Research Problem Review 78-17

LEVEL II

AD A076720

TASK VALIDATION FOR THE AN/TPQ-36 RADAR SYSTEM

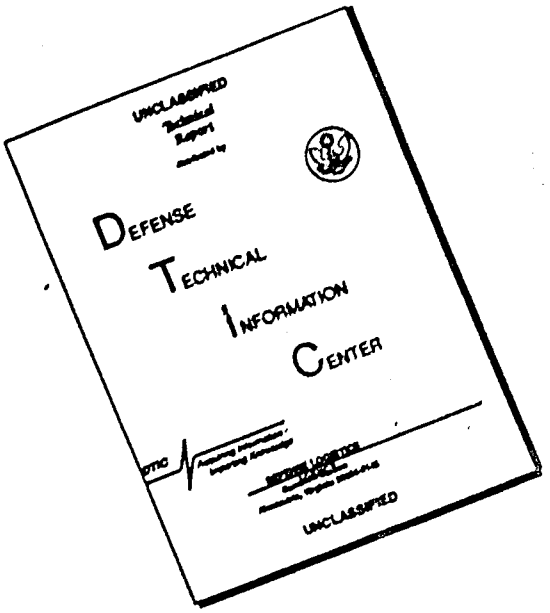
T. R. Tremble, Jr. and D. L. Finley

ARI FIELD UNIT AT FORT BENNING, GEORGIA

U. S. Army
Research Institute for the Behavioral and Social Sciences

September 1978

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

U. S. ARMY RESEARCH INSTITUTE
FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency under the Jurisdiction of the Deputy Chief of Staff for Personnel

JOSEPH ZEIDNER
Technical Director (Designate)

WILLIAM L. HAUSER
Colonel, US Army
Commander

NOTICES

DISTRIBUTION: Primary distribution of this report has been made by ARI. Please address correspondence concerning distribution of reports to: U. S. Army Research Institute for the Behavioral and Social Sciences, ATTN: PERI-P, 5001 Eisenhower Avenue, Alexandria, Virginia 22333.

FINAL DISPOSITION: This report may be destroyed when it is no longer needed. Please do not return it to the U. S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

Army Project Number
2Q763743A773,
(16) 2Q763731A773

System Development
and Training

(14) ARI-RES PROBLEM-REV-78-17

Research Problem Review 78-17

(6) TASK VALIDATION FOR THE AN/TPQ-36 RADAR SYSTEM

(10) T. R. Tremble, Jr. [redacted] D. L. Finley

ARI FIELD UNIT AT FORT BENNING, GEORGIA

(11) Sept[redacted]78

(12) 100

Submitted as complete and
technically accurate, by
H. C. Strasel
Field Unit Chief

Approved by:

A. H. Birnbaum, Acting Director
Organizations and Systems Research
Laboratory

Joseph Zeidner
Technical Director (Designate)
U.S. Army Research Institute for the
Behavioral and Social Sciences

Research Problem Reviews are special reports to military management. They are usually prepared to meet requests for research results bearing on specific management problems. A limited distribution is made--primarily to the operating agencies directly involved.

FOREWORD

This research was performed by the Army Research Institute--Fort Benning Field Unit. It is part of an ongoing program directed toward development of cost-effective methods for individual and collective training. This program includes research on multiple aspects of the design, development, evaluation, and integration of cost- and training-effective Army training systems.

This report presents the method and results of a study to validate personnel task descriptions for the new AN/TQP-36 radar system. The tasks were described as a step in training system development, and the validation was performed to assure the completeness and accuracy of these descriptions. The study was designed and performed in response to requests by the U.S. Army Field Artillery School (USAFAS) and the U.S. Army Training and Doctrine Command (TRADOC) Training Devices Directorate.

The study was executed at the AN/TPQ-36 contractor's plant and at Fort Carson, Colo., using the new equipment training (NET) programs, maintenance demonstrations, and operational test II (OT II) as vehicles. Close coordination with ARI concerning schedules and events by Leo W. Wall, USAFAS Supervisor Training Specialist, resulted in a successful task-validation effort.

ARI research in training systems development is conducted as an in-house effort augmented by contracts with selected organizations having unique capabilities for research in the area. This study was performed by ARI personnel from the Fort Benning, Ga., Field Unit. The project, conducted as part of Army Project 2Q763731A773, FY 76 Work Program, and Army Project 2Q763743A773, FY 77, was directly responsive to the requirements of the USAFAS and TRADOC.

JOSEPH ZEIDNER
Technical Director (Designate)

TASK VALIDATION FOR THE AN/TPQ-36 RADAR SYSTEM

BRIEF

Requirement

To validate task descriptions for operator and maintenance personnel in the new AN/TQP-36 radar system and to assess the suitability of the 26B MOS for system maintenance, in support of programs to develop the radar training system and the parent system concurrently.

Procedure:

The validation effort consisted of two steps: (1) an analysis and revision of the original task descriptions based on data from an operator training course, a maintenance demonstration, and interviews with development test II (DT II) and training course participants; and (2) an evaluation of the revised descriptions through performance observation and personnel survey during the AN/TQP-36 operational test II (OT II).

Findings:

The task validation results are most definitive for the operator tasks and least definitive for the direct support/general support (DS/GS) maintenance tasks. The sets of revised task descriptions were generally adequate bases for a fully valid set of tasks. Needed changes include:

1. Specification and inclusion of additional tasks omitted from the original set.

2. Modification and, in some cases, expansion of some original descriptions so as to more accurately describe the content and scope of the task.

3. Reassessment of which position is responsible for performing some tasks.

4. Description of the DS/GS diagnostic tasks at a more consistent and functional level.

The evidence suggests that the 26B MOS is not entirely suitable for AN/TQP-36 requirements. A systematic study is recommended to determine if the best approach is to modify present 26B MOS training or to create a new MOS.

Jobholders' opinions regarding task learning difficulty and appropriate training site were also obtained:

1. Most of the operator tasks were rated easy to learn, with only 11% rated as moderately difficult. In contrast, 50%-70% of the organizational and DS/GS tasks were rated as moderately difficult or difficult to learn.

2. With respect to training location, both school and on-job-training (OJT) were selected for all operator tasks, all organizational maintenance tasks, and 86% of the DS/GS maintenance tasks.

Utilization of Findings:

The results of this study are being used to realize a finalized set of task descriptions, to develop POI's and soldiers' manuals, as an input to the 26B MOS suitability question, and as an input to the design and development of operator and maintenance training devices and associated scenarios.

TASK VALIDATION FOR THE AN/TPQ-36 RADAR SYSTEM

CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

TASK VALIDATION FOR THE AN/TPQ-36 RADAR SYSTEM

INTRODUCTION

The U.S. Army Field Artillery School (USAFAS) is developing training programs for the operators, organizational-level mechanics, and direct support/general support (DS/GS) mechanics of the AN/TPQ-36 radar, one of the two radars in the Firefinder system (originally called the Mortar and Artillery Locating Radars (MALOR) system) currently under development. The AN/TPQ-36, a highly mobile radar for automatically locating mortar and other high-angle weapons and short-range rockets, consists of a shelter mounted on a gamagoat and a trailer. The shelter contains display/control consoles for operators, computer equipment, and communications equipment. The antenna, system generator, and associated equipment are mounted on the trailer.

As an early step in the instructional systems development (ISD) approach adopted by USAFAS (TRADOC, 1973; TRADOC, 1975), the tasks to be performed by incumbents of each position were described. USAFAS then asked the U.S. Army Research Institute (ARI) Field Unit at Fort Benning, Ga., to undertake a field validation of the task descriptions and to examine the suitability of the 26B Military Occupational Specialty (MOS) for system maintenance. Suitability of 26B questioned MOS was because innovations in the Firefinder equipment were believed to call for maintenance skills different from those defined by MOS 26B20 and 26B30.

This report presents ARI's findings on the extent to which the task descriptions accurately and completely define the three jobs and on the suitability of the 26B MOS for system maintenance. The body of the report presents the method, results, conclusions, and recommendations of the validation study. The appendixes contain the following:

1. Appendix A contains the original task statements provided to ARI by USAFAS for validation.

2. Appendix B presents the revised task statements developed from the original task descriptions and validated during Operational Test II (OT II) of the AN/TPQ-36.

3. Appendixes C, D, and E present selected detailed results on the validity of some tasks of the operator, organizational-level mechanic, and DS/GS mechanic, respectively. The complete results are available from the files of the ARI Field Unit at Fort Benning.

4. Appendix F summarizes responses to three questionnaires administered to jobholders during OT II.

Rather than presenting a final set of tasks, this report provides the basis for developing a task set which a committee of subject-matter experts could act on. In addition to ARI's task-analytic and operational experience, in-depth knowledge of the AN/TPQ-36 system, its employment, and operator and mechanic training are needed to formulate a complete and valid task list.

METHOD

Three steps were undertaken to validate the original task descriptions. First, the task descriptions were analyzed to identify necessary revisions. Second, the original statements were revised to serve as a framework for data collection. Third, task validation data were collected through observation and survey of OT II personnel in the field.

The analysis of the original task descriptions used information from five principal sources: (a) technical manuals;[1] (b) an operator's training course conducted in January 1977; (c) a maintenance demonstration conducted in February 1977; (d) discussions with subject-matter experts; and (e) task-analysis materials accompanying the original descriptions. These materials variously described standards/criteria for evaluating task performance, task elements, requisite knowledges/skills, and references to technical materials describing the task.

Based on this information, three analytic operations were undertaken. First, the original descriptions were reorganized. The task statements were originally grouped as tasks of both the operator and organizational-level mechanic, tasks of the organizational-level mechanic only, and tasks of the DS/GS mechanic. These were reorganized into three new lists, each containing tasks that are the primary responsibility of one job position only. These reorganized task lists appear in Appendix A. This reorganization assumed cumulative skill qualification from operator (lowest), to organizational-level mechanic, to DS/GS mechanic.

Second, the adequacy of each task statement as a task description was analyzed and assessed. A task was defined as a sequence of activities that (a) together have identifiable start and end conditions, (b) may be performed independently of other activity sequences, and (c) cannot be meaningfully divided into separate performances. Assessment criteria included the accuracy, completeness, and specificity with which a task was described.

---

[1] DEP TM 11-5840-354-12 was the technical manual consulted for the operator and organizational-level mechanic job positions, with Change 1, February 1976, to this manual available, DEP TM 11-5840-354-1 and DEP TM 11-5840-354-2 (both, October 1976) providing information about the DS/GS position, changes to which were not available for review.

Third, the completeness and adequacy of each job description were evaluated. A list required augmentation if either (a) a task was not included in the list or (b) several separate tasks were described as a single task in the original list.

These analyses identified the requirements for revision of the original task descriptions. ARI independently revised the original descriptions for the operator and organizational-level mechanic. Subject-matter experts were needed to revise the original DS/GS task statements; therefore, the DS/GS tasks were revised through working meetings held at USAFAS. The three revised task lists are presented in Appendix B.

Field data were collected during two periods of the AN/TPQ-36 OT II in order to validate the revised task descriptions. During the primary data-collection period of 4-19 May, both friendly and hostile fire exercises were conducted. Radar maintainability was demonstrated during the second period, 22-23 June.

During both periods, three categories of data were collected by directly observing operators (n = 4) and mechanics (n = 1 for each mechanic position) as they performed their respective duties. First, the occurrence of tasks in the revised task lists was recorded. Second, general observations about tasks already listed and about the existence of additional tasks were noted. Third, to verify observations of a mechanic's performance, the mechanic was questioned after the completion of each maintenance activity. The mechanic reported in his own words the tasks undertaken to repair a problem and associated his descriptions with task descriptions in the revised task list.

During the primary data collection period, five operators and both mechanics completed questionnaires structured to obtain information specific to each task. For each task in their respective task lists, operators/mechanics responded to the items in Figure 1. In addition, they responded to three general-issue items designed to identify inaccuracies, areas of incompleteness, and general inadequacies in the revised task descriptions. Finally, pertinent to MOS qualification, both organizational-level and DS/GS mechanics responded to the following item: "Was your 26B training applicable to maintenance of the AN/TPQ-36 radar? List those aspects that were applicable. Also list those aspects that were not applicable." The DS/GS mechanic also reviewed the DS/GS task list to identify tasks for which the organizational-level mechanic has primary responsibility.

Did you perform this task during OT II? (Select one)

_____ Yes

_____ No

How difficult was it to learn how to perform this task proficiently? (Circle the number of your response.)

5	4	3	2	1
very difficult	moderately difficult	not difficult at all	moderately easy	very easy

Where should operators/maintenance personnel be trained to perform this task? (Select only one.)

_____ In school

_____ Partly in school and partly through practice on-the-job.

_____ On-the-job training only.

If you indicated that all or part of training for this task should occur in school, what type of school training is required? (Select as many as desired.)

_____ The student should be told about the task and how to do it.

_____ Performance of the task should be demonstrated to the student.

_____ The student should practice the task to become familiar with how to do it.

_____ The student should practice the task until he can perform it skillfully.

Figure 1. Task-specific questionnaire items.

RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

Task Validation

The task-validation data are most definitive for the operator position; least definitive for the DS/GS mechanic. Factors contributing to this variation include differences in sample size (five operators as opposed to one organizational-level mechanic and one DS/GS mechanic); differences in levels of training (the DS/GS mechanic was not MOS qualified); available documentation (operator and organizational maintenance technical manual changes were available; DS/GS manual changes were not available); and events during OT II (most operator tasks, half the organizational maintenance tasks, and only one-fourth of the DS/GS tasks were actually performed).

The strongest and most definitive recommendations therefore will be made for operator tasks, while recommendations for DS/GS tasks will be more suggestive and less specific. Moreover, all conclusions and recommendations presented here should be viewed in terms of recent changes in equipment or maintenance allocation charts which would impact on task performance or the assignment of tasks to job positions.

a. Operator Tasks.

(1) Suitability of Revised Task List.

(a) Findings.

Of the 47 tasks in the revised list, performance of 41 was either directly observed by researchers or reported by operators during OT II. The tasks reflected in the remaining six statements (operator: 30, 33, 38, 40, 41, 42, Appendix B) were not performed. Based on the operator's technical manual, it appears that the latter six statements do describe actual tasks but that test conditions did not permit their occurrence during the primary observation period.

(b) Conclusions.

The revised task list describes activities required to operate and perform operator maintenance responsibilities on the AN/TPQ-36 radar.

(c) Recommendations.

The revised task list should be used as the basis for development of the final operator task list.

(2) Accuracy of Description.

(a) Findings.

Several operators indicated that one task (operator: 20, Appendix B) is relevant to operation of the radar but is not the responsibility of the operator. They suggested that this task is performed instead by supervisory personnel.

(b) Conclusions.

The revised task list is not entirely accurate as a job definition. At least one task may not be the responsibility of radar operators.

(c) Recommendations.

Assess the aforementioned task (operator: 20, Appendix C) to determine if it is in fact an operator task. If not, delete it from the operator task list and place it in the list of tasks for the appropriate job position.

(3) Completeness of Description.

(a) Findings.

Discussions with operators and direct observation also indicated that the task list may be incomplete with respect to the following performance areas (operator: 13, 16, 17, 19, 20, Appendix B):

1. Changing of search parameters;
2. Communication with a unit calling for a friendly fire mission;
3. Radar gunnery;
4. Detection and processing of hostile targets;
5. Operator supervision;
6. Cover, concealment, and camouflage;
7. Survey skills and mapreading; and
8. Vehicle driving.

(b) Conclusions.

The revised task list is not complete as a description of the operator job.

(c) Recommendations.

1. Review the task list and responsibilities of operators to identify the tasks that should be added to the list, especially for the performance areas just mentioned. For areas of incompleteness, derive the necessary task descriptions.

2. Fifteen tasks, originally designated for both the operator and organizational-level mechanic, were judged to be the responsibility of the organizational-level mechanic alone. Consequently, they were placed in the task list for the mechanic. These tasks (operator: 1-15, Appendix B) should be reviewed to assure that operators are not to perform them. These tasks should be reinstated in the operator's task list if they are performed by operators.

(4) Adequacy of Task Description.

(a) Findings.

Observation and survey data were obtained on the adequacy of the task statements as task descriptions. Several statements were found to be inadequate.

1. Several revised task statements appear to describe more than one task (operator: 12, 15, 16, 19, 23, 26, 27, Appendix B).

2. In the revised task list, the operator's job is described in terms of equipment operation. Observation suggested that operators' tasks in several areas (operator: 15, 16, 17, 20, Appendix B) are not completely described by equipment operation. Rather, such tasks seem to involve performance so that the radar accomplishes its tactical functions in a combat situation.

3. Two revised statements (operator: 13, 15, Appendix B) describe performances that are possibly procedures of other tasks as opposed to tasks per se.

4. The tasks reflected in several statements are difficult to understand (operator: 14, 21, 26, Appendix B) because they are not described in commonly recognized terminology.

(b) Conclusions.

Several items in the revised operator task list are not adequate as task descriptions and require further revision.

(c) Recommendations.

The following are recommended to improve the adequacy of the task descriptions.

1. Determine if the task statements presented under numbers 12, 15, 16, 19, 23, 26, and 27, Appendix C, actually describe multiple tasks. If so, develop separate task descriptions for each task. Three general criteria should be used in making this determination. The first is the definition of a task presented earlier (see page 3). If a statement describes more than one task according to this definition, each task should be described separately. The second criterion is that the procedures, steps, or sequences of activities involved in candidate tasks differ from those of other tasks. The third criterion is that the prerequisite knowledges and skills for the candidate tasks differ.

2. Evaluate the tasks presented under numbers 15, 16, 17, and 20, Appendix C, to determine if they completely describe the required performances. In particular, determine if these tasks should reflect the tactical employment of the radar as well as equipment operation. That is, these tasks directly concern operation of the radar to accomplish its combat functions. They are presently described in terms of equipment operation. This is compatible with the notion, expressed in discussions with USAFAS, that radar operators are not responsible for tactics. Observation generally supports this view; however, it did appear that operators do have responsibility for decisions/actions which influence tactical effectiveness. In conducting hostile fire missions, for example, the operator's apparent function is to operate the radar so that as many targets as possible are rapidly and accurately processed. It is questionable whether this function is completely described by the revised task list. In particular, the present task descriptions do not describe the activities potentially required of operators (for example, decisions about the use of target averaging or methods of operation under ECM) required to apply the capabilities of the radar so that these effects are obtained. The intent of this recommendation is to insure that USAFAS determines the extent to which operators have a responsibility for such tactical functions and that, to the extent necessary, the task list is revised to reflect these functions.

3. Determine if tasks presented under numbers 13 and 15, Appendix C, describe elements of a task as opposed to a task itself. If so, delete these statements from the task list, and take actions to insure that the actual operator task is completely described.

4. Evaluate all statements to determine if they are described in terms that are readily understood by trained radar operators. If not, revise them accordingly. Three tasks (operator: 14, 21, 26, Appendix C) are described in unfamiliar terms.

b. Organizational-Level Maintenance Tasks.

(1) Suitability of Revised Task List.

(a) Findings.

Observation of performances and the organizational-level mechanic's responses to the survey instrument provided data as to whether the revised task list describes tasks performed by the mechanic. Survey responses are summarized in Appendix F. The mechanic indicated that he had performed 32 of the 70 tasks in the revised task list prior to or during primary observation period; moreover, three tasks, which the organizational-level mechanic reported not having performed prior to it, were directly observed during the maintenance demonstration of OT II. These tasks are also designated in Appendix F. Thus, half of the tasks in the revised organizational-level maintenance task list were performed during OT II. Responses to the questionnaire indicated that the tasks reflected in the remaining 38 statements were recognized by the organizational-level mechanic as being his responsibility.

(b) Conclusions.

The revised task list for the organizational-level mechanic describes tasks performed by incumbents of this position to maintain the AN/TPQ-36 radar.

(c) Recommendations.

The revised task list should be used to develop the final organizational-level maintenance task list.

(2) Accuracy of Description.

(a) Findings.

The revised task list contains two tasks (mechanic: 3, 13, Appendix B) which the organizational-level mechanic recognized as tasks but which are not described in a more recent version of the technical manual.

(b) Conclusions.

Due to changes in the AN/TPQ-36 radar system, it is possible that the tasks described by these statements are no longer the responsibility of the organizational-level mechanic.

(c) Recommendations.

1. Determine if tasks 3 and 13 describe activities which are the primary responsibility of the organizational-level mechanic. If they are not, delete them from task list for this position and reallocate them to the appropriate list.

2. As part of the reorganization presented in Appendix A, task numbers 1-15 were allocated to the organizational-level mechanic. The accuracy of this allocation should be reviewed by subject matter experts.

(3) Completeness of Description.

(a) Findings.

Two tasks in the original task list (mechanic: 2, 25, Appendix A) were not included in the revised list. Discussions with the organizational-level mechanic suggest, however, that these do constitute actual tasks. Also, two additional tasks (mechanic: 41, Appendix B) were identified as a result of OT II.

(b) Conclusions.

The revised task is incomplete.

(c) Recommendations.

Assess the revised task list overall for completeness. Also, the two tasks identified in item 41, Appendix D, should be added to the task list. Finally, two of the original task statements (see numbers 2 and 25) should be evaluated to determine whether they should be reinstated as task descriptions.

(4) Adequacy of Task Description.

(a) Findings.

Several task statements are inadequate as task descriptions. One revised task statement (mechanic: 15, Appendix B) implies that the task is performed only after the results of a particular test have been obtained. Evidence indicates that the task is performed under other conditions as well.

Several revised task statements (mechanic: 4, 5, 6, 35, 38, 39, Appendix B) describe multiple troubleshooting procedures or the replacement/alignment of more than one item within a functional area of the system. In the revised task list, multiple operations or items were combined into a single statement when the procedures and prerequisite knowledges/skills for all combined operations appeared to be similar.

Observation of selected maintenance actions suggested that the frequency, sensitivity, or difficulty of all operations combined into a single task is not necessarily the same. These differences suggest that certain combined operations should be broken into separate tasks.

Two problems were identified with the descriptions of tasks undertaken to correct faults. First, several corrective tasks (mechanic: 36, 38, 39, Appendix B) are described redundantly in the task list. Second,

it became questionable whether all corrective tasks had been identified. Specifically, as a fault identification test is conducted, the mechanic executes certain actions (for example, card replacements) that may correct the identified fault.

The knowledges and skills required to execute corrective actions did not appear to differ from those required to execute other actions comprising the test. Consequently, such actions were described in the revisions as part of the test procedures. The adequacy of this approach was questioned by the manner in which the mechanic described his actions. In particular, distinctions were made between actions through which the source of a failure is identified and actions that correct it. Such distinctions suggest that perhaps several of the corrective actions should be identified as separate tasks.

(b) Conclusions.

The adequacy of certain task descriptions is questionable. These descriptions require further analysis to determine whether and how they should be modified.

(c) Recommendations.

1. Revise the following task description (see number 15, Appendix D) by deleting reference to the results of the transmitter power off-line fault isolation test: "In accordance with the results of the transmitter power off-line fault isolation test, use the Transmitter Troubleshooting Diagram (DEP TM 11-5840-354-12, current version) to diagnose problems and to identify necessary corrections." Data suggest that this task is sometimes performed when this test has not been conducted.

2. Use the criteria advanced earlier (see recommendation (4)(c)1, operator tasks) to determine if tasks identified under numbers 4, 5, 6, 35, and 39, Appendix D, each describe multiple tasks. If so, describe each task separately.

3. Three steps are recommended to offset the redundancy and potential incompleteness of the corrective tasks identified above. First, determine if corrective actions, not presently described as separate tasks, should be identified as separate tasks. This may be accomplished by analyzing seven tasks (see numbers 4, 5, 6, 7, 8, 9, and 14, Appendix D) which describe both fault identification procedures and corrective actions in a single task statement. Second, develop a separate task statement for each corrective task that is identified in the first step and for which separate task descriptions have not already been developed. These two steps should reduce the incompleteness of the task list. Third, revise each of the seven tasks analyzed in the first step by deleting reference to corrective actions. One of these statements, for example, presently appears as follows: "Perform the weapons location unit fault isolation test, to include taking corrective actions in accordance with

printouts/displays." This statement would be revised as follows: "Perform the weapons location unit fault isolation test." This third action would reduce the redundancy in the revised task list.

c. DS/GS Maintenance Tasks.

(1) Suitability of Revised Task List.

(a) Findings.

Data were collected concerning the extent to which the revised task statements describe actual DS/GS maintenance tasks. Only 14 of the 68 tasks were either observed as performed or reported as performed by the DS/GS mechanic during OT II. Table 1 summarizes these tasks by their numbers in the revised task list (see Appendix B). The mechanic's responses to the survey instrument suggest, however, that he recognized all the remaining tasks as performances required to maintain the AN/TPQ-36. Thus, the revised task statements appear to describe maintenance performances.

Table 1

DS/GS Tasks Performed During OT II
(by Task-List Number)

Observation of task performance	DS/GS mechanic's reports of own performance	
	Task reported	Task not reported
Task observed	1, 2, 18, 65, 66, 67 (n = 6)	8, 14, 26, 31, 49, 64 (n = 6)
Task not observed	3, 25 (n = 2)	See other tasks in task list (n = 54)

Data as to whether these maintenance performances are tasks of the DS/GS mechanic were also collected. In responding to the questionnaire, the DS/GS mechanic allocated primary responsibility for each task. Of the 68 tasks, 43 were judged to be the responsibility of the DS/GS

mechanic. Of the remaining 25 tasks, 22 were judged to be the responsibility of the organizational-level mechanic, 1 an operator/crew task, and 2 debatable (that is, either DS/GS or organizational-level maintenance). These data suggest a sizable part (36%) of the revised task list may not be the responsibility of the DS/GS mechanic.

The available technical manuals were examined to determine if the mechanic's suggested reallocations of the 25 tasks assigned to DS/GS match the task allocations implied by the manuals. Table 2 summarizes by task number the results of this analysis. Materials in the technical manuals indicated that 15 of the 25 tasks which the DS/GS mechanic judged to be allocated to another jobholder are the responsibility of the DS/GS mechanic; 1 is the responsibility of the organizational-level mechanic; and, for the remaining 9 tasks, responsibility could not be determined. These data suggest considerable disagreement between the DS/GS mechanic and the technical manual.

Table 2

Allocation of Questionable DS/GS Tasks
(by Task Numbers)

Technical manual allocation	DS/GS mechanic's judgment of appropriate reallocation of some DS/GS tests		
	Organizational	Operator/crew	Organizational or DS/GS
DS/GS	8, 9, 10, 11, 12, 13, 21, 27, 32, 33, 34, 35, 61	---	14, 41
	(n = 13)	(n = 0)	(n = 2)
Organizational	60	---	---
	(n = 1)	(n = 0)	(n = 0)
Questionable	4, 5, 6, 25, 62, 63, 64, 65	45	---
	(n = 8)	(n = 1)	(n = 0)

(b) Conclusions.

The suitability of the revised task list as a basis for the final DS/GS job description is uncertain. Only a small number of maintenance activities were observed during OT II and only one mechanic was available for questioning. The available data suggest, however, that an appreciable number of the tasks listed may not be DS/GS tasks.

(c) Recommendations.

Each of the revised tasks should be assessed to assure that it is the responsibility of the DS/GS mechanic. Those tasks which are this mechanic's responsibility should then be used in the development of the final DS/GS task list. Tasks which are determined to be the responsibility of another position should be placed in the task list for that position.

(2) Completeness of Description.

(a) Findings.

Data on the completeness of the task list indicate that the task list is not exhaustive. First, several observed activities may constitute DS/GS tasks and are not included in the task list:

1. Replace RF converter assembly,
2. Load the general maintenance aid program to troubleshoot faults,
3. Adjust the X-band test target, and
4. Align twt RFA1 and power supply.

Second, observations suggested that the 14 diagnostic tasks (DS/GS: 3, 4, 8, 15, 18, 21, 22, 24, 31, 60, 61, 62, 65, 68, Appendix B) do not describe all tasks uniquely performed by the DS/GS mechanic to isolate faults in all components of the radar. For example, diagnosis of faults in the receiver-exciter is not explicitly described as a task, but the DS/GS mechanic was required to do this on several occasions during the primary observation period.

Third, indirect evidence was obtained that the task list does not cover all alignment tasks. The DS/GS mechanic's written comments about certain replacement tasks included the following: "replacement and not alignment rated," "alignment is easy," "alignment is difficult," and so forth. Such responses suggest that items replaced as part of these tasks also require alignment. The task list was assessed to determine if alignments of these items are described as DS/GS tasks. The revised task list does not include alignments of the following mechanic-designated items: (a) azimuth encoder, (b) antenna elevation actuator, (c) transmitter cathode regulator, (d) transmitter crowbar assembly, (e) transmitter

crowbar assembly trigger card, (f) voltage divider, and (g) twt amplifier and power supply.

(b) Conclusions.

The revised DS/GS task list is not complete. Several tasks were identified during OT II that are not included in the revised task list. Additional data suggest that the job of the DS/GS mechanic requires further analysis to insure that diagnostic and alignment tasks are completely described.

(c) Recommendations.

1. Assess the four activities identified during OT II as candidate tasks (paragraph (a) above) and determine if they do constitute actual tasks of the DS/GS mechanic. If they are tasks of this mechanic, they should be added to the task list.

2. Determine if the alignments implied by the mechanic's responses must be performed as part of maintenance of the AN/TPQ-36. If so, the DS/GS task list should be amended to insure that they are appropriately described in the list of the mechanic who performs them. It should be noted that this may require development of additional task statements for alignments that constitute separate tasks. If an alignment is a task element of another task already described, this task description should be revised if necessary and as appropriate.

3. Determine if all diagnostic tasks have been identified. An approach for doing so is suggested later, as part of recommendation (3)(c)3.

(3) Adequacy of Task Description.

(a) Findings.

Several additional observations about the adequacy of the DS/GS task statements stem from OT II. Several statements may not describe tasks. Two (DS/GS: 1 and 2, Appendix B) appear to describe prerequisite knowledges and skills. References in the technical manuals could not be located for two task statements (DS/GS: 25 and 41, Appendix E); these may not describe tasks either.

Four task descriptions (DS/GS: 8, 63, 64, 68, Appendix B) fail to specify the performances involved so that the task can be identified from the activities of the mechanic.

The "level" at which certain diagnostic tasks are described may be either too broad or too narrow and specific. Eight (DS/GS: 3, 8, 15, 18, 24, 31, 61, 69, Appendix B) describe tasks in broad terms--so that a variety of procedures could exemplify performance of the task. For example, task number 69 (Appendix B) reads, "Isolate faults in the synchronizer."

The rest (DS/GS: 4, 21, 22, 60, 62, 65, Appendix B) appear to describe tasks performed through a limited number of relatively well-defined procedures; for example, task number 21, "Conduct the antenna temperature converter test."

Possibly this variation in level of description accurately reflects differences in the nature of the DS/GS mechanic's diagnostic tasks. However, several broad task descriptions fail to identify either completely or with sufficient precision the performances comprising the tasks. From the task statement alone, for example, an observer would have difficulty determining that a mechanic is performing task number 69. Moreover, several specific task descriptions may be inadequate, in that they do not describe the full range of procedures used by the DS/GS mechanic to test the function (or component) of the radar. Also, two specific statements (DS/GS: 62 and 65, Appendix B) appear to describe subtasks of other tasks.

(b) Conclusions.

Several of the revised task descriptions are inadequate as task descriptions. Four statements may not describe actual tasks. The most prevalent problem, however, is the level of specificity with which certain tasks are described. This problem is especially characteristic of the 14 diagnostic tasks.

(c) Recommendations.

1. Determine if task numbers 1, 2, 25, 41 (Appendix E) describe actual tasks. If not, they should be deleted from the task list.

2. Revise two task statements (numbers 63 and 64, Appendix E) to indicate the components that the mechanic operates upon.

3. The 14 diagnostic tasks pose a special problem. Several tasks (numbers 3, 8, 15, 18, 24, 31, 61, 68, Appendix E) are described in broad terms. The remaining 6 tasks (numbers 4, 21, 22, 60, 62, 65, Appendix E) are described with greater specificity. It should be determined whether these 14 tasks are each described at the appropriate level of specificity.

One approach for making these determinations is as follows. First, determine the framework for identifying DS/GS diagnostic tasks. One or a combination of two options is available. One consists of the functional areas of the AN/TPQ-36 radar described in the DS/GS technical manuals. The other consists of the major components of the radar. Selection of the appropriate framework is important since it implies the perspective that the mechanic should adopt in diagnosing faults. If the mechanic "thinks" in terms of functions, for example, his perspective is likely to be broader so that he considers the various components that form or feed into it. Second, within this framework, identify the faults that the DS/GS mechanic must diagnose. If functional areas is the framework, for example, the faults within this function would be identified. Third, for

each problem, identify the procedures or activities that would be used to diagnose it. If more than one set of procedures could be used, identify each set. Fourth, develop task statements that reference the fault and imply the procedures used to identify it. If only one set of diagnostic procedures would be used, only one task statement would be derived. If more than one set of procedures would be used, it will be necessary to determine the number of task descriptions required. A single task statement should be developed for each complete set of procedures that constitutes an independent method of problem diagnosis. Regardless of the number of task descriptions, each should identify the fault and the diagnostic activities precisely enough that a knowledgeable observer could identify the troubleshooting task from the behaviors of the DS/GS mechanic.

26B MOS

a. Findings. To obtain data on the appropriateness of the 26B MOS, the two mechanics were asked whether their 26B MOS training was applicable to maintenance of the AN/TPQ-36. A positive response was expected to indicate the opinion that current training for this MOS (modified by instruction on nomenclature, operating characteristics, and such, unique to the AN/TPQ-36) is generally suitable for the Firefinder radars. A negative response would indicate either that present training for the 26B MOS needs to be altered or that a new MOS and associated training need to be established. The two mechanics were also asked to identify those aspects of their 26B training that were applicable and inapplicable to maintenance of the AN/TPQ-36.

The DS/GS mechanic had not been MOS trained. Only the organizational-level mechanic was able to respond to these items. He indicated the following: (a) 26B MOS training was not generally applicable to maintenance of the AN/TPQ-36 radar; (b) 26B instruction on the functions of the major parts of a radar is applicable to maintenance of the AN/TPQ-36; and (c) present training in electronics, especially on tube theory, is not applicable.

b. Conclusions. The evidence obtained regarding the suitability of the 26B MOS for maintenance of the AN/TPQ-36 radar is limited and does not support a firm conclusion. The organizational-level mechanic during OT II expressed the view that 26B MOS training was not generally applicable to maintenance of the AN/TPQ-36. While not conclusive, this opinion tends to support the position that present training for the 26B MOS needs to be altered or that a new MOS and associated training need to be established in order to prepare personnel to maintain the Firefinder radars.

c. Recommendations. Limited evidence suggests that there may be a need to modify present MOS qualifications. It is recommended that the issue of the suitability of the 26B MOS for maintenance of the Firefinder radars be systematically studied. The study should be designed to identify (1) the discrepancy between current 26B training and the knowledges/

skills/attitudes required to perform the AN/TPQ-36 maintenance tasks and (2) the continued need for 26B skill qualification as the Firefinder radars are placed in the Army's inventory of equipment. Both types of information are needed to determine whether to modify present MOS training (and if so, how) or to create a new MOS.

Task Training Data

Several items were included in the survey instruments in order to collect information pertinent to the amount and type of training required for the operator and maintenance tasks. These items concerned the difficulty of learning to perform each task, the requirement for school versus on-the-job training (OJT), and the type of school training required. Responses to these items, summarized here, appear in more detail in Appendix F.

a. Findings.

(1) Operator Training.

Table 3 summarizes the operators' average rating of difficulty of learning to perform the operator tasks. Responses of operators and mechanics to this item are somewhat suspect. Some may have rated the tasks for difficulty of task performance as opposed to difficulty of learning to perform the task. Learning difficulty was rated on a 5-point scale from 1 (very easy) to 5 (very difficult).

Most tasks were rated within the range of 1.8-2.4, suggesting that they were moderately easy to learn. This table also highlights the five tasks that operators judged most difficult to learn: (a) communication through accepted RTO procedures; (b) detection of jamming through observation of the B-scope; (c) survey skills (operator: 45, 46, Appendix B); and (d) hostile target processing through COARSE and FINE adjustment switchlamps.

Operators were also asked whether they should be trained in school, partly in school and partly through OJT, or through OJT alone. For those tasks judged to require school training, operators indicated the level or type of training required. Response options for type of school training were as follows: inform the student about the task and how to perform it, demonstrate performance of the task, provide practice so that the student becomes familiar with how to perform it, or provide practice so that the student can perform the task skillfully. The "highest" level of training judged to be required for a task is reported. That is, the four response options were treated as a hierarchy of increasing levels of training in the order presented. Thus, if an operator indicated that a student should be informed about a task and also be given familiarization training, his judgment of required training was tallied as familiarization practice. For these two items, the operators' modal responses to each task were the same: a combination of school training and OJT is

Table 3

Rated Difficulty of Learning Operator Tasks
(by Task Numbers)

Average learning difficulty rating on a 1-5 scale	Task statement number[a]
1.0	43 (n = 1)
1.5	35 (n = 1)
1.6	8 (n = 1)
1.8	1, 2, 13, 14, 15, 18, 19, 20, 37 (n = 9)
2.0	4, 7, 11, 21, 25, 26, 27, 29, 34, 44, 47 (n = 11)
2.2	5, 6, 16, 22, 23, 24, 36, 39 (n = 5)
2.4	3, 9, 10, 12, 32 (n = 5)
2.6	31 (n = 1)
2.8	28, 46 (n = 2)
3.0	17 (n = 1)
3.2	45 (n = 1)

[a]Six of the 47 tasks (operator: 30, 33, 38, 40, 41, 42) were not rated.

required and school training should provide practice for skill-level development.

(2) Organizational-Level Maintenance Training.

The organizational-level mechanic's ratings of learning difficulty are summarized in Table 4. In this table, organizational-level maintenance tasks are also placed in one of four categories, as follows: (a) diagnostic, emphasizing the identification of faults; (b) corrective, concerning correction of identified faults; (c) preventive, acting to prevent maintenance problems; and (d) tasks not fitting into any of the above categories. The mechanic tended to rate corrective tasks as more difficult to learn than diagnostic or preventive tasks.

Table 4

Learning Difficulty of Organizational Maintenance Tasks
(by Task Number)

Task classification	Mechanic-assigned learning-difficulty rating				Average learning-difficulty rating
	1	2	3	4	
Diagnostic	---	18, 19, 20	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 21, 23, 24, 25, 26, 27, 28, 29, 46, 47	15	2.9
	(n = 0)	(n = 3)	(n = 26)	(n = 1)	(n = 30)
Corrective[a]	---	64, 67, 68, 69	30, 31, 34, 35, 36, 37, 41, 42, 44, 45, 62, 63	32, 33, 38, 39, 40, 43, 60, 61, 70	3.2
	(n = 0)	(n = 4)	(n = 12)	(n = 9)	(n = 25)
Preventive	50, 56, 57	49, 51, 52, 53, 54, 55, 58	48	---	1.8
	(n = 3)	(n = 7)	(n = 1)	(n = 0)	(n = 11)
Other	---	22	59	---	2.5
	(n = 0)	(n = 1)	(n = 1)	(n = 0)	(n = 2)

[a]Two corrective tasks were not rated for learning difficulty.

The mechanic indicated that all organizational-maintenance tasks (except one--judged to require only school training) should be taught through a combination of school training and OJT. The mechanic's judgments of type of required school training are summarized in Table 5. The mechanic believed that a student should be provided either familiarization-level or skill-level practice in school for all but one organizational-maintenance tasks. The mechanic also tended to judge that diagnostic tasks require a higher level of school training than preventive/corrective tasks.

Table 5

School Training Required for
Organizational Maintenance Tasks
(by Task Number)

Mechanic-assigned training level of requirement[a]	Task type			
	Diagnostic	Corrective	Preventive	Other
Information about task	---	---	57	---
	(n = 0)	(n = 0)	(n = 1)	(n = 0)
Familiarization practice	2, 3, 4, 5, 6, 7, 14, 20, 21, 23, 24, 25, 26, 27, 28, 29, 46, 47	30, 31, 33, 35, 36, 37, 38, 39, 40, 41, 42, 44, 45, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70	48, 49, 50, 51, 52, 53, 54, 55, 56, 58	22
	(n = 18)	(n = 24)	(n = 10)	(n = 1)
Skill-level practice	1, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19	32, 34, 43	---	59
	(n = 12)	(n = 3)	(n = 0)	(n = 1)

[a]No task was judged to require demonstration as the highest level of training.

(3) DS/GS Maintenance Training.

Table 6 summarizes the DS/GS mechanic's ratings of difficulty of learning the tasks in the revised DS/GS task list. In this table, tasks are classified as diagnostic, corrective/preventive, or other. As for the other two job positions, these tasks were generally rated as "moderately easy" (scale value of 2) to "not at all difficult" (scale value of 3) to learn. The 14 diagnostic tasks were rated slightly more difficult to learn than the 52 corrective/preventive tasks.

In terms of training location (see Table 7), the DS/GS mechanic indicated that 15 (or 29%) of the corrective/preventive tasks and one (or 7%) of the diagnostic tasks could be taught through OJT. The remaining tasks were judged to require school training or a combination of school training and OJT. The DS/GS mechanic believed most tasks required familiarization practice as part of school training.

b. Conclusions/Recommendations.

The data reported on learning difficulty and type of training are inconclusive for several reasons. In combination with other information, however, these data may serve as inputs to decisions about (a) tasks that should be trained in school and (b) the depth and type of instruction required for the tasks.

Table 6

Learning Difficulty of DS/GS Maintenance Tasks
(by Task Number)

Task classification	DS/GS mechanic-assigned learning-difficulty rating				Mean learning-difficulty rating
	1	2	3	4	
Diagnostic	65	4, 24, 60, 61, 62	3, 8, 21, 68	15, 18, 22, 31	2.7
	(n = 1)	(n = 5)	(n = 4)	(n = 4)	(n = 14)
Corrective/ preventive	5, 6, 12, 13, 43, 63, 64	11, 16, 27, 32, 33, 34, 35, 36, 37, 38, 39, 40, 42, 44, 45, 48, 50, 51, 66, 67	9, 10, 14, 17, 25, 26, 29, 30, 41, 46, 47, 49, 52, 53, 54, 55, 56, 57, 59	7, 19, 20, 23, 28, 58	2.5
	(n = 7)	(n = 20)	(n = 19)	(n = 6)	(n = 52)
Other	---	---	2	1	3.5
	(n = 0)	(n = 0)	(n = 1)	(n = 1)	(n = 2)

Table 7

Training Required for DS/GS Tasks
(by Task Number)

DS/GS mechanic-assigned training level of requirement	Task type		
	Diagnostic	Corrective/ preventive	Other
OJT only	65	5, 6, 9, 10, 11, 12, 13, 27, 29, 32, 33, 34, 35, 63, 64	---
	(n = 1)	(n = 15)	(n = 0)
Information about task	4	---	---
	(n = 1)	(n = 0)	(n = 0)
Demonstration of task	3, 61	7, 30, 48	2
	(n = 2)	(n = 3)	(n = 1)
Familiarization practice	8, 15, 21, 22, 24, 31, 60, 62, 68	14, 17, 19, 20, 23, 25, 26, 28, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 66, 67	1
	(n = 9)	(n = 33)	(n = 1)
Skill-level practice	18	16	---
	(n = 1)	(n = 1)	(n = 0)

CONCLUSIONS

Task Validation

Operator Tasks. The revised task list describes activities required to operate and perform operator maintenance responsibilities on the AN/TPQ-36 radar. The revised task list should be used as the basis for development of the final operator task list.

The revised task list is not entirely accurate as a job definition. At least one task--enable line printer to print hostile-fire locations (operator: 20, Appendix B)--may not be the responsibility of radar operators. The task should be assessed; if it is not an operator task, it should be deleted from the operator task list and placed in the list for the appropriate job position.

The revised task list is not complete as a description of the operator job. The task list and responsibilities of operators should be reviewed to identify tasks that should be added to the list, especially for the following performance areas: (a) changing of search parameters; (b) communication with a unit calling for a friendly fire mission; (c) radar gunnery; (d) detection and processing of hostile targets; (e) operator supervision; (f) cover, concealment, and camouflage; (g) survey skills and mapreading; and (h) vehicle driving. For areas of incompleteness, the necessary task descriptions should be derived.

Fifteen tasks, originally designated for both the operator and organizational-level mechanic, were judged to be the responsibility of the mechanic alone. Consequently, they were placed in the task list for the mechanic. These tasks (mechanic: 1-15, Appendix B) should be reviewed to assure that operators are not to perform them. These tasks should be reinstated in the operator's task list if they are performed by operators.

Several items in the revised operator task list are inadequate as task descriptions and require further revision. The following are recommended to improve the adequacy of the task descriptions.

It should be determined if certain task statements (operator: 12, 15, 16, 19, 23, 26, 27, Appendix B) actually describe multiple tasks. If so, separate task descriptions should be devleoped for each task. Three general criteria should be used in making this determination. The first is the definition of a task as a particular sequence of activities (complete definition in Method section). If a statement describes more than one task according to this definition, each task should be described separately. The second criterion is that the procedures, steps, or sequences of activities involved in candidate tasks differ from those of other tasks. The third criterion is that the prerequisite knowledges and skills for the candidate tasks differ.

Certain tasks (operator: 15, 16, 17, 20, Appendix B) should be evaluated to determine if they completely describe the required performances. In particular, it should be determined if these tasks should reflect the tactical employment of the radar as well as equipment operation. These tasks directly concern operation of the radar to accomplish its combat functions, but presently are described in terms of equipment operation. This is compatible with the notion, expressed in discussions with USAFAS, that radar operators are not responsible for tactics. Observation generally supports this view; however, it did appear that operators do have responsibility for decisions/actions which influence tactical effectiveness.

In conducting hostile fire missions, the operator's apparent function is to operate the radar so that as many targets as possible are rapidly and accurately processed. It is questionable whether this function is completely described by the revised task list. In particular, the present task descriptions do not describe the activities potentially required of operators (for example, decisions about the use of target averaging or methods of operation under ECM) who have to apply the capabilities of the radar so that certain effects are obtained. USAFAS should determine the extent of operator responsibility for tactical functions and the task list should be revised to the extent necessary to reflect these functions.

It should be determined if two tasks (operator: 13, 15, Appendix B) describe elements of a task as opposed to a task itself. If so, these statements should be deleted and actions taken to insure that the actual operator task is completely described.

All statements should be evaluated to determine if they are described in terms readily understood by trained radar operators. If not, they should be revised accordingly. Three tasks (operator: 14, 21, 26, Appendix B) are described in unfamiliar terms.

Organizational-Level Maintenance Tasks. The revised task list for the organizational-level mechanic describes tasks performed by incumbents of this position to maintain the AN/TPQ-36 radar. The revised task list should be used to develop the final organizational-level maintenance task list.

Due to changes in the AN/TPQ-36 radar system, the tasks described by these statements may no longer be the responsibility of the organizational-level mechanic. It should be determined if "Load and execute memory computer confidence test" and "Load and start transmitter power off-line fault test" describe activities which are the primary responsibility of the organizational-level mechanic. If they are not, they should be deleted from the task list for this position and reallocated to the appropriate list(s). As part of the reorganization presented in Appendix B, task numbers 1-15 were allocated to the organizational-level mechanic. The accuracy of this allocation should be reviewed by subject-matter experts.

The revised task list is incomplete and should be assessed overall for completeness. Also, two tasks (mechanic: 41, Appendix A)--alignment of synchronizer and beam steering assembly--should be added to the task list. Finally, two of the original task statements (mechanic: 2, 25, Appendix A) should be evaluated to determine if they should be reinstated.

The adequacy of certain task descriptions is questionable. These descriptions require further analysis to determine whether and how they should be modified.

The following task description (mechanic: 14, Appendix B): "In accordance with the results of the transmitter power off-line fault isolation test, use the Transmitter Troubleshooting Diagram (DEP TM 11-5840-354-12, current version) to diagnose problems and to identify necessary corrections," should be revised by deleting reference to the results of the transmitter power off-line fault isolation test. Data suggest that this task is sometimes performed when the test has not been conducted.

The multiple-task criteria previously described should be used to determine if certain tasks (mechanic: 4, 5, 6, 35, 39, Appendix B) describe multiple tasks. If so, each task should be described separately.

Three steps are recommended to offset the redundancy and potential incompleteness of the corrective tasks (mechanic: 36, 38, 39, Appendix B). First, it should be determined if corrective actions, not presently described as separate tasks, should be identified as such. This may be accomplished by analyzing seven tasks (mechanic: 4, 5, 6, 7, 8, 9, 14, Appendix B) which describe both fault-identification procedures and corrective actions in a single task statement. Second, a separate task statement should be developed for each corrective task identified in the first step and for which separate task descriptions do not already exist. These two steps should reduce the incompleteness of the task list. Third, each of the seven tasks analyzed in the first step should be revised by deleting reference to corrective actions. Task 9, for example, appears in Appendix B as follows: "Perform the weapons location unit fault isolation test, to include taking corrective actions in accordance with printouts/displays." In Appendix A, Task 5 is revised as follows: "Perform the weapons location unit fault isolation test." This third step would reduce the redundancy in the revised task list.

DS/GS Maintenance Tasks. The suitability of the revised task list as a basis for the final DS/GS job description is uncertain. Only a small number of maintenance activities were observed during OT II and only one mechanic was available for questioning. The available data suggest, however, that an appreciable number of the tasks listed may not be DS/GS tasks.

Each of the revised tasks should be assessed to determine if it is the responsibility of the DS/GS mechanic. These tasks which are this mechanic's responsibility should then be used in the development of the

final DS/GS tasks list. Tasks determined to be the responsibility of another position should be placed in the task list for that position.

The revised DS/GS task list is not complete. Several tasks identified during OT II are not included in the revised task list. Additional data suggest that the job of the DS/GS mechanic requires further analysis to insure that diagnostic and alignment tasks are completely described.

The four activities identified during OT II as candidate tasks (replace RF converter assembly, load the general maintenance aid program to troubleshoot faults, adjust the X-band test target, and align twt RFA1 and power supply) should be assessed to determine if they do constitute actual tasks of the DS/GS mechanic. If so, they should be added to the task list.

It should be determined if the alignments implied by the mechanic's responses must be performed as part of maintenance of the AN/TPQ-36. If so, the DS/GS task list should be amended to insure that they are appropriately described in the list of the mechanic who performs them. This may require additional task statements for alignments that constitute separate tasks. If an alignment is a part of another task already described, the existing task description should be revised if necessary and as appropriate.

It should be determined if all diagnostic tasks have been identified. An approach for doing so is suggested later in this section.

Several revised task descriptions are inadequate. Four statements may not describe actual tasks. The most prevalent problem, however, is the level of specificity with which certain tasks are described. This problem is especially characteristic of the 14 diagnostic tasks.

If DS/GS tasks 1, 2, 25, and 41 (Appendix B) do not describe actual tasks, they should be deleted from the task list. Two task statements (DS/GS: 63, 64, Appendix B) should be revised to indicate the trailer components that the mechanic operates upon.

The 14 diagnostic tasks pose a special problem. Eight tasks (DS/GS: 3, 8, 15, 18, 24, 31, 61, 68, Appendix B) are described in broad terms; six (DS/GS: 4, 21, 22, 60, 62, 65, Appendix B) are described more specifically. It should be determined whether these 14 tasks are each described at the appropriate level of specificity.

One approach for making these determinations is as follows. First, the framework for identifying DS/GS diagnostic tasks should be determined, either the functions or the components of the AN/TPQ-36 radar, or both. The framework implies the perspective that the mechanic should adopt in diagnosing faults. If mechanics "think" in terms of functions, for example, their perspective is likely to be broader than if they consider separately the various components that form or feed into the radar.

Second, within this framework, the faults that the DS/GS mechanic must diagnose should be identified. If "functional areas" is the framework, the faults within each function would be identified.

Third, for each problem, identify the diagnostic procedures or activities. If more than one set of procedures should be used, each set should be identified. Fourth, task statements that catalog faults and imply the procedures used to identify them should be developed. A separate task statement should be developed for each complete set of procedures that constitutes an independent method of problem diagnosis. Regardless of the number of task descriptions, each should identify the fault and the diagnostic activities precisely enough that a knowledgeable observer could identify the troubleshooting task from the behaviors of the DS/GS mechanic.

26B MOS

The evidence obtained regarding the suitability of the 26B MOS for maintenance of the AN/TPQ-36 radar is limited and does not support a firm conclusion. During OT II, the organizational-level mechanic expressed the view that 26B MOS training was not generally applicable to maintenance of the AN/TPQ-36. While not conclusive, this opinion tends to favor alteration of present training for the 26B MOS needs or establishment of a new MOS and associated training, in order to prepare personnel to maintain the Firefinder radars.

Limited evidence suggests that present MOS qualifications may need to be modified. The possible suitability of the 26B MOS for maintenance of the Firefinder radars should be systematically studied. The study should identify (a) the discrepancy between current 26B training and the knowledges/skills/attitudes required to perform the AN/TPQ-36 maintenance tasks and (b) the continued need for 26B skill qualification as the Firefinder radars are placed in the Army's inventory of equipment. Both types of information are needed to determine whether to modify present MOS training (and if so, how) or to create a new MOS.

Task Training Data

The data reported on learning difficulty and type of training are inconclusive for several reasons. In combination with other information, however, these data may serve as bases for decisions about (a) tasks that should be trained in school and (b) the depth and type of instruction required for the tasks.

REFERENCES

DEP TM 11-5840-354-1 DS/GS Mechanic Training Manual. October 1976.

DEP TM 11-5840-354-2 DS/GS Mechanic Training Manual. October 1976.

DEP TM 11-5840-354-12 Operator and Organizational-Level Mechanic Job Positions Technical Manual. October 1976.

U.S. Army Training and Doctrine Command (TRADOC). Interservice Procedures for Instructional Systems Development. Pamphlet 350-30. Contract N61339-73-C-0150, (U.S. Army Combat Arms Training Board, Fort Benning, Georgia). Tallahassee, Florida: Florida State University, August 1975.

U.S. Army Training and Doctrine Command (TRADOC). Training: Systems Engineering of Training (Course Design). (Reg. 350-100-1). Fort Monroe, Virginia: Author, July 1973.

APPENDIX A

ORIGINAL TASK LISTS

OPERATOR TASKS

1. Introduction to radar set AN/TPQ-36 and DEP TM 11-5840-354-12 (Oct. 76).

2. Cite the capabilities, limitations, missions, and equipment of the AN/TPQ-36 radar set.

3. Describe the operation of the radar set on the physical-description, block-diagram level.

4. Cite the safety precaution when working on a radar.

5. Identify and cite the function of the operator's controls and indicators.

6. Identify and cite the function of the operator's controls and indicators located on the trailer.

7. Perform generator starting and stopping procedures.

8. Perform radar set start-stop procedures.

9. Map installation on the WLU (weapons location unit).

7. Operate and load the high speed line printer.

7. Perform operator/computer communications.

7. Initializing and program loading.

7. Perform operating procedures.

7. Control and monitor the transmitter status remotely.

7. Perform priority zone and censor zone operating procedures.

7. Perform typical friendly contact operation sequence.

7. Perform typical hostile contact operation sequence.

7. Transmit a TACFIRE message.

7. Prepare the radar set AN/TPQ-36 for operation under unusual conditions.

7. Perform operations through electronic countermeasures (jamming).

7. Prepare radar set AN/TPQ-36 for movement by gamagoat.

7. Preparation and removal of shelter from the gamagoat.

7. Prepare radar set AN/TPQ-36 for movement by helicopter (external) and by aircraft (internal).

7. Perform the radar set AN/TPQ-36 installation from helicopter mode.

7. Prepare radar set AN/TPQ-36 for movement by railroad.

7. Perform instructions for installation of radar set from gamagoat.

10. Inspect and perform operator/crew maintenance.

ORGANIZATIONAL-LEVEL MAINTENANCE TASKS

1. Perform computer confidence test.

2. Perform the off-line status tests loading procedures.

3. Perform the off-line status tests short load procedure.

4. Perform the off-line signal processor fault isolation test.

5. Perform the WLU fault isolation test.

6. Perform the off-line fault detection tests.

---

1. Numbers 1-15 were originally designated for the operator and organizational maintenance training course.

7. Perform the beam steering off-line fault detection test.

8. Perform the receiver-exciter off-line fault detection test.

9. Perform the phase detector off-line fault detection test.

10. Perform the clutter rejection without transmitter off-line fault detection test.

11. Perform the clutter rejection with transmitter off-line fault detection test.

12. Perform the B-scope off-line fault detection test.

13. Perform the general maintenance aid off-line fault detection test.

14. Perform the antenna stability off-line fault detection test.

15. Perform the transmitter power output off-line fault detection test.

16. Provide the student with a physical description of the UYK-15 computer.

17. Provide the student with a working knowledge of digital fundamentals.

18. Provide the student a working knowledge of digital fundamentals (binary math).

19. Provide the student with a working knowledge of digital fundamentals (octal math).

20. Provide the student with a working knowledge of the central processor unit of the UYK-15 computer.

21. Provide the student with a working knowledge of the input/output controller transfer data in and out of the UYK-15 computer.

22. Provide the student with a working knowledge of the 333 random access memory unit.

23. Introduction to the diagnostic troubleshooting procedures for the AN/UYK-15 computer.

24. Perform the AN/UYK computer turn-on procedure.

25. Perform the program load diagnostic troubleshooting operating procedure.

26. Perform the program load diagnosis troubleshooting operating procedure.

27. Perform the AN/UYK-15 computer central processor diagnostic troubleshooting procedure.

28. Perform the computer memory diagnostic troubleshooting operating procedure.

29. Perform the computer IOC diagnostic troubleshooting procedure.

30. Perform the computer additional options diagnostic troubleshooting operating procedure.

31. Perform the computer power protection and automatic recovery diagnostic troubleshooting operating procedure.

32. Perform the computer memory resume interrupt diagnostic troubleshooting operating procedure.

33. Perform the AN/UYK-15 computer initialization diagnostic troubleshooting operating procedure.

34. Perform the AN/UYK-15 computer NDRO test program.

35. Perform the computer confidence testing procedure.

36. Perform the replacement and alignment procedures of the shelter power distribution system.

37. Perform replacement and alignment of line printer, line printer drive belts, line printer cards, and alignment of hammers.

38. Perform the replacement and alignment procedure of the B-scope.

39. Perform the replacement and alignment procedures of the synchronizer and beam steering assembly power supplies.

40. Perform the replacement and alignment procedure of the transmitter low voltage, receiver-exciter, and trailer and trailer assembly power supplies.

41. Alignment of synchronizer and beam steering assembly.

DS/GS TASKS

1. Trailer power distribution function.

2. Trailer clock distribution.

3. Exciter function.

4. Beam steering function.

5. Antenna positioning and monitoring function.

6. Receiver function.

7. Transmitter function.

8. Shelter power distribution function.

9. Peripheral device controller function.

10. Computer interface buffer function.

11. Synchronizer function.

12. Shelter clock distribution function.

13. Video processor function.

14. A to D converter subfunction.

15. MTI and DDS subfunction.

16. Doppler filters subfunction.

17. Recombination and log conversion subfunction.

18. Mean level generator subfunction.

19. Target detection subfunction.

20. Clutter mapper subfunction.

21. Built-in test equipment function.

22. B-scope interface function.

23. Weapons location function.

24. Know how to use the trailer on-site troubleshooting block diagrams.

25. Know how to use the shelter on-site troubleshooting block diagrams.

26. Trailer on-site component removal and replacement.

27. Shelter on-site removal and replacement.

28. Trailer component on-site alignment.

29. Shelter component on-site alignment.

30. Cable repair and checkout.

31. Termipoint method of wire replacement.

APPENDIX B

REVISED TASK LISTS

OPERATOR TASKS

1. Perform radar set start procedures.

2. Load the operational program.

3. Load and execute the initialization program.

4. Return to the initialization program.

5. Rewind the mag tape unit.

6. Operate and load the high speed line printer.

7. Enable the line printer to print all initialization data.

8. Stow the antenna for shutdown or maintenance.

9. Install a map on the weapons location unit.

10. Determine the highest and lowest terrain elevations on a map prepared for installation on the weapons location unit.

11. Perform radar set stop procedures.

12. Conduct typical friendly contact operation sequences from entry (or change) of correct friendly fire parameters to transmission of TACFIRE messages.

13. Return the radar to the hostile mode of operation after having completed friendly fire missions.

14. Enable the line printer to print fire search control parameters.

15. Enable processing of hostile-fire locations through target averaging.

16. Process a hostile target for transmission of TACFIRE through manual height adjustment techniques.

17. Process a hostile target for transmission to TACFIRE through use of COARSE and FINE adjustment switchalarms.

18. Display a hostile-fire location that had been permanently stored in memory.

19. Delete a currently displayed hostile-fire location, a single permanently stored location, or a range of permanently stored locations.

20. Enable the line printer to print all or selected hostile-fire locations that have been processed for storage.

21. Determine the height of a location displayed on a map on the weapons location unit.

22. Select the area to be covered by and enter a priority zone.

23. Select the area to be covered by and enter a censor zone.

24. Delete a zone (either priority or censor).

25. Print the coordinates of zones stored in the computer.

26. Display on the B-scope priority zones stored in the computer.

27. Display on the B-scope censor zones stored in the computer.

28. Detect the occurrence of jamming through observation of the B-scope.

29. Determine the azimuth of a jamming source by enabling operation of the jam strobe.

30. Transmit a TACFIRE message.

31. Conduct radio/telephone communications in accordance with accepted radio/telephone procedures.

32. Prepare radar set AN/TPQ-36 for operation under unusual climactic conditions.

33. Install and operate the portable air conditioner suitable for use with the AN/TPQ-36.

34. Remove, clean, and reinstall all air filters on the shelter and trailer.

35. Perform the line printer performance test.

36. Perform operator/crew maintenance in accordance with instructions in the current DEP TM 11-5840-354-12.

37. Prepare radar set AN/TPQ-36 for movement by gamagoat.

38. Prepare and remove the shelter from the gamagoat.

39. Perform instructions for installation of radar set AN/TPQ-36 from gamagoat.

40. Prepare radar set AN/TPQ-36 for movement by helicopter (external) and by aircraft (internal).

41. Perform the radar set AN/TPQ-36 installation from helicopter mode.

42. Prepare radar set AN/TPQ-36 for movement by railroad.

43. Display the time of day.

44. Perform generator starting and stopping procedures.

45. Determine grid coordinates of a radar site that was not previously surveyed.

46. Determine the boresight reference angle for a radar site that was not previously surveyed.

47. Control and monitor the transmitter status remotely.

48. Describe and locate the contents of DEP TM 11-5840-354-12 (current version).

---

1. Items 48-53 describe prerequisite knowledges/skills; field data were not collected for them.

49. Cite the capabilities, limitations, missions, and equipment of the AN/TPQ-36 radar set.

50. Describe the operation of the radar set on the physical-description, block-diagram level.

51. Cite the safety precautions when working on a radar.

52. Identify and cite the function of the operator's controls and indicators located in the shelter.

53. Identify and cite the function of the operator's controls and indicators located on the trailer.

ORGANIZATIONAL-LEVEL MAINTENANCE TASKS

1. Execute the program load diagnostic troubleshooting procedure.

2. Load and execute the central processor confidence test.

3. Load and execute the memory computer confidence test.

4. Load and execute the IOC computer confidence test.

5. Load and execute the additional options computer confidence test.

6. Cycle a computer confidence test.

7. Load the off-line status tests according to the short load procedure.

8. Load and start the off-line signal processor fault isolation tests. Perform corrective actions indicated by failure messages.

9. Perform the weapons location unit fault isolation test, to include taking corrective actions in accordance with printouts/displays.

10. Conduct the line printer off-line fault detection test, to include taking the necessary corrective actions.

11. Conduct the beam steering unit off-line fault detection test, to include taking the necessary corrective actions.

12. Conduct the receiver-exciter off-line fault detection test, to include taking the necessary corrective actions.

13. Load and start the transmitter power (output) off-line fault isolation test.

14. In accordance with results of the transmitter power off-line fault isolation test, use the Transmitter Troubleshooting Diagram (DEP TM 11-5840-354-12, Oct. 76) to diagnose problems and identify necessary corrections.

15. Conduct the phase detector off-line fault detection test, to include taking necessary corrective actions.

16. Perform the clutter rejection without transmitter off-line fault detection test.

17. Perform the clutter rejection with transmitter off-line fault detection test.

18. Load and start the B-scope off-line fault detection test.

19. Conduct the antenna stability off-line fault detection test, to include taking necessary corrective actions.

20. Load and start the general maintenance off-line fault detection test.

21. Select and execute the program functions that can be enabled through the general maintenance off-line fault detection test.

22. Perform the AN/UYK-15 computer turn-on procedure.

23. Perform the AN/UYK-15 computer central processor diagnostic troubleshooting procedure.

24. Perform the computer memory diagnostic troubleshooting operating procedure.

25. Perform the computer IOC diagnostic troubleshooting procedure.

26. Perform the computer additional options diagnostic troubleshooting operating procedure.

27. Perform the computer power protection and automatic recovery diagnostic troubleshooting operating procedures.

28. Perform the computer memory resume interrupt diagnostic troubleshooting operating procedure.

29. Use the power distribution diagrams to isolate power distribution problems.

30. Replace power supplies in the shelter power supply assembly.

31. Align power supplies in the shelter power supply assembly.

32. Replace line printer 1A1A105.

33. Replace line printer 1A1A105 belts.

34. Adjust the evenness and density of the line printer's printouts by aligning the hammers.

35. Replace B-scope 1A1A104.

36. Adjust the pattern displayed on B-scope 1A1A104 by aligning the B-scope.

37. Replace the power supplies in the synchronizer and beam steering assembly.

38. Replace blower 2A1A202A4B1 in the synchronizer and beam steering assembly.

39. Align power supplies in the synchronizer and beam steering assembly.

40. Replace items---metering circuit card, inverter regulator, and power supplies---in the transmitter low voltage subassembly.

41. Align power supplies in the transmitter low voltage subassembly.

42. Replace items---RF converter assembly, frequency multiplier assembly, oscillator assemblies, and power supplies---in the receiver-exciter assembly.

43. Align power supplies, DS balance, and gain balance in the receiver-exciter assembly.

44. Replace power supplies in the trailer assembly.

45. Align items in the signal processor.

46. Perform AN/UYK-15 computer initialization diagnostic troubleshooting operating procedure.

47. Perform the AN/UYK-15 computer NDRO test program.

48. In accordance with organizational preventive maintenance instructions, check all parts of the line printer for abnormal wear or damage and for proper mechanical and electrical functioning. Clean the line printer as prescribed.

49. Visually inspect for and, if necessary, clean the transmitter amplifier of dust accumulation on voltage bushings and surrounding components.

50. Inspect system cables for physical damage, cuts, breaks, and broken or loose connectors and connections.

51. Inspect and, if necessary, clean or replace light fixtures in the shelter interior.

52. In accordance with organizational preventive maintenance instructions, check and, if necessary, clean shelter blowers and filters.

53. In accordance with organizational preventive maintenance instructions, check and, if necessary, clean trailer blowers and filters.

54. In accordance with organizational preventive maintenance instructions, check and maintain the trailer tripod assembly.

55. Check the antenna radome for cleanliness and, if necessary, clean it as prescribed in organizational preventive maintenance instructions.

56. Check and maintain all system panels so that they are free from defective controls, faulty lamps, and dirt.

57. Call direct support to test items as prescribed in organizational preventive maintenance instructions.

58. Record running time of limited life items, and notify site commander of which items should be replaced as prescribed in organizational preventive maintenance instructions.

59. Flush the core of the computer's memory.

60. Remove and replace shelter blower 1A1A101B1.

61. Remove and replace shelter blower fan 1A1A101B2.

62. Remove and replace the switchlamp for the peripheral device controller and the weapons location unit.

63. Remove and replace the mag tape electronic assembly.

64. Remove and replace the mag tape transport assembly.

65. Remove and replace the computer set processor assembly.

66. Remove and replace the computer set memory assembly.

67. Remove and replace telephone TA-43/PT.

68. Remove and replace telephone TA-312/PT.

69. Remove and replace radio set AN/VRC-A47.

70. Remove and replace blower motor 2A1A203A2B1.

71. Describe the UYK-15 computer.

72. Demonstrate a working knowledge of digital fundamentals.

73. Demonstrate a working knowledge of digital fundamentals (binary math).

74. Demonstrate a working knowledge of digital fundamentals (octal math).

75. Demonstrate a working knowledge of the central processor unit of the UYK-15 computer.

---

2. Numbers 71-79 describe prerequisite knowledges and skills; field data were not collected for them.

76. Demonstrate a working knowledge of how the input/output controller transfers data in and out of the UYK-15 computer.

77. Demonstrate a working knowledge of the 333 random access memory unit.

78. Know the diagnostic troubleshooting procedures for the AN/UYK-15 computer.

79. Demonstrate knowledge of the electrical-mechanical skills, to include the following required to perform maintenance tasks:

jump I/O channels

measure AC/DC voltage

replace assemblies

check fuses

replace cards

check for and, if necessary, replace units with electrical faults.

DS/GS MAINTENANCE TASKS

1. Identify the test equipment required to perform DS/GS maintenance on the AN/TPQ-36 radar.

2. Use schematic diagrams to identify the components of the AN/TPQ-36 radar and their relationships.

3. Use schematic diagrams and manual test equipment to isolate faults in the common shelter power distribution button system.

4. Check power supplies and power distribution panels in the common shelter to determine if they are functioning properly.

5. Replace malfunctioning power supplies in the common shelter.

6. Adjust power supplies in the common shelter using the multimeter.

7. Repair the line printer.

8. Identify faults in the weapons location unit using the weapons location unit fault isolation test and tests conducted with manual equipment.

9. Remove and install the servo amplifier of the weapons location unit.

10. Remove and install the display encoder of the weapons location unit.

11. Remove and install the servo motor of the weapons location unit.

12. Remove and install the numeric and alphameric LED of the weapons location unit.

13. Remove and install the easting lamp of the weapons location unit.

14. Perform the map drum northing alignment of the weapons location unit.

15. Isolate faults in the AN/UYK-15 computer using prescribed diagnostic troubleshooting procedures and tests.

16. Replace defective wires using the termipoint method of wire replacement.

17. Adjust the computer power supply.

18. Isolate faults in the signal processor using the off-line signal processor fault isolation tests, manual test equipment, and schematic diagrams.

19. Align the clock oscillator card in the signal processor.

20. Align the in-phase timing, quadrature timing, and reference supply calibration of the A/D converter.

21. Conduct the antenna temperature converter test.

22. Conduct the antenna status, near-field probe test.

23. Remove and install the antenna phase shifter.

24. Determine the stability of the antenna positioning system by conducting manual tests and the antenna stability off-line fault detection test.

25. Adjust the azimuth encoder.

26. Align the tilt sensor.

27. Remove and install azimuth drive assembly 2A1A207.

28. Remove and install azimuth encoder 2A1A208.

29. Remove and install tilt sensor 2A1A202A2.

30. Remove and install antenna elevation actuator 2A1A210Z1.

31. Use schematic diagrams to isolate faults in the transmitter.

32. Remove and install transmitter fault processor circuit card 2A1A203A1A2A1.

33. Remove and install transmitter cathode regulator 2A1A203A2A2.

34. Remove and install transmitter crowbar assembly 2A1A203A2A4.

35. Remove and install transmitter crowbar assembly trigger card 2A1A203A2A4A1.

36. Remove and install voltage divider 2A1A203A2A3.

37. Remove and install floating deck circuit card 2A1A203A2A6.

38. Remove and install isolation power transformer 2A1A203A2T3.

39. Remove and install pulse modulator 2A1A203A2A5.

40. Remove and install pulse amplifier card 2A1A203A2A5A1.

41. Remove and install twt amplifier and power supply 2A1A203A2A9.

42. Remove and install twt pulse amplifier 2A1A203A2V1.

43. Remove and install inverter transformer assembly 2A1A203A2A1.

44. Remove and install microwave assembly receiver protector 2A1A205Z1.

45. Boresight radar set AN/TPQ-36.

46. Remove and install boresight telescope 2A1A202A3.

47. Align boresight telescope 2A1A202A3.

48. Align spirit levels.

49. Align phase shifter drive current.

50. Zero the ion pump current meter in fault processor circuit card 2A1A203A1A2A1.

51. Zero the twt cathode current meter in fault processor circuit card 2A1A203A1A2A1.

52. Adjust the detect RF fault level (RFA1 RF OUT, RFA2 RF OUT, and HI VSWR) on fault processor circuit card 2A1A203A1A2A1.

53. Make initial settings for the high voltage (high voltage overvoltage, cathode voltage window, collector voltage window) on fault processor circuit card 2A1A203A1A2A1.

54. Adjust floating deck circuit card 2A1A203A2A6 (grid pulse voltage, twt filament voltage, and filament fault window).

55. Preadjust the peak current in inverter regulator 2A1A203A1A3.

56. Adjust the twt RF moderator pulse coincidence of fault processor circuit card 2A1A203A1A2A1 (RF TO ON TRIG DLY, ON TO OFF TRIG DLY, and TRIG VOIDTH).

57. Make final adjustments of the RFA2 twt drive, RFA2 twt RF drive (output power), and inverter regulator stability.

58. Replace clock generator card 2A1A202A4A2A27.

59. Align clock generator card 2A1A202A4A2A27.

60. Isolate faults in the beam steering unit using the beam steering unit off-line fault detection test.

61. Align phase shifter drive current.

62. Use schematic diagrams and manual test equipment to isolate faults in the trailer power distribution panel.

63. Determine if power supplies on the trailer are functioning properly.

64. Remove and install power supplies on the trailer.

65. Adjust power supplies on the trailer.

66. Check all cables in the AN/TPQ-36 system to determine if they are functioning properly.

67. Repair or replace defective cables in the AN/TPQ-36 system.

68. Align the receiver-exciter.

69. Isolate faults in the synchronizer.

APPENDIX C

OPERATOR TASKS: SELECTED VALIDATION DATA

The original Appendix C contains the analysis, revised task statement, field data, and additional comments for all operator tasks in the original list (as given in Appendix A). This original appendix is on file at ARI-Benning. Presented herein are four tasks, selected to provide the reader with examples of the detailed validation study results.

11. Perform operator/computer communications.

a. Analysis: This statement appears to describe a task. However, comparison of this task with other tasks in the task list suggests that it simply describes other tasks at a more general, less specific level.

b. Revised Task Statement: This task was not included in the revised task list since other tasks seemed to more meaningfully describe the performances required for interface between the computer and operators.

c. Field Data: None.

d. Additional Comment: This task statement should be re-examined to verify the conclusion that it does not describe a task separate from other tasks in the revised lits. If it does describe a task not included in the list, it should be reinstated.

16. Perform typical friendly contact operation sequence.

a. Analysis: This task was separated into two tasks which could be performed independently each other.

b. Revised Task Statement:

(1) Conduct typical friendly contact operation sequences from entry (or change) of correct friendly fire parameters to transmission of TACFIRE messages.

(2) Return the radar to the hostile mode of operation after having completed friendly fire missions.

c. Field Data:

(1) Observation and operator responses indicate that the two task statements do represent operator tasks.

(2) The average rating of the difficulty of learning how to conduct friendly fire missions was 2.4 (see Appendix F). This rating indicates that this task was not very difficult to learn; however, it does suggest that conduct of friendly fire missions was one of the 10 most difficult-to-learn tasks.

(3) Observation of friendly fire missions led to several impressions.

(a) In the original and revised task statements, entry of the parameters for a friendly fire mission and processing of rounds are combined into a single task. Although both of these activities (plus communication with TACFIRE which was not observed) are required to complete a fire mission, they perhaps should be viewed as separate tasks. First, it was observed that a considerable period of time can elapse between the entry of parameters for a mission and the processing of rounds. During this interval, operators may have to change the parameters for the mission. Second, entry and processing seem to require different types of performances. Entry involves receipt of fire commands, translation of these commands into inputs to the computer, and entry of these inputs. Processing a target appears to be somewhat less complex in that except for setting the radar to transmit, operators simply respond to outputs of the computer without having to manipulate or translate the outputs themselves. Third, different types of errors can be made in performing these tasks. In entering the parameters for friendly fire missions, for

example, an operator may translate a fire command into the incorrect parameters. In processing rounds, speed appeared to be a more important factor (for example, several friendly rounds were not processed because the operator failed to enable the radar to transmit soon enough to detect them).

(b) It was observed that conduct of friendly fire missions requires coordination of the radar operator with the unit calling for the mission. For example, radar operators have to receive and respond to commands for fire missions. Moreover, the timing as well as the accuracy with which the radar was readied to detect and track rounds appeared to be important.

(c) Knowledge of radar gunnery had to be applied in order to interpret or deal with certain events. For example, on several occasions, the radar provided reports of multiple rounds when only one round had actually been fired. In other instances, the radar failed to detect bursts or datum planes because of the adjustment of the rounds being fired; inputs to the FDC corrected these problems.

d. Additional Comment:

(1) Whether entry of parameters for friendly fire missions and processing of rounds should be separate tasks or remain as a single task should be determined. If they remain a single task, evaluation standards should be multidimensional.

(2) Knowledges, skills, and tasks stemming from the requirement for operators to coordinate with the FDC (or other unit calling for a fire mission) need to be identified and entered in the task list. This requirement also has implications for training. In training operators to conduct friendly fire missions, for example, it may be desirable to simulate initial fire commands plus calls indicating that rounds have been fired.

(3) The original and revised tasks are described in terms of the requirements to operate the equipment of the radar. There was no apparent effort to integrate these requirements with the tactical function of the radar operator in combat. The present tasks should be evaluated to determine if they accurately and completely describe operators tasks in terms of this function. If the present tasks are not descriptive of this function, further revising of the task list is required.

18. Transmit a TACFIRE message.

a. Analysis: The original task statement appears to be adequate.

b. Revised Task Statement: None.

c. Field Data: Field data were not collected on this task because TACFIRE was not used during OT II.

d. Additional Comment: None.

21. Prepare radar set AN/TPQ-36 for movement by gamagoat.

a. Analysis: This original task statement seemed to be adequate.

b. Revised Task Statement: None.

c. Field Data: Data collected during OT II indicate that this statement describes a task in which operators participate. This task is a crew task as opposed to a task performed by an individual.

d. Additional Comment: None.

APPENDIX D

ORGANIZATIONAL MAINTENANCE TASKS: SELECTED VALIDATION DATA

The original Appendix D contains the analysis, revised task statement, field data, and additional comments for all organizational maintenance tasks in the original list (as given in Appendix A). This original appendix is on file at ARI-Benning. Presented herein are four tasks, selected to provide the reader with examples of the detailed validation study results.

4. Perform the off-line signal processor fault isolation test.

a. Analysis: Examination of accompanying training analysis materials indicated that the original task statement does not completely describe the tasks embraced by it. These materials suggested that this statement was intended to include both loading the test and taking indicated corrective actions.

b. Revised Task Statement: Load and start the off-line signal processor fault isolation tests. Perform corrective actions indicated by failure messages.

c. Field Data: Data collected during OT II suggest that this statement describes a task performed by an organizational-level mechanic.

d. Additional Comments:

(1) As presently written, test loading, fault detection, and fault correction are included in a single task. These should be separated into separate tasks if the knowledges and skills required to perform one task (for example, loading) are judged to differ substantially from those required to perform another task (for example, corrective actions).

(2) Whether this task is to be performed by operators as well as organizational-level mechanics needs to be determined.

10. Perform the clutter rejection without transmitter off-line fault detection test.

a. Analysis: The original task statement appeared adequate.

b. Revised Task Statement: None.

c. Field Data: This task was performed by the organizational-level mechanic during OT II.

d. Additional Comment: Whether this task is to be performed by operators as well as organizational-level mechanics should be determined.

27. Perform the computer memory diagnostic troubleshooting operating procedure.

a. Analysis: The original statement seemed adequate.

b. Revised Task Statement: None.

c. Field Data: Although this task was not performed prior to or during the data collection period of OT II, it appeared to be recognized as a task by the organizational-level mechanic.

d. Additional Comment: None.

35. Perform the replacement and alignment procedures of the shelter power distribution system.

a. Analysis: The original task statement seemed to describe several sets of performances that should be considered to be separate tasks.

b. Revised Task Statement: The following three task statements were developed:

(1) Use the power distribution diagrams to isolate power distribution problems.

(2) Replace power supplies in the shelter power supply assembly.

(3) Align power supplies in the shelter power supply assembly.

c. Field Data: Although the tasks referenced by the revised task statements were not performed prior to or during the primary data-collection period, they appeared to be recognized as tasks by the organizational-level mechanic.

d. Additional Comment: There are several different power supplies in the shelter power distribution system. As it will impact on further training development, it should be determined whether the replacement and alignment of each type of power supply should be viewed as a separate task.

APPENDIX E

DS/GS TASKS: SELECTED VALIDATION DATA

The original Appendix E contains the analysis, revised task statement, field data, and additional comments for all DS/GS tasks in the original list (as given in Appendix A). This original appendix is on file at ARI-Benning. Presented herein are four tasks, selected to provide the reader with examples of the detailed validation study results.

4. Check power supplies and power distribution panels in the common shelter to determine if they are functioning properly.

a. Field Data:

(1) Performance of this task by the DS/GS mechanic was neither observed nor reported.

(2) The DS/GS mechanic indicated that this statement describes a task of the organizational-level mechanic.

b. Additional Comment: It should be determined whether this statement describes a task of the organizational-level mechanic, the DS/GS mechanic, or both. It is likely that the statement describes performances relevant to both echelons of maintenance. That is, these performances may constitute a task for the organizational-level mechanic, for the DS/GS mechanic; they may be procedures undertaken as part of task number 3.

7. Repair the line printer.

a. Field Data:

(1) The DS/GS mechanic reported that he had performed this task during OT II.

(2) Compared to his ratings of other tasks, the DS/GS mechanic rated this task as relatively more difficult to learn (see Appendix F).

b. Additional Comment: None.

27. Remove and install azimuth drive assembly 2A1A207.

a. Field Data:

(1) This task was performed by the organizational-level mechanic during OT II.

(2) The organizational-level mechanic and DS/GS mechanic provided conflicting reports as to the level of maintenance responsible for this task. Specifically, each mechanic indicated that the other mechanic is responsible for replacement of this assembly.

b. Additional Comment: Whether this statement describes a task of the organizational-level mechanic or DS/GS mechanic needs to be determined. DEP TM 11-5840-354-34-2 (October, 1976) indicates that this is a DS/GS-level task.

60. Isolate faults in the beam steering unit using the beam steering unit off-line fault detection test.

a. Field Data:

(1) Performance of this task by the DS/GS mechanic was neither observed nor reported.

(2) It was reported by both mechanics that this task is the responsibility of the organizational-level mechanic.

b. Additional Comment: As the allocation of maintenance functions is understood, both the organizational-level mechanic and DS/GS mechanic have responsibilities for troubleshooting the beam steering unit. The principal method available to the organizational-level mechanic is the beam steering unit off-line fault detection test, and he would conduct this test as first echelon maintenance. Depending on the results of this test, DS/GS support would be called. The DS/GS mechanic would then use the beam steering unit test <u>plus</u> less automated methods to isolate the fault. Based on this understanding, the present task statement does tend to describe an organizational-level task. It would describe a task of the DS/GS mechanic if it were revised so that in addition to the beam steering unit test, the methods used by the DS/GS mechanic to supplement this test were also described in it.

APPENDIX F

SUMMARY OF RESPONSES TO SURVEY INSTRUMENTS

Table F-1

Summary of Responses to Operator Questionnaire[1]

Task	Occurrence[2]	Difficulty[3]	Training Location[4]	School Training Required[5]
Perform radar set start procedures.	Yes	1.8	S/OJT	S
Load the operational program.	Yes	1.8	S/OJT	S
Load and execute the initialization program.	Yes	2.4	S/OJT	S
Return to the initization program.	Yes	2.0	S/OJT	S
Rewind the mag tape unit.	Yes	2.2	S/OJT	S
Operate and load the high speed line printer.	Yes	2.2	S/OJT	S
Enable the line printer to print all initialization data.	Yes	2.0	S/OJT	S

[1] N=5 for most items.

[2] Yes and No designate whether respondents indicated that the task had or had not, respectively, been performed during OT II.

[3] Figures represent the average rated difficulty of the task on a 5-point scale from 1=easy to 5=difficult.

[4] Modal responses concerning whether training for the task should be conducted in school (S), partly in school and partly through OJT (S/OJT), or through OJT only (OJT) are presented. Responses to several tasks were bi-modal.

[5] Modal responses concerning the type of school training required for a task are presented. S indicates that most respondents believed that school training should provide enough practice to allow skillful performance of the task.

Table F-1 (cont'd)

Task	Occurrence[2]	Difficulty[3]	Training Location[4]	School Training Required[5]
Stow the antenna for shutdown or maintenance.	Yes	1.6	S/OJT; OJT	S
Install a map on the weapons location unit.	Yes	2.4	S/OJT; OJT	S
Determine the highest and lowest terrain elevations on a map prepared for installation on the weapons location unit.	Yes	2.4	S/OJT	S
Perform radar set stop procedures.	Yes	2.0	S/OJT	S
Conduct typical friendly contact operation sequences from entry (or change) of correct friendly fire parameters to transmission of TACFIRE messages.	Yes	2.4	S/OJT	S
Return the radar to the hostile mode of operation after having completed friendly fire missions.	Yes	1.8	S/OJT; OJT	S
Enable the line printer to print fire search control parameters.	Yes	1.8	S/OJT	S
Enable processing of hostile-fire locations through target averaging.	Yes	1.8	S/OJT	S

Table F-1 (cont'd)

Task	Occurrence[2]	Difficulty[3]	Training Location[4]	School Training Required[5]
Process a hostile target for transmission of TACFIRE through manual height adjustment techniques.	Yes	2.2	S/OJT	S
Process a hostile target for transmission to TACFIRE through use of COURSE and FINE adjustment switchlamps.	Yes	3.0	S/OJT	S
Display a hostile-fire location that had been permanently stored in memory.	Yes	1.8	S/OJT	S
Delete a currently displayed hostile-fire location, a single permanently stored location, or a range of permanently stored locations.	Yes	1.8	S/OJT. OJT	S
Enable the line printer to print all or selected hostile-fire locations that have been processed for storage.	Yes	1.8	S/OJT; OJT	S
Determine the height of a location displayed on a map on the weapons location unit.	Yes	2.0	S/OJT	S
Select the area to be covered by and enter a priority zone.	Yes	2.2	S/OJT	S
Select the area to be covered by and enter a censor zone.	Yes	2.2	S/OJT	S

Table F-1 (cont'd)

Task	Occurrence[2]	Difficulty[3]	Training Location[4]	School Training Required[5]
Delete a zone (either priority or censor).	Yes	2.2	S/OJT	S
Print the coordinates of zones stored in the computer.	Yes	2.0	S/OJT	S
Display on the B-scope priority zones stored in the computer.	Yes	2.0	S/OJT; OJT	S
Display on the B-scope censor zones stored in the computer.	Yes	2.0	S/OJT; OJT	S
Detect the occurrence of jamming through observation of the B-scope.	Yes	2.8	S/OJT	S
Determine the azimuth of a jamming source by enabling operation of the jam strobe.	Yes	2.0	S/OJT; OJT	S
Transmit a TACFIRE message.[6]	No	-	-	-
Conduct radio/telephone communications in accordance with accepted radio/telephone procedures.	Yes	2.6	S/OJT	S
Prepare radar set AN/TPQ-36 for operation under unusal climatic conditions.	Yes	2.4	S/OJT; OJT	S

[6]TACFIRE was not employed during OT II.

Table F-1 (cont'd)

Task	Occurrence[2]	Difficulty[3]	Training Location[4]	School Training Required[5]
Install and operate the portable air conditioner suitable for use with the AN/TPQ-36.[7]	No	-	-	-
Remove, clean, and reinstall all air filters on the shelter and trailer.	Yes	2.0	S; S/OJT	S
Perform the line printer performance test.	Yes	1.5	S/OJT	S
Perform operator/crew maintenance in accordance with instructions in the current DEP TM 11-5840-354-12.	Yes	2.2	S/OJT	S
Prepare radar set AN/TPQ-36 for movement by gamagoat.	Yes	1.8	S/OJT	S
Prepare and remove the shelter from the gamagoat.[8]	No	-	-	-
Perform instructions for installation of radar set AN/TPQ-36 from gamagoat.	Yes	2.2	S/OJT	S

[7]The air conditioner had not been used during OT II.

[8]This task had not been performed as part of OT II. One respondent indicated that he had performed it, however.

Table F-1 (cont'd)

Task	Occurrence[2]	Difficulty[3]	Training Location[4]	School Training Required[5]
Prepare radar set AN/TPQ-36 for movement by helicopter (external) and by aircraft (internal).[9]	No	-	-	-
Perform the radar set AN/TPQ-36 installation from helicopter mode.[9]	No	-	-	-
Prepare radar set AN/TPQ-36 for movement by railroad.[9]	No	-	-	-
Display the time of day.	Yes	1	S; S/OJT	S
Perform generator starting and stopping procedures.	Yes	2.0	S/OJT	S
Determine grid coordinates for a radar site that was not previously surveyed.	Yes	3.2	S/OJT	S
Determine the boresight reference angle for a radar site that was not previously surveyed.	Yes	2.8	S/OJT	S
Control and monitor the transmitter status remotely.[10]	Yes	2.0	S;S/OJT; OJT	S

[9]These tasks had not been performed as part of OT II. No respondent reported having ever performed them.

[10]Responses by the three respondents who indicated familiarity with task are summarized.

Table F-2

Responses to Organizational Maintenance Questionnaire[1]

Task	Occurrence[2]	Learning[3] Difficulty	Training[4] Location	School[5] Training Required
Execute the program load diagnostic troubleshooting procedure.	Yes	3	S/OJT	S
Load and execute the central processor confidence test.	Yes	3	S/OJT	F
Load and execute the memory computer confidence test.	No	3	S/OJT	F
Load and execute the IOC computer confidence test.	No	3	S/OJT	F
Load and execute the additional options computer confidence test.	No	3	S/OJT	F
Cycle a computer confidence test.	No	3	S/OJT	F

[1] N=1 for all items.

[2] Yes and No designate whether the respondent indicated that the task had or had not, respectively, been performed during OT II.

[3] Figures represent the rated difficulty of learning to perform the task on a five-point scale, where 1=very easy and 5=very difficult to learn.

[4] Responses concerning whether training for the task should be conducted in school (S), partly in school and partly through OJT (S/OJT), or through OJT only (OJT) are presented.

[5] Responses concerning the type of school training required for a task are presented. F and S indicate that the respondent believed that school training should provide enough practice so that the student, respectively, is familiar with how to perform the task or can perform it skillfully. T indicates that the respondent believed that the student should simply be told about the task and how to do it.

Table F-2 (cont'd)

Task	Occurrence[2]	Learning[3] Difficulty	Training[4] Location	School[5] Training Required
Load the off-line status tests according to the short load procedure.	No	3	S/OJT	F
Load and start the off-line signal processor fault isolation tests. Perform corrective actions indicated by failure messages.	Yes	3	S/OJT	S
Perform the weapons location unit fault isolation test, to include taking corrective actions in accordance with printouts/displays.	Yes	3	S/OJT	S
Conduct the line printer off-line fault detection test, to include taking the necessary corrective actions.	Yes	3	S/OJT	S
Conduct the beam steering unit off-line fault detection test, to include taking the necessary corrective actions.	Yes	3	S/OJT	S
Conduct the receiver-exciter off-line fault detection test, to include taking the necessary corrective actions.	Yes	3	S/OJT	S
Load and start the transmitter power (output) off-line fault isolation test.	Yes	3	S/OJT	S

Table F-2 (cont'd)

Task	Occurrence[2]	Learning[3] Difficulty	Training[4] Location	School[5] Training Required
In accordance with results of the transmitter power off-line fault isolation test, use the Transmitter Troubleshooting Diagram (DEP TM 11-5840-354-12, Oct. 76) to diagnose problems and identify[6] necessary corrections.",[7]	No	3	S/OJT	F
Conduct the phase detector off-line fault detection test, to include taking necessary corrective actions,	Yes	4	S/OJT	S
Perform the clutter rejection without transmitter off-line fault detection test.	Yes	3	S/OJT	S
Perform the clutter rejection with transmitter off-line fault detection test.	Yes	3	S/OJT	S
Load and start the B-scope off-line fault detection test.	Yes	2	S/OJT	S
Conduct the antenna stability off-line fault detection test, to include taking necessary corrective actions.	Yes	2	S/OJT	S
Load and start the general maintenance off-line fault detection test.	Yes	2	S/OJT	F
Select and execute the program functions that can be enabled through the general maintenance off-line fault detection test.	No	3	S/OJT	F

Table F-2 (cont'd)

Task	Occurrence[2]	Learning[3] Difficulty	Training[4] Location	School[5] Training Required
Perform the AN/UYK-15 Computer turn-on procedure.	Yes	2	S/OJT	F
Perform the AN/UYK-15 Computer central processor diagnostic troubleshooting procedure.	No	3	S/OJT	F
Perform the computer memory diagnostic troubleshooting operating procedure.	No	3	S/OJT	F
Perform the computer IOC diagnostic troubleshooting procedure.	No	3	S/OJT	F
Perform the computer additional options diagnostic trouble-shooting operating procedure.	No	3	S/OJT	F
Perform the computer power protection and automatic recovery diagnostic trouble-shooting operating procedures.	No	3	S/OJT	F
Perform the computer memory resume interrupt diagnostic troubleshooting operating procedure.	No	3	S/OJT	F
Use the power distribution diagrams to isolate power distribution problems.[6,7]	No	3	S/OJT	F
Replace power supplies in the shelter power supply assembly.	No	3	S/OJT	F

Table F-2 (cont'd)

Task	Occurrence[2]	Learning Difficulty[3]	Training Location[4]	School Training Required[5]
Align power supplies in the shelter power supply assembly.	No	3	S/OJT	F
Replace line printer 1A1A105.	Yes	4	S/OJT	S
Replace line printer 1A1A105 belts.	No	4	S/OJT	F
Adjust the evenness and density of the line printer's printouts by aligning the hammers.	Yes	3	S/OJT	S
Replace B-scope 1A1A104.	No	3	S/OJT	F
Adjust the pattern displayed on B-scope 1A1A104 by aligning the B-scope.	No	3	S/OJT	F
Replace the power supplies in the synchronizer and beam steering assembly.	No	3	S/OJT	F
Replace blower 2A1A202A4B1 in the synchronizer and beam steering assembly.	No	4	S/OJT	F
Align power supplies in the synchronizer and beam steering assembly.	No	4	S/OJT	F
Replace items---metering circuit card, inverter regulator, and power supplies---in the transmitter low voltage subassembly.	No	4	S/OJT	F

Table F-2 (cont'd)

Task	Occurrence[2]	Learning[3] Difficulty	Training[4] Location	School[5] Training Required
Align power supplies in the transmitter low voltage subassembly.	No	3	S/OJT	F
Replace items--RF converter assembly, frequency multiplier assembly, oscillator assemblies, and power supplies--in the receiver-exciter assembly.	No	3	S/OJT	F
Align power supplies, DC balance, and gain balance in the receiver-exciter assembly.	Yes	4	S/OJT	S
Replace power supplies in the trailer assembly.	No	3	S/OJT	F
Align items in the signal processor.	No	3	S/OJT	F
Perform the AN/UYK-15 computer initialization diagnostic troubleshooting operating procedure.	Yes	3	S/OJT	F
Perform the AN/UYK-15 computer NDRO test program.	No	3	S/OJT	F
In accordance with organizational preventive maintenance instructions, check all parts of the line printer for abnormal wear or damage and for proper mechanical and electrical functioning. Clean the line printer as perscribed.	Yes	3	S	F

Table F-2 (cont'd)

Task	Occurrence[2]	Learning[3] Difficulty	Training[4] Location	School[5] Training Required
Visually inspect for and, if necessary, clean the transmitter amplifier for dust accumulation on voltage bushings and surrounding components.	Yes	2	S/OJT	F
Inspect system cables for physical damage, cuts, breaks, and broken or loose connectors and connections.	Yes	1	S/OJT	F
Inspect and, if necessary, clean or replace light fixtures in the shelter interior.	Yes	2	S/OJT	F
In accordance with organizational preventive maintenance instructions, check and, if necessary, clean shelter blowers and filters	Yes	2	S/OJT	F
In accordance with organizational preventive maintenance instructions, check and, if necessary, clean trailer blowers and filters.	Yes	2	S/OJT	F
In accordance with organizational preventive maintenance instructions, check and maintain the trailer tripod assembly.	Yes	2	S/OJT	F
Check the antenna radome for cleanliness and, if necessary, clean it as prescribed in organizational preventive maintenance instructions.	Yes	2	S/OJT	F
Check and maintain all system panels so that they are free from defective controls, faulty lamps, and dirt.	Yes	1	S/OJT	F

Table F-2 (cont'd)

Task	Occurrence[2]	Learning[3] Difficulty	Training[4] Location	School[5] Training Required
Call direct support to test items as prescribed in organizational preventive maintenance instructions.	Yes	1	S/OJT	T
Record running time of limited life items, and notify site commander of which items should be replaced as prescribed in organizational preventive maintenance instructions.	Yes	2	S/OJT	F
Flush the core of the computer's memory.	Yes	3	S/OJT	S
Remove and replace shelter blower 1A1A101B1.[6,7]	No	4	S/OJT	F
Remove and replace shelter blower fan 1A1A101B2.	No	4	S/OJT	F
Remove and replace the switchlamp for the peripheral device controller and the weapons location unit.	No	3	S/OJT	F
Remove and replace the mag tape electronic assembly.	No	3	S/OJT	F
Remove and replace the mag tape transport assembly.	Yes	2	S/OJT	F
Remove and replace the computer set processor assembly.[6]	No	-	S/OJT	F

Table F-2 (cont'd)

Task	Occurrence[2]	Learning[3] Difficulty	Training[4] Location	School[5] Training Required
Remove and replace the computer set memory assembly.[1]	No	-	S/OJT	F
Remove and replace telephone TA-43/PT.	No	2	S/OJT	F
Remove and replace telephone TA-312/PT.	No	2	S/OJT	F
Remove and replace radio set AN/VRC-47.	No	2	S/OJT	F
Remove and replace blower motor 2A1A203A2B1.	No	4	S/OJT	F

[1] The respondent did not recall the difficulty of learning to perform these tasks.

[2] Performance of these tasks was observed after the mechanic had already responded to the survey instrument.

Table F-3

Summary of Responses to DS/GS Maintenance Questionnaire[1]

Task	Occurrence[2]	Learning Difficulty[3]	Training Location[4]	School Training Required[5]
Identify the test equipment required to perform DS/GS maintenance on the AN/TPQ-36 radar.	Yes	4	S/OJT	D/F
Use schematic diagrams to identify the components of the AN/TPQ-36 radar and their relationships.	Yes	3	S	T/D
Use schematic diagrams and manual test equipment to isolate faults in the common shelter power distribution button system.	No	3	S	T/D

[1] N=1 for all items.

[2] Yes and No designate whether the DS/GS mechanic indicated that he had or had not, respectively, performed the task prior to or during the primary data-collection period.

[3] Figures represent the rated difficulty of learning to perform the task on a five-point scale, where 1=very easy to learn and 5=very difficult to learn.

[4] Responses concerning whether training for the task should be conducted in school (S), partly in school and partly through OJT (S/OJT), or through OJT only (OJT) are presented.

[5] Responses concerning the type of school training required for a task are presented. F and S indicate that the DS/GS mechanic believed that school training should provide enough practice so that the student, respectively, is familiar with how to perform the task or can perform it skillfully. T and D indicate that the mechanic believed, respectively, that the student should simply be told about the task or that performance of the task should be demonstrated to the student.

Table F-3 (cont'd)

Task	Occurrence[2]	Learning Difficulty[3]	Training Location[4]	School Training Required[5]
Check power supplies and power distribution panels in the common shelter to determine if they are functioning properly.	No	2	S	T
Replace malfunctioning power supplies in the common shelter.	No	1	OJT	---
Adjust power supplies in the common shelter using the multimeter.	No	1	OJT	---
Repair the line printer.	Yes	4	S/OJT	T/D
Identify faults in the weapons location unit using the weapons location unit fault isolation test and tests conducted with manual equipment.	No	3	S/OJT	T/D/F
Remove and install the servo amplifier of the weapons location unit.	No	3	OJT	---
Remove and install the display encoder of the weapons location unit.	No	3	OJT	---
Remove and install the servo motor of the weapons location unit.	No	2	OJT	---

Table F-3 (cont'd)

Task	Occurrence[2]	Learning Difficulty[3]	Training Location[4]	School Training Required[5]
Remove and install the numeric and alphameric LED of the weapons location unit.	No	1	OJT	---
Remove and install the easting lamp of the weapons location unit.	No	1	OJT	---
Perform the map drum northing alignment of the weapons location unit.	No	3	S/OJT	T/D/F
Isolate faults in the AN/UYK-15 computer using prescribed diagnostic troubleshooting procedures and tests.	No	4	S/OJT	T/D/F
Replace defective wires using the termipoint method of wire replacement.	No	2	S/OJT	T/D/F/S
Adjust the computer power supply.	No	3	S	T/D/F
Isolate faults in the signal processor using the off-line signal processor fault isolation tests, manual test equipment, and schematic diagrams.	Yes	4.5	S/OJT	T/D/F/S

Table F-3 (cont'd)

Task	Occurrence[2]	Learning Difficulty[3]	Training Location[4]	School Training Required[5]
Align the clock oscillator card in the signal processor.	No	4	S/OJT	T/D/F
Align the in-phase timing, quadrature timing, and reference supply calibration of the A/D converter.	No	4	S/OJT	T/D/F
Conduct the antenna temperature converter test.	No	3	S	T/F
Conduct the antenna status, near-field probe test.	No	4	S/OJT	T/D/F
Remove and install the antenna phase shifter.	No	4	S/OJT	T/D/F
Determine the stability of the antenna positioning system by conducting manual tests and the antenna stability off-line fault detection test.	No	2	S/OJT	T/D/F
Adjust the azimuth encoder.	Yes	3	S/OJT	D/F
Align the tilt sensor.	No	3	S/OJT	T/D/F
Remove and install azimuth drive assembly 2A1A207.	No	2	OJT	---

Table F-3 (cont'd)

Task	Occurrence[2]	Learning Difficulty[3]	Training Location[4]	School Training Required[5]
Remove and install azimuth encoder 2A1A208.	No	4	S/OJT	T/D/F
Remove and install tilt sensor 2A1A202A2.	No	3	OJT	---
Remove and install antenna elevation actuator 2A1A210Z1.	No	3	S/OJT	T/D
Use schematic diagrams to isolate faults in the transmitter.	No	4	S/OJT	T/D/F
Remove and install transmitter fault processor circuit card 2A1A203A1A2A1.	No	2	OJT	---
Remove and install transmitter cathode regulator 2A1A203A2A2.	No	2	OJT	---
Remove and install transmitter crowbar assembly 1A1A203A2A4.	No	2	OJT	---
Remove and install transmitter crowbar assembly trigger card 2A1A203A2A4A1.	No	2	OJT	---
Remove and install voltage divider 2A1A203A2A3.	No	2	S/OJT	T/D/F

Table F-3 (cont'd)

Task	Occurrence[2]	Learning Difficulty[3]	Training Location[4]	School Training Required[5]
Remove and install floating deck circuit card 2A1A203A2A6.	No	2	S/OJT	T/D/F
Remove and install isolation power transformer 2A1A203A2T3.	No	2	S/OJT	T/D/F
Remove and install pulse modulator 2A1A203A2A5.	No	2	S/OJT	T/D/F
Remove and install pulse amplifier card 2A1A203A2A5A1.	No	2	S/OJT	T/D/F
Remove and install twt amplifier and power supply 2A1A203A2A9.	No	3	S/OJT	T/D/F
Remove and install twt pulse amplifier 2A1A203A2V1.	No	2	S/OJT	T/D/F
Remove and install inverter transformer assembly 2A1A203A2A1.	No	1	S/OJT	T/D/F
Remove and install microwave assembly receiver protector 2A1A205Z1.	No	2	S/OJT	T/D/F
Boresight radar set AN/TPQ-36.	No	2	S/OJT	T/D/F

Table F-3 (cont'd)

Task	Occurrence[2]	Learning Difficulty[3]	Training Location[4]	School Training Required[5]
Remove and install boresight telescope 2A1A202A3.	No	3	S	T/D/F
Align boresight telescope 2A1A202A3.	No	3	S	T/D/F
Align spirit levels.	No	2	S	T/D
Align phase shifter drive current.	No	3	S/OJT	T/D/F
Zero the ion pump current meter in fault processor circuit card 2A1A203A1A2A1.	No	2	S/OJT	T/D/F
Zero the twt cathode current meter in fault processor circuit card 2A1A203A1A2A1.	No	2	S/OJT	T/D/F
Adjust the detect RF fault level (RFA1 RF OUT, RAA2 RF OUT, and HI VSWR) on fault processor circuit card 2A1A203A1A2A1.	No	3	S/OJT	T/D/F
Make initial settings for the high voltage (high voltage overvoltage, cathode voltage window, collector voltage window) on fault processor circuit card 2A1A203A1A2A1.	No	3	S/OJT	T/D/F

Table F-3 (cont'd)

Task	Occurrence[2]	Learning Difficulty[3]	Training Location[4]	School Training Required[5]
Adjust floating deck circuit card 2A1A203A2A6 (grid pulse voltage, twt filament voltage, and filament fault window).	No	3	S/OJT	T/D/F
Preadjust the peak current in inverter regulator 2A1A203A1A3.	No	3	S/OJT	T/D/F
Adjust the twt RF-moderator pulse coincidence of fault processor circuit card 2A1A203A1A2A1 (RF TO ON TRIG DLY, ON TO OFF TRIG DLY, and TRIG VOIDTH).	No	3	S/OJT	T/D/F
Make final adjustments of the RFA2 twt drive, RFA2 twt RF drive (output power), and inverter regulator stability.	No	3	S/OJT	T/D/F
Replace clock generator card 2A1A202A4A2A27.	No	4	S/OJT	T/D/F
Align clock generator card 2A1A202A4A2A27.	No	3	S/OJT	T/D/F
Isolate faults in the beam steering unit using the beam steering unit off-line fault detection test.	No	2	S/OJT	T/D/F

Table F-3 (cont'd)

Task	Occurrence[2]	Learning Difficulty[3]	Training Location[4]	School Training Required[5]
Use schematic diagrams and manual tests equipment to isolate faults in the trailer power distribution panel.	No	2	S/OJT	T/D
Determine if power supplies on the trailer are functioning properly.	No	2	S/OJT	T/F
Remove and install power supplies on the trailer.	No	1	OJT	---
Adjust power supplies on the trailer.	No	1	OJT	---
Check all cables in the AN/TPQ-36 system to determine if they are functioning properly.	Yes	1	OJT	---
Repair or replace defective cables in the AN/TPQ-36 system.	Yes	2	S/OJT	T/D/F
Align the receiver/exciter.	Yes	2	S/OJT	T/D/F
Isolate faults in the synchronizer.	No	3	S/OJT	T/D/F