

AD A045753

12

AD

14 DRSAR/SA/N-69

6 105MM HOWITZER PRODUCTION
TRADE-OFF ANALYSIS

9 Final rpt.

10 NORMAN H. TRIER

11 AUGUST 1977

12 34 F.

DDC
RECEIVED
NOV 1 1977
REGISTERED
F
H

Approved for public release. Distribution unlimited.

AD No. _____
DDC FILE COPY



US ARMY ARMAMENT MATERIEL READINESS COMMAND
SYSTEMS ANALYSIS DIRECTORATE
ROCK ISLAND, ILLINOIS 61201

410 156

mt

DISPOSITION

Destroy this report when no longer needed. Do not return it to the originator.

DISCLAIMER

The findings in this report are not to be construed as an official Department of the Army position.

WARNING

Information and data contained in this document are based on input available at the time of preparation. Because the results may be subject to change, this document should not be construed to represent the official position of the US Army Development & Readiness Command unless so stated.

| REPORT DOCUMENTATION PAGE | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
|--|--|---|
| 1. REPORT NUMBER DRSAR/SA/N-69 | 2. GOVT ACCESSION NO. | 3. RECIPIENT'S CATALOG NUMBER |
| 4. TITLE (and Subtitle) 105MM HOWITZER PRODUCTION TRADE-OFF ANALYSIS | 5. TYPE OF REPORT & PERIOD COVERED Note - Final | |
| | 6. PERFORMING ORG. REPORT NUMBER | |
| 7. AUTHOR(s) Norman H. Trier | 8. CONTRACT OR GRANT NUMBER(s) | |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Materiel Readiness Command Systems Analysis Directorate (DRSAR-SA) Rock Island, IL 61201 | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS | |
| 11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Materiel Readiness Command Systems Analysis Directorate (DRSAR-SA) Rock Island, IL 61201 | 12. REPORT DATE August 1977 | |
| | 13. NUMBER OF PAGES 38 | |
| 14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) | 15. SECURITY CLASS. (of this report) UNCLASSIFIED | |
| | 15a. OF CLASSIFICATION/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) 105mm Howitzers M101A1 Howitzer XM204 Howitzers M102 Howitzer Cost Analysis | | |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report addresses (a) the cost of producing XM204 Howitzers to replace the Army's current assets of M101A1 and M102 Howitzers, and (b) the potential net revenues (total revenues minus overhaul costs) of selling overhauled M101A1 and M102 Howitzers via Foreign Military Sales (FMS). For part (a), various mixes of XM204, M101A1, and M102 Howitzers were considered, and for part (b), various selling prices were considered. | | |

DDC
FORM 1
NOV 1 1977
REGISTERED
F

CONTENTS

| | <u>Page</u> |
|--|-------------|
| OBJECTIVE | 5 |
| INTRODUCTION. | 5 |
| ALTERNATIVE | 8 |
| APPROACH. | 8 |
| ASSUMPTIONS | 11 |
| DATA. | 12 |
| RESULTS | 12 |
| SUMMARY | 19 |
| REFERENCES. | 20 |
| APPENDIX A SUPPORT INPUT COST/SCHEDULE DATA. | 21 |
| APPENDIX B SUPPORTING OUTPUT COST DATA | 31 |
| DISTRIBUTION LIST | 38 |

| | |
|---------------------------------|---|
| ACCESSION for | |
| NIS | White Section <input checked="" type="checkbox"/> |
| DDC | Buff Section <input type="checkbox"/> |
| MANUFACTURED | <input type="checkbox"/> |
| CLASSIFICATION | |
| BY | |
| DISTRIBUTION/AVAILABILITY CODES | |
| SPECIAL | |
| A | |

Next page is blank.

OBJECTIVE

The Systems Analysis Directorate was tasked^{1,2} to determine:

- a. The cost of producing XM204 Howitzers to replace the Army's current assets of M101A1 and M102 Howitzers.
- b. The potential net revenues (total revenues minus overhaul costs) of selling overhauled M101A1 and M102 Howitzers via Foreign Military Sales (FMS).

INTRODUCTION

The Development Acceptance (DEVA) In-Process Review (IPR) for the XM204 Howitzer, a soft recoil 105mm towed howitzer, (shown in Figure 1) is scheduled for December 1977. Depending on the Development and Operation testing and other considerations such as higher priority systems and the availability of funds, the Research, Development and Acquisition Committee (RDAC) could decide to support the production of the XM204 Howitzers. If the XM204 Howitzers are produced and fielded, the current Army assets of 105mm howitzers (Table 1)^{3,4} would be replaced, and according to the Army Materiel Plan Summary (SAMPAM)⁵, the potential distribution of Army 105mm howitzer assets in FY83 would be similar to that shown in Table 2. If the XM204's are fielded, there is the possibility of overhauling and selling existing Army assets of 105mm howitzers to FMS customers and diverting that revenue to production of XM204 Howitzers. This report addresses the potential net revenues which could be received from FMS for existing 105mm howitzers assets and the investment which would be required to produce and field XM204 Howitzers.

¹DF from DRDAR-XM to DRSAR-AS, subject: XM204 Review Project, dated 23 Mar 77.

²DF from DRSAR-AS to 9 Directorates, subject: 105mm Howitzer Production, dated 29 Mar 77.

³DF from DRSAR-MMH to DRSAR-AS, subject: 105mm Howitzer Production, XM204, dated 27 Apr 77. CONFIDENTIAL

⁴Meeting between Mr. Aukland, DRSAR-MMH, and Mr. Trier, DRSAR-SA, subject: Quantity of M101A1 and M102 Howitzers in Reserves and National Guard, dated 28 Apr 77.

⁵Army Materiel Plan Summary, 3 January 1977, Printout numbers G0180000M00, G0180100M00, G0180200M00, and G0180300M00. CONFIDENTIAL.

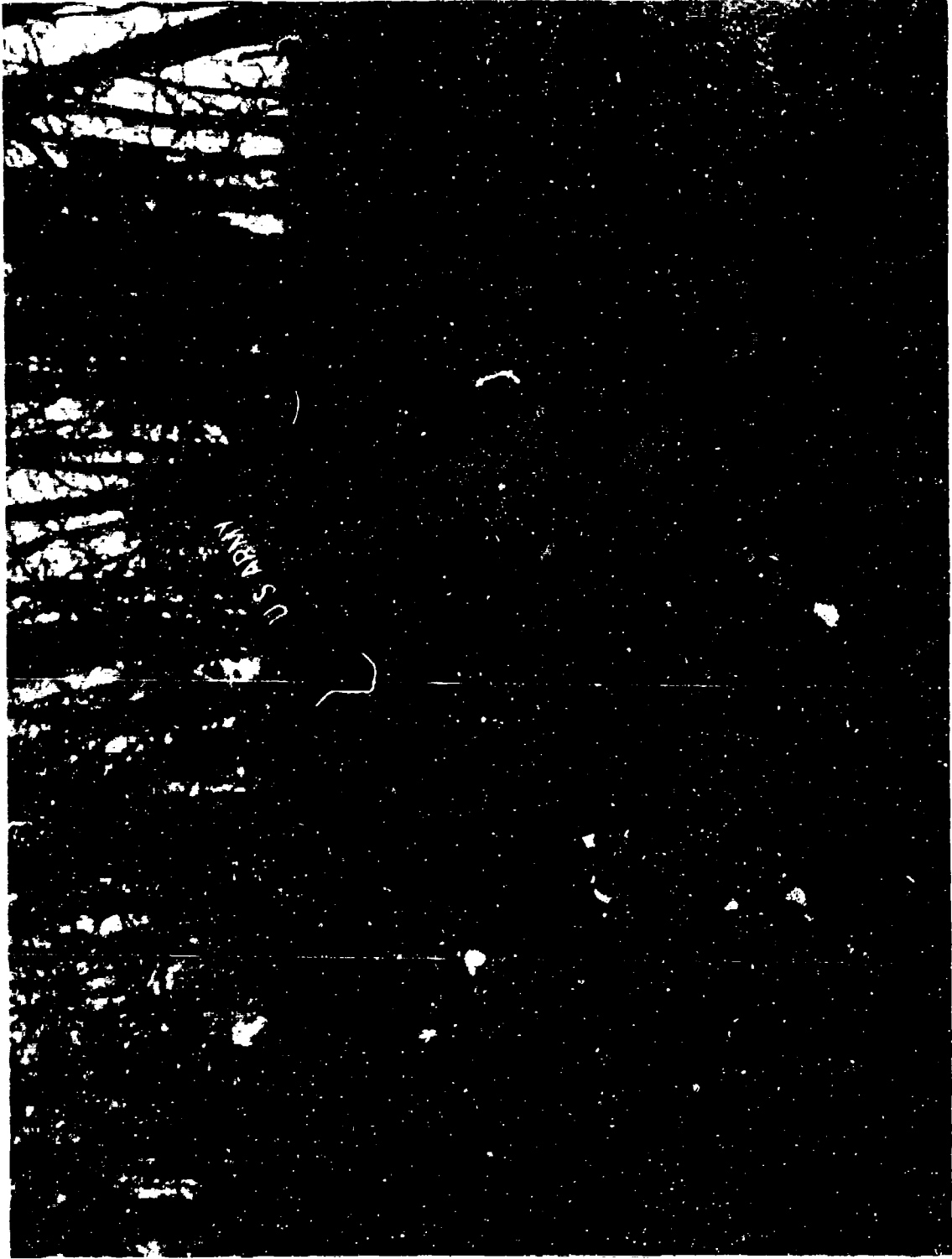


Figure 1. 105mm Towed Howitzer, XM204

TABLE 1. CURRENT ARMY ASSETS OF 105MM HOWITZERS^{a,b}

| | <u>Active Army</u> | <u>Reserves & National Guard</u> | <u>Totals</u> |
|--------|------------------------|--|---------------|
| M101A1 | 300 | 445 | 745 |
| M102 | 449 | 135 | 584 |
| Totals | 749 | 580 | 1,329 |

^aDRSAR-MMH DF to DRSAR-AS, subject: 105mm Howitzer Production, XM204, dated 27 Apr 77. CONFIDENTIAL

^bMeeting between Mr. Aukland, DRSAR-MMH, and Mr. Trier, DRSAR-SA, subject: Quantity of M101A1 and M102 Howitzers in Reserves and National Guard, dated 28 Apr 77.

TABLE 2. POTENTIAL DISTRIBUTION OF ARMY ASSETS^a
OF 105MM HOWITZERS

| | <u>Active Army</u> | <u>Reserves & National Guard</u> | <u>Totals</u> |
|--------|------------------------|--|---------------|
| M101A1 | -- | -- | -- |
| M102 | 248 | 30 | 278 |
| XM204 | 545 | 573 | 1,118 |
| Totals | 793 | 603 | 1,396 |

^aArmy Materiel Plan Summary, 3 January 1977, Printout numbers G018000M00, G0180100M00, G0180200M00, and G0180300M00, CONFIDENTIAL

ALTERNATIVES

Four alternatives (ALT 1, 2, 3, and 4) were identified for this analysis and are listed in Table 3. Each alternative addresses the replacement of the current Army assets of 105mm howitzers with new production of XM204 Howitzers.

ALT 1 addresses the replacement of 105mm howitzers in Active Army, Reserves, and National Guard units with XM204 Howitzers. This is done in accordance with potential distribution of 105mm howitzers as found in the 3 Jan 77 SAMPAM (refer to Table 2).

ALT 2 addresses the replacement of 105mm howitzers with XM204 Howitzers in Active Army only while retaining a mix of M101A1 and M102 Howitzers in the Reserve and National Guard units.

ALT 3 addresses the replacement of all M101A1 Howitzers in current Army assets with XM204 Howitzers, while retaining the current assets of M102 Howitzers.

ALT 4 addresses the replacement of all M102 Howitzers in current Army assets with XM204 Howitzers, while retaining the current assets of M101A1 Howitzers.

For each of the four alternatives, the potential distribution of Army 105mm Howitzers is displayed in Table 4. In addition, for each alternative, the production schedules of XM204 Howitzers, the overhaul schedules for the M101A1 and M102 Howitzers, and the FMS schedules for overhauled M101A1 and M102 Howitzers which were used in this analysis are displayed in Appendix A, Tables A-1, A-2, A-3, and A-4.

APPROACH

The analysis was consistent with guidelines in AR 11-28, Economic Analysis and Program Evaluation for Resource Management⁶, in that all input data were converted to constant FY77 dollars and all monies to be expended in the future years were discounted to FY77 by applying the 10% discount factors.

The investment costs of XM204 Howitzers include the Initial Production Facilities (IPF), production costs, initial provisioning and training, and publications. The per unit production cost estimate includes the hardware and support costs, test ammunition, and first destination transportation.

⁶AR 11-28, Economic Analysis and Program Evaluation for Resource Management, 15 Jan 76.

TABLE 3. ALTERNATIVES

ALT 1:

- a. Produce 1,118 XM204 Howitzers for Active Army Reserves, and National Guard.
- b. Overhaul 745 M101A1 Howitzers and 306 M102 Howitzers.
- c. Sell, via FMS, the overhauled M101A1 and M102 Howitzers.

ALT 2:

- a. Produce 793 XM204 Howitzers for Active Army only.
- b. Overhaul 300 M101A1 and 426 M102 Howitzers from current Active Army assets.
- c. Sell, via FMS, the overhauled M101A1 and M102 Howitzers.

ALT 3:

- a. Produce 812 XM204 Howitzers for Active Army, Reserves, and National Guard.
- b. Overhaul 745 M101A1 Howitzers from current Army assets.
- c. Sell, via FMS, the overhauled M101A1 Howitzers.

ALT 4:

- a. Produce 651 XM204 Howitzers for Active Army, Reserves, and National Guard.
- b. Overhaul 584 M102 Howitzers from current Army assets.
- c. Sell, via FMS, the overhauled M102 Howitzers.

Table 4. POTENTIAL DISTRIBUTION OF ARMY 105MM HOWITZER ASSETS
FOR EACH ALTERNATIVE

| | <u>Active Army</u> | <u>Reserves & National Guard</u> | <u>Totals</u> |
|---------------|------------------------|--|---------------|
| <u>ALT 1:</u> | | | |
| XM204s | 545 | 573 | 1,118 |
| M102s | 248 | 30 | 278 |
| M101A1s | -- | -- | -- |
| Total | 793 | 603 | 1,396 |
| <u>ALT 2:</u> | | | |
| XM204s | 793 | -- | 793 |
| M102s | -- | 158 | 603 |
| M101A1s | -- | 445 | -- |
| Total | 793 | 603 | 1,396 |
| <u>ALT 3:</u> | | | |
| XM204s | 344 | 468 | 812 |
| M102s | 449 | 135 | 584 |
| M101A1s | -- | -- | -- |
| Total | 793 | 603 | 1,396 |
| <u>ALT 4:</u> | | | |
| XM204s | 493 | 158 | 651 |
| M102s | -- | -- | -- |
| M101A1s | 300 | 445 | 745 |
| Total | 793 | 603 | 1,396 |

The per unit overhaul cost estimate for both the M101A1 and M102 Howitzers includes labor expenses, general and administration (G&A) expenses, indirect maintenance expense (IME), materiel, test ammunition, and transportation charges.

The selling price of overhauled M101A1 and M102 Howitzers for Foreign Military Sales (FMS) was calculated by applying the methodology used for the FMS of M101A1 Howitzers in 1976.^{7,8} That is, the FMS selling price was determined as 80% of their respective standard prices plus the cost of overhaul and test ammunition. Then, since FMS prices are subject to change, the FMS prices were parameterized to demonstrate how changes in selling price affect the potential revenue received.

ASSUMPTIONS

It was assumed that:

- a. The production schedule for XM204 Howitzers is feasible when considering the workload of the appropriate manufacturing facilities.
- b. The XM204 Howitzer production and delivery schedules, the M101A1 and M102 Howitzer overhaul schedules, and the FMS delivery schedules shown in Tables A-1, A-2, A-3, and A-4 are valid for this analysis.
- c. For FMS, the M101A1 and M102 Howitzers will be delivered the same year in which they are overhauled.
- d. Cost of the test ammunition for the overhauled M101A1 and M102 Howitzers is equal to the cost of test ammunition for the XM204 Howitzer.
- e. The per unit production cost for the XM204 Howitzers is valid for production of 1,118 howitzers for ALT 1, as well as for production of lesser quantities of howitzers for ALT 2, 3 and 4.
- f. The cost for IPY, initial provisioning and training, and publications for the XM204 Howitzers are applied equally to all four alternatives.
- g. Transportation costs, estimated as 3% of the Hardware and Support (Engineering and Production) Costs of the new production of XM204 Howitzers, are applied equally to the M101A1, M102, and XM204 Howitzers.

⁷ FONECON, Mr. Aukland, DRSAR-MMH and Mr. Trier, DRSAR-SA, subject: Standard Price of M101A1 and M102 Howitzers and Determination of FMS Selling Price, dated 25 Apr 77.

⁸ DALO-ILP MSG 132055Z Sep 76. CONFIDENTIAL.

h. Transportation costs for FMS will be paid by the foreign country and are, therefore, not included in the estimation of net revenues received from FMS of M101A1 and M102 Howitzers.

DATA

The following data were used in this analysis:

a. Current Army assets of 105mm howitzers (Table 1) are 745 M101A1 and 584 M102 Howitzers.

b. XM204 Howitzer production and delivery schedules, M101A1 and M102 Howitzer overhaul schedules, and FMS schedules for FY81 through FY87 (Tables A-1, A-2, A-3 and A-4).

c. FMS selling prices for overhauled M101A1 and M102 Howitzers (Table A-5) are \$31,193 and \$126,040, respectively.

d. Overhaul costs for M101A1 and M102 Howitzers⁹ (Table A-6) are \$12,820 and \$36,760, respectively.

e. XM204 Howitzer estimates are \$121.5K for new production costs per unit, \$6.29M for Initial Production Facilities (IPF), \$2.9M for initial provisioning and training, and \$3.4M for publications (Table A-7).

f. Estimated transportation cost is \$3.6K per weapon for the XM204 Howitzer, the M101A1 Howitzer, and the M102 Howitzer.

RESULTS

Table 5 displays the investment costs that would be incurred to procure and field XM204 Howitzers for each alternative. Production costs were calculated each year according to the number of howitzers produced (refer to production schedules in Tables A-1, A-2, A-3, and A-4). All costs were then discounted to constant FY77 dollars.

The costs of overhauling the M101A1 and M102 Howitzers in preparation for FMS customers are displayed in Table A-8. These overhaul costs would be paid out of the revenues obtained from the FMS customers. Figures 2, 3, 4 and 5 display the potential net revenues (total revenues (Figures B-1, B-2, B-3 and B-4) minus overhaul costs (Table B-2)) which could be received from FMS of M101A1 and M102 Howitzers for ALT 1, 2, 3 and 4, respectively. Each figure displays two curves (straight lines); one shows the potential net revenues obtained by selling M101A1 Howitzers, and the other shows the potential revenues obtained by selling M102 Howitzers.

⁹ DF from DRSAR-CPE to DRSAR-ASA, subject: 105mm Howitzer Production, XM204, dated 12 Apr 77.

TABLE 5. XM204 HOWITZER FIELDING COSTS
(In Constant Discounted FY77 Dollars)

| | |
|---|---------|
| <u>ALT 1</u> | |
| XM204 Production (Qty = 1,118) | \$71.9M |
| Initial Production Facilities | 4.6M |
| Initial Provisioning and Training | 2.2M |
| Publications | 2.4M |
| TOTAL | \$81.1M |
| <u>ALT 2</u> | |
| XM204 Production (Qty = 793) | \$53.7M |
| Initial Production Facilities | 4.6M |
| Initial Provisioning and Training | 2.2M |
| Publications | 2.4M |
| TOTAL | \$62.9M |
| <u>ALT 3</u> | |
| XM204 Production (Qty = 812) | \$54.8M |
| Initial Production Facilities | 4.6M |
| Initial Provisioning and Training | 2.2M |
| Publications | 2.4M |
| TOTAL | \$64.0M |
| <u>ALT 4</u> | |
| XM204 Production (Qty = 651) | \$45.0M |
| Initial Production Facilities | 4.6M |
| Initial Provisioning and Training | 2.2M |
| Publications | 2.4M |
| TOTAL | \$54.2M |

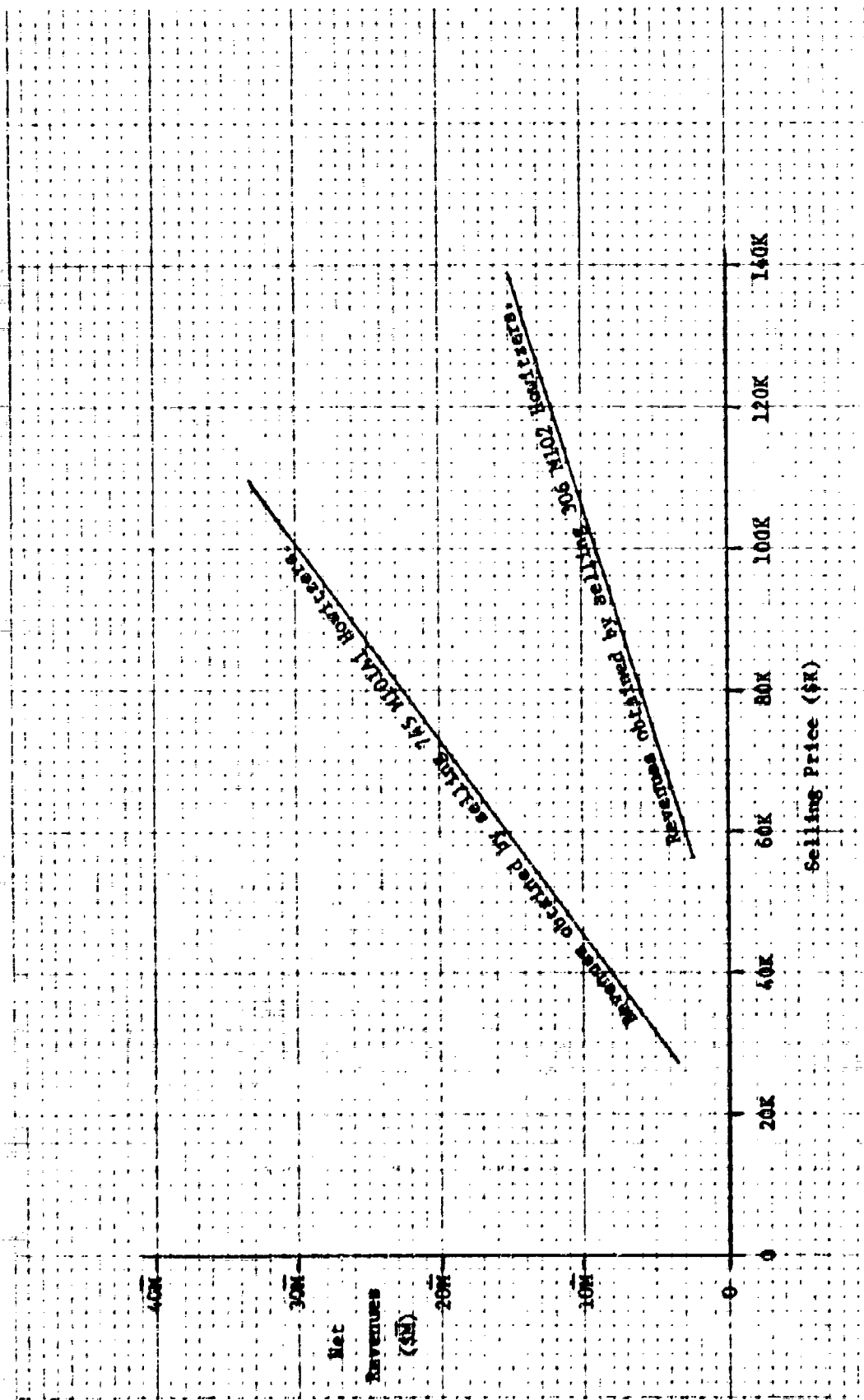


Figure 2. Potential Net Revenues from FMS for A17-1
 (in Constant Discounted FY77 Dollars)

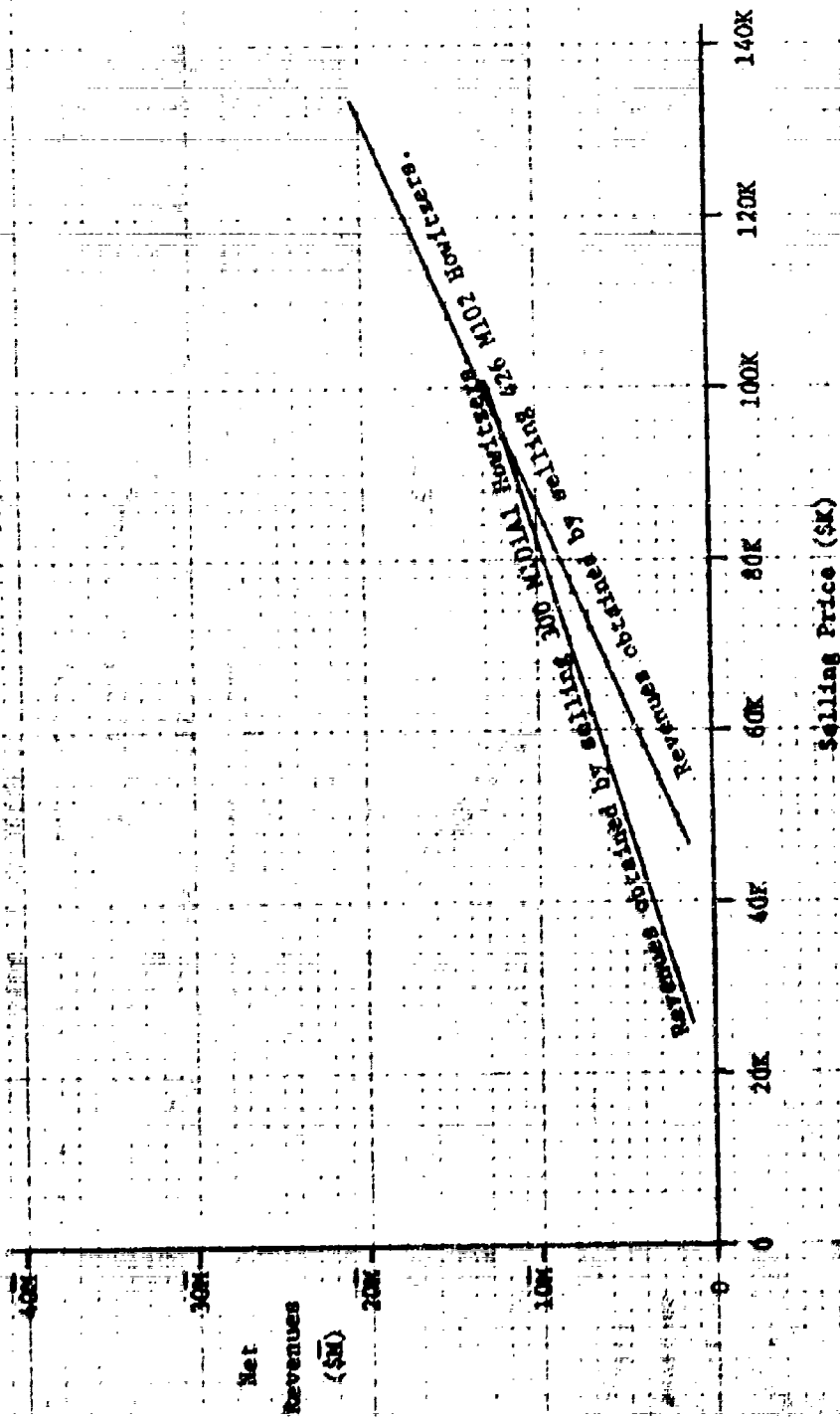


Figure 3. Potential Net Revenues from FMS for ALT 2
(In Constant Discounted FY77 Dollars)

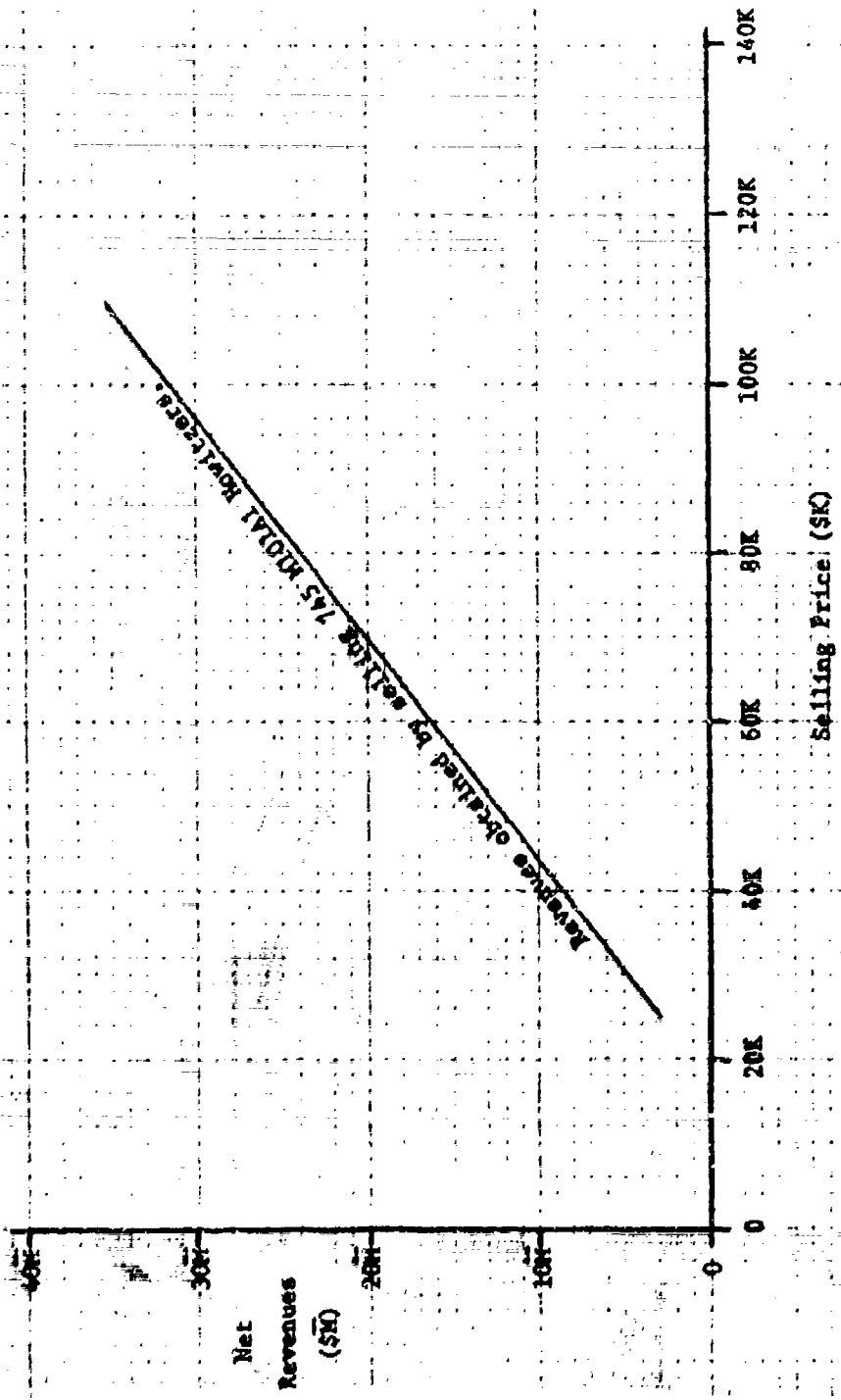


Figure 4. Potential Net Revenues from RMS for AIJ 3
(In Constant Discounted FY77 Dollars)

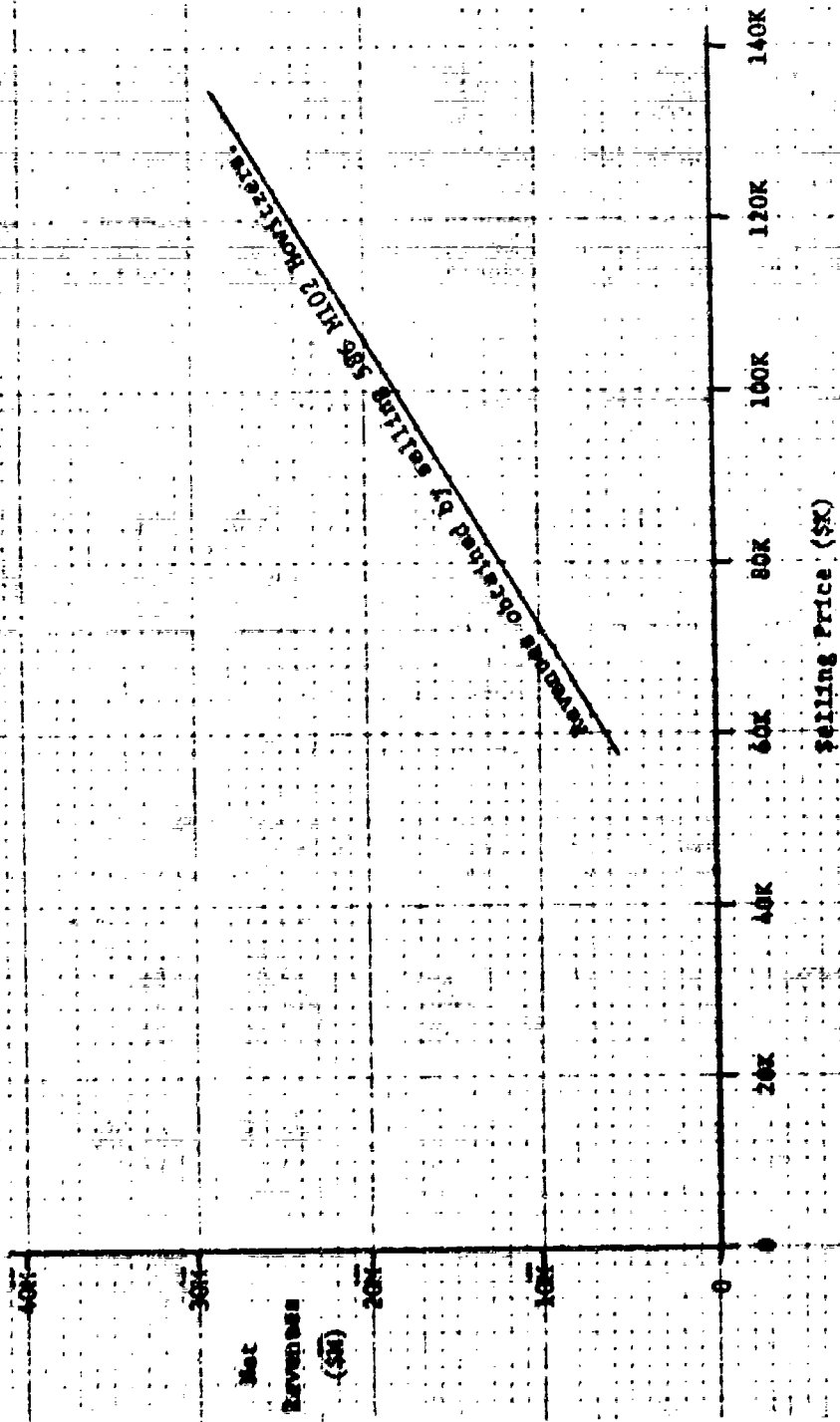


Figure 3. Potential Net Revenues from FMS for A11-4
 (in Constant Discounted F177 Dollars)

In order to exemplify the use of the figures, two cases shall be discussed. In the two cases, different FMS selling prices will be used to show how revenue varies with selling prices. The selling prices used are:

| | <u>M101A1</u> | <u>M102</u> |
|--------|---------------|-------------|
| Case 1 | ~\$31K | ~\$126K |
| Case 2 | ~\$97K | ~\$ 97K |

The values for Case 1 were determined as 80% of their respective standard prices plus the cost of overhaul and test ammunition (see Table A-5). The values for Case 2 were determined as 80% of new production costs of XM204 Howitzers. Net FMS revenues corresponding to the selling prices were obtained from Figures 2, 3, 4 and 5 and are displayed in Table 6.

TABLE 6. NET FMS REVENUE (\$M)
(In Constant Discounted FY 77 Dollars)

| | <u>Quantity Sold</u> | | <u>Revenues for Case 1</u> | <u>Revenues for Case 2</u> |
|-------|----------------------|-------------|------------------------------|------------------------------|
| | <u>M101A1</u> | <u>M102</u> | <u>M101A1 + M102 = TOTAL</u> | <u>M101A1 + M102 = TOTAL</u> |
| ALT 1 | 745 | 306 | 4.8 + 13.0 = \$17.8M | 28.5 + 8.6 = \$37.1M |
| ALT 2 | 300 | 426 | 2.0 + 18.6 = \$20.6M | 12.2 + 12.2 = \$24.4M |
| ALT 3 | 745 | .. | 5.1 + 0.0 = \$ 5.1M | 30.4 + 0.0 = \$30.4M |
| ALT 4 | - | 586 | 0.0 + 26.0 = \$26.0M | 0.0 + 17.1 = \$17.1M |

The net revenues shown in Table 6 would probably go to the US Government General Revenue Fund for subsequent Congressional appropriation. If these funds were reverted to the XM204 program, the net costs of each alternative could be calculated as is done in Table 7.

TABLE 7. ALTERNATIVE NET COSTS FOR XM204 HOWITZERS
(In Constant Discounted FY 77 Dollars)

| <u>Case 1:</u> | <u>ALT 1</u> | <u>ALT 2</u> | <u>ALT 3</u> | <u>ALT 4</u> |
|----------------------|--------------|--------------|--------------|--------------|
| XM204 Fielding Costs | \$81.1M | \$62.9M | \$64.0M | \$54.2M |
| Net FMS Revenues | 17.8 | 20.6 | 5.1 | 26.0 |
| Net Costs | \$63.3M | \$42.3M | \$58.9M | \$28.2M |
| <u>Case 2:</u> | | | | |
| XM204 Fielding Costs | \$81.1M | \$62.9M | \$64.0M | \$54.2M |
| Net FMS Revenues | 37.1 | 24.5 | 30.4 | 17.1 |
| Net Costs | \$44.0M | \$38.5M | \$33.6M | \$37.1M |

SUMMARY

For each alternative plan of fielding XM204 Howitzers, the discounted investment costs were determined. These costs included Initial Production Facility (IPF) costs, production and transportation, initial provisioning and training, and publications. It was determined that:

a. For ALT 1, if 1,118 XM204 Howitzers were produced and delivered to Active Army, Reserve, and National Guard units, an investment of \$81M will be required.

b. For ALT 2, if 793 XM204 Howitzers were produced and delivered to Active Army units only, an investment of \$63M would be required.

c. For ALT 3, if 812 XM204 Howitzers are produced and delivered to Active Army, Reserve, and National Guard units to replace all M101A1 Howitzers, an investment of \$64M would be required.

d. For ALT 4, if 651 XM204 Howitzers were produced and delivered to Active Army, Reserve, and National Guard units to replace all M102 Howitzers, an investment of \$54M would be required.

For each of the four alternative plans addressed in this analysis, potential net revenues (total revenues minus overhaul costs) were calculated for the sale of overhauled M101A1 and M102 Howitzers to Foreign Military Sales (FMS) customers. Figures 2, 3, 4 and 5 display those net revenues for ALT 1, 2, 3 and 4, respectively.

According to current policy, the FMS selling price for overhauled M101A1 and M102 Howitzers would be ~\$31K and ~\$126K, respectively (Table A-5). At these selling prices, the potential net revenues which could be received for ALT 1, 2, 3 and 4 are \$18M, \$21M, \$5M, and \$26M, respectively. It should be noted that potential revenues depend directly on the quantities of howitzers sold. For example, if M102 Howitzers could not be sold (say, for example, due to too high a price or low desirability), and only M101A1 Howitzers were sold, the potential net revenues for ALT 1, 2, 3 and 4 would be only \$5M, \$2M, \$5M, and \$0M, respectively. Lastly, if different selling prices could be justified, the subsequent potential net revenues could be obtained from Figures 2, 3, 4 and 5 as demonstrated in this report.

REFERENCES

1. DF from DRDAR-XM to DRSAR-AS, subject: XM204 Review Project, dated 23 Mar 77.
2. DF from DRSAR-AS to 9 Directorates, subject: 105mm Howitzer Production, dated 29 Mar 77.
3. DF from DRSAR-MMH to DRSAR-AS, subject: 105mm Howitzer Production, XM204 (U), dated 27 Apr 77. CONFIDENTIAL.
4. Meeting between Mr. Aukland, DRSAR-MMH, and Mr. Trier, DRSAR-SA, subject: Quantity of M101A1 and M102 Howitzers in Reserves and National Guard, dated 28 Apr 77.
5. Army Materiel Plan Summary, 3 January 1977, Printout numbers G0180000M00, G0180100M00, G0180200M00, and G0180300M00. CONFIDENTIAL.
6. AR 11-28, Economic Analysis and Program Evaluation for Resource Management, dated 15 Jan 76.
7. FONECON, Mr. Aukland, DRSAR-MMH and Mr. Trier, DRSAR-SA, subject: Standard Price of M10A1 and M102 Howitzers and Determination of FMS Selling Price, dated 25 Apr 77.
8. DALO-ILP MSG 132055Z Sep 76, CONFIDENTIAL.
9. DF from DRSAR-CPE to DRSAR-ASA, subject: 105mm Howitzer Production, XM204, dated 12 Apr 77.

APPENDIX A

SUPPORTING INPUT COST/SCHEDULE DATA

Next page is blank.

TABLE A-1. SCHEDULES FOR ALTERNATIVE 1

| | FY81 | FY82 | FY83 | FY84 | FY85 | FY86 | FY87 | TOTAL |
|---|------|------|------|------|------|------|------|-------|
| ALT 1: | | | | | | | | |
| XM204 Production Schedule^a | 8 | 50 | 168 | 288 | 288 | 316 | --- | 1,118 |
| Delivery Sch.: Active Army^b | - | 33 | 109 | 228 | 175 | --- | --- | 545 |
| Res. & Nat. Guard^b | - | --- | --- | --- | 113 | 302 | 158 | 573 |
| Overhaul Sch.: Active Army^c | - | 30 | 100 | 210 | 161 | --- | --- | 501 |
| Res. and Nat. Guard^c | - | --- | --- | --- | 108 | 290 | 152 | 550 |
| M101A1: from Active Army^d | - | 18 | 60 | 126 | 96 | --- | --- | 300 |
| Res. & Nat. Guard^d | - | --- | --- | --- | 87 | 235 | 123 | 445 |
| M102: from Active Army^d | - | 12 | 40 | 84 | 65 | --- | --- | 201 |
| Res. & Nat. Guard^d | - | --- | --- | --- | 21 | 55 | 29 | 105 |
| FMS Delivery Sch.: M101A1^e | - | 18 | 60 | 126 | 183 | 235 | 123 | 745 |
| M102^e | - | 12 | 40 | 84 | 86 | 55 | 29 | 306 |

^aObtained from MAJ Roddy, DRDAR-XM (RIA).

^bNumber of Howitzers delivered in a given year equals 1/2 of the number of XM204 Howitzers produced the prior year plus 1/2 of the number of XM204 Howitzers produced that same year (e.g., in FY83, the number of Howitzers delivered = 1/2(50) + 1/2(168) = 109).

^cThe overhaul schedule is calculated by multiplying the ratio of the number of M101A1 and M102 Howitzers replaced and the number of XM204 Howitzers fielded times the delivery schedule (e.g., for FY83, the number of Howitzers overhauled from the Active Army equals (501 + 545) x 109 = 100).

^dM101A1 Howitzers and M102 Howitzers are overhauled concurrently according to the ratio in which they are replaced in Active Army, and then in the Reserves and National Guard (e.g., the number of M101A1 Howitzers overhauled in FY83 equals (300 + 501) x 100 = 60; the number of M102 Howitzers equals (201 + 501) x 100 = 40).

^eFor FMS, the M101A1 and M102 Howitzers will be delivered the same year in which they were overhauled.

TABLE A-2. SCHEDULES FOR ALTERNATIVE 2

| | FY81 | FY82 | FY83 | FY84 | FY85 | FY86 | FY87 | TOTAL |
|--|------|------|------|------|------|------|------|-------|
| <u>ALI 2:</u> | | | | | | | | |
| XM204 Production Schedule | 8 | 50 | 168 | 286 | 279 | --- | -- | 793 |
| Delivery Schedule ^a | - | 33 | 109 | 229 | 284 | 139 | -- | 793 |
| Overhaul Sch.: from Active Army ^b | - | 30 | 100 | 209 | 260 | 127 | -- | 726 |
| M101A1 ^c | - | 12 | 41 | 86 | 108 | 53 | -- | 300 |
| M102 ^c | - | 18 | 59 | 123 | 152 | 74 | -- | 426 |
| FMS Delivery Sch.: M101A1 ^d | - | 12 | 41 | 86 | 108 | 53 | -- | 300 |
| M102 ^d | - | 18 | 59 | 123 | 152 | 74 | -- | 426 |

^aNumber of Howitzers delivered in a given year equals 1/2 of the number of XM204 Howitzers produced the prior year plus 1/2 of the number of XM204 Howitzers produced that same year (e.g., in FY83, the number of Howitzers delivered equals $1/2(50) + 1/2(168) = 109$).

^bThe overhaul schedule is calculated by multiplying the ratio of the number of M101A1 and M102 Howitzers replaced and the number of XM204 Howitzers fielded times the delivery schedule (e.g., for FY83, the number of Howitzers overhauled equals $(726 + 793) \times 109 = 100$).

^cM101A1 and M102 Howitzers are overhauled concurrently according to the ratio in which they are replaced (e.g., the number of M101A1 Howitzers overhauled in FY93 equals $(300 + 726) \times 100 = 41$; the number of M102 Howitzers equals $(426 + 726) \times 100 = 59$).

^dFor FMS, the M101A1 and M102 Howitzers will be delivered the same year in which they were overhauled.

TABLE A-3. SCHEDULES FOR ALTERNATIVE 3

| | FY81 | FY82 | FY83 | FY84 | FY85 | FY86 | FY87 | TOTAL |
|--|------|------|------|------|------|------|------|-------|
| ALT 3: | | | | | | | | |
| XM204 Production Schedule | 8 | 50 | 168 | 288 | 288 | 10 | -- | 812 |
| Delivery Sch.: Active Army ^a | - | 33 | 109 | 202 | --- | --- | -- | 344 |
| Res. & Nat. Guard ^a | - | --- | --- | 26 | 288 | 154 | -- | 468 |
| Overhaul Sch.: from Active Army ^b | - | 29 | 95 | 176 | --- | --- | -- | 300 |
| Res. & Nat. Guard ^b | - | --- | --- | 25 | 274 | 146 | -- | 445 |
| FMS Delivery Sch: M101A1 ^c | - | 29 | 95 | 201 | 274 | 146 | -- | 745 |

^a Number of Howitzers delivered in a given year equals 1/2 of the number of XM204 Howitzers produced the prior year plus 1/2 of the number of XM204 Howitzers produced that same year (e.g., in FY83, the number of Howitzers delivered equals $1/2(50) + 1/2(168) = 109$).

^b The overhaul schedule is calculated by multiplying the ratio of the number of M101A1 and M102 Howitzers replaced and the number of XM204 Howitzers fielded times the delivery schedule (e.g., for FY83, the number of Howitzers overhauled equals $(300 + 344) \times 109 = 95$).

^c For FMS, the M101A1 and M102 Howitzers will be delivered the same year in which they were overhauled.

TABLE A-4. SCHEDULES FOR ALTERNATIVE 4

| | FY81 | FY82 | FY83 | FY84 | FY85 | FY86 | FY87 | TOTAL |
|--|------|------|------|------|------|------|------|-------|
| ALT 4: | | | | | | | | |
| XM204 Production Schedule | 8 | 50 | 168 | 288 | 137 | -- | -- | 651 |
| Delivery Sch.: Active Army ^a | - | 33 | 109 | 228 | 123 | -- | -- | 493 |
| Res. & Nat. Guard ^a | - | -- | -- | -- | 90 | 68 | -- | 158 |
| Overhaul Sch.: from Active Army ^b | - | 30 | 99 | 208 | 112 | -- | -- | 449 |
| Res. and Nat. Guard ^b | - | -- | -- | -- | 77 | 58 | -- | 135 |
| FMS Delivery Sch: M102 ^c | - | 30 | 99 | 208 | 189 | 58 | -- | 584 |

^a Number of Howitzers delivered in a given year equals 1/2 of the number of XM204 Howitzers produced the prior year plus 1/2 of the number of XM204 Howitzers produced that same year (e.g., in FY83, the number of Howitzers delivered equals $1/2(50) + 1/2(168) = 109$).

^b The overhaul schedule is calculated by multiplying the ratio of the number of M101A1 and M102 Howitzers replaced and the number of XM204 Howitzers fielded times the delivery schedule (e.g., for FY83, the number of Howitzers overhauled equals $(449 + 493) \times 109 = 99$).

^c For FMS, the M101A1 and M102 Howitzers will be delivered the same year in which they were overhauled.

TABLE A-5. ESTIMATED FMS SELLING PRICE^{a, b}

| <u>M101A1 Howitzer:</u> | |
|--|-------------|
| 80% of the standard price of \$21,254 | = \$17,003 |
| Overhaul cost ^c | = 12,820 |
| Test ammunition ^c | = 1,370 |
| | <hr/> |
| FMS Selling Price | = \$31,193 |
| | |
| <u>M102 Howitzer:</u> | |
| 80% of the standard price of \$109,887 | = \$ 87,910 |
| Overhaul cost ^c | = 36,760 |
| Test ammunition ^c | = 1,370 |
| | <hr/> |
| FMS Selling Price | = \$126,040 |

^a Method to compute FMS selling price and standard prices for the M101A1 and M102 Howitzers were obtained via FONECON between Mr. Aukland, DRSAR-MM and Mr. Trier, DRSAR-SA on 25 April 1977.

^b DALO-ILP MSG 132055Z Sep 76 (C).

^c Data obtained from DRSAR-CPE DF to DRSAR-ASA, subject: 105mm Howitzer Production, XM204, dated 12 April 1977. Cost of test ammunition for the M101A1 and M102 Howitzers was assumed equal to the cost of test ammunition that was estimated for the XM204 Howitzer.

TABLE A-6. OVERHAUL COSTS ESTIMATES FOR M101A1 and M102 HOWITZERS^a
(In Constant FY77 Dollars)

| <u>M101A1 OVERHAUL - PRON M17 OE 3020210H3</u> | |
|--|--------------------|
| Labor | \$ 2,894.52 |
| General & Administrative (G&A) | 709.81 |
| Indirect Maintenance Expense (IME) | 2,447.98 |
| Materiel | 6,767.98 |
| TOTAL | \$12,820.29 |
| | |
| <u>M102 OVERHAUL - PRON M16 DF 3010910H3</u> | |
| Labor | \$ 3,025.10 |
| G&A | 544.77 |
| IME | 2,834.59 |
| Materiel | 27,791.13 |
| FY76 TOTAL | \$34,195.59 |
| | x 1.0750 |
| FY77 TOTAL | \$36,760.20 |

^aDF from DRSAR-CPE to DRSAR-ASA, subject: 105mm Howitzer Production, XM204, dated 12 Apr 77.

TABLE A-7. UNIT AND PROGRAM COSTS OF THE XM204 HOWITZER^a
(In Constant FY77 Dollars)

| <u>Per Unit Cost of XM204 Howitzer Production</u> | | | |
|---|-------------|-------------|--------------|
| Hardware and Support | | | \$120,123.20 |
| Test Ammunition | | | 1,370.35 |
| | | | <hr/> |
| | | | \$121,493.65 |
| | <u>FY79</u> | <u>FY80</u> | <u>FY81</u> |
| Initial Production Facilities | --- | \$1.0M | \$5.29M |
| Initial Provisioning | \$0.4M | \$0.9M | \$1.6M |
| Publications | --- | --- | \$3.4M |

^aDF from DRSAR-CPE to DRSAR-ASA, subject: 105mm Howitzer Production, XM204, dated 12 Apr 77.

Next page is blank.

APPENDIX B

SUPPORTING OUTPUT COST DATA

Next page is blank.

TABLE B-1. XM204 HOWITZER FIELDING COSTS: YEAR BY YEAR

| | FY77 CONSTANT DOLLARS (\$M) | | | | | | | | | |
|-------|-----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| | <u>FY79</u> | <u>FY80</u> | <u>FY81</u> | <u>FY82</u> | <u>FY83</u> | <u>FY84</u> | <u>FY85</u> | <u>FY86</u> | <u>FY87</u> | <u>TOTAL</u> |
| ALT 1 | 0.4 | 1.9 | 11.3 | 6.3 | 21.0 | 36.0 | 36.0 | 39.5 | -- | 152.4 |
| ALT 2 | 0.4 | 1.9 | 11.3 | 6.3 | 21.0 | 36.0 | 34.9 | --- | -- | 111.8 |
| ALT 3 | 0.4 | 1.9 | 11.3 | 6.3 | 21.0 | 36.0 | 36.0 | 1.3 | -- | 114.2 |
| ALT 4 | 0.4 | 1.9 | 11.3 | 6.3 | 21.0 | 36.0 | 17.1 | --- | -- | 94.0 |

| | FY77 CONSTANT DISCOUNTED DOLLARS (\$M) | | | | | | | | | |
|-------|--|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| | <u>FY79</u> | <u>FY80</u> | <u>FY81</u> | <u>FY82</u> | <u>FY83</u> | <u>FY84</u> | <u>FY85</u> | <u>FY86</u> | <u>FY87</u> | <u>TOTAL</u> |
| ALT 1 | 0.35 | 1.5 | 8.1 | 4.1 | 12.4 | 19.4 | 17.6 | 17.6 | -- | 81.1 |
| ALT 2 | 0.35 | 1.5 | 8.1 | 4.1 | 12.4 | 19.4 | 17.1 | --- | -- | 62.9 |
| ALT 3 | 0.35 | 1.5 | 8.1 | 4.1 | 12.4 | 19.4 | 17.6 | 0.6 | -- | 64.0 |
| ALT 4 | 0.35 | 1.5 | 8.1 | 4.1 | 12.4 | 19.4 | 8.4 | --- | -- | 54.2 |

TABLE B-2. M101A1 and M102 HOWITZER OVERHAUL COSTS
(In Constant Discounted FY77 Dollars)

| | M101A1 | | M102 | |
|-------|------------|-------------|------------|-------------|
| | <u>Qty</u> | <u>Cost</u> | <u>Qty</u> | <u>Cost</u> |
| ALT 1 | 745 | \$6.4M | 306 | \$ 6.5M |
| ALT 2 | 300 | 2.8M | 426 | 9.2M |
| ALT 3 | 745 | 6.8M | --- | --- |
| ALT 4 | --- | --- | 586 | 12.9M |

REPRODUCING PAGE BLANK-NOT FILM

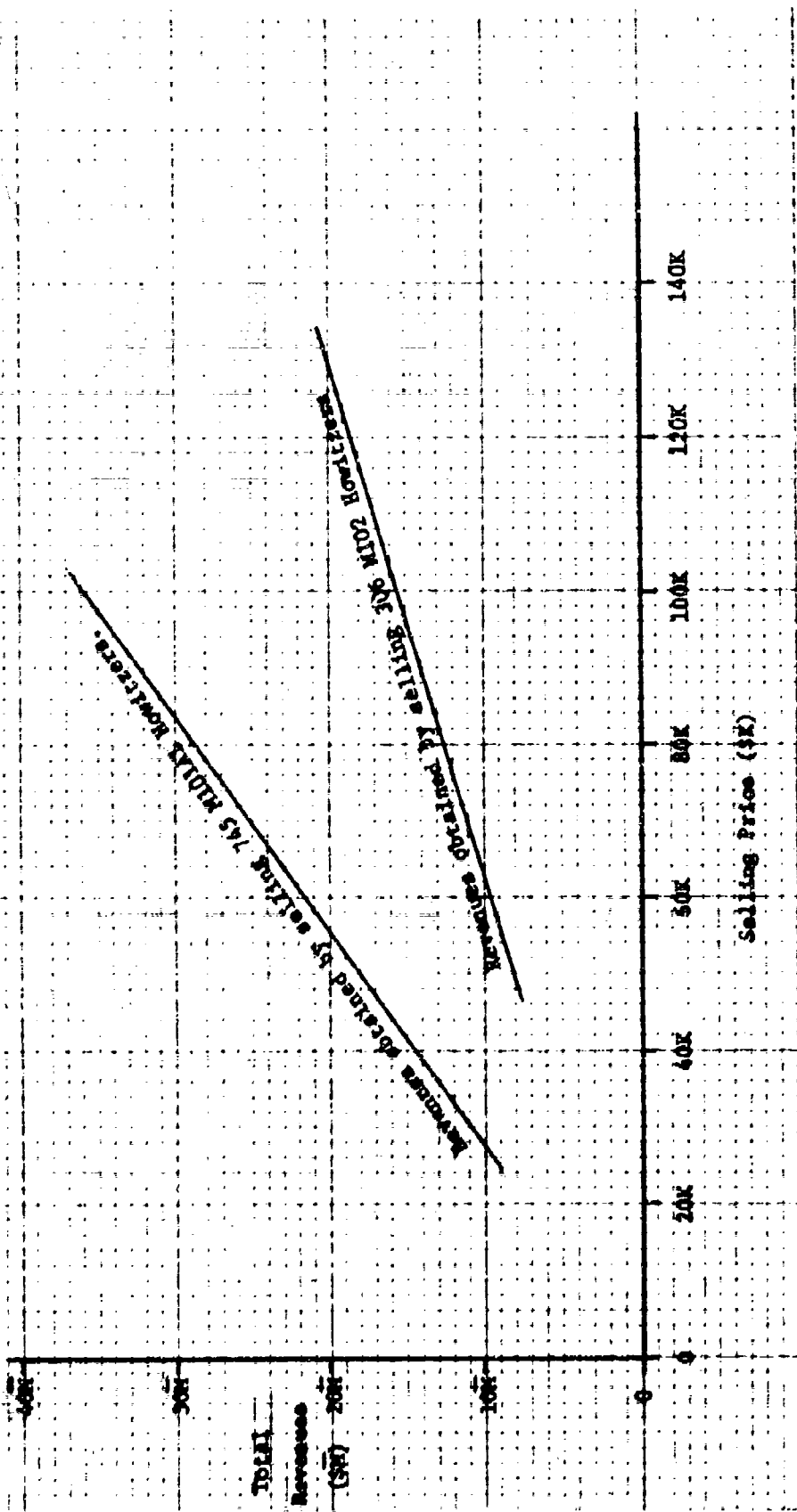


Figure 3-1. Potential Revenues from FMS for ALI 1
(In Constant Discounted FY77 Dollars)

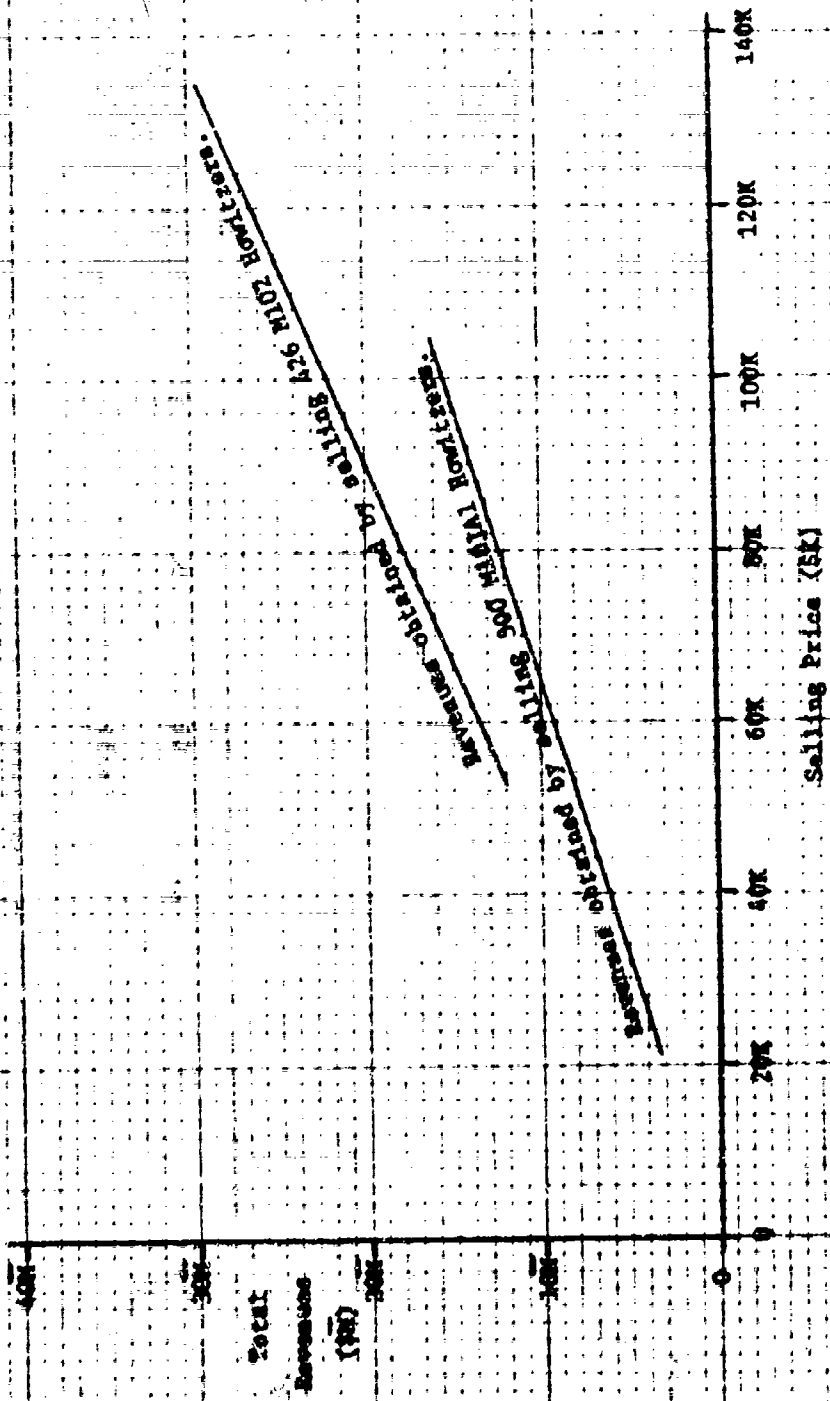


Figure B-3. Potential Revenue from FMS for ALT-2
(in Constant Discounted FY77 Dollars)

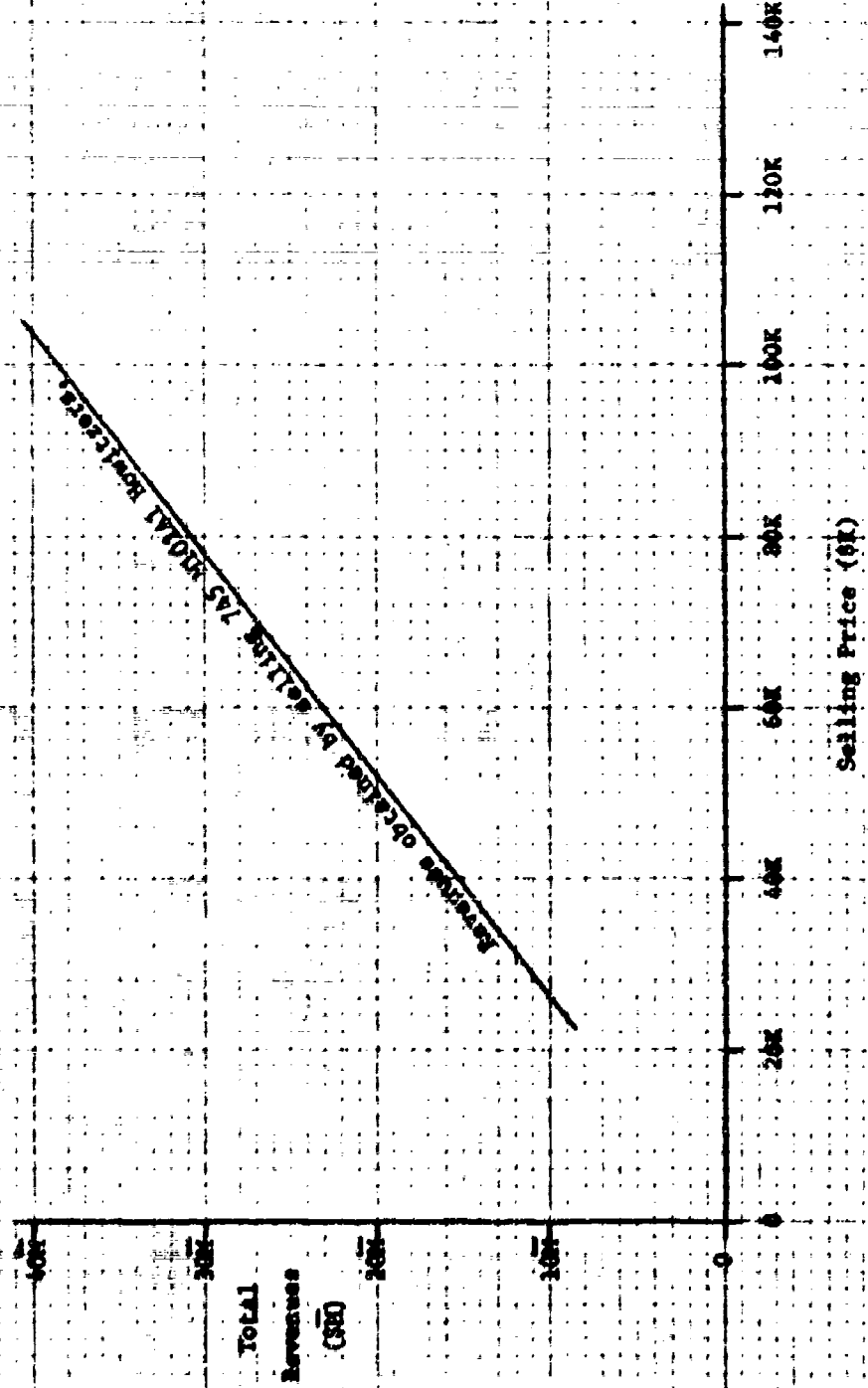


Figure B-3. Potential Revenues from PMS for ALI-3
(In Constant Discounted FY77 Dollars)

1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
2046
2047
2048
2049
2050

Total
Revenue
(\$M)

200K 400K 600K 800K 1000K 1200K 1400K

Selling Price (\$/L)

Figure 1-1. Potential Revenues from IMS For ALF 4
(In Constant Discounted FY77 Dollars)

DISTRIBUTION LIST

No. of Copies

| | |
|---------|--|
| 2 12 | <p>Commander US Army Armament Materiel Readiness Command ATTN: DRSAR-AS DRSAR-SA Rock Island, IL 61201</p> |
| 2 | <p>Commander Rock Island Arsenal ATTN: SARRI-ADL Rock Island, IL 61201</p> |
| 1 | <p>Commander US Army Armament Research and Development Command ATTN: DRDAR-XM Dover, NJ 07801</p> |
| 1 1 | <p>Commander US Army Materiel Systems Analysis Activity ATTN: DRXSY-GS DRXSY-C Aberdeen Proving Ground, MD 21005</p> |
| 2 | <p>Director US Army TRADOC Systems Analysis Activity ATTN: ATAA-SL (Tech Library) White Sands Missile Range, NM 88002</p> |
| 1 | <p>Commandant US Army Field Artillery School ATTN: ATSF-CD-FA Fort Sill, OK 73503</p> |
| 12 | <p>Defense Documentation Center Cameron Station Alexandria, VA 22314</p> |