hence, the following instructions apply for both codes. There are two files or logical units to be considered: (1) the input file Tape 11 (logical unit 11) contains the binary shotline data to be converted, (i.e., SHOTGEN or FASTGEN shotline data); (2) the output file Tape 1 (logical unit 1) contains the converted GIFT Tape 1 shotline data.

The card input to these two conversion codes is quite simple and consists of two sets of cards. The first card set consists of one card only. This card contains the following information: (1) in columns 1 through 10, right adjust the number of views to be converted (I10 FORMAT); (2) in column 20 is an integer indicating the number of components to be written per line for the Tape 1 shotlines. This number must be 1, 2, or 3. The CETANK and KETANK vulnerability codes require 2 components per line; (3) in columns 21 through 80 enter the title of this system, date, units, or other pertinent information.

The second set of cards consists of one card for each view to be converted. Each card in this set uses a 2F10.0 FORMAT. The azimuth angle (in degrees) for the view goes in columns 1 through 10 while the elevation angle (in degrees) for the view goes in columns 11 through 20. Again, this second set of cards has one card for each view to be converted. The views (shotline data) will appear on the converted shotline file (Tape 1) in the order they are input on these cards. All these above instructions are listed on comment cards at the beginning of each code.

Table D-I contains a listing of the SGCVRT code, and Table D-II contains a listing of the FGCVRT code.

TABLE D-I. Listing of the SGCVRT Code

```
      PROGRAM SGCVRT(INPUT,OUTPUT,TAPE1,TAPE11,TAPE5=INPUT,TAPE6=OUTPUT)
      DIMENSION AX(170),AY(170),AZ(170),IECO(170),ETH(170),IES(170)
      DIMENSION ITEM(100),CLOS(100),CNORM(100),CANGI(100),KSPAC(100),
     1          SLOS(100),XI(100),XO(100),CNORMO(100),CNORMI(100),
     2          CANGO(100)
      DIMENSION AZM(50),ELEV(50),TITLE(10)
C
CC    THIS PROGRAM CONVERTS SHOTGEN SHOTLINES TO GIFT TAPE1 SHOTLINES
CC       OPTION FOR 1,2, OR 3 COMPONENTS PER LINE
C
CC    KEITH APPLIN  X3431  8328  RM110
C
CC    TAPE11 = SHOTGEN SHOTLINE TAPE TO BE CONVERTED
CC    TAPE1  = GIFT GRID TYPE SHOTLINES - OUTPUT FILE
C
CC    ORDER OF CARD INPUT
CC      1. NVIEWS,ICPL,TITLE   (2I10,6A10)
CC            NVIEWS = NUMBER OF VIEWS DESIRED ON TAPE1   (I10)
CC            ICPL   = OPTION FOR NUMBER OF COMPONENTS PRINTED PER LINE
CC                     1 = 1 COMPONENT PER LINE
CC                     2 = 2 COMPONENTS PER LINE
CC                     3 = 3 COMPONENTS PER LINE
CC                     (1,2,OR 3 ARE THE ONLY CHOICES)
CC                     (MOST COMMON CHOICE IS 2)
CC            TITLE  = TARGET TITLE  (6A10)
CC      2. AZM,ELEV    (2F10.0)
CC            AZM  = AZIMUTH(DEG) FOR THIS VIEW     (F10.0)
CC            ELEV = ELEVATION (DEG) FOR THIS VIEW  (F10.0)
CC      ***REPEAT STEP 2. NVIEWS TIMES
C
CC    NOTE - THE VIEWS WILL APPEAR ON TAPE1 IN THE ORDER THEY ARE
CC           INPUT IN STEP 2.
C
      TOLLOS=.01
      X5=0.0
      Y5=0.0
      Z5=0.0
C
CC    READ CARD INPUT
C
      READ(5,700) NVIEWS,ICPL,(TITLE(I),I=1,6)
  700 FORMAT(2I10,6A10)
      IF(NVIEWS.GT.0) GOTO 71
      WRITE(6,4001) NVIEWS
 4001 FORMAT(1H1,5X,'NVIEWS = ',I10,5X,'MUST BE POSITIVE  STOP')
      STOP
   71 IF(ICPL.GE.1.AND.ICPL.LE.3) GOTO 72
      WRITE(6,4002) ICPL
 4002 FORMAT(1H1,5X,'ICPL =',I10,5X,'MUST BE 1,2, OR 3    STOP')
      STOP
   72 CONTINUE
C
CC    WRITE INITIAL HEADER LINE ON TAPE1
C
      CALL DATE(DAT)
      WRITE(1,2011) NVIEWS,DAT,(TITLE(I),I=1,6)
 2011 FORMAT(I5,7A10)
```

```
C
CC     DO LOOP 777 IS THE BIG LOOP FOR EACH VIEW
C
       DO 777 KA=1,NVIEWS
C
CC     READ AZIMUTH AND ELEVATION FOR THIS VIEW
C
       READ(5,710) AZM(KA),ELEV(KA)
  710  FORMAT(2F10.0)
       IF(EOF(5)) 781,782
  781  J=KA-1
       WRITE(6,783) NVIEWS,J
  783  FORMAT(1H1,5X,'** ERROR  REQUESTED',I5,2X,'VIEWS BUT DATA FOR ONLY
      1',I5,2X,'STOP')
       STOP
  782  CONTINUE
C
CC     SEARCH FOR THIS VIEW ON TAPE11
C
       REWIND 11
    1  READ(11) A,E,GRID,NX,HMAX,HMIN,VMAX,VMIN,RA
       IF(EOF(11)) 1000,501
  501  IF(AZM(KA).EQ.A.AND.ELEV(KA).EQ.E) GOTO 707
       CALL SKIPFE(11,1,1)
       GOTO 1
 1000  WRITE(6,510) AZM(KA),ELEV(KA)
  510  FORMAT(1H1,' VIEW',2F12.1,2X,'NOT ON SHOTGEN FILE - STOP')
       STOP
C
CC     FOUND VIEW -- BEGIN PROCESSING
C
  707  WRITE(6,500) A,E,ICPL
  500  FORMAT(1H1,5X,'PROCESSING VIEW A=',F5.0,2X,'E=',F5.0,/,5X,I2,2X,
      1'COMPONENTS PER LINE')
C
CC     WRITE VIEW HEADER LINE ON TAPE1
C
       WRITE(1,2012) A,E,XS,YS,ZS,GRID
 2012  FORMAT(2E20.8,4E10.3)
C
CC     READ SHOTGEN SHOTLINES - 6 WORDS/LINE IN BLOCKS OF 170 LINES
C
       N=0
       NCELL=0
       LL=200
  111  NCELL=NCELL+1
  100  N=N+1
  110  LL=LL+1
       IF(LL.LE.170) GOTO 120
       READ(11) (AX(L),AY(L),AZ(L),IECO(L),ETH(L),IES(L), L=1,170)
       LL=1
  120  IF(N.GT.50) GOTO 150
C
CC     PRODUCE INFO FOR GIFT GRID TAPE1 SHOTLINES
C
       ITEM(N)=MOD(IECO(LL),10000)
       IF(ITEM(N).EQ.0) GOTO 776
       XI(N)=AX(LL)
       H=FLOAT(IFIX(AY(LL))/10000)*.1
```

```
      V=FLOAT(IFIX(AZ(LL))/1000)*.1
      CLOS(N)=ETH(LL)
      KSPAC(N)=IES(LL)/10000
      CANGI(N)=FLOAT(MOD(IES(LL),10000)/100)
      IF(ICPL.EQ.1) CANGO(N)=FLOAT(MOD(IES(LL),100))
      CNORM(N)=FLOAT(IECU(LL)/10000)*.0001
      CNORMO(N)=CNORM(N)
      IF(CNORM(N).EQ.0) CNORM(N)=CLOS(N)*COS(CANGI(N)/57.2957795)
      CNORMI(N)=CNORM(N)
      IF(CNORMO(N).EQ.0.AND.ICPL.EQ.1) CNORMO(N)=CLOS(N)*COS(CANGO(N)/57
     1.2957795)
      IF(KSPAC(N).EQ.9) GOTO 230
      GOTO 100
  150 IF(IES(LL).LT.90000) GOTO 110
      N=N-1
      KSPAC(50)=9
      WRITE(6,524) H,V
  524 FORMAT(10X,'NUMBER OF COMPONENTS ALONG RAY ',2F12.3,2X,'EXCEEDS 50
     1-SKIP REST OF COMPONENTS')
C
CC    FINISHED THIS CELL
C
  230 NCOMP=N
      OFIRST=XI(1)
      OLAST=XI(NCOMP)-CLOS(NCOMP)
      JF=NCOMP-1
      DO 11 I=1,JF
      IF(KSPAC(I).EQ.9) GOTO 11
      J=I+1
      SLOS(I)=XI(J)-XI(I)-CLOS(I)
      IF(XI(2).LT.XI(1)) SLOS(I)=XI(I)-XI(J)-CLOS(I)
      IF(SLOS(I).LT.0.0) CLOS(I)=CLOS(I)+SLOS(I)
      IF(SLOS(I).LE.TOLLOS) SLOS(I)=0.0
      IF(SLOS(I).EQ.0.0) KSPAC(I)=0
   11 CONTINUE
      SLOS(NCOMP)=0.0
C
CC    WRITE HEADER FOR THIS CELL
C
      IF(ICPL.NE.2) WRITE(1,2013) H,V,H,V,NCOMP,OFIRST,OLAST,A,E
 2013 FORMAT(2F7.1,2F9.3,I3,2F8.2,2H A,F6.1,2H E,F6.1)
      IF(ICPL.EQ.2) WRITE(1,2014) H,V,OFIRST,OLAST,NCOMP,H,V,A,E
 2014 FORMAT(F6.1,F7.1,3X,2F8.2,8X,I3,7X,2F9.3,1X,1HA,F4.0,2H,E,F4.0)
C
CC    WRITE REST OF CELL INFO
C
      IF(ICPL.GT.1)GOTO 40
C
CC    PRINT ONE COMPONENT PER LINE
C
      DO 31 I=1,NCOMP
      WRITE(1,2101) ITEM(I),CLOS(I),CNORMI(I),CANGI(I),CNORMO(I),CANGO(I
     1),KSPAC(I),SLOS(I),I
 2101 FORMAT(I4,2F7.2,F6.1,F7.2,F6.1,I3,F7.2,29X,I4)
   31 CONTINUE
```

```
C
CC    NEXT CELL
C
   32 N=0
      GOTO 111
   40 IF(ICPL.GT.2) GOTO 45
C
CC    PRINT TWO COMPONENTS PER LINE
C
      DO 12 I=1,NCOMP,2
      J=I
      IF(KSPAC(I).EQ.9) GOTO 13
      J=I+1
      WRITE(1,2102) ITEM(I),CLOS(1),CNORM(1),CANGI(I),KSPAC(1),SLOS(I),
     1              ITEM(J),CLOS(J),CNORM(J),CANGI(J),KSPAC(J),SLOS(J),J
 2102 FORMAT(2(I4,2F7.2,F6.1,I3,F7.2),7X,I4)
      GOTO 12
   13 WRITE(1,2103) ITEM(I),CLOS(I),CNORM(1),CANGI(I),KSPAC(I),SLOS(1),J
 2103 FORMAT(I4,2F7.2,F6.1,I3,F7.2,41X,I4)
   12 CONTINUE
      GOTO 32
C
CC    PRINT THREE COMPONENTS PER LINE
C
   45 DO 46 I=1,NCOMP,3
      IF(KSPAC(I).EQ.9) GOTO 47
      J=I+1
      IF(KSPAC(J).EQ.9) GOTO 48
      K=J+1
      WRITE(1,2104) ITEM(I),CLOS(I),CANGI(I),KSPAC(1),SLOS(I),
     1              ITEM(J),CLOS(J),CANGI(J),KSPAC(J),SLOS(J),
     2              ITEM(K),CLOS(K),CANGI(K),KSPAC(K),SLOS(K)
 2104 FORMAT(3(I4,F7.2,F5.1,I3,F7.2))
      GOTO 46
   48 WRITE(1,2105) ITEM(I),CLOS(I),CANGI(I),KSPAC(I),SLOS(I),
     1              ITEM(J),CLOS(J),CANGI(J),KSPAC(J),SLOS(J)
 2105 FORMAT(2(I4,F7.2,F5.1,I3,F7.2))
      GO TO 46
   47 WRITE(1,2106) ITEM(I),CLOS(I),CANGI(I),KSPAC(1),SLOS(I)
 2106 FORMAT(I4,F7.2,F5.1,I3,F7.2)
   46 CONTINUE
      GOTO 32
C
CC    END OF VIEW
C
  776 FIN=999.9
      WRITE(1,2107) FIN
 2107 FORMAT(F6.1,71X,'END')
      ENDFILE 1
      NCELL=NCELL-1
      WRITE(6,803) A,E,NCELL
  803 FORMAT(5X,'FINSHED VIEW A=',F4.0,' E=',F4.0/,5X,
     1'NUMBER OF CELLS=',I7)
  777 CONTINUE
      STOP
      END
```

TABLE D-II. Listing of the FGCVRT Code

```
      PROGRAM FGCVRT(INPUT,OUTPUT,TAPE1,TAPE11,TAPE5=INPUT,TAPE6=OUTPUT)
      DIMENSION RLOS(3,170),LOS(5,170)
      DIMENSION ITEM(100),CLOS(100),CNORM(100),CANGI(100),KSPAC(100),
     1          SLOS(100),XI(100),XO(100),CNORMO(100),CNORMI(100),
     2          CANGO(100)
      DIMENSION AZM(50),ELEV(50),TITLE(10)
C
CC    THIS PROGRAM CONVERTS FASTGEN SHOTLINES TO GIFT TAPE1 SHOTLINES
CC       OPTION FOR 1,2, OR 3 COMPONENTS PER LINE
C
CC    KEITH APPLIN  X3431  8328  RM110
C
CC    TAPE11 = FASTGEN SHOTLINE TAPE TO BE CONVERTED
CC    TAPE1  = GIFT GRID TYPE SHOTLINES - OUTPUT FILE
C
CC    ORDER OF CARD INPUT
CC      1. NVIEWS,ICPL,TITLE    (2I10,6A10)
CC            NVIEWS = NUMBER OF VIEWS DESIRED ON TAPE1   (I10)
CC            ICPL   = OPTION FOR NUMBER OF COMPONENTS PRINTED PER LINE
CC                      1 = 1 COMPONENT PER LINE
CC                      2 = 2 COMPONENTS PER LINE
CC                      3 = 3 COMPONENTS PER LINE
CC                      (1,2,OR 3 ARE THE ONLY CHOICES)
CC                      (MOST COMMON CHOICE IS 2)
CC            TITLE  = TARGET TITLE  (6A10)
CC      2. AZM,ELEV     (2F10.0)
CC            AZM  = AZIMUTH(DEG) FOR THIS VIEW      (F10.0)
CC            ELEV = ELEVATION (DEG) FOR THIS VIEW   (F10.0)
CC      ***REPEAT STEP 2. NVIEWS TIMES
C
CC    NOTE - THE VIEWS WILL APPEAR ON TAPE1 IN THE ORDER THEY ARE
CC           INPUT IN STEP 2.
C
      TOLLOS=.01
      X5=0.0
      Y5=0.0
      Z5=0.0
C
CC    READ CARD INPUT
C
      READ(5,700) NVIEWS,ICPL,(TITLE(I),I=1,6)
  700 FORMAT(2I10,6A10)
      IF(NVIEWS.GT.0) GOTO 71
      WRITE(6,4001) NVIEWS
 4001 FORMAT(1H1,5X,'NVIEWS = ',I10,5X,'MUST BE POSITIVE  STOP')
      STOP
   71 IF(ICPL.GE.1.AND.ICPL.LE.3) GOTO 72
      WRITE(6,4002) ICPL
 4002 FORMAT(1H1,5X,'ICPL =',I10,5X,'MUST BE 1,2, OR 3    STOP')
      STOP
   72 CONTINUE
C
CC    WRITE INITIAL HEADER LINE ON TAPE1
C
      CALL DATE(DAT)
      WRITE(1,2011) NVIEWS,DAT,(TITLE(I),I=1,6)
 2011 FORMAT(I5,7A10)
```

```
C
CC     DO LOOP 777 IS THE BIG LOOP FOR EACH VIEW
C
       DO 777 KA=1,NVIEWS
C
CC     READ AZIMUTH AND ELEVATION FOR THIS VIEW
C
       READ(5,710) AZM(KA),ELEV(KA)
  710  FORMAT(2F10.0)
       IF(EOF(5)) 781,782
  781  J=KA-1
       WRITE(6,783) NVIEWS,J
  783  FORMAT(1H1,5X,'** ERROR  REQUESTED',I5,2X,'VIEWS BUT DATA FOR ONLY
      1',I5,2X,'STOP')
       STOP
  782  CONTINUE
C
CC     SEARCH FOR THIS VIEW ON TAPE11
C
       REWIND 11
    1  READ(11) A,E,GRID,NX,HMAX,HMIN,VMAX,VMIN,RA
       IF(EOF(11)) 1000,501
  501  IF(AZM(KA).EQ.A.AND.ELEV(KA).EQ.E) GOTO 707
   27  READ(11) ((RLOS(J,K),J=1,3),(LOS(J,K),J=1,5),K=1,170)
       DO 26 I=1,170
       IF(LOS(2,I).EQ.0) GOTO 1
   26  CONTINUE
       GOTO 27
 1000  WRITE(6,510) AZM(KA),ELEV(KA)
  510  FORMAT(1H1,' VIEW',2F12.1,2X,'NOT ON FASTGEN FILE - STOP')
       STOP
C
CC     FOUND VIEW -- BEGIN PROCESSING
C
  707  WRITE(6,500) A,E,ICPL
  500  FORMAT(1H1,5X,'PROCESSING VIEW A=',F5.0,2X,'E=',F5.0,/,5X,I2,2X,
      1'COMPONENTS PER LINE')
C
CC     WRITE VIEW HEADER LINE ON TAPE1
C
       WRITE(1,2012) A,E,X5,Y5,Z5,GRID
 2012  FORMAT(2E20.8,4E10.3)
C
CC     READ FASTGEN SHOTLINES - 8 WORDS/LINE IN BLOCKS OF 170 LINES
C
       N=0
       NCELL=0
  111  NCELL=NCELL+1
       LL=200
  100  N=N+1
  110  LL=LL+1
       IF(LL.LE.170) GOTO 120
       READ(11) ((RLOS(J,K),J=1,3),(LOS(J,K),J=1,5),K=1,170)
       LL=1
  120  IF(N.GT.50) GOTO 150
C
CC     PRODUCE INFO FOR GIFT GRID TAPE1 SHOTLINES
C
       ITEM(N)=LOS(2,LL)
       IF(ITEM(N).EQ.0) GOTO 776
```

```
      XI(N)=RLOS(1,LL)
      H=RLOS(2,LL)
      V=RLOS(3,LL)
      CLOS(N)=FLOAT(LOS(3,LL))*.01
      KSPAC(N)=MOD(LOS(1,LL),10)
      CANGI(N)=ACOS(1.0/(FLOAT(LOS(4,LL))*.001))*57.2957795
      IF(ICPL.EQ.1) CANGO(N)=ACOS(1.0/(FLOAT(LOS(5,LL))*.001))*57.295779
     15
      CNORM(N)=FLOAT(LOS(1,LL)/10)*.01
      CNORMO(N)=CNORM(N)
      IF(CNORM(N).EQ.0) CNORM(N)=CLOS(N)*COS(CANGI(N)/57.2957795)
      CNORMI(N)=CNORM(N)
      IF(CNORMO(N).EQ.0.AND.ICPL.EQ.1) CNORMO(N)=CLOS(N)*COS(CANGO(N)/57
     1.2957795)
      IF(KSPAC(N).EQ.9)GOTO 230
      GOTO 100
  150 IF(MOD(LOS(1,LL),10).LT.9) GOTO 110
      N=N-1
      KSPAC(50)=9
      WRITE(6,524) H,V
  524 FORMAT(10X,'NUMBER OF COMPONENTS ALONG RAY ',2F12.3,2X,'EXCEEDS 50
     1-SKIPPED REST OF COMPONENTS')
C
CC    FINISHED THIS CELL
C
  230 NCOMP=N
      DFIRST=XI(1)
      DLAST=XI(NCOMP)-CLOS(NCOMP)
      JF=NCOMP-1
      DO 11 I=1,JF
      IF(KSPAC(I).EQ.9) GOTO 11
      J=I+1
      SLOS(I)=XI(J)-XI(I)-CLOS(I)
      IF(XI(2).LT.XI(1)) SLOS(I)=XI(I)-XI(J)-CLOS(I)
      IF(SLOS(I).LT.0.0) CLOS(I)=CLOS(I)+SLOS(I)
      IF(SLOS(I).LE.TOLLOS) SLOS(I)=0.0
      IF(SLOS(I).EQ.0.0) KSPAC(I)=0
   11 CONTINUE
      SLOS(NCOMP)=0.0
C
CC    WRITE HEADER FOR THIS CELL
C
      IF(ICPL.NE.2) WRITE(1,2013) H,V,H,V,NCOMP,DFIRST,DLAST,A,E
 2013 FORMAT(2F7.1,2F9.3,I3,2F8.2,2H A,F6.1,2H E,F6.1)
      IF(ICPL.EQ.2) WRITE(1,2014) H,V,DFIRST,DLAST,NCOMP,H,V,A,E
 2014 FORMAT(F6.1,F7.1,3X,2F8.2,8X,I3,7X,2F9.3,1X,1HA,F4.0,2H,E,F4.0)
C
CC    WRITE REST OF CELL INFO
C
      IF(ICPL.GT.1)GOTO 40
C
CC    PRINT ONE COMPONENT PER LINE
C
      DO 31 I=1,NCOMP
      WRITE(1,2101) ITEM(I),CLOS(I),CNORMI(I),CANGI(I),CNORMO(I),CANGO(I
     1),KSPAC(I),SLOS(I),I
 2101 FORMAT(I4,2F7.2,F6.1,F7.2,F6.1,I3,F7.2,29X,I4)
   31 CONTINUE
```

```
C
CC    NEXT CELL
C
   32 N=0
      GOTO 111
   40 IF(ICPL.GT.2) GOTO 45
C
CC    PRINT TWO COMPONENTS PER LINE
C
      DO 12 I=1,NCOMP,2
      J=I
      IF(KSPAC(I).EQ.9) GOTO 13
      J=I+1
      WRITE(1,2102) ITEM(I),CLOS(I),CNORM(I),CANGI(I),KSPAC(I),SLOS(I),
     1              ITEM(J),CLOS(J),CNORM(J),CANGI(J),KSPAC(J),SLOS(J),J
 2102 FORMAT(2(I4,2F7.2,F6.1,I3,F7.2),7X,I4)
      GOTO 12
   13 WRITE(1,2103) ITEM(I),CLOS(I),CNORM(I),CANGI(I),KSPAC(I),SLOS(I),J
 2103 FORMAT(I4,2F7.2,F6.1,I3,F7.2,41X,I4)
   12 CONTINUE
      GOTO 32
C
CC    PRINT THREE COMPONENTS PER LINE
C
   45 DO 46 I=1,NCOMP,3
      IF(KSPAC(I).EQ.9) GOTO 47
      J=I+1
      IF(KSPAC(J).EQ.9) GOTO 48
      K=J+1
      WRITE(1,2104) ITEM(I),CLOS(I),CANGI(I),KSPAC(I),SLOS(I),
     1              ITEM(J),CLOS(J),CANGI(J),KSPAC(J),SLOS(J),
     2              ITEM(K),CLOS(K),CANGI(K),KSPAC(K),SLOS(K)
 2104 FORMAT(3(I4,F7.2,F5.1,I3,F7.2))
      GOTO 46
   48 WRITE(1,2105) ITEM(I),CLOS(I),CANGI(I),KSPAC(I),SLOS(I),
     1              ITEM(J),CLOS(J),CANGI(J),KSPAC(J),SLOS(J)
 2105 FORMAT(2(I4,F7.2,F5.1,I3,F7.2))
      GO TO 46
   47 WRITE(1,2106) ITEM(I),CLOS(I),CANGI(I),KSPAC(I),SLOS(I)
 2106 FORMAT(I4,F7.2,F5.1,I3,F7.2)
   46 CONTINUE
      GOTO 32
C
CC    END OF VIEW
C
  776 FIN=999.9
      WRITE(1,2107) FIN
 2107 FORMAT(F6.1,71X,'END')
      ENDFILE 1
      NCELL=NCELL-1
      WRITE(6,803) A,E,NCELL
  803 FORMAT(5X,'FINSHED VIEW A=',F4.0,' E=',F4.0/,5X,
     1'NUMBER OF CELLS=',I7)
  777 CONTINUE
      STOP
      END
```

DISTRIBUTION LIST

No. of Copies	Organization
12	Commander Defense Documentation Center ATTN: DDC-DDA Cameron Station Alexandria, VA 22314
3	Director Defense Advanced Research and Project Agency ATTN: Tech Info Ctr 1400 Wilson Boulevard Arlington, VA 22209
1	Chairman Defense Science Board Washington, DC 20315
1	Director Institute for Defense Analyses 400 Army-Navy Drive Arlington, VA 22202
1	Director Defense Intelligence Agency ATTN: DB-4C3, R. Sauer DT, L. Bradley Washington, DC 20301
1	Commander US Army EngineerWaterways Experiment Station Vicksburg, MS 39180
1	Commander US Army Materiel Development and Readiness Command ATTN: DRCDMD-ST 5001 Eisenhower Avenue Alexandria, VA 22333
1	Commander US Army Materiel Devel and Readiness Command ATTN: DRCDMD 5001 Eisenhower Avenue Alexandria, VA 22333
1	Commander US Army Materiel Devel and Readiness Command ATTN: DRCDMD-T, Mr. Hughis 5001 Eisenhower Avenue Alexandria, VA 22333
1	Commander US Army Materiel Devel and Readiness Command ATTN: DRCDMD-K, B. Chasnov 5001 Eisenhower Avenue Alexandria, VA 22333
1	Commander US Army Materiel Devel and Readiness Command ATTN: DRCDMD-WN, J. Gensoir 5001 Eisenhower Avenue Alexandria, VA 22333
1	Commander US Army Materiel Devel and Readiness Command ATTN: DRCDMD-M, Mr. Youmans 5001 Eisenhower Avenue Alexandria, VA 22333
1	Commander US Army Materiel Devel and Readiness Command ATTN: DRCDMD-MT, Mr. Hall 5001 Eisenhower Avenue Alexandria, VA 22333

DISTRIBUTION LIST

No. of Copies	Organization
1	Commander US Army Materiel Devel and Readiness Command ATTN: DRCDMD-GV 5001 Eisenhower Avenue Alexandria, VA 22333
6	Commander US Army Armament Rsch and Devel Command ATTN: DRDAR-AD-C, J. Killen E. Lacher T. Ricciardi DRDAR-LCS-E, Mr. Einbinder DRDAR-TSS (2 cys) Dover, NJ 07801
1	Commander US Army Armament Materiel Readiness Command ATTN: DRSAR-LEP-L Rock Island, IL 61299
2	Commander US Army Watervliet Arsenal ATTN: SARWV-RDD-AT Mr. R. Thierry SWEDV-RDD-SP Mr. E. Turnball Watervliet, NY 12189
1	Commander US Army White Sands Missile Range ATTN: STEWS-TE-AG Mr. T. Werneking Bldg. 1676 White Sands, NM 88002
1	Commander US Army Aviation Research and Development Command ATTN: DRSAV-E St. Louis, MO 63166
1	Director US Army Air Mobility Research and Development Lab Ames Research Center ATTN: COL J. Geary Moffett Field, CA 94035
1	Director Applied Technology Lab US Army Research and Technology Labs (AVRADCOM) ATTN: SAVDL-EU-MOS E.V. Merritt Mr. L. Hewin Fort Eustis, VA 23604
1	Commander US Army Communications Rsch and Development Command ATTN: DRDCO-PPA-SA Fort Monmouth, NJ 07703
6	Commander US Army Electronics Research and Development Command ATTN: DELEW-RD, Dr. R. Wiseman, Dr. E. Collett DELEW-IO DELEW-VL DELEW-NL DELEW-WL Fort Monmouth, NJ 07703
3	Commander US Army Electronics Research and Development Command Technical Support Activity ATTN: DELSD-L DELSD-GG-E, Mr. Goldy (2 cys) Fort Monmouth, NJ 07703

DISTRIBUTION LIST

No. of Copies	Organization
1	Commander US Army Harry Diamond Lab ATTN: DRXDO-TI 2800 Powder Mill Road Adelphi, Maryland 20783
3	Commander/Director Atmospheric Sciences Lab US Army Electronics Rsch and Devel Command ATTN: DELSD-BL-AS, Dr. Holt, Mr. R. Gomez, Mr. J. Mason White Sands Missile Range, NM 88002
1	Chief Officer of Missile Electronics Warfare ATTN: DELSD-WL-ML White Sands Missile Range, NM 88002
4	Director Night Vision Laboratory ATTN: DRSEL-NV, J. Moulton Mr. J. Johnson DRSEL-NV-SD, Mr. Jordan, Mr. Spande Fort Belvoir, VA 22060
6	Director Night Vision Laboratory ATTN: DRSEL-NV-VI Mr. F. Zegel Mr. S. Rodak Mr. F. Shields Dr. Vatsia Mr. J. Ho Mr. J.T. Wood Fort Belvoir, VA 22060
6	Commander US Army Missile Research and Development Command ATTN: DRDMI-R, W. Pittman DRDMI-RB, Dr. Kobler DRDMI-RFM, COL Funke DRDMI-REI, H. Jackson DRDMI-HF, N. Mangus DRDMI-YDL Redstone Arsenal, AL 25809
5	Commander US Army Missile Research and Development Command ATTN: DRDMI-RE, R. Farmer DRDMI-REO, B. Sitton (3 cys) Redstone Arsenal, AL 35809
2	Commander US Army Missile Research and Development Command ATTN: DRDMI-RDP, J.M. Brown, T. Summers Redstone Arsenal, AL 35809
5	Commander US Army Mobility Equipment R&D Command ATTN: DRDME-WC SMEFB-MC, Mr. Gee SMEFB-MB, J. Hopkins STSGB, Mr. A. Perri Mr. L. Long Fort Belvoir, VA 22060
6	Commander US Army Tank-Automotive Rsch & Devel Command ATTN: DRDTA-UL DRDTA-RGD, O. Renius DRDTA-Z, Mr. Wilburn DRDTA-REMA Mr. Pagano Mr. Tasdemiroglu Warren, MI 48090

DISTRIBUTION LIST

No. of Copies	Organization
1	Director US Army TRADOC Systems Analysis Activity ATTN: ATAA-SL White Sands Missile Range, NM 88002
1	Commander Naval Air Development Ctr ATTN: SAED/SDE/Mr. Mitchell Warminster, PA 18974
1	Commander Naval Missile Center CODE 5110, Mr. Nofrey Point Mugu, CA 93042
2	Commander/Director David W. Taylor Naval Ship Rsch and Devel Center ATTN: CODE 1741, J. Sykes CODE 1749, Dr. Fisch Bethesda, MD 20084
5	Commander Naval Surface Weapons Ctr ATTN: CODE 433, R. Craig CODE GAV, Mr. Logan CODE GAV, J. Nelson CODE GAV, W. Hooks CODE MAL, Tech Lib Silver Springs, MD 20910
3	Commander Naval Surface Weapons Ctr ATTN: DG-10, T. McCantsl DG-10, W. Ralph DG-10, J. Rech Dahlgren, VA 22448
6	Commander Naval Weapons Center ATTN: Code 31701, M. Keith Code 4565, C. Sandburg Code 4071, Mr. Galloway, Mr. Gould Code 4565, H. Drake Code 3181, B. Grove China Lake, CA 93555
1	Commander Naval Operation Test and Evaluation Force US Naval Base Norfolk, VA 23511
3	Commander Naval Research Lab Anacostia Station ATTN: Code 6214 Mr. Furgusun Code 7785 Mr. J. Baker Tech Info Center Washington, DC 20375
3	AFATL (DLRV, R. McGuire, Mr. Flint, Mr. Griner) Eglin AFB, FL 32542
1	AFATL (DLRD, J. Collins) Eglin AFB, FL 32542
1	AFATL (DLYW, Mr. Adams) Eglin AFB, FL 32542
3	ASD (XROT, G. Bennett, ENFTV, J. Howard, ADDP, R. Hilbrand) Wright-Patterson AFB, OH 45433

DISTRIBUTION LIST

No. of Copies	Organization
1	Boeing Aerospace Company ATTN: Bill Herlin Mail Stop 41-37 Org: 2-80-60 P.O. Box 3999 Seattle, Washington 98124
1	Falcon Research & Development Company 696 Fairmount Avenue Baltimore, MD 21204
1	Falcon Research & Development ATTN: R.K. Miller 1225 South Huron Denver, Co 80223
1	MAGI ATTN: Herb Steinberg 3 Westchester Plaza Elmsford, NY 10523
1	Quest Research Corp. ATTN: J. Alcott Suite 407 6845 Elm Street McLean, VA 22101
1	Value Engineering Inc. ATTN: J. Murphy 2550 Huntington Avenue Alexandria, VA 22303
1	OSU ATTN: G. Spradling P.O. Box 1925 Eglin AFB, FL 32542
2	Southwest Research Institute Department of Mech Sciences ATTN: Dr. E. Baker Mr. R.L. Bessey 8500 Culebra Road P.O. Drawer 28510 San Antonio, TX 78284

Aberdeen Proving Ground

Dir, USAMSAA
ATTN: DRXSY-D, J. Sperrazza
G. Holloway
R. Astor
B. Cummings
W. Brooks
H. Kostiak
G. Zeller
D. Waldon
L. Bain
DRXSY-MP, H. Cohen

Cdr, USATECOM
ATTN: DRSTE-TO-F

Dir, Wpns Sys Concepts Team
ATTN: DRDAR-ACW
Bldg. E3516, EA

USER EVALUATION OF REPORT

Please take a few minutes to answer the questions below; tear out this sheet and return it to Director, US Army Ballistic Research Laboratory, ARRADCOM, ATTN: DRDAR-TSB, Aberdeen Proving Ground, Maryland 21005. Your comments will provide us with information for improving future reports.

1. BRL Report Number ______________________________

2. Does this report satisfy a need? (Comment on purpose, related project, or other area of interest for which report will be used.)

____

____

____

3. How, specifically, is the report being used? (Information source, design data or procedure, management procedure, source of ideas, etc.) ______________________________

____

____

4. Has the information in this report led to any quantitative savings as far as man-hours/contract dollars saved, operating costs avoided, efficiencies achieved, etc.? If so, please elaborate.

____

____

5. General Comments (Indicate what you think should be changed to make this report and future reports of this type more responsive to your needs, more usable, improve readability, etc.) __________

____

____

____

6. If you would like to be contacted by the personnel who prepared this report to raise specific questions or discuss the topic, please fill in the following information.

Name: ______________________________

Telephone Number: ______________________________

Organization Address: ______________________________

____

____