DRSAR/SA/N-55

COST/SCHEDULE UNCERTAINTY ANALYSIS FOR VADS SHORT RANGE (RAM) PRODUCT IMPROVEMENT PROGRAM

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FEBRUARY 1977

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

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

A cost/schedule uncertainty analysis was conducted on the short range (RAM) product improvement program (PIP) for the Vulcan Air Defense System (VADS). The short range PIP addresses the product improvements to the self-propelled (M163) and towed (M167) VADS, changes to VADS support and test equipment, and documentation of those changes in the appropriate technical manuals. The Venture Evaluation and Review Technique (VERT), a network analyzer, was used to simulate the VADS PIP from July 1, 1976 to the completed application of all product

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improvements and the fielding of the new manuals and test equipment.

SUMMARY

A cost/schedule uncertainty analysis was conducted on the short range (RAM) product improvement program (PIP) for the Vulcan Air Defense System (VADS). The short range PIP addresses the product improvements to the self-propelled (M163) and towed (M167) VADS, changes to VADS support and test equipment, and documentation of those changes in the appropriate technical manuals. The Venture Evaluation and Review Technique (VERT)[1], a network analyzer, was used to simulate the VADS PIP from 1 July 1976 to the completed application of all product improvements and the fielding of the new manuals and test equipment.

It was estimated that the expected time from 1 July 1976 to complete the short range PIP would be 126 weeks at an expected 10.5\bar{M}$, with 90% probability intervals for time and cost of 119 to 133 weeks and 10.2\bar{M}$ to 10.7\bar{M}$. The narrow confidence interval for cost reflects the fact that most of the funds for the contract with General Electric Company have been negotiated. The expected time to complete the application of the product improvements to VADS by the depot level contractor teams was 78 weeks at an expected 7.5\bar{M}$, with a 90% probability intervals of 76 to 79 weeks and 7.3\bar{M}$ to 7.7\bar{M}$. The scheduled time and cost for the completion of the contractor teams are 76 weeks and 7.473\bar{M}$.

This analysis was concerned only with the RAM portion of the VULCAN product improvement program. Effectiveness improvements to the system have been studied by the Applied Physics Laboratory of John Hopkins University[2]. It is expected the 30% to 70% of the current RAM product improvements will be affected by changes required to make effectiveness improvements[3].

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[1] Moeller, G.L., VERT - A Tool to Assess Risk, Proceedings from Eleventh US Army Operations Research Symposium, May 1972.

[2] FS-76-070, Vulcan Air Defense System (VADS) Effectiveness Improvement Study, Final Report, Fleet Systems Division, Applied Physics Laboratory, John Hopkins University, April 1976.

[3] Briefing to MG Lewis by Mr. Bill Arnold, DRCPM-ARGADS, Subject: VADS Effectiveness Product Improvement Program, 7 September 1976.

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OBJECTIVE

This analysis was performed to determine the cost/schedule uncertainties of the Vulcan Air Defense Systems (VADS) short range (RAM) product improvement program (PIP) from July 1, 1976 to the completion of that PIP.

INTRODUCTION

The RAM PIP program was approved for sole source procurement by the Department of the Army (DA)[4]. Therefore, the risks addressed in this study pertain only to the single alternative of the sole source contractor being able to apply the modification kits by a certain time.

First, the nature of the product improvement program and the review of the activities that are needed for completion of the program are presented. Then, the interdependency of the many activities are discussed. Finally, the cost/schedule results with uncertainty are presented and analyzed.

A discussion of each product improvement is contained in Appendix A, followed by the supporting data and time and cost distributions for the completion of major activities for the Cost/Schedule Uncertainty Analysis (Appendix B).

BACKGROUND

The Vulcan Air Defense System (VADS) was designated and fielded in two versions: the self-propelled (M163) and the towed (M167). These systems (shown in Figure 1) are currently deployed world wide, with the M167 towed Vulcan primarily in airborne or airmobile divisions.

A series of modifications to improve the reliability, availability, and maintainability (RAM) of VADS were developed during the past four to five years by the US Army Armament Command (ARMCOM), the Tank and Automotive Command (TACOM), and system contractors. Because of the large number modifications, the total impact to VADS is considered a major change and the modified systmes have an "A1" model configuration.

In March 1975, AMC received DA direction[4] to accelerate the VADS product improvement program. During June 1975, ARMCOM was granted[5] special procurement authority (sole source), an 02 priority, and authority to field with draft technical manuals (TMs) in order to accomplish an accelerated application. The application of the modification kits to the systems in the field will be accomplished by depot level contractor teams as part of an accelerated program.

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[4]Teletype from DAMA-WSW to AMCRP-GV, subject: Acceleration of Vulcan PIP's and M10 Gunner Training Device, dtd R 291346Z April 1975.

[5]Teletype from AMCRP-GV to AMSAR-CP, subject: Acceleration of Vulcan PIP, dtd r 202017Z June 1975.

VULCAN AIR DEFENSE SYSTEM

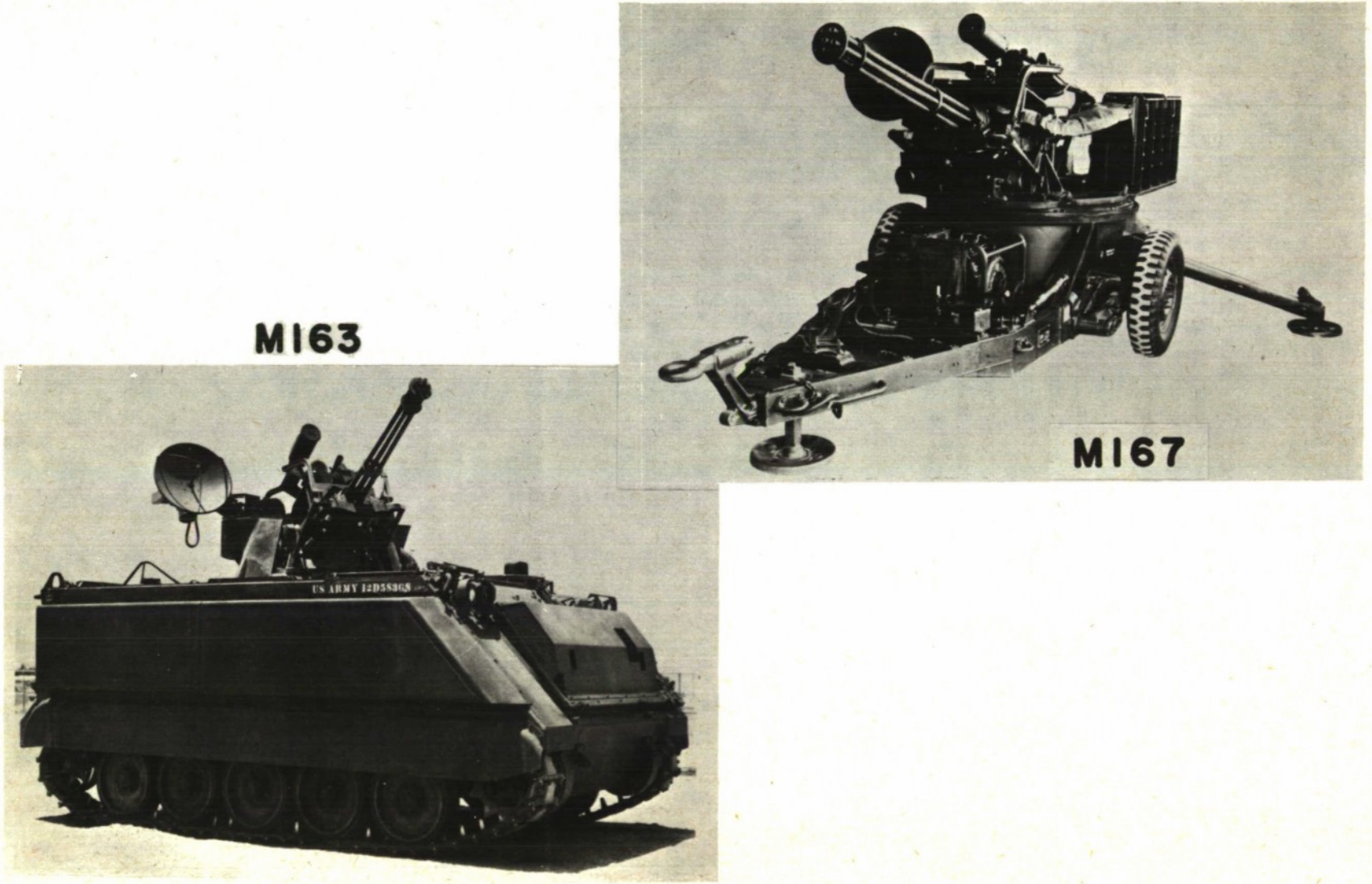

Figure 1. The Vulcan Air Defense System, Self-propelled (M163) and Towed (M167)

Table 1 lists the product improvements and indicates their applicability to the self-propelled (M163) or towed (M167) VADS. A discussion of each of the product improvements is presented in Appendix A. These product improvements are being applied by depot level contractor teams (with the exception of the ammunition cans which were troop-issued). Since letter contracts to apply the product improvements had been awarded to General Electric Company (GE) on 24 October 1975[6] and 7 November 1975[7], the altervative to employ Army modification teams was not analyzed.

The Effectiveness PIP will run concurrently with the RAM PIP. A VADS effectiveness improvement study by the Applied Physics Laboratory of John Hopkins University[2] outlined 12 options, each with varying degrees of effectiveness improvements. In a briefing to DA[8], DRCPM-ARGADS had proposed that Option 2 of the above report be implemented. DRCPM-ARGADS was then directed to look at several additions to Option 2, including a laser range finder and modification of the radar to make it less susceptible to jamming. If Option 2 is adopted, the servo amplifiers, M61 sights, sight current generator and analog computer would be replaced. Consequently, the new MWM-3 test sets would be modified as much as 70% (on a parts count basis) since they are used to test the integrity of the fire control.

NETWORK ANALYSIS

The Venture Evaluation and Review Technique (VERT)[1] was used to simulate the VADS short range product improvement program from 1 July 1976 to the completion of the short range PIP. A network showing the major areas addressed is shown in Figure 2. Consideration was given to the following areas and their interactions: the armament and radar modification team schedules, the manufacturing and delivery of the modification kits, the draft manuals, the maintenance support equipment, TECOM tests at APG, the in process review (IPR), and funding.

The application of the product improvements is being accomplished by two types of teams. The radar modification teams are applying the radar reliability modifications to VADS, and the armament modification teams are applying all other modifications. As of 1 July 1976, all four radar modification teams had been hired and were working at Fort Bliss and Fort Campbell. Three of the five armament teams had been hired and were working at Fort Bliss and Fort Campbell but were not applying modifications

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[6] Contract DAAA 09-76-C-2046, dtd 24 Oct 1975, with General Electric, Utica, NY.

[7] Contract DAAA 09-76-C-2045, dtd 7 Nov 1975, with General Electric, Burlington, VT.

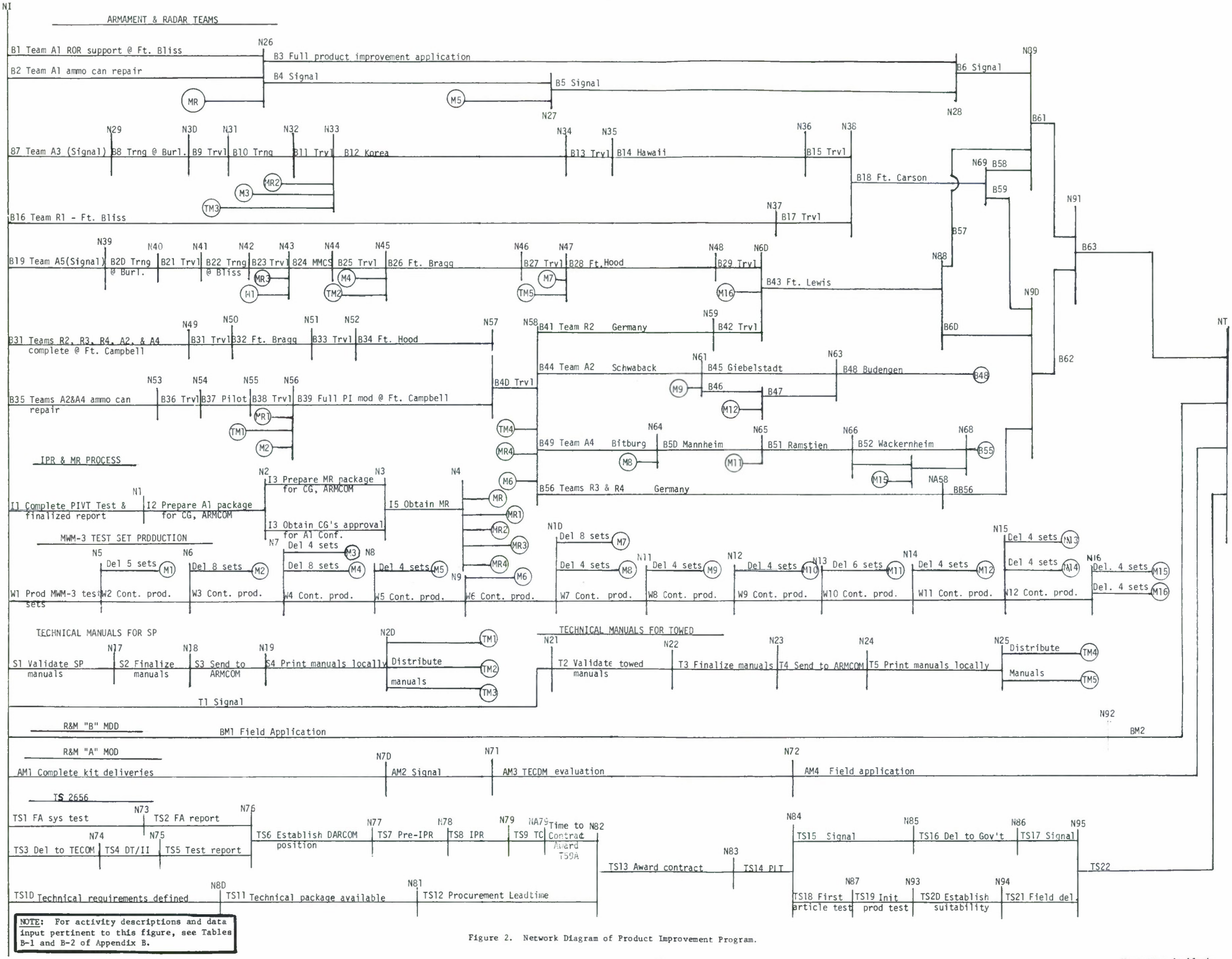
[2] Loc. Cit.

[8] Briefing to DA by DRCPM-ARGADS, subject: Vulcan Effectiveness Improvements Briefing, dtd 7 Oct 1976.

[1] Loc. Cit.

TABLE 1. LIST OF PRODUCT IMPROVEMENTS

Product Improvements	M163	M167
Radar Reliability	X	X
Lockout Suspension Interlock	X	
Fuel Cell Bladder	X	
Antenna Portection Brackets	X	
Radome	X	X
Link Disposal	X	
Controlled Conveyer	X	
Ammo Storage	X	
Servo Amplifier	X	X
M61 Sight Control Assembly	X	X
Low Voltage Protection	X	X
Sight Current Generator	X	X
Rounds Counter		X
Auxiliary Power Unit		X
Hydraulic Shields		X
Equilibrators	X	X
Ammunition Can Assembly		X



NOTE: For activity descriptions and data input pertinent to this figure, see Tables B-1 and B-2 of Appendix B.

Figure 2. Network Diagram of Product Improvement Program.

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for which materiel release (MR) had not yet been granted. Following the approval of the "A1"configuration[9], and the Materiel Release (MR)[10] of the short range product improvements for the self-propelled and towed VADS and the MWM-3 test sets, the armament teams were authorized to begin applying all the RAM product improvements, providing that the MWM-3 test sets and technical manuals were available.

Concurrently, changes are being made to the AN/TSM 115 shop set and the TS-2656 test set. The improvements to the AN/TSM 115 shop set are twofold. First, compatibility modifications (referred to as the R&M (B)) will be applied to make all AN/TSM 115 shelters the same configuration. Secondly, modifications (referred to as the R&M (A)) will be applied to expand the capability of the AN/TSM 115 for testing radar units. The TS-2656A1 will replace the present TS-2656 and will enable field maintenance personnel to validate radar operational readiness in terms of range, subclutter visibility, minimum discernible signal, and average transmit power. (The present TS-2656 is incapable of performing measurements to determine Vulcan radar operational effectiveness).

COST/SCHEDULE RESULTS

For the short range product improvement program, the time and cost of each activity were accumulated from 1 July 1976, to the completion of each of the main areas. A summary of the time and cost distributions, extracted from the computer printout of the simulation (located in Appendix B), is shown in Table 3. This summary shows the expected times and costs with 90% probability intervals between the upper (5%) and lower (5%) values for each main area of the product improvement program.

TABLE 3. SUMMARY OF COST/SCHEDULE RESULTS[a]

	Time (WKS)			Cost ($K)		
	5%	Expected	95%	5%	Expected	95%
Armament Mod Teams	76	78	79	4970	5140	5300
Radar Mod Teams	76	77	79	2330	2340	2380
Mfg of Mod Kits		52			-	
Technical Manuals						
Self-propelled	12.5	13.5	13.5	-	-	-
Towed	20.9	21.5	22.0	-	-	-
Maintenance Support Equip						
AN/TSM 115 Shelter						
R&M B Mod	37	42	49	90	98	107
R&M A Mod	-	84	-	144	156	171
MWM-3 Test Set	-	63	-	-	-	-
TS-2656A1 Test Set	119	126	133	2590	2740	2880

[a]From 1 July 1976 to completion.

[9]Letter from DRSAR-CG to HQDA(DAMA), subject: Type Classification Actions, dtd 2 Sept 1976.

[10]Letters from DRSAR-CG to DRCQA, subject: Release of Materiel for Issue (Full), dtd 3 Sept 1976.

ANALYSIS OF RESULTS

It was determined from the simulation that there is only a 9% chance that the armament teams will complete their application schedule by 16 December 1977, and only a 12% chance that the radar teams will complete their schedules by that date. There is, however, a 66% chance for the armament teams and a 82% chance for the radar teams to complete their schedules by 1 January 1978. Any extended effort past 16 December 1976 will, of course, increase the contractual costs.

The above probabilities are based on the assumption that other factors, such as the fielding of interim technical manuals and the production and delivery of MWM-3 test sets and modification kits, stay within their estimated variability. It was determined that if the expected time of 13 weeks for the availability of interim technical manuals is slipped an additional four weeks, it should not seriously impact the schedule of the armament or radar teams.

Furthermore, there should not be any delay of the modification teams due to a shortage of kits, since production of the modification kits has been continuing as if to meet the originally scheduled completion date of July 1977. The only period of concern seems to be during the first quarter of FY77, where delays to the modification teams could occur due to improper distribution of kits or delays in processing.

The production and delivery of the MWM-3 test sets should not impact on the application schedule of the modification teams. Variability in the production rate was not expected since approximately 90% of the parts are on hand at Frankford Arsenal, and the test sets need only to be assembled. FY7T and FY77 costs will be almost entirely labor costs for assembling the test sets, and the final cost for a MWM-3 test set is expected to be $10K per unit. Even if production is delayed, the modification teams can continue, since the contractor has been furnished prototype models of the MWM-3 test set and the modification teams will be taking these prototype sets with them.

Other factors such as the R&M "A" Mod and R&M "B" Mod for the AN/TSM 115 test shelters and the TS-2656A1 test sets do not appear to jeopardize the armament or radar modification teams schedules. Therefore, during the remaining months of 1976, critical management attention should focus on the timely fielding of interim technical manuals, the production and delivery of MWM-3 test sets, and the production and delivery of the modification kits. After 1 January 1977 there seems to be no critical impacts due to shortage of modification kits or test sets. However, further problems could occur unless the users assure that VADS units are supplied to the teams on schedule and that adequate facilities are available.

REFERENCES

1. Moeller, G.L., VERT - A Tool to Assess Risk, Proceedings of the Eleventh US Army Operations Research Symposium, May 1972.

2. FS-76-070, Vulcan Air Defense System (VADS) Effectiveness Improvement Study, Final Report, Fleet Systems Division, Applied Physics Laboratory, John Hopkins University, April 1976.

3. Briefing to MG Lewis by Mr. Bill Arnold DRCPM-ARGADS, subject: VADS Effectiveness Product Improvement Program, 7 Sept 1976.

4. Teletype from DAMA-WSW to AMCRP-GV, subject: Acceleration of Vulcan PIP's and M10 Gunner Training Device, dtd April 1975.

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7. Contract DAAA 09-76-C-2045, dtd 7 November 1975, with General Electric, Burlington, VT.

8. Briefing to DA by DRCPM-ARGADS, subject: Vulcan Effectiveness Improvements Briefings, dtd 7 October 1976.

9. Letter from DRSAR-CG to HDQA(DAMA), subject: Type Classification Actions, dtd 2 September 1976.

10. Letters from DRSAR-CG to DRCQA, subject: Release of Materiel for Issue (Full), dtd 3 September 1976.

11. Letter from SARFA-MAE-A to DRSAR-SAS, subject: Estimated Time to Repair a Modified Unserviceable AN/VPS-2 Radar, dated 15 June 1976.

12. Letter from AMSAR-ASV to AMCDLS, subject: VADS Accelerated PIP, dtd 10 October 1975.

13. 1st Indorsement from DALO-SMM-D to DECRE-ID, subject: VADS Accelerated PIP, dtd 14 March 1976.

14. DRSAR-MMR CMT1 to DRSAR-SAS, subject: Draft Cost/Schedule Uncertainty Analysis for VADS Short Range (RAM) Product Improvement Program, dtd 14 October 1976.

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APPENDIX A

DISCUSSION OF PRODUCT IMPROVEMENTS

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APPENDIX A. DISCUSSION OF PRODUCT IMPROVEMENTS

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APPENDIX A

DISCUSSION OF PRODUCT IMPROVEMENTS

There will be a total of 17 product improvements applied to VADS during the short range PIP, (see Table 1). In addition, three of the maintenance support equipment units will be product-improved. A discussion of each of these product improvements follows.

RADAR RELIABILITY

The goal of the radar reliability product improvement is to increase the mean-time-between-failure (MTBF) from 30 hours to 100 hours. During the Product Improvement Verification Test (PIVT), a MTBF of 122 hours was demonstrated. To achieve the 122 hours MTBF, approximately 200 components were removed and replaced. Modifications were made to internal RF cables, electrolytic capacitors, operational amplifiers, RF filters, blower motor inverter, klystron power supply circuit, enclosure gaskets, radiate lens, and parts of the power supply. These modifications affect 4 of the 6 radar units (receiver transmitter (unit 2), receiver (unit 3), computer (unit 4), and power supply (unit 5)).

Several failures to VADS radar system occurred during the PIVT, which resulted in cold temperature fixes to the 3A2 (AGC fix), 2A2 (CR21 also has parts replacements), and the CR18.

Failures also occurred to the doppler amplifier during the PIVT. If a decision is made to incorporate the fix to the doppler amplifier, the new doppler amplifier will be directly exchangeable and its application should take 2 or 3 members of a modification (mod) team approximately 3 weeks to complete installation in CONUS.

Another problem involves the klystron in the radar receiver/transmitter (unit 2). The klystron tube manufactured by Varian is a primary factor impacting the current delivery of the radar subassembly by AEL-EMTECH. The main problem in the production delay is the lack of mutual understanding and agreement between Frankford Arsenal and Varian regarding the testing of klystron electrical linearity requirements.

An additional problem deals with the application of the kits to unserviceable radar units. This problem surfaced due to the contract agreement with GE-Utica which states that if a radar unit is supplied in an operable state to the modification team, it must be modified, tested, and returned to the user in an operable condition. However, if a radar unit is supplied to the modification team in an inoperable state, it must only be modified and returned to the user; it need not be tested.

Good maintenance philosophy and MIL-M-63002C (TM) dictate that electronic assemblies should not be modified until they are brought to a serviceable condition. One reason is that if an unserviceable radar unit is modified and returned to the user in an unserviceable but modified condition, the user's task of fixing the radar unit is further complicated

by the presence of unfamiliar modifications which may not have been applied correctly. With these factors in mind, the fire control section at Frankford Arsenal (SARFA-MAE-A) estimated[11] that if the radar modification kit were applied to 4 unserviceable units (units #2, 3, 4, and 5), it could take an additional 81 to 97 manhours to bring them to a serviceable condition.

Frankford Arsenal also stated[11] that one method to reduce the number of inoperable units modified by GE's mod teams would be to supply each team with a float radar system (units 2 through 5) and major subassemblies, i.e., 3A2, 3A5, 2A7, 2A2, 4A20, 5A3A4, etc. The teams would substitute these items for any defective components in a system being modified and only serviceable units would be modified. The modified radar would then be returned to the using unit and the float assemblies would be removed. Using units would then know what subassemblies were in need of repair/replacement. This would then eliminate most of the lengthy repair time previously cited. This method was not feasible, however, since ARMCOM had requested[12], but could not obtain[13] additional funds to have GE repair all radar units before modification.

Instead of having the modification teams repair the radar units, ARMCOM has been coordinating with the users (explaining the consequences of supplying unserviceable radar units to GE's mod teams and supplying repair parts to the user on an 02 priority) and the users have been making a concerted effort to make their radar units operable before sending them to the mod teams. However, even with this effort, the users have not been able to supply only operable radar units to GE's modification teams due to shortage of repair parts, units requiring depot repairs, shortage of time to make the necessary repairs, etc. Therefore, the impact to the users is going to depend directly on the timely supply of needed repair parts and the users' effort and ability to bring their radar units to operable conditions before supplying the radar units to the modification teams.

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[11] Letter from SARFA-MAE-A to DRSAR-SAS, subject: Estimated Time to Repair a Modified Unserviceable AN/VPS-2 Radar, dtd 15 June 1976.

[12] Letter from AMSAR-ASV to AMCDLS, subject: VADS Accelerated PIP, dtd 10 October 1975.

[13] 1st Indorsement from DALO-SMM-D to DRCRE-ID, subject: VADS Accelerated PIP, dtd 14 March 1976.

An additional problem exists with the radar modification.[14] Some new parts to be installed during the modification have the same part number and National Stock Number (NSN) as the old parts they replace, even though they have different operating characteristics. This situation could result in field repair activities demodifying VPS-2 radars by inadvertently replacing new configured parts with old configured parts with the same part number. This is especially true at Ft. Bragg, Ft. Campbell, and Ft. Bliss where radars have been modified and new manuals are not available.

LOCKOUT SUSPENSION INTERLOCK

The chassis of the 20mm SP M741 vehicle has eight suspension lockout cylinders that stabilize the vehicle for firing. Presently, a warning light indicates if the lockout cylinders are engaged, but the driver is still able to drive the vehicle and cause damage to the lockout cylinders. The lockout suspension interlock is an electro-mechanical stop that does not allow the throttle of the vehicle to be advanced when the suspension lockout system is engaged, thus eliminating damage to roadwheel arms and lockout cylinders.

FUEL CELL BLADDER

Vibration of the M741 chassis causes fatigue cracks in the fuel cell wall, and results in fuel leakage in the crew compartment. The fuel cell bladder product improvement is a rubber bladder which will be placed in the present vehicle fuel cell, to provide a more reliable method of containing the fuel. Prior to installation of the fuel cell bladder, vehicles with fatigue cracks in the fuel cell will be repaired.

ANTENNA PROTECTION BRACKETS

The radar antenna protection brackets will be welded on the turret to support a future antenna protection device. The purpose of the antenna protection is to reduce the catastropic antenna damage by undergrowth and branches. The antenna protection device is expected to decrease the radar performance slightly. However, the users have agreed on the amount of degradation and the amount of protection afforded by this device.

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[14] DRSAR-MMR-CMT 1 to DRSAR-SAS, subject: Draft Cost/Schedule Uncertainty Analysis for VADS Short Range (RAM) Product Improvement Program, dtd 14 October 1976.

RADOME

The radome antenna protection device is a fiberglass radome which provides partial protection of the radar antenna reflector and feed horn against oncoming brush and personnel abuse. The radome will reduce damage to the antenna and minimize boresight misalignment between mechanical and electrical axis (misalignment prevents the radar from staying on target).

LINK DISPOSAL

The self-propelled VADS currently utilizes a linkless feed system. Since the ammunition for VADS is linked, these links must be removed during the loading of the ammunition. During the current loading process in the self-propelled VADS, the links are expended in the crew compartment, and create a potential hazard to the crew and equipment (the links can lodge between the mount and the floor, jamming the turret).

The link disposal product improvement, a flexible chuting to the outside to permit disposal of used links, resolves the above problems. The link disposal passes the links to the outside of the vehicle so that the links are not expended and accumulated inside the vehicle and the crew is not exposed (as they now are) when dumping expended links.

CONTROLLED CONVEYOR

The linkless feed system on the self-propelled VADS conveys the 20mm cartridges from the ammunition drum to the M168 cannon. This system currently required that every element in the conveyor feed system must contain either a live or a dummy cartridge for proper feeding and drum exit operation. When empty spaces in the conveyor are encountered or when a "runaway" condition exists, catastrophic failure of the feeder can occur. The controlled conveyor eliminates this failure mode by allowing for empty spaces in the conveyor system and/or ammunition drum. Since empty spaces will be allowed, all the ammunition in the feed chute and ammunition drum can be fired, resulting in an increase of ready ammunition. This also eliminates the need for dummy rounds and reduces ammunition drum wear (dummy rounds are steel, but parts of the ammunition drum are aluminum).

Early tests demonstrated that the controlled conveyor exhibited high drag characteristics which caused early wear on conveyor elements and sprocket peening. In addition, the road test under dust conditions showed that the dust reduced the firing rates, especially the low rates. However, minor changes in design and the hardening of gears were expected to solve earlier problems. Even though there was still some drag, the required rates were met during testing. It is not known if this improvement will correct all the deficiencies indicated, but it is hoped that if it does, the logistics costs will be reduced as much as 28% for the linkless feed system.

AMMUNITION STORAGE

Ammunition in the self-propelled VADS is currently stored by suspending it from wall hooks and securing it to the hull with tie down straps. This method of storage permits damage to the ammunition and the links during periods of travel, and results in excessive wear to the drum partitions and possible failure to the feed system.

The new ammunition storage is to provide an improved and safer method for carrying the reserve ammunition and transferring it to the ammunition feed and storage system. Other benefits resulting from this improvement are that the two enclosed containers permit power feeding into the drum, which results in faster loading of ammunition (reload time is decreased by 1.5 minutes) by only one crewman, and that the ammunition storage capacity is increased from 800 to 1030 rounds.

The ammo storage modification kits produced were defective due to faulty specifications. Fixes to these kits have been made by a contractor modification team.

SERVO AMPLIFIER

State-of-the-art components were used to design the current servo amplifier in 1963. However, several of the components are no longer manufactured except for VADS, resulting in significant cost increases. In addition, new manufacturing processes for some components have changed the component characteristics, one of which can cause uncontrolled turret runaway.

The new servo amplifier, by using advanced technology components, should reduce costs and reduce chance of turret runaway. The new amplifier will also allow smooth tracking at angular rates below 3^{o} per second (actually down to 0.1^{o} per second) which includes most incoming targets at reasonable engagement ranges and will improve the acceleration performance in order to catch up to targets at close ranges. In addition, the present pulse frequency modulated design will be changed to a pulse-width modulated design.

One problem that still exists, even with the new servo amplifier, is that if radios are transmitting at the same frequency, the servo amplifier can still mistakenly use the radio signals to calculate the lead angles. The solution to this problem was to forbid the use of certain radio frequencies. Other problems are erratic slew action (especially at high and low temperatures), excessive blacklash (4 mils are allowed but there are 10 mils in the box alone), and excessive wear (at one location a steel screw rubs against aluminum).

M61 SIGHT

With the present M61 Sight it is possible to apply or withdraw power to the gyro when it is in the uncaged state. This can result in failures ranging in cost from $50 to $12,000 (the cost of the Sight). The product

improvement to the M61 Sight was to eliminate the possibility of applying or withdrawing power to the gyro when it is in the uncaged state. However, tests have shown that the product improvement to the sight, an electro-mechanical interlock between the sight and the system power switch, exhibits susceptability to mechanical interference if not properly aligned and the switch arrangements allow the system to be de-energized with the sight uncaged. To ease the latter problem, a warning decal will be installed in the interim until the M61 Sight is replaced as part of the VADS Effectiveness PIP.

LOW VOLTAGE PROTECTION

Present conditions permit damage to the electronic components in the fire control system when the system voltage drops below a certain voltage. The low voltage protection modification causes power to the fire control system to be interrupted when the battery voltage drops below a specified value. In addition, if air defense usage is required during low voltage condition, the switch may be set to override which will reactivate the fire control.

SIGHT CURRENT GENERATOR

The present sight current generator (SCG) uses potentiometer settings in the lead angle computation and incorporates ballistic data generated at the time of the Vulcan fielding. The new SCG will use solid state components which reflect the latest ballistics and improve the acquisition time delay (this is presently erratic) logic circuits to eliminate a random malfunction. In addition, the new design does not use a double ended ballistics card and, thus, removes the necessity for opening the SCG to change ballistics.

The new SCG was to incorporate the "correct" ballistics of the M246 ammunition. However, even with accurate input data, the lead angle is not computed correctly because the system does not compensate for the inaccuracies in the system. In addition, the computing voltages are degraded at low temperatures.

ROUND COUNTER

Presently there is no accurate method for keeping track of the quantity of rounds fired from the towed VADS. This information is essential for accomplishing round dependent maintenance action, so round counters will be incorporated on the towed VADS.

AUXILIARY POWER UNIT

The present auxiliary power unit (APU) for the towed Vulcan has a modified automatic reset breaker which is a nonstandard, unsupportable supply item for TROSCOM. This product improvement will provide a new automatic reset circuit breaker module separate from the standard 1.5

KW APU and will make the APU supportable by TROSCOM in the field.

HYDRAULIC SHIELDS

With the current towed configuration, it is possible for crew members to use the hydraulic cylinders for a step. A shield will be installed to prevent damage to cylinders.

EQUILIBRATORS

The new equilibrators, with their increased outside diameter and overall length, will provide better balance for tipping parts through the range of elevation, reduce gun drift in elevation during firings, and provide interchangeability between the self-propelled and towed systems. Because of the increased size of the new equilibrators, the turret covers on the self-propelled Vulcans will have to be modified and the turret covers on the towed Vulcans will have to be replaced with new covers. Both the equilibirators and the modification/replacement of the turret covers were to be accomplished by the user. However, due to difficulties incurred when removing the equilibrators and since the new equilibrators hit the driver's hatch cover when the gun traversed at a minus 5 degrees, a modification kit was developed. Those kits and the equilibrators will be applied by GE's modification teams.

AMMUNITION CAN ASSEMBLY

The product improvement to the ammunition can assembly increases the storage capacity from 300 to 500 rounds and, thus, increases the air-to-ground engagement capability without reloading. This product improvement was troop-issued and will not be applied by contractor modification teams.

AN/TSM-115 SHELTERS: R&M A MOD

The reliability and maintainability modification (R&M A) will expand the capability of the AN/TSM-115 test shelters for testing radar units. This modification will provide hardware and software changes necessary to accomodate the modifications performed during the VADS short range PIP and will provide new capabilities which will allow the test and repair of high cost radar components that were previously replaced.

AN/TSM-115 SHELTERS: R&M B MOD

At present there are several fielded configurations of the AN/TSM-115 test shelters (24 of 36 shelters are of an old nonstandard configuration and have experienced 6 to 7 years of field-use). The R&M B modification will bring all AN/TSM-115 test shelters to the same configuration. This modification is being applied by the R&R program in CONUS, but will be applied in Europe by a contractor modification team (contract was ready by June 1, 1976). The newly revised TM's are written to this configuration, so it is necessary to have the R&M B mod applied before the new TM's are distributed.

TS 2656 TEST SET

The present radar tester (TS-2656), which weighs 154 pounds and has a MTBF of 16 hours, has been described as inadequate and incapable of measuring the operation readiness of the radar, even though practically all Vulcan direct support units advise that they have used the TS-2656 in conjunction with a slave radar with excellent results. However, the new TS-2656A1, weighing approximately 60 pounds with a MTBF of 100 hours minimum, offers simplified controls, fewer components, and a more reliable test capability. The new TS-2656A1 Test Set will enable field maintenance personnel to validate the Vulcan Range-Only Radar (ROR) operational readiness in terms of range, subclutter visibility, minimum discernible signal, transmitted power and AGC linearity.

MWM-3 TEST SET

The MWM-3 test set, an improvement to the MWM-2 test set, will provide static checks and service for the sight current generator, control panel sequence, and servo amplifier. The system checkout time will be reduced from 2.5 hours per system on the MWM-2 test set to 55 minutes per system on the MWM-3 test set. Until recently, production was suspended as a result of FY71, FY72, and FY73 funding withdrawal by DA. However, with the funding released in June 76, it is estimated that 10 units can be produced during each of the first three months (beginning with June), and 12 units can be produced during each following month until the quantities desired have been produced.

APPENDIX B

SUPPORTING DATA

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APPENDIX B. SUPPORTING DATA

TABLES

FIGURES

FIGURES (Cont'd)

TABLE B-1. ACTIVITY DESCRIPTIONS FOR THE NETWORK OF FIGURE 2

The short range (RAM) product improvement program for VADS was simulated from 1 July 1976 to its completion. Following are descriptions of the major activities which are presented in the network format of Figure 2.

B1 through B63 represents the application of the product improvements to the self propelled and towed VADS in the field by the 5 armament and 4 radar modification teams.

B1 through B6 represent the activities of armament team number 1 as it performs its work at Ft. Bliss.

B7 through B15 and B18 represent the activities of armament team number 3. This team first trains at GE - Burlington and Ft. Bliss before it travels overseas to Korea, Hawaii, and back to Ft. Carson where it applies the full product improvement to those VADS.

B16 through B18 represents the activities of radar team number 1 as it applies the radar reliability kit at Ft. Bliss and at Ft. Carson.

B19 through B29 and B43 represent the activities of armament team number 5 as it trains at GE - Burlington and Ft. Bliss, and then applies the full product improvements at MMCS, Ft. Bragg, Ft. Hood, and Ft. Lewis.

B30 through B34 represent the activities of three radar teams and supporting elements of two armament teams as they work at Ft. Campbell, Ft. Bragg, and Ft. Hood.

B35 through B39 represent the activities of the remaining elements of two armament teams as they repair defective ammunition cans, apply pilot modifications at Ft. Bliss, and then apply the full product improvements at Ft. Campbell.

B41 through B43 represent the activities of radar team number 2 as it applies the radar PI at Germany and then at Ft. Lewis.

B44 through B48 represents the activities of armament team number 2 as it applies the full product improvements at Schwaback, Giebelstadt and Budengen.

B49 through B54 represent the activities of armament team number 4 as it applies full product improvements at Bitbarg, Mannheim, Ranstien, and Wackernheim.

B56 represents two radar teams as they apply the radar reliability product improvement kit to VADS in Germany.

I1 through I5 represent the activities needed to obtain A1 designation and subsequent material release for the PIP kits.

TABLE B-1. ACTIVITY DESCRIPTIONS FOR THE NETWORK OF FIGURE 2 (Cont'd)

MR1 through MR4 represent the release and delivery of the modification kits once the material release was granted.

W1 through W12 represent the monthly production of MWM-3 test sets at Frankford Arsenal, and M1 through M16 signal the delivery of those test sets to the designated filed locations.

S1 through S4 represent the activities needed to obtain technical manuals for the self-propelled VADS and related support equipment so that the armament teams can begin to apply the full product improvements. Those activities depicted are validation, finalization, shipping, and printing.

TM1 through TM3 represent the distribution of the technical manuals for the self-propelled VADS and its related test equipment for interim use until official manuals are fielded.

T1 through T5 represent those activities required to field technical manuals for the towed VADS for interim use. The activities are similar to the self-propelled (S1 through S4), and TM4 and TM5 represent the distibution of the towed manuals.

BM1 represents the field application of the R&M "B" mod.

AM1 represents the delivery of parts for the kits, and AM2 represents the assembly of kits and the shipment of those kits to TECOM for tests. AM3 represents TECOM's evaluation of those kits, and AM4 represents the field application of those kits.

TS1 through TS22 represent the program for the TS-2656A1. TS1 through TS5 represent the test performed on the TS-2656A1, the reports of which will be used for the IPR process (TS6 through TS9). Following the type classification (TS9) of the test set, TS9A represents the minimum time before a contract can be awarded. Concurrent with the above, TS10 through TS12 must also be completed before a contract can be awarded. Those activities are defining technical requirements (TS10), compiling the technical package (TS11), and the procurement leadtime (TS12). When the above activities are completed, a contract can be awarded (TS13).

TS14 through TS22 represent the activities needed to produce, test, and deliver the TS-2656A1 test sets to the field. A first article test will be performed on the first production units (TS18), followed by TECOM's initial production test (TS19). Once the new sets have been established as suitable (TS20), they will be delivered to the field (TS21).

TABLE B-2. INPUT DATA FOR THE NETWORK OF FIGURE 2

ARC	DESCRIPTION	TIME (WKS) MIN	MAX	MOST LIKELY
B1	Ft. Bliss: ROR support	-	-	10
B2	Ammo can repair	-	-	8
B3	Full PI application	62	70	67
B8	Training at Burlington	-	-	2
B9	Travel	-	-	1
B10	Training at Ft. Bliss	-	-	6
B11	Travel	-	-	2
B12	Korea	17	22	20
B13	Travel	-	-	2
B14	Hawaii	16	20	18
B15.	Travel	-	-	1
B16	Ft. Bliss, Radar	52	61	57
B17	Travel	-	-	2
B18	Ft. Carson	16	18	17
B20	Training at Burlington	-	-	2
B21	Travel	-	-	1
B22	Training at Ft. Bliss	-	-	4
B23	Travel	-	-	1
B24	MMCS	-	-	4
B25	Travel	-	-	1
B26	Ft. Bragg	12	15	14
B27	Travel	-	-	2
B28	Ft. Hood	23	29	27
B29	Travel	-	-	2
B30	Complete work at Ft. Campbell	-	-	1
B31	Travel	-	-	1
B32	Ft. Bragg	9	11	10
B33	Travel	-	-	1
B34	Ft. Hood	9	11	10

TABLE B-2. INPUT DATA FOR THE NETWORK OF FIGURE 2 (Cont'd)

ARC	DESCRIPTION	TIME (WKS) MIN	MAX	MOST LIKELY
B35	Ammo can repair at Ft. Bliss	-	-	8
B36	Travel	-	-	1
B37	Pilot mod. at Ft. Bliss	-	-	6
B38	Travel	-	-	1
B39	Full PI application at Ft. Campbell	7	9	8
B40	Travel	-	-	2
B41	Germany	31	36	34
B42	Travel	-	-	2
B43	Ft. Lewis	12	16	14
B44	Schwaback	14	19	17
B45	Giebelstadt	14	19	17
B48	Budengen	14	19	16
B49	Bitbarg	7	10	9
B50	Mannheim	12	15	14
B51	Ramstien	7	10	9
B52	Wackenheim	16	19	18
B56	Germany	46	52	50
I2	Prepare A1 package for CG, ARRCOM	-	-	1
I3	Obtain approval for CG	-	-	1
I4	Prepare MR package for CG, ARRCOM	-	-	1
I5	Obtain MR from CG	0.5	2	1
MR1-MR4	Signals MR and kit deliveries	-	-	-
W1-W12	Monthly production time table	4	5	4.5
M1-M16	Signals delivery of MWM-3 test sets	-	-	-
S1	Validate tech manuals for SP	-	-	4
S2	Finalize manuals	-	-	3
S3	Ship to ARRCOM	1	2	1.5
S4	Print manuals locally	4	5	4.5
TM1-TM3	Signals availability of SP manuals	-	-	-

TABLE B-2. INPUT DATA FOR THE NETWORK OF FIGURE 2 (Cont'd)

ARC	DESCRIPTION	TIME (WKS) MIN	MAX	MOST LIKELY
T2	Validate tech manuals for towed	-	-	4
T3	Finalize manuals	2	3	2.5
T4	Ship to ARRCOM	1	2	1.5
T5	Print manuals locally	4	5	4.5
TM4,TM5	Signals availability of towed manuals	-	-	-
BM1	Field application of R&M "B" mod	35	52	39
TS1	FA Systems Test	13	22	17
TS2	FA Report Available	3	4	3
TS3	Deliver to TECOM	9	17	13
TS4	DT/II Test (TECOM)	9	18	13
TS5	Test Report Available	6	8	6
TS6	Establish DARCOM Position	3	4	3
TS7	Pre-IPR	1	2	1
TS8	IPR	1	2	.1
TS9	Type Classification	6	8	6
TS9A	Time to Contract Award	-	-	2
TS10	Technical Requirements Defined	17	22	19
TS11	Technical Package Avilable	5	9	7
TS12	Procurement Leadtime	17	26	22
TS13	Award Contract (Signal)	-	-	-
TS14	Production Leadtime	26	39	30
TS16	Scheduled Delivery to Government	-	-	30
TS18	First Article Test	8	13	10
TS19	Initial Production Test	8	17	13
TS20	Establish Suitability	4	8	4
TS21	Field Delivery	-	-	17
AM1	Complete Parts Deliveries	-	-	13
AM2	Assemble Kits & Deliver to TECOM	-	-	15

TABLE B-2. INPUT DATA FOR THE NETWORK OF FIGURE 2 (Cont'd)

ARC	DESCRIPTION	TIME (WKS) MIN	TIME (WKS) MAX	MOST LIKELY
AM3	TECOM Evaluation (Scheduled)			13
AM4	Field Application (Scheduled)			39
			COST ($K)	
	Armament Mod Teams			
	FY7T	-	-	815[a]
	FY77	3099	3425	3262[b]
	FY78	941	1238	990[b,c]
	Radar Mod Teams			
	FY7T	-	-	383[a]
	FY77	-	-	1531
	FY78	-	489	391[c]
	AN/TSM-115			
	R&M "B" Mod FY77	-	113	90[c]
	R&M "A" Mod FY77-78	-	180	144[c]
	TS 2656A1			
	Contract Cost Projections	2112	2508	2320
	In-House Support Costs	386	472	428

[a]Estimated by multiplying the monthly average of FY77 by 3.

[b]Variability of $\pm$ 5% of proposed value (most-likely) was assigned.

[c]Variability of + 25% was assigned to allow for cost overrun.

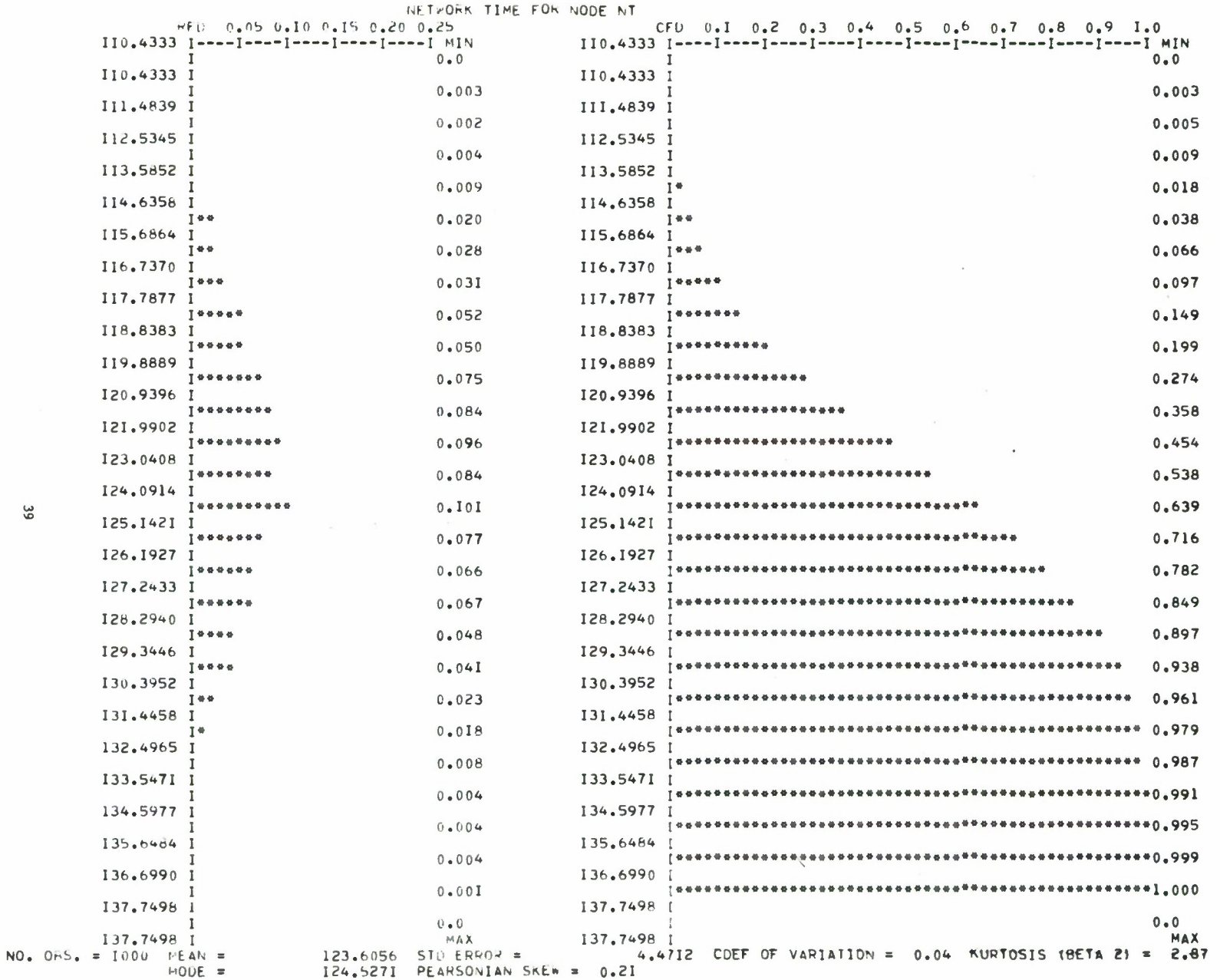


Figure B-1. Time Distribution for the Completion of the Short Range (RAM) PIP from 1 July 76.

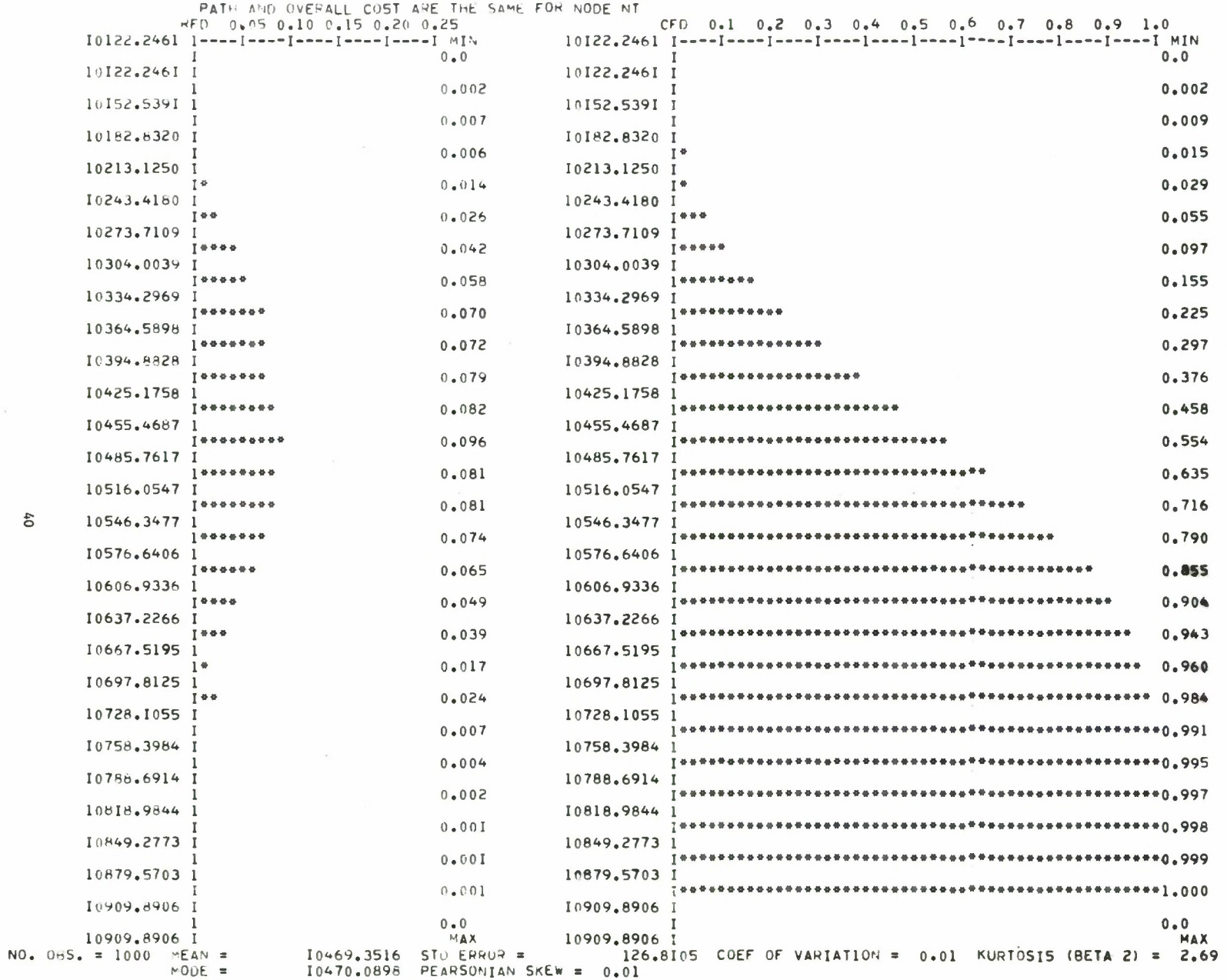
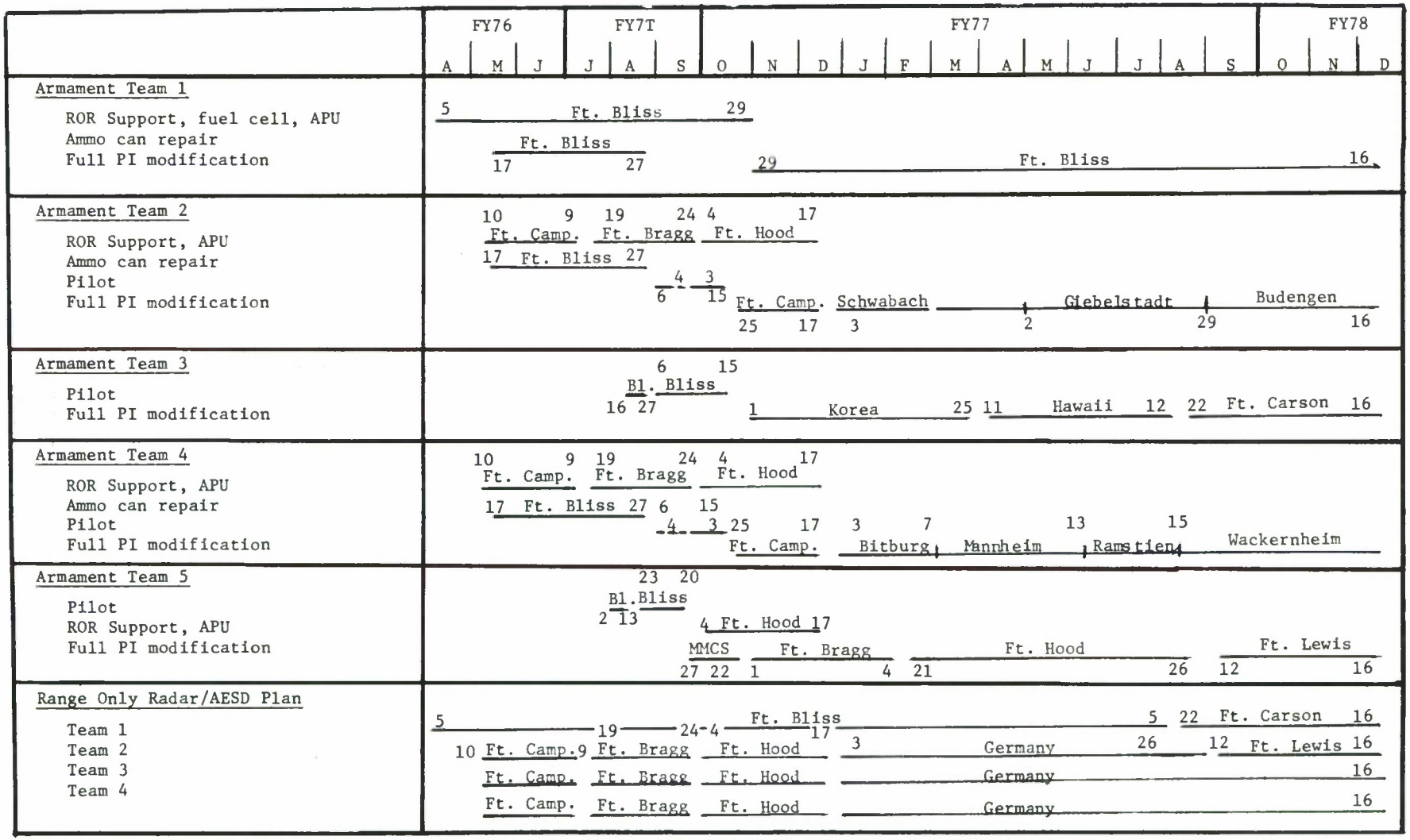


Figure B-2. Cost Distribution for the Completion of the Short Range (RAM) PIP from 1 July 76.

Table B-3. APPLICATION SCHEDULE FOR THE ARMAMENT AND RADAR MODIFICATION TEAMS[a]



[a]VADS Product Improvement Field Retrofit Program, dated 24 June 1976 per letter 24 June 1976 from DRSAR-PPC-WA, signed Donald H. Phillips, Contracting Officer.

TABLE B-4. APPLICATION TIME ESTIMATES FOR THE ARMAMENT AND RADAR MODIFICATIONS TEAMS[a]

MODIFICATION TEAMS		TIME (WKS) Min	Max	Most Likely	Scheduled As Of 24 June 76
I. ARMAMENT MOD TEAMS					
Team 1:	Ft. Bliss	65	73	70	70
Team 2:	Ft. Campbell	7	9	8	8
	Schwabach	14	19	17	17
	Giebelstadt	14	19	17	17
	Budengen	14	19	16	16
Team 3:	Korea	17	22	20	20
	Hawaii	16	20	18	17
	Ft. Carson	16	18	17	17
Team 4:	Ft. Campbell	7	9	8	8
	Bitburg	7	10	9	9
	Mannheim	12	15	14	14
	Ramstien	7	10	9	9
	Wackernheim	16	19	18	18
Team 5:	Ft. Bragg	12	15	14	14
	Ft. Hood	23	29	27	27
	Ft. Lewis	12	16	14	14
II. RADAR MOD TEAMS					
Team 1:	Ft. Bliss	65	73	70	70
	Ft. Carson	16	18	17	17
Team 2:	Ft. Campbell	8	11	9	10
	Ft. Bragg	9	11	10	10
	Ft. Hood	9	12	11	11
	Germany	31	36	34	34
	Ft. Lewis	12	16	14	14
Team 3:	Ft. Campbell	9	11	9	10
	Ft. Bragg	9	11	10	10
	Ft. Hood	9	12	11	11
	Germany	46	52	50	50
Team 4:	Ft. Campbell	9	11	9	10
	Ft. Bragg	9	11	10	10
	Ft. Hood	9	12	11	11
	Germany	46	52	50	50

[a] Extracted from DRSAR-MAG Comment 2 to DRSAR-SA, subject: Request for Data: VADS Application Schedule, dtd 10 Aug 76.

TABLE B-5. APPLICATION COST ESTIMATES FOR THE ARMAMENT AND RADAR MODIFICATION TEAMS[a]

APPLICATION COST ESTIMATES FOR THE ARMAMENT MOD TEAMS[b]		
FY 76 & 7T	(actual)	$ 2,101,594.
FY 77	(proposed)	$ 3,261,976.
FY 78	(proposed)	$ 990,196.
TOTAL		$ 6,353,766.

APPLICATION COST ESTIMATES FOR THE RADAR MOD TEAMS[c]		
FY 76 & 7T	(actual)	$ 1,508,000.
FY 77	(negotiated)	$ 1,531,488.
FY 78	(negotiated)	$ 390,541
TOTAL		$ 3,430,029.

[a]Data obtained from Don Phillips, DRSAR-PPC, on 5 Aug 76. Figures shown are as of 12 July 76.

[b]Cost Plus Fixed Fee (CPFF) contract with incremental funding (DAAA 09-76-C-2045) with GE, Burlington, dtd 7 Nov 75.

[c]CPFF contract with incremental funding (DAAA 09-76-C-2046) with GE, Utica, dtd 24 Oct 75.

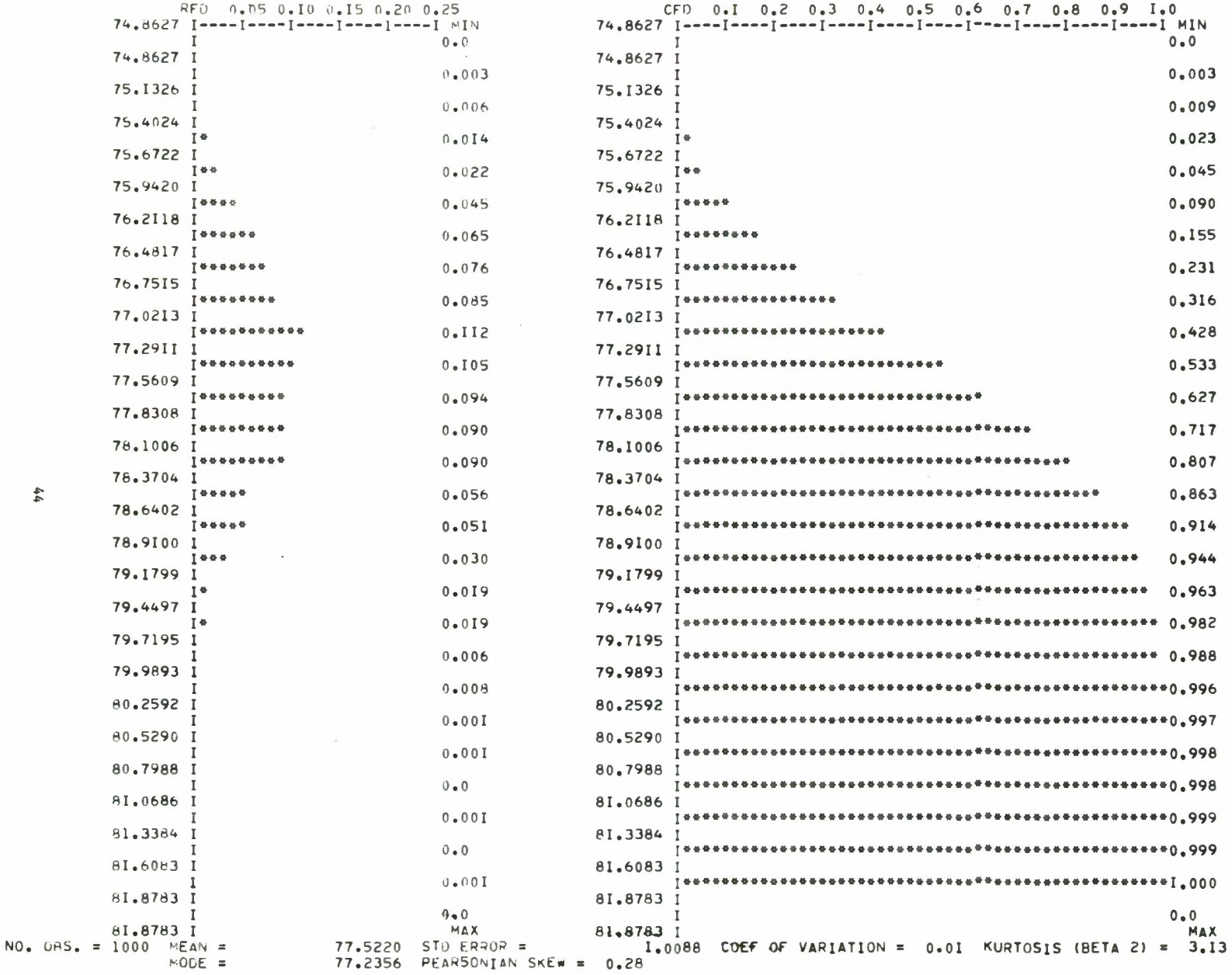


Figure B-3. Time Distribution for the Completion of the Armament Modification Teams from 1 July 76.

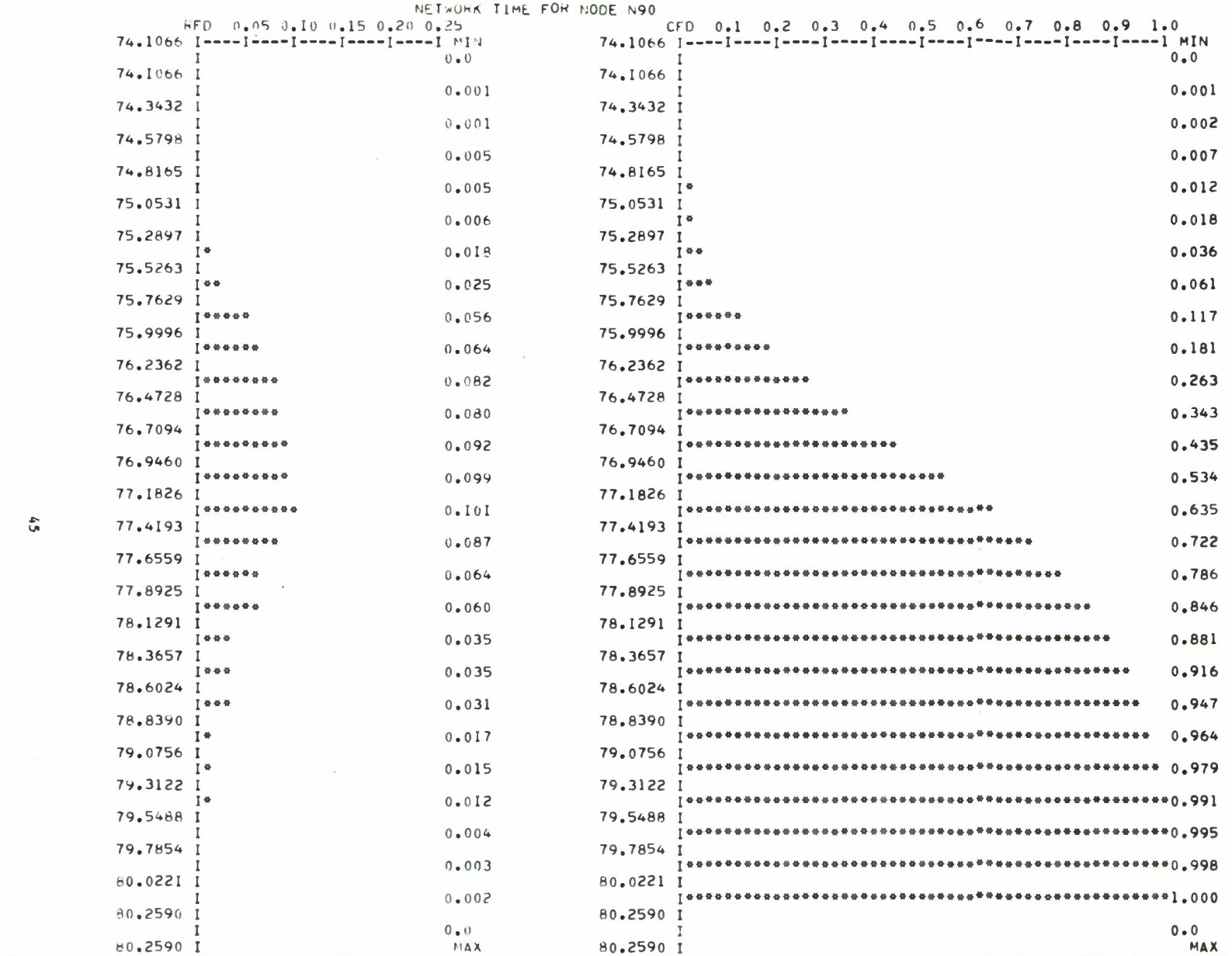


Figure B-4. Time Distribution for the Completion of the Radar Modification Teams from 1 July 76.

TABLE B-6. LIST OF PUBLICATIONS AFFECTED BY VADS PIP

New Publications:

MWO 9-1005-286-50-1 (Draft MWO 9-1005-286-50) Towed (t)
MWO 9-2350-300-50-1 (Draft MWO 9-2350-300-50) Self-propelled (sp)
MWO 9-4940-336-50-1 (Draft MWO 9-4940-336-50) t & sp - TSM 115
TM 9-4933-215-14 Test Set MWM - 3

Revisions of Publications: (M163A1/M167A1)

TM 9-2350-300-20-1 sp
TM 9-2350-300-20-2 sp
TM 9-2350-300-20P sp
TM 9-2350-300-34 sp
TM 9-2350-300-34P sp
LO 9-1005-286-10 t
LO 9-2350-300-10 sp
TM 9-1005-286-20-1 t
TM 9-1005-286-20-2 t
TM 9-1005-286-20P t
TM 9-1005-286-34-1 t
TM 9-1005-286-34-2 t
TM 9-1005-286-34P t
TM 9-1005-286-ESC t
TM 9-2350-300-ESC sp
TM 9-6920-354-14 (Trainer, M44) - sp (Armament)
TM 9-6920-355-14 (Trainer, M45) - sp (Armament System)
TM 9-6920-356-14 (Trainer, M46) - sp (Fire Control)
TM 9-4940-366-14 (Shelter AN/TSM-115 t & sp
TM 9-4933-210-13 Test Set AN/TSM-100) t & sp
TM 9-4933-210-30P (Test Set AN/TSM-100) t & sp

Publications Requiring Change to M163A1/M167A1 configuration: (Contract No. DAAA09-74-2007-0016)

TM 9-1005-286-10 "New look" t
TM 9-2350-300-10 "New look" sp

TABLE B-7. COST/SCHEDULE FOR VADS TECHNICAL MANUALS

SP & Support Manuals Schedule[a]

Validation	July 1976
Finalize Manuals	July to August (3 wks)
Send Finalized Copies to ARRCOM	1-2 wks (sent on 19 Aug 76)
Local Printing (for interim use)	4 to 5 wks

Towed & Support Manuals Schedule[a]

Validation	13 Sep 76 to 8 Oct 76
Finalize Manuals	2 to 3 wks
Ship to ARRCOM	1 to 2 wks
Local Printing (for interim use)	4 to 5 wks

Contractual Funds for 163/167 Manuals

	FY 76	FY 7T & 77
DAAF03-73-A-0150-0033	(previously completed)	- -
DAAA09-76-C-2002[b]	$1,525,931	not readily available

[a] Data obtained from Paul Wilson of DRSAR-MAS-T in response to DRSAR-SAS DF, 5 Aug 76, subject: Request for Data: VADS Cost/Schedule for Draft Technical Manuals.

[b] Data obtained from Ken Owens and Don Phillips of DRSAR-PPC during August 1976.

TABLE B-8. MODIFICATION KIT PRODUCTION COSTS[a]

PEMA PRINCIPLE FUNDS FOR THE M163 and M167 MOD KITS
AS OF 30 JUNE 76 ($MILLIONS)

	Program Authority	Obligated	Disbursions
FY 76	15.8[b]	13.074	1.857
FY 75	6.084	5.86	3.323
FY 74	3.907	3.54	3.21
FY 73	6.178	5.369	4.155
FY 72	0.546	0.543	0.547
TOTALS	32.515	28.386	13.092

[a]Data obtained from John Miller, DRSAR-PPW-A, on 4 Aug 76.

[b]For FY 76, $20.8 $\overline{M}$ was issued to DRSAR-PPW, of which approximately 5\overline{M}$ is for the mid range PIP, leaving approximately 15.8\overline{M}$ for the short range PIP.

TABLE B-9. MODIFICATION KIT PRODUCTION SCHEDULES[a]

	Prior to FY76	FY76 J	A	S	O	N	D	J	F	M	A	M	J	TT J	A	S	FY77 O	N	D	J	F	M	A	M	J
Radar Reliability		3	-	-	-	-	50	287	-	-	-	-	-	-	69	100	100	100	100						
CUM		3				3	53	340						340	409	509	609	709	809						
ACTUAL		3	3	3	3	15	53	58	328	-	-	340	340												
Lockout Suspension Interlock												14	367												
CUM												14	381												
ACTUAL												-													
Radome													30	54	75	75	75	75	75	75	75	75			
CUM													30	84	159	234	309	384	459	534	609				
ACTUAL																									
Link Disposal						5	10	16	20	15	20	20	30	35	45	30	25	30	27	12	12	12	17		
CUM						5	15	31	51	66	86	106	136	171	216	246	271	301	328	340	352	364	381		
ACTUAL						5	15	31	51	66	86	106													
Controlled Conveyor	25	15	20	20	20	10	10	12	12	12	12	12	-	5	29	30	30	30	24	12	12	12	12	14	
CUM	25	40	60	80	100	110	120	132	144	158	168	180	180	185	214	244	274	304	328	340	352	364	374	390	
ACTUAL	0	25	48	67	100	110	120	132	144	150	168	180	180												
Ammo Storage	381																								
CUM	381																								
ACTUAL	341	381																							
Servo Amplifier						15	30	48	60	75	75	75	75	75	105	115	115	125	116	145	140	140	140	120	65
CUM						15	45	93	153	228	303	378	453	528	633	748	863	988	1104	1249	1389	1529	1669	1789	1854
ACTUAL						15	45	93	153	228	303	378													
M61 Sight Control Assy						7	23	16	30	35	35	35	45	35	55	58	50	50	50	50	50	50	70	30	27
CUM						7	30	46	76	111	146	181	226	261	316	374	424	474	524	574	624	674	744	774	801
ACTUAL						7	30	46	76	111	146	181													
Low Voltage Protection						8	20	15	25	30	30	30	50	40	50	50	50	54	50	50	50	50	50	50	
CUM						8	28	43	68	98	128	158	208	248	298	348	398	452	502	552	602	652	702	752	
ACTUAL						8	28	43	68	98	128	158													
Sight Current Generator						6	17	16	24	23	25	25	25	25	30	43	40	45	50	70	70	70	70	60	
CUM						6	23	39	63	86	111	136	161	186	216	259	299	344	394	464	534	604	674	734	
ACTUAL						0	23	39	63	86	111	136													
Equilibrator	174	50	50	50	50	50	50	50	50	38	6														
CUM	174	224	274	324	374	424	474	524	574	612	618														
ACTUAL	274	324	524	618																					
Ammo Can Assembly	15	25	40	40	40	40	22																		
CUM	15	40	80	120	160	200	222																		
ACTUAL	58	88	88	122	160	200	222																		

[a]Extracted from data obtained from J. Miller, DRSAR-PPW, 4 Aug 76. Table displays production schedule for most kits, but does not display production of spare parts.

TABLE B-10. AN/MWM-3 ARMAMENT ORGANIZATIONAL MAINTENANCE TEST SET: SUMMARY[a]

	1976								1977												1978	
	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J-A	M
Frankford Arsenal Production	-	10	10	10	12	12	12	12	12	12	12	12	12	12	8	-	-	-	-	-	-	-
Cummulative Production	-	10	20	30	42	54	66	78	90	102	114	126	138	150	158	158	158	158	158	158	158	158
Cummulative Army Requirement	-	-	6	11	19	27	39	45	52	64	68	72	78	82	82	90	98	98	98	98	98	98
Balance	-	10	14	19	23	27	27	33	38	38	46	54	60	68	76	68	60	60	60	60	60	60
Cum Foreign Military Sales	4	8	14	14	14	14	20	20	20	20	20	20	20	20	20	20	20	20	20	24	24	32
Balance	-4	2	0	5	9	13	7	13	18	18	26	34	40	48	56	48	40	40	40	36	36	28
Cum Other Requirements	-	-	-	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Final Balance	-4	2	0	0	3	7	1	7	12	12	20	28	34	42	50	42	34	34	34	30	30	22

[a] Data extracted from DRSAR-ASV DF to DRSAR-MMT-T, subject: VADS Test Set AN/MWM-3, LINZ82485, NSN 4933-00-421-4081, dated 21 Jun 76.

TABLE B-11. COST/SCHEDULE FOR THE AN/TSM-115 "A" MOD AND "B" MOD

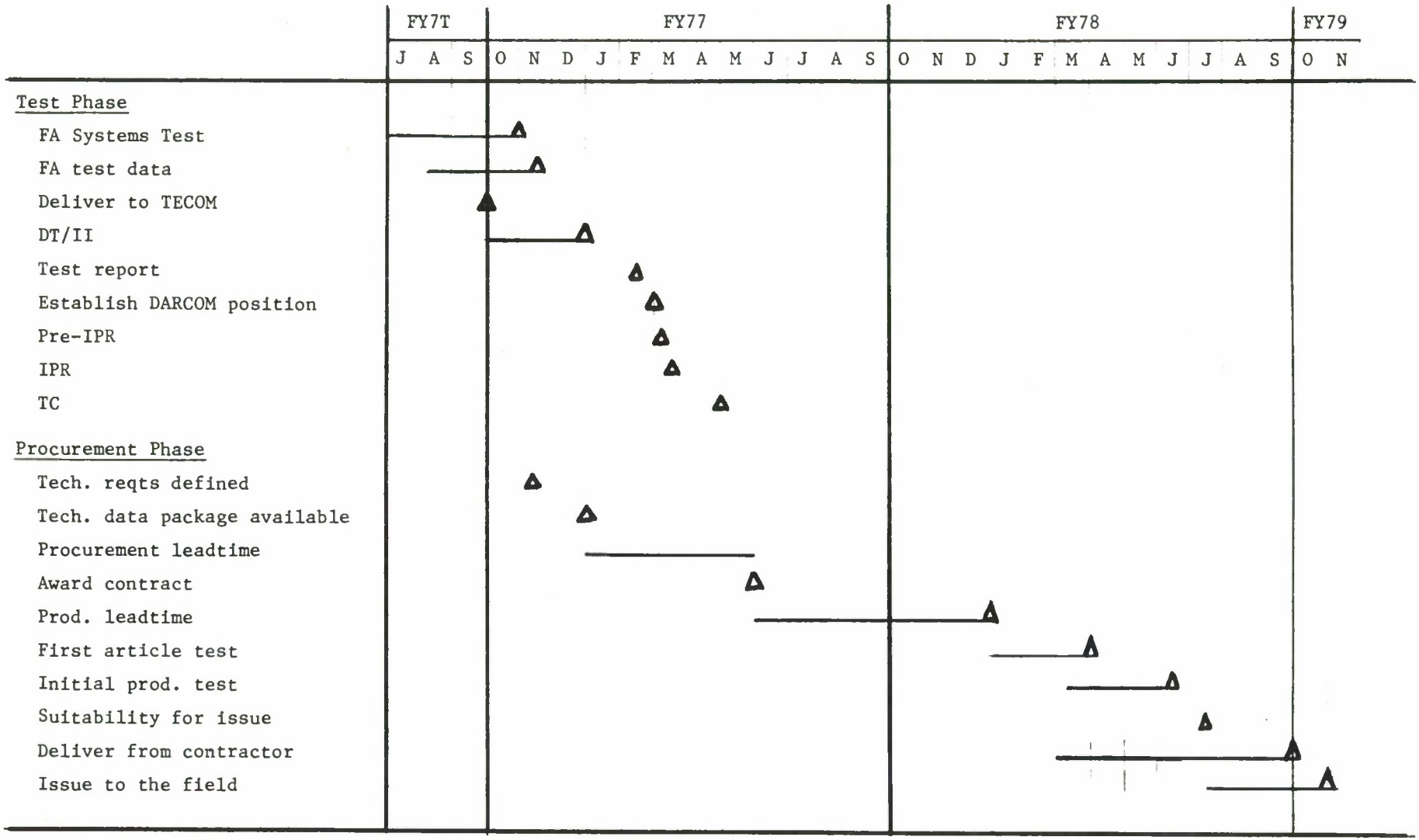
	TIME	COST[a]	
		FY76 & Prior	FY77-FY78
AN/TSM-115 "B" Mod		$ 439K	$ 90K
Field Application[b]	Jun 76 to Jul 77		
AN/TSM-115 "A" Mod and TMs		$1,038K	$144K
Complete kit deliveries	Sep 76		
TECOM evaluation[c]	15 Jan 77 to 15 May 77		
Field application[c]	15 May 77 to Feb 78		

[a]Extracted from DRSAR-MAG-SF Comment 2, subject: Request for Data: Cost/ Schedule for R&M A and R&M B Mods to the AN/TSM-115 Shelter, dtd 20 Aug 76.

[b]According to the above referenced Comment 2, the application of the B Mod is 75% complete, but will not be finished until July 1977.

[c]Data obtained from the AEL Service Corporation's Unsolicited Proposal for the AN/VPS-2 Maintenance Support Equipment Modification Program, dtd May 1976.

TABLE B-12. SCHEDULE FOR THE TS-2656A1 TEST SETS[a]



[a]Schedule is shown in most likely times using the data obtained from J. Bartkowski, SARFA-FCS, dated 10 Sep 76. A schedule with minimum times would show a completion date of June FY78.

TABLE B-13. TIME ESTIMATES FOR THE TS-2656A1 TEST SETS[a]

ACTIVITY/MILESTONE	VARIABILITY Min	Most Likely	Max
Test Phase			
FA Systems test (began 1 July 76)	3 mos	4 mos	5 mos
Complete assembly of FA test data	3 wks	3 wks	4 wks
Deliver to TECOM	2 Aug 76	30 Sep 76	30 Oct 76
DT/II (TECOM)	2 mos	3 mos	4 mos
Complete test report (TECOM)	6 wks	6 wks	8 wks
Establish DARCOM position (ARRCOM)	3 wks	3 wks	4 wks
Pre-IPR (ARRCOM)	1 wk	1 wk	2 wks
IPR (ARRCOM)	1 wk	1 wk	2 wks
Type classification (ARRCOM)	6 wks	6 wks	8 wks
Procurement Phase			
Tech. requirements defined	1 Nov 76	15 Nov 76	1 Dec 76
Tech. Data Package Available (from 1 Nov 76)	1 mo	1.5 mos	2 mos
Procurement Leadtime	4 mos	5 mos	6 mos
Production Leadtime	6 mos	7 mos	9 mos
First article test	2 mos	2.5 mos	3 mos
Initial production test	2 mos	3 mos	4 mos
Establish suitability for issue	1 mo	1 mo	2 mos
Delivery from contractor		7 mos	
Issue to field		4 mos	

[a]Data obtained from J. Bartkowski, SARFA-FCS, dated 10 Sep 76.

TABLE B-14. COST ESTIMATES FOR THE TS-2656A1 TEST SETS[a]

CONTRACT COST PROJECTIONS ($K)

QUANTITY	UNIT COST	TOTAL HARDWARE	ECO CONTINGENCY	TOTAL[b]	VARIABILITY
60	32.	1,920	192.	2,112.	Min
60	35.	2,100	210.	2,320	Most Likely
60	38.	2,280	228.	2,508	Max

IN-HOUSE SUPPORT COSTS OF PRODUCTION ($K)

ENGINEERING	QA	TOTAL[c]	VARIABILITY
305	81	386	Min
340	88	428	Most Likely
375	97	472	Max

a Data obtained from J. Bartkowski, SARFA-FCS, dated 10 Sep 76.

b Does not include costs for technical manuals and spare parts.

c Does not include IPT test costs for TECOM.

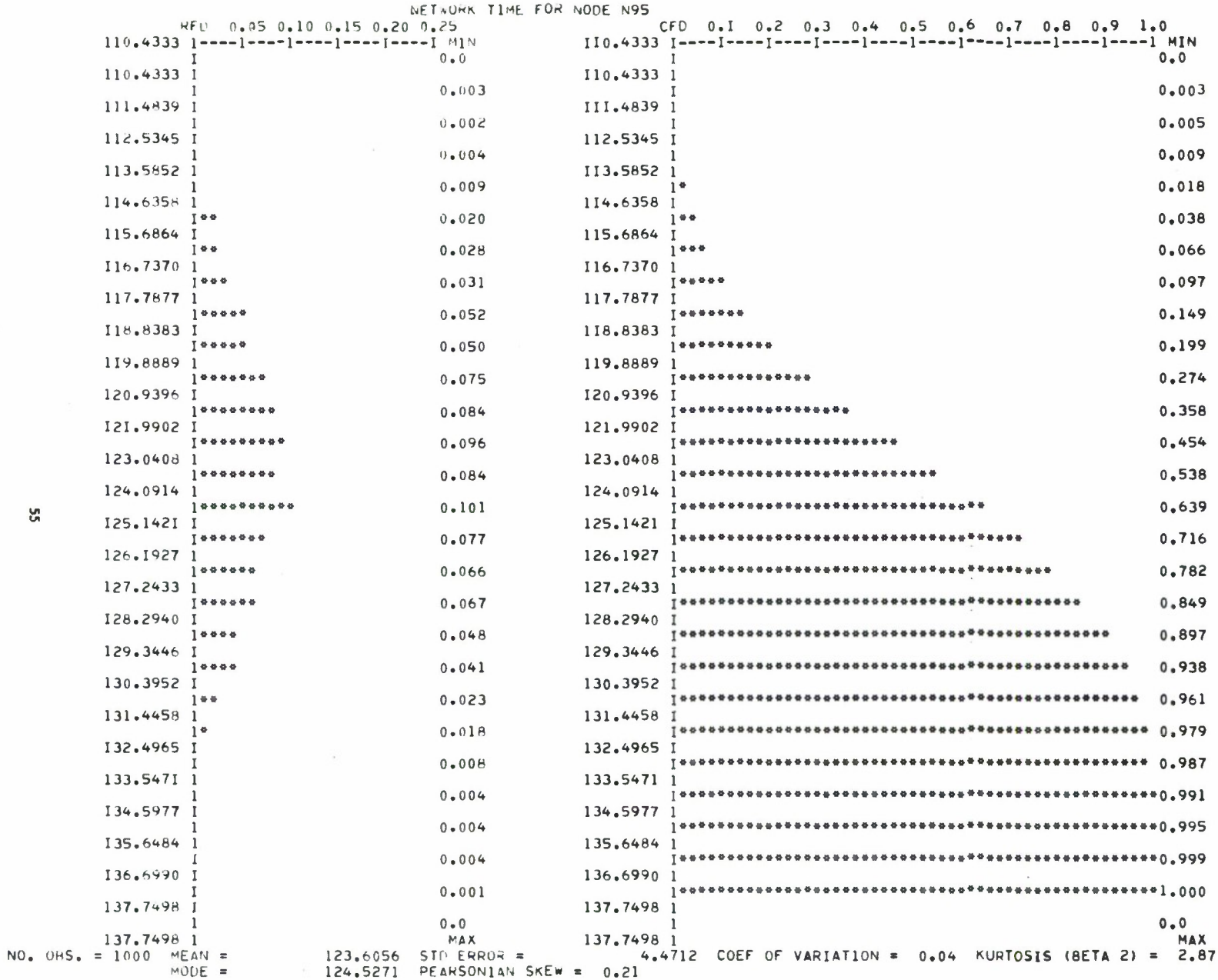
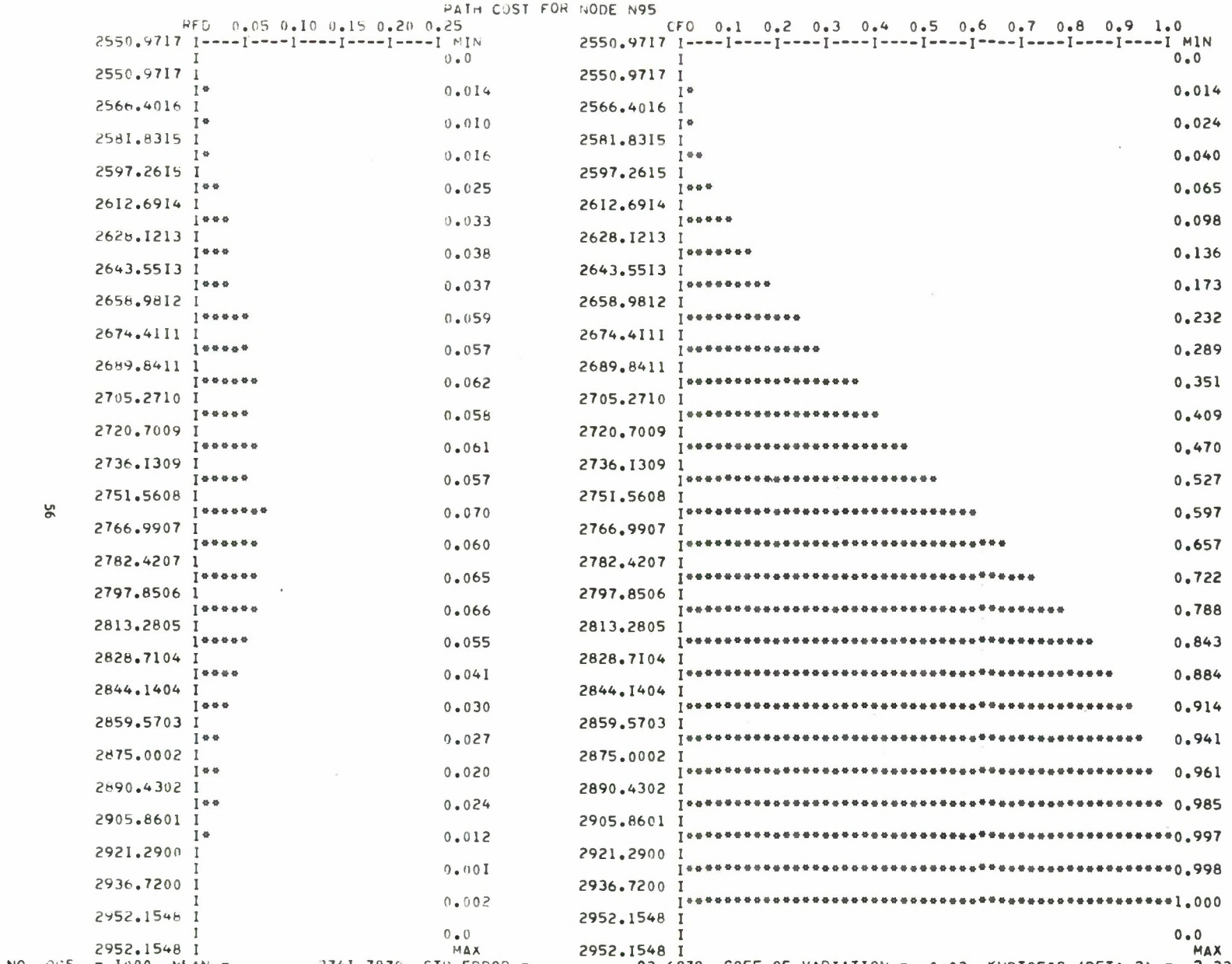


Figure B-5. Time Distribution for the Completion of the TS 2656 Program from 1 July 76.



Fiugre B-6. Cost Distribution for the Completion of the TS 2656 Program from 1 July 76.

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